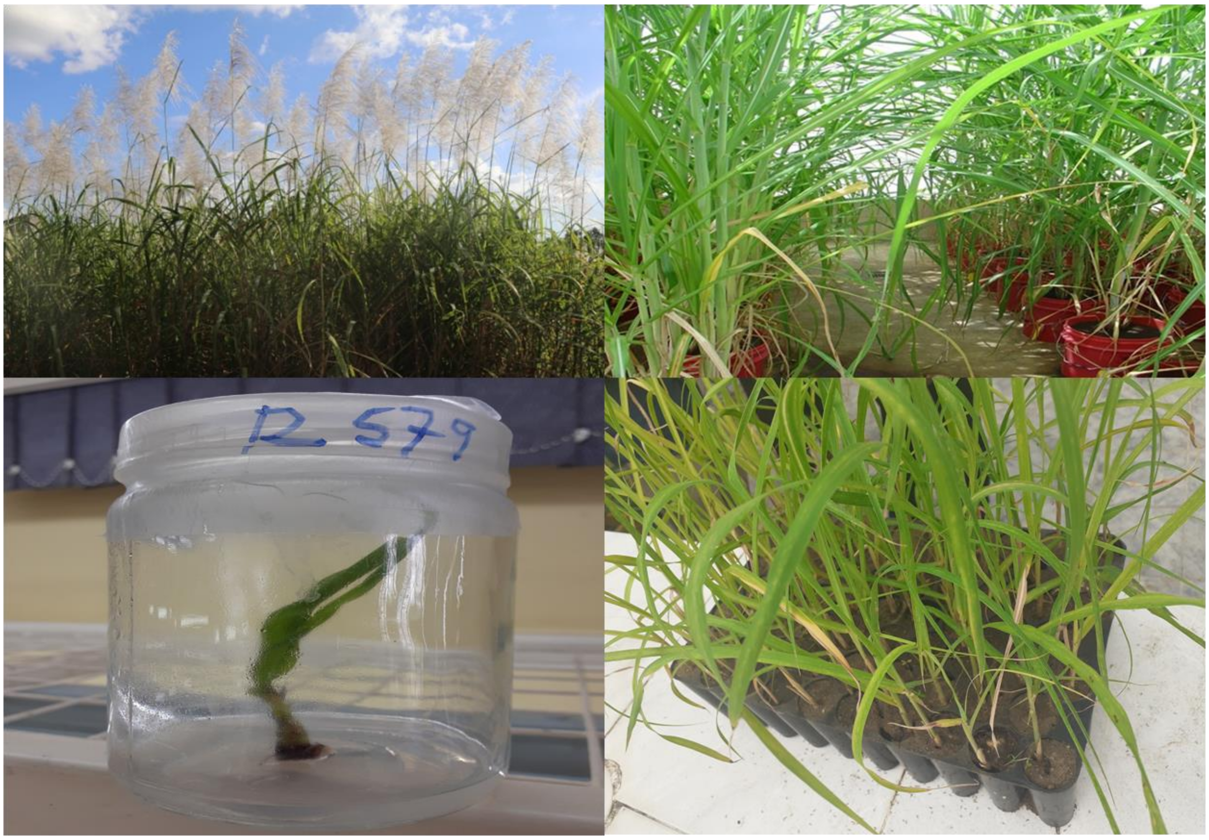
TANZANIA AGRICULTURAL RESEARCH INSTITUTE
KIBAHA



ANNUAL PROGRESS REPORT 2019-2020

TIME TABLE FOR ANNUAL SUGARCANE RESEARCH TECHNICAL MEETING
DATE: 5th JUNE 2020
TARI KIBAHA

TIME	**EVENT**	**RESPONSIBLE**
Chairperson (Director of Technology Transfer and Partnership)		
S. I: Rapporteur (Minza/Mziray)		
08 00-08.30	Registration	Reinfrida
08.30-08.45	Welcome Note and Introduction	Sub Centre Manager
08.45-08:55	Opening remarks	TARI Director Research and Innovation
08.55-09.10	Research highlights	Coordinator
09.10-09.20	Discussion	All
09.20-10.00	Breeding	Andrew/Nsajigwa/Cathy
10.00-10.10	Discussion	All
10.10-10.40	**TEA BREAK**	**All**
S II: Rapporteur (Catherine, Pachi)		
10.40-11:20	Agronomy & Physiology	Leyla/Rose/Mage
11:20-11:30	Discussion	All
11.30-12:10	Entomology	Nguvu/Fadhila
12:10-12:20	Discussion	All
12:20-12.50	Pathology & Nematology	Minza/Beatrice
12.50-13:00	Discussion	All
13:00-14.00	**LUNCH**	**All**
S. III: Rapporteur: (Beatrice, Kachewile)		
14:00-14:30	Technology Transfer and Partnership	Msemo/Diana
14:30-14:40	Discussion	All
14:40-14:50	Kilombero Sugar Company	Agronomist
14:50-15:00	Mtibwa Sugar Estates	Agronomist
15:00 – 15:10	Kagera Sugar Ltd	Agronomist
15:10 – 15:20	Tanganyika Planting Company	Agronomist
15:20 – 15: 40	Discussion	All
15:40 – 16:00	2019/2020 Projects	Coordinator
16:00-16:20	Discussion	All
16:20 – 16:40	Refreshments	All
S. IV: Rapporteur: (Nsajigwa, Nyanda)		
16:40-17:00	General Recommendations	All
17:00-17:10	Closing Remarks	Representative SIDTF
17:10-17:30	**Departure**	**All**

ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis ofVariance
B	Barbados
C	Clone/Line
CC	Crop Cycle
CG	Contractgrowers
CG	Guatemala
CHD	Current Harvest Date
CP	CanalPoint
DoP	Date of Planting
DUS	Distinctiveness UniformityStability
FP	FarmersPractice
GC	GeneticCombinations
GENSTAT	GeneralStatistics
IP	Improved practice
K1	Kilombero onefactory
K2	Kilombero twofactory
KSC	Kilombero SugarCompany
KSL	Kagera SugarLimited
LSD	Least SignificantDifference
M	Mauritius
MN	Malawi/Natal
MSE	Mtibwa SugarEstates
N	Natal
NPT	National PerformanceTrials
OGs	Outgrowers
PC	PlantCane
PHD	Previous Harvest Date
POCS	Per cent Obtainable CaneSugar
Q/KQ	Queensland
R	Reunion
R1	First Ratoon
R2	SecondRatoon
R3	ThirdRatoon
RCBD	Randomized Complete BlockDesign
RT	RecommendedTechnology
SBT	Sugar Board ofTanzania
SPF	Sugar ProcessingFactories
TCH	Tonnes Cane perHectare
TCHA	Annual Tons Cane per Hectare
TOSCI	TanzaniaOfficial Seed Certification Institute
TPC	Tanganyika PlantingCompany
TPRI	Tropical Pesticides ResearchInstitute
TSH	TonnesofSugarperHectare

TSHA	Annual Tons Sugar per Hectare
WICSCBS	WestIndiesCentralSugarCaneBreedingStation

SUGARCANE RESEARCH HIGHLIGHTS 2019/20

Figure 1. 1 Sugarcane

1.1 Introduction

The Tanzania Agricultural Research Institute (TARI, Kibaha) is working on demand driven research to solve problems hindering sugarcane production. Among the problem facing sugarcane production is limited area conducive for sugarcane production and at the same time the area near sugar mill. Sugar production in Tanzania is halfway to meet country demand. The country need to invest on more sugar factory and at the same time farmers need to work hard to make sure sugarcane are enough to feed factories. In order to increase productivity, use of improved agronomic practices is crucial. TARI Kibaha has been working on researches to come up with solutions for biotic and abiotic factors such as improved varieties tolerant to drought and resistance to pest and diseases, fertilizers recommendations and management of pests and diseases. The technologies developed as a result of research activities are disseminated to sugarcane growers using different techniques which are easy to understand and apply.

In order to share research outputs, TARI Kibaha has organized Technical Committee Meeting for researchers and sugarcane stakeholders to share what have been done for the whole year. The main purpose of the meeting is to review the findings and progress of research activities implemented in year 2019/2020 and proposes research activities for 2020/21. In this meeting, TARI Kibaha invited different stakeholders including; representatives from sugarcane out growers, agronomists from estates (Kilombero, Mtibwa, Kagera Sugar Estates and TPC), DAICOs (Kilombero, Kilosa, Misenyi, Mvomero), Mkulazi Holding Company, and members from SBT, SIDTF, AWF-SUSTAIN Bagamoyo Sugar Estate, Essoco, DEDs, Abood Radio. Furthermore, representatives from TARI will participate in this meeting (Director of Technology Transfer and partnership and Director of TARI Mlingano.

During the previous meeting (2018/19) participants came up with recommendations for the purpose of improving sugarcane researches. The recommendations discussed and agreed to be part of action plan (Table 1.1).

Table 1.1 Recommendation agreed for the year 2018/2019

RECOMMENDATION	RESPONSIBLE PERSONEL	TIME FRAME	REMARKS
1. Post-harvest losses along the value chain	TARI Kibaha and KSC	Jun-20	To be established 2020/21
2. Quality control of seedcane	TARI Kibaha and TOSCI	Jun-20	
Developed protocol by TARI Kibaha	TARI Kibaha	Jun-20	Protocol established and shared to TOSCI
TARI Kibaha to train TOSCI staff on sugarcane production practices	TARI Kibaha	Jun-20	Not yet trained
Protocol to be standardized by TOSCI	TOSCI		Not yet standardized
3. Seed production system	SBT and TARI Kibaha	Jun-20	
Tissue culture should be applied for producing clean and rapid seedcane multiplication of seedcane	TARI Kibaha		Protocol for seedcane multiplication developed and expected to start multiplication 2020/21
Pressing policy on using clean seedcane	SBT		
Viable plan for seedcane production	TARI Kibaha		Established nursery B in out growers field at Kilombero and Mtibwa
Estimation of seedcane demand	TARI Kibaha		Not yet
Establishment of subsidy system in sugarcane crop	TARI Kibaha		Current there is no subsidy in other crops but input will be available on time
4. ICT for technology dissemination	TARI Kibaha	Jun-20	

To engage more mobile company	TARI Kibaha		New proposal written to start 2020/21
To establish committee for generation/packaging information (journalist should be included to add catchy words)	TARI Kibaha		New proposal written to start 2020/21
All actors involved to be involved and approve the massages	TARI Kibaha		New proposal written to start 2020/21
5. Strengthening of pests and diseases committee	SBT	Jun-20	
Liaison officer should be engaged	SBT		
6. Effective collaboration between TARI and LGA's	TARI Kibaha and LGA's	Jun-20	
There must be a mode of operation and communication between the two	TARI Kibaha and LGA's		Communication channel established
Extension officers at LGA's need to be more enlightening on sugarcane production and act as TOT	TARI Kibaha		Training manual for senior staff developed

This year 2019/20 Annual technical meeting organized for the online participation due to presence of Pandemic disease COVID-19.

Weather

The total rainfall amount at TARI-Kibaha as recorded by Kibaha meteorological station from June 2019 to 30th May 2020 was 1618 mm which indicates an increase in total rainfall amount as compared to 2018/2019 (869.2 mm). In 2019/2020 the highest amount of rainfall was recorded in April, 2020 while in 2018/2019 the highest amount was recorded in May, 2019. Similar scenario was observed in other parts of the country including sugarcane growing areas. The high rainfall in 2019/2020 has affected research activities including treatment application (fertilizers, pesticides) and data collection.

1.1.2 Staffs

Researchers at TARI Kibaha are divided according to TARI organization structure according to their fields of specialization. In this structure, researchers can either fall under Research and Innovation or Technology Transfer and Partnership. Research and Innovation department comprise of breeding, agronomy, crop protection (Entomology, Pathology, Nematology). Technology transfer and partnership has only one component implemented at TARI Kibaha which is technology transfer. The system of working under discipline of specialization utilizes available skills and identifies gaps within the institute. In order to ensure developed technologies reach the target groups, Technologies Transfer and partnerships is emphasized. To strengthen, this section TARI has separated it from research section part in order to concentrate on reaching farmers through trainings, awareness, shows etc.

Sugarcane research program is comprised of 24 staffs; six of them are technicians and field officers while nineteen are scientists. (Table 1.2) Among 19 scientists, 17 are fulltime scientists and one is working under contract as Entomologist who is directly paid by sugar development trust funds (SIDTF). Two staffs are on study leave at SUA for BSc and PhD. In January 2020, the program received one staff (breeder) who was transferred from TARI Mikocheni and she is in her final stages of PhD studies. The program also, lost three staffs; one got transfer to another institution (Baraka Ernest), the second one is retiring in less than two weeks to come (Mohamed Mwinjuma), the third one passed away December 2019 (Stanley Kajiru). In terms of serving in sugar industry, Baraka Ernest served for less than a year; Mohamed Mwinjuma served for 37 years while Stanley Kajiru served for 25 years may his soul rest in eternal peace.

Table 1. 2 Research staffs responsible for sugarcane researches at TARI Kibaha

No	**Name**	**Education**	**Specialization**	**Duty**
1	Dr Hildelitha . Msita	PhD	Bioscience engineering	Centre Manager
2	Dr Nessie Luambano	PhD	Plant Nematology	Coordinator
3	Ambilikile Mwenisongole	MSc	Agricultural Economics	Technology transfer
4	Herman Kalimba	MSc	Agronomy	Agronomy
5	Leyla Lwiza	MSc	Soil Science	Agronomy
6	Minza Masunga	MSc	Molecular Pathology	Pathology
7	Beatrice Kashando	MSc	Nematology	Nematology
8	Magreth Mziray	MSc	Water Management	Agronomy
9	Andrew Kachiwile	MSc	Crop Science-Crop Improvement	Breeding
10	George Mwasinga	MSc	Crop Science-Crop Improvement	Breeding
11	Catherine Gwandu	MSc	Molecular biology and Biotechnology	Breeding
12	Margareth Kinyau	MSc	Agricultural Economics	Technology transfer
13	John Msemo	MSc	Rural Development and Marketing	Technology transfer
15	Diana Nyanda	MSc	Agric. Education and Extension	Technology transfer

16	Nsajigwa Mwakyusa	BSc	Agriculture General	Breeding
17	Fadhila Urasa	BSc	Agriculture General	Entomology
18	Rose Pachi	BSc	General Science	Agronomy
19	Robert Mlimi	Diploma	Genera Agriculture	Field Officer
20	Renifrida Polini	Diploma	Laboratory Science	Technician
21	Yeremiah Mbaga	Diploma	Laboratory Science	Technician
22	Giovanni Nguvu	MSc	Crop Science-Entomology	Entomology
23	Amri Yusuph	MSc	Environmental and Natural resource Economics	Study leave
24	Judith Setebe	Diploma	Genera Agriculture	Study leave

1.2 Research Activities

In the financial year 2019/2020 a total of 42 project activities (appendix 1) were approved by 38th Sugarcane Research Steering Committee meeting held on 21st June 2019. The approved projects are from Breeding, Agronomy, Entomology, Pathology and Nematology and technology transfer and percentage projects distribution are shown in Table 1.3.

Table 1.3: Total number of projects approved in 2019/2020

Discipline	**Number of projects**	**Total budget (TZS)**
Breeding	8	115,558,000.00
Agronomy	13	117,182,000.00
Entomology	9	108,992,500.00
Pathology and Nematology	6	108,809,811.00
Technology Transfer	6	118,834,000.00
Total	**42**	**574,217,311.00**

In addition to the named funds (Table 1.3), the committee approved funds for research coordination TZS 82,407,600.00 and station upkeep TZS 222, 028,200.00. The following are projects and outputs achieved by each discipline for 2019/2020.

1.2.1 Sugarcane Breeding

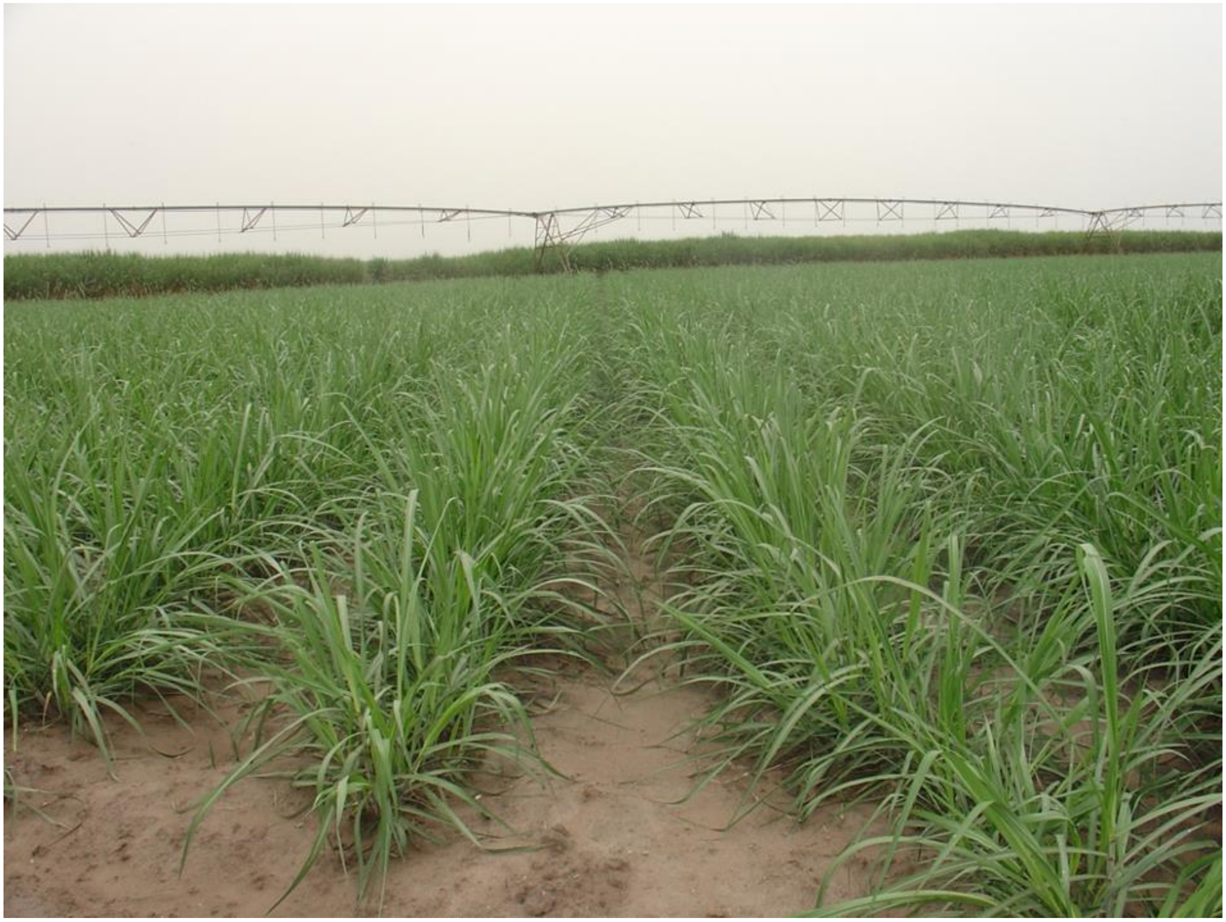


Figure 1. 2 Multiplication of clean sugarcane planting materials

Quarantine and distribution of newly imported sugarcane varieties

A total of seventeen (17) new varieties, eight (8) varieties (N55, N587, N59, N61, N62, N63, N64 and N65) were imported from SASRI and Nine (9) varieties (M1392/00, R 582, R 584, R 586, R 01/6060, R 02/4046, R 02/4077, R 05/2001 and R 06/2060) were imported from CIRAD planted in the closed quarantine in September 2019 and May 2020 respectively. Thirteen (13) varieties (N55, N58, N59, N61, N62, N63, N64, N65, CPCL 05-1102, GT3, GT5, GT18 and R 01/0277) are under open quarantine at Kilombero. Eight (8) new varieties (N39, R 587, R 98/4146, R 00/8180, R 00/2460, GT 15, FR 89/746 and CP 06-2042) were released from open quarantine distributed to four estates: KSC, MSE, and KSL & TPC for seedcane bulking.

Selection of Smut Resistant Sugarcane Varieties

Assessment on the reaction of varieties to smut was done by exposing candidate varieties to high smut pressure by artificially inoculating seedcane with fresh smut spores and planting in a nursery. All test varieties were planted between infester rows of an artificially infected susceptible variety (NCo376). The reaction of test varieties in the form of numbers of infected stalks was compared with the most susceptible (NCo376) and resistant (EA70-97) varieties. Out of 88 varieties, 28 showed to be promising in resisting smut disease.

Preliminary Evaluation of New Varieties/Clones in Different Sugarcane Estates

This project aimed to evaluate performance of newly introduced varieties in sugarcane estates of Tanzania. A total of 9 trials have been established: 2 at TPC, 3 at KSL and 4 at MSE in 2019/2020 season. 11 on-going preliminary variety trials at KSC, KSL, MSE and TPC have been harvested at different crop stages. And out of 152 varieties/clones, 26 promising sugarcane varieties and/or lines have been identified for further evaluation stage.

National Performance Trials

The trials are under assessment of regulatory authority (TOSCI), in order for them to be sure of what has been said as special characters for the varieties before they release. In this work, six varieties which include rainfed (TZ93-KA-120, TZ93-KA-122, R 570 and N47) and irrigated (N36 and R 85/1334) varieties were planted in different sugarcane estates. Reports have been submitted to TOSCI for application of official variety release.

Rapid Seedcane Multiplication

Poor quality planting materials is among factors limiting sugarcane production. Therefore a total of 10 sugarcane varieties (NCo376, R579, N41, R570, N25, N30, TZ-93-KA-122, R 583, N47 and TZ-93-KA-120) were sourced from TARI Kibaha for rapid seedcane multiplication. This will increase sugarcane productivity in Tanzania through improved access and deployment of healthy seed canes. 23,904 seedlings produced from ten sugarcane varieties.

Sugarcane Germplasm Conservation for Sustainable Sugarcane Sector Development

Germplasm conservation conserves the genetic traits of endangered and commercially valuable species. A total of 320 sugarcane cultivars including 41 local sugarcane cultivars have been collected and conserved at TARI Kibaha for future utilization in breeding program.

An efficient protocol for large scale production of sugarcane through micro-propagation

Sugarcane program aimed to apply use of rapid multiplication procedures in producing seedcane. This is to ensure quality and disease free planting materials are available. Hence TARI Kibaha has developed an efficient protocol for large scale production of sugarcane through micro-propagation.

1.2.2 Sugarcane Agronomy

Figure 1.3: Field assessment in Intergrated weed management trial at Kagera mill area

Evaluation of existing agronomic package to selected sugarcane varieties in outgrowers fields of Kilombero mill area

The average sugarcane yield in outgrowers fields has remained low (30-40 tons/ha) below the attainable yield potential of more than 100 tons/ha. Most of the farmers use varieties which are susceptible to a number of diseases especially smut. In order to recommend new sugarcane varieties for out growers under rainfed environment, trials were established to assess promising varieties. Two promising varieties (R 570 and N 47) for use in cane growers' of under rainfed condition have been identified. Data for official release and use have been submitted to TOSCI

Evaluation of different levels of fertilizers for improved sugarcane productivity at Kagera Mill Area

Fertilizer trials comprised of different rates of NPK were established in OG fields of Kagera mill area. Among 12 fertilizer combinations tested, 4 treatment combinations have been screened for further evaluation. Two treatments $N_{150}P_{25}K_{150}$ and $N_{150}P_{75}K_{150}$ have shown significant difference and a trial to test their performance is in progress.

Strategies for managing striga weed in sugarcane growing areas of Tanzania

Study on morphological characterization of Striga weeds in the sugarcane growing areas of Tanzania was done at Kilombero mill area. Two species *S. hermonthica* and *S. asiatica* were observed. Pot experiment for Intergrated striga management strategies is on progress at TARI-Kibaha

Intergrated weed management strategies for sugarcane production at Kagera mill area

In this study common weeds affecting sugarcane production were identified. (Broad leaves grasses and sedges). Assessment of herbicides action on control of weed species was done based on direct comparison between treated and untreated plots**.** Results shows that all treatment combinations were effective in controlling weeds for more than nine weeks

Effects of green harvesting verses burning on soil properties, growth, yields of sugarcane and determination of cost benefit analysis in Tanzania

In this study soil sampling for physical and chemical characterization of the experimental sites before the onset of the experiment was done. The experiment in six sites; three at Mtibwa and three at Kilombero were established. Data collection is in progress.

1.2.3 Sugarcane Entomology

Figure 1. 4 Entomopathogens attack aphid on left and stalk borer damage on right

Study of seasonal insect population fluctuations influenced by weather changes and crop management practices in all estates and out grower's fields

This study aimed at monitoring major sugarcane insect pest population fluctuations influenced by weather changes and crop management practices. Only 25% of surveyed MCP fields were free from YSA, however, the severity was very low as more than 75% of the infested field had severity below the economic threshold; similar trends were observed to Eldana and White scale.

Evaluation of white scale damage and sugar loss in selected varieties

The sugarcane whitescale (*Aulacaspis tegalensis*) is one of the most important sugarcane pest. However, information on yield losses and determination of appropriate control measures are important for proper management recommendations. The objective of the present study was to develop protocol for an artificial inoculation technique and later adopted for establishment of high white scale insect pressure necessary for screening of new sugarcane varieties.

The Effectiveness of Prophylactic Soil Treatment and Foliar Applications of locally available insecticides for Yellow Sugarcane Aphids control

This trial was carried out at Kilombero Sugar Estate fields in one site (field 325) as ratoon to confirm 2018/2019 results. Results have indicated that. Neonicotinoids insecticides (Attackan, Drone and Actara) are highly effective in reduction of YSA population and damage on sugarcane.

Evaluation of resistance of sugarcane varieties to Yellow Sugarcane Aphid infestation in cages

Yellow sugarcane aphids (YSA) are one among the key insect pest which causes damage to sugarcane in Tanzania. Due to this fact, we intend to study the host pest resistant to YSA on varieties which are either released or advanced stage of evaluation. Varieties R 85/1334, R 579, CG96-52, BR971004 and line TZ93-KA-120 showed promising results**.**

1.2.4. Sugarcane Pathology and Nematology

Figure 1. 5 Sugarcane smut disease

Assessment of smut disease on sugarcane fields in Tanzania

Sugarcane smut a fungal disease caused by *Sporisorium scitamineum*, is one of the most severe disease causing significant yield loss in sugarcane production. The objective of this work was to assess the incidence of smut disease on sugarcane varieties on estates and out growers' fields during dry and wet seasons. A total of 400 fields assessed for smut incidence, 84% of fields from out-growers and 49% from fields from estates were found to have smut below the economic threshold of 4%. There was a variation on the incidence of smut on sugarcane varieties where the higher smut incidence was observed on variety NCO 376, CO 617 & R575 and ratoon crop was mostly affected by smut as compared with plant cane. Similarly, during dry period the incidence of smut on sugarcane fields was higher and lower on wet season across sites.

Sugarcane Nematology

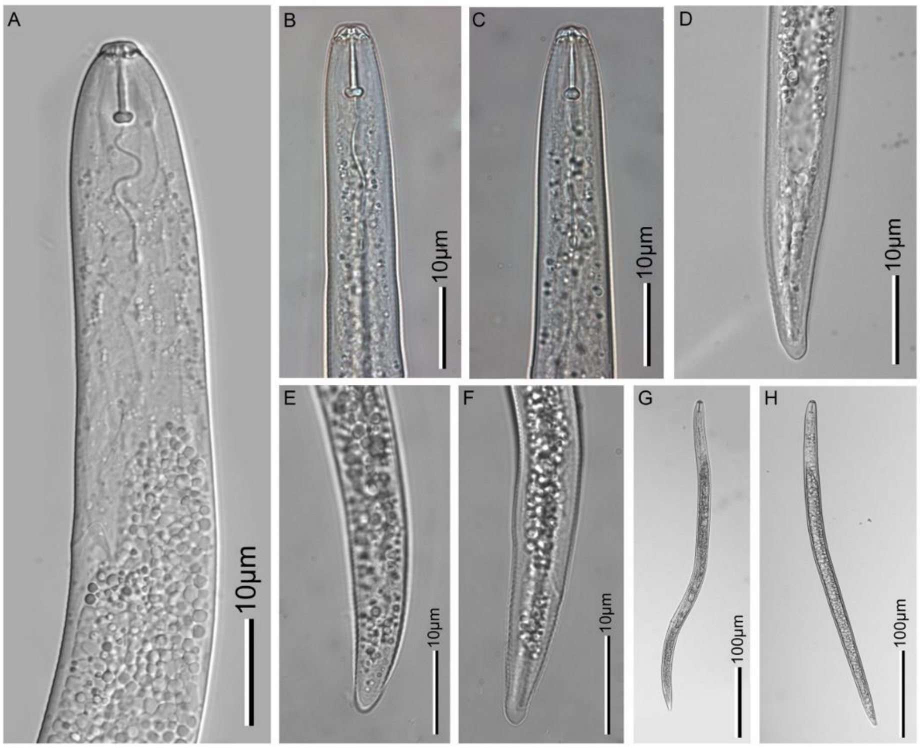


Figure 1.6: Plant parasitic nematode (*Pratylenchus zeae*) which affects sugarcane plants

Distribution and identification of plant parasitic nematodes in sugarcane growing areas in Tanzania.

A survey for assessment and sampling for plant parasitic nematodes associated with sugarcane in soil and root samples were accomplished at the four sugar Estates (KSL, KSC, Mtibwa and TPC) and in outgrowers' fields. The study identified 13 genera of plant parasitic nematodes were found in association with the roots and soil of the sugarcane, these were; *Pratylenchus*, *Meloidogyne, Rotylenchulus*, *Tylenchus*, *Tylenchorhynchus*, *Longidorus***,** *Helicotylenchus*, *Criconema, Trichodorus, Xiphinema, Scutellonema, Paralongidorus, and Aphilenchoides*. The most dominant was *Pratylenchus* followed by *Meloidogyne*.

Establishing suitable integrated nematode management methods for plant parasitic nematodes affecting sugarcane in Tanzania.

To ensure effective management of plant parasitic nematodes in sugarcane production the use of IPM is important. The integrated pest management trial established in 2019 at KSL to screen effectiveness of different materials showed that population of *Pratylenchus, Meloidogyne* and *Xiphinema* were controlled much by sunn hemp and filter cake.

1.2.5 Technology Transfer

Figure 1. 7 FFS farmers at Kwadori receiving sugarcane inputs

Strategies to improve extension services to sugarcane growers through Farmers Field School

Farmer field school (FFS) consist of groups of people with a common interest, who get together on a regular basis to study the "how and why" of a particular topic. Under sugarcane research we aimed to establish areas for FFS as a training centre in selected villages and to empower farmers with knowledge and skills of sugarcane production practices**.** Results from FFS established in 2018/2019 at Lumango village in Kilosa district showed increase in yield of FFS practice was 110 t/ha while farmer practice was 70t/ha. Furthermore, a total of 478 (258 males and 220 female) farmers and other stakeholder learned through FFS. Total of three FFS established in 2019/2020, at Kilombero and Mtibwa mill areas, 47 farmers were trained on new technologies.

Awareness creation through use of demonstrations as one of extension method

In the year 2019/20, nine (9) demonstration plots were established in Kilombero and Mtibwa mill areas. Total of 655, (358 males and 297 females) farmers were learned sugarcane technologies through visiting the established demonstration plots. In this report the data captured and discussed are the demonstration plots of 2018/19 where by nine demonstration plots were established at

Kilombero, Kilosa and Mvomero districts. The results obtained from research practices were higher than farmers practice.

The multiplication of clean seedcane through nursery B

In sugarcane production areas, farmers face challenge of assessing clean planting materials. TARI Kibaha established multiplication under nursery B near farmers' fields at the mill areas using varieties NCo376, Co617 and R 570. In the year 2019/20, total areas of 12 acres were planted to growers at Kilombero, Kilosa and Mvomero districts. The multiplication nursery of 38.5 acres established in 2017/18, out of which only 8.5 acres were harvested and planted to 85 acres of commercial fields.

Scaling up sugarcane production technologies through training and development of extension materials

TARI Kibaha was invited to display, train and demonstrate different technologies that is important to farmers to increase sugarcane production and productivity at Sokoine University of Agriculture (SUA). A total of 1938 (1201 male and 737 female) people attended TARI booths/pavilion. A total of 2100 fliers, 8 banners displayed and 150 brochures from TARI Kibaha distributed during exhibition. Total of 40 students from university of Dar es salaam (29 males and 11 females) acquired basic knowledge and function of the research activities conducted at TARI Kibaha. A total of 24 (17 males and 7 females) new recruited extension workers of Kilombero Sugar Company were trained on activities of demonstration plot and farmers field school located at Kilosa and Kilombero district.
Apart from that a total of 5000 flyers, 5000 Brochure and 500 books in Swahili version have been developed and printed. 2820 flyers, 2300 brochures and 150 training manuals in Swahili version have been distributed. A total of 2567 visitors (1733 males and 834 females) visited TARI pavilion during nanenane exhibition

Promoting sugarcane production technologies to cane growers through Mass media technology

Radio is one of the important mass media for transferring information to communities. In 2019/20 technologies were transferred through radio and news papers to disseminate technologies. Total of 26 radio episodes were recorded and aired through TBC radio, 33 by Abood radio, 26 by Karagwe radio. Three documentaries were produced at Kilombero, Kilosa and Mvomero districts. A total of 335 calls and 6000 messages were received from different listeners.

1.3 General Achievements

Papers submitted to Internal Progress Review, reports and thesis

1. Monitoring of Plant Parasitic Nematode in sugarcane growing area of Tanzania
2. Study of seasonal insect population fluctuations as influenced by weather changes and crop management practices in all estates and out grower's fields.
3. Factors influencing disease spread on sugarcane outgrowers fields in Tanzania

4. Annual progress report 2019-2020 compiled for sugarcane research technical committee meeting
5. Draft for sugarcane seed standard introduced to TOSCI after meeting with TOSCI staffs twice for presentation and later improvement of draft. Currently, the draft is with TOSCI who have already met SBT and Mtibwa Sugarcane Company.

Awareness materials and training Manuals

7 banners, 14 posters, 5000 copies (2428 distributed) flyers, 5000 copies (3250 distributed) brochures and 500 copies (130 distributed) training manuals were printed and distributed to; October 2019, Launching of Agriculture season in Dumila, Kilosa

1. January 2020, 50 years anniversary of Kibaha Education Centre
2. December 2019, Sokoine University Agriculture show
3. August 2019, Agriculture shows (Nanenane exhibition) Eastern zone (Morogoro) and at National Level at Nyakabindi.

Capacity building

1. Two researchers from breeding section attended two weeks training courses in Ethiopia and Kenya respectively
2. Four researchers attended a two weeks field attachment course on Cane husbandry at Kilombero Sugar Company

Proposal development and submission

1. Promotion of improved technologies for increased sugarcane production and productivity towards self-sugar sufficiency in Tanzania. The full proposal submitted to Agricultural Sector Development Project- II (ASDP-11)
2. Conservation agriculture in sugarcane production. Concept note submitted to DANIDA

1.5 Challenges

1. Need for building capacity through teller made courses from different countries
2. Staff success is required since most of the staffs are expecting to retire in not more than 5years to come
3. Research trials were challenged by excessive rainfall, hence researchers missed most of the data (Table 1.4)
4. The outbreak of pandemic disease COVID-19 interfered the routine research activities especially during 3rd and 4th quarters (March-May)

Table 1.4: List of on-going projects for 2019/20 which does not have results

SECTION	PROJECT CODE	PROJECT NAME	CHALLENGES	STATUS
PATHOLOGY	CPP 2017/01/03	Diagnosis of sugarcane disease and management	Breakdown of machine	ONGOING
NEMATOLOGY	CPP 2018/02/02	A study on crop loss on plant parasitic nematodes associated with sugarcane in Tanzania	Waiting for suitable time for data collection	ONGOING
ENTOMOLOGY	CPE 2019/03	Production of White scale predator, *R. lophanthae*, in screen house for field releases	Trial was repearted due to infestation from other pest, no data cllected to date.	ONGOING
ENTOMOLOGY	CPE 2019/05	Impacts of predators on Population dynamics of Yellow Sugarcane Aphid in Kilombero and Kagera Estates	Effect of weather	ONGOING
ENTOMOLOGY	CPE 2019/07	Efficacy of selected Biopesticides in control of Yellow Sugarcane Aphid *Sipha flava*	Effect of weather	ONGOING
ENTOMOLOGY	CPE 2019/08	Assessment of Economic and Yield loss due to Yellow Sugarcane Aphid *Sipha flava*	Effect of weather	ONGOING
ENTOMOLOGY	CPE 2019/09	Efficacy of selected Insecticides in the control of sugarcane stem borer *Eldana saccharina* (Walker**)** (Lepidoptera: Pyralidae) in Tanzania	Efficacy trial for un-registered pesticides are conducted by TPRI	CANCELLED
TECHNOLOGY TRANSFER AND PARTINERSHIP	TT 2019/06	Development of mobile phone message and video contents on sugarcane farming for growers and other actors on value chain	Apps for deliverering message are on progress	ONGOING

2.0 SUGARCANE BREEDING

2.1 Quarantine and Distribution of Newly Imported Sugarcane Varieties

Project code: SCB 2017/01
Investigators: A. Kachiwile, N. Mwakyusa, G. Mwasinga, R. Mlimi and C. Gwandu
Collaborators: TPRI
Duration: 2019/20
Completion: Ongoing

Project summary

Sugarcane varieties are fundamentals for sugarcane sector development. Varieties with improved traits to resist pests, diseases and tolerate drought in harsh environment providing more protection against crop failure, the purpose of the project was to introduce new sugarcane germplasm, monitoring and selection of superior varieties. The selection is based on their performance in closed and open quarantine before they are released to sugar estates in Tanzania. A total of seventeen (17) new varieties, eight (8) varieties (N55, N58, N59, N61, N62, N63, N64 and N65) were imported from SASRI and Nine (9) varieties (M1392/00, R 582, R 584, R 586, R 01/6060, R 02/4046, R 02/4077, R 05/2001 and R 06/2060) were imported from CIRAD planted in the closed quarantine in September 2019 and May 2020 respectively. Thirteen (13) varieties (N55, N58, N59, N61, N62, N63, N64, N65, CPCL 05-1102, GT3, GT5, GT18 and R 01/0277) are under open quarantine at Kilombero. Eight (8) new varieties (N39, R 587, R 98/4146, R 00/8180, R 00/2460, GT 15, FR 89/746 and CP 06-2042) were released from open quarantine distributed to four estates: KSC, MSE, KSL & TPC for seedcane bulking.

2.1.1 Introduction

Plant breeding is defined as the art and science of changing plants genetically (Allard, 1960). Therefore, it is crop evolution directed by man through conscious decision to keep the progeny of certain parents in preference to others in diverse genetic population (Simmonds, 1978). The introduction of new sugarcane varieties is among of the activities in the breeding section. The introduced varieties were from South Africa, Mauritius, United States, Australia, Reunion and Brazil. Evaluation of the varieties in major sugarcane growing areas is done in collaboration with sugarcane estates so as to identify superior genotypes with improved agronomical performance and tolerance to biotic and abiotic stresses.

Objective

To introduce new germplasm of sugarcane, monitor and select superior varieties based on their performance in closed and open quarantine before they are released to the sugarcane estates.

Specific Objectives

i. To introduce new sugarcane varieties in sugarcane estates of Tanzania
ii. To evaluate the performance of the new sugarcane varieties
iii. To select the superior sugarcane varieties for commercialization

Outputs

i. 17 new varieties imported and planted in closed quarantine
ii. 13 new varieties graduated to open quarantine
iii. 8 new varieties released from open quarantine for seedcane bulking in the four sugarcane estates and TARI-Ifakara

2.1.2 Materials andmethods

Imported 17 new varieties were planted in closed quarantine screen house at TARI-Kibaha. The plant materials were inspected by National Plant Quarantine Services from Tropical Pesticides Research Institute (TPRI) before planting and released to Cane growers in Tanzania. Each variety consisted of 6 setts with one eye bud each. Prior to planting, the cutting knife was sterilized by washing with sodium hypochloride solution 3.5/v; before using it for cutting another variety. Setts were dipped into mixed solution of Baleyton 250 WP (*Triadimefon 250g*) fungicide with Diazinon (*Neucidol 50 EC*) insecticide for 10 minutes for a ratio of 1ml of Baleyton and 1g of Diazinon to 1 litre of water. The setts were planted into 20 dm^3 baskets containing sterilized soil, one variety per basket. Irrigation of setts planted was done by using tape water. After planting, 20mls of insecticide per 20 litres of water (Karate 500 EC *lambda-cyhalothrin*) was sprayed to control insect pests inside the screenhouse.

2.1.3 Results

Imported varieties in closed quarantine:

Seventeen (17) new varieties, N55, N58, N59, N61, N62, N63, N64, N65, M1392/00, R 582, R 584, R 586, R 01/6060, R 02/4046, R 02/4077, R 05/2001 and R 06/2060 were imported from South Africa and France in September 2019 and May 2020 respectively. Eight (8) varieties (N55, N58, N59, N61, N62, N63, N64 and N65) from SASRI had good germination and graduated to open quarantine in March 2020. Nine (9) varieties (M1392/00, R 582, R 584, R 586, R 01/6060, R 02/4046, R 02/4077, R 05/2001 and R 06/2060) are planted in closed quarantine at TARI - Kibaha (Table 2.1).

Table 1.1: CIRAD varieties planted in closed quarantine at TARI Kibaha

S/N	Variety	No of setts & eye buds	Germination (%)	Remarks
1	M 1392/00	6 setts 1 eye bud each	100	Good
2	R 582	6 setts 1 eye bud each	100	Good
3	R 584	6 setts 1 eye bud each	100	Good
4	R 586	6 setts 1 eye bud each	100	Good
5	R 01/6060	6 setts 1 eye bud each	100	Good
6	R 02/4046	6 setts 1 eye bud each	100	Good
7	R 02/4077	6 setts 1 eye bud each	100	Good
8	R 05/2001	6 setts 1 eye bud each	100	Good
9	R 06/2060	6 setts 1 eye bud each	100	Good

Varieties under open quarantine

- Thirteen (13) varieties (N55, N58, N59, N61, N62, N63, N64, N65, CPCL 05-1102, GT3, GT5, GT18 and R 01/0277) are under open quarantine at Kilombero.

Varieties released from open quarantine

- Eight (8) new varieties (N39, R 587, R 98/4146, R 00/8180, R 00/2460, GT 15, FR 89/746 and CP 06-2042) were released from open quarantine distributed to four estates: KSC, MSE, KSL, TPC and TARI-Ifakara for seedcane bulking.

2.1.4 Discussion

Introducing new varieties and clones to the sugarcane industry in the country have a high impact on commercialization by sugarcane estates. The performance of the planted variety in the closed and open quarantine depends on genetic adaptability to the new environment that is subjected. The better performing varieties are typically adapted to the environmental condition resulting in promising commercial elite varieties for sugar industry development in Tanzania.

2.1.5 Recommendations

Some of new varieties have been observed to be specific and wide adaptable to different agro-climatic environment; they will improve our sugar industry in terms of their production and germplasm collection for future variety improvement program

2.2 Selection of Smut Resistant Sugarcane Varieties

Project code: SCB 2017/02
Investigators: A. Kachiwile, G. Mwasinga, N. Mwakyusa, R. Mlimi and C. Gwandu
Collaborators: Sugarcane estates and TARI-Ifakara
Duration: 2019/20
Completion: Ongoing

Project summary

Sugarcane smut resistance is influenced by three major factors: sugarcane genotype, the pathogen, and the environment. Assessment on the reaction of varieties to smut was done by exposing candidate varieties to high smut pressure by artificially inoculating seedcane with fresh smut spores and planting in a nursery. All test varieties were planted between infester rows of an artificially infected susceptible variety (NCo376). The experiment design was a Randomized Complete Block Design (RCBD) replicated three times. Plot sizes were two rows 1.2 m apart and 8 m long. Total numbers of stalks were counted and number of infected stalks were calculated as percentages and subjected to analysis of variance. The reaction of test varieties in the form of numbers of infected stalks was compared with the most susceptible (NCo376) and resistant (EA70-97) varieties. A total of 10 sugarcane varieties showed to be promising in resisting smut disease.

2.2.1 Introduction

Sugarcane smut disease, caused by *Sporisorium scitamineum,* can cause significant yield loss when susceptible cultivars are planted. There is 0.6 to 0.7% yield loss for every 1% increase in diseased plants (Magarey *at al.,* 2014). Sugarcane smut can cause any amount of loss to susceptible varieties from 30% to total crop failure .Sugarcane smut managed effectively when resistant cultivars are planted, which is the most economical and effective measure for disease prevention and control (Xing, 2013). Infected plants show a profound metabolic modification resulting in the development of a whip-shaped structure (sorus) composed of a mixture of plant tissues and fungal hyphae. Within this structure, *ustilospores* develop and disseminate the disease. Resistant varieties grown in all areas regularly and show some smut infection but not suffering with cane yield loss (Magarey *et al.,* 2014). In Tanzania, sugarcane smut disease has been causing problem in all estates and to outgrowers (OGs) where growers use clean seedcane as means of managing the disease. However, the management techniques used is not effective and hence this project aimed to evaluate new imported sugarcane varieties for their resistance to this disease.

Objective

To determine the reaction of newly imported varieties to smut infections so as to identify resistant varieties

Specific objective

To evaluate new imported sugarcane varieties for their resistance to smut disease.

Achieved Output

A total of 28 sugarcane varieties showed to be promising in resisting smut disease

2.2.2 Materials and methods

A total of five experimental trials comprised of fifteen (7N and 8R), nineteen (4CP and 15R), twenty four (7B and 17R), twenty four (23B and 1M) varieties and 3 checks varieties were in three cropping cycles (PC, R1 and R2). Susceptible check variety was NCo376, while R 579 and EA 70-79 included as resistant varieties. The treatments were planted in Randomized Complete Block Design and replicated 3 times, having a spacing of 1.2 m and length of 8 m, each plot was planted with 40 setts containing two eye buds inoculated with 2 grams of smut spores in 1litre of water per plot stayed overnight. Data on diseases incidences were collected by counting number of infested stools per plot and later percentage infection calculated from the total plants.

Statistical analysis

Data on percent disease incidence were square root transformed before subjecting into ANOVA using GENSTAT statistical package version14, Means were compared using LSD at P=5%

2.2.3 Results

Smut Screening: Trial Number 1

A total of fifteen (15) varieties were tested for three crop cycles and compared to NCo376 and EA70-97 in a smut screening trial. Results for PC are Table 2.2, indicated that, levels of mean smut infection rate percentage varied among test varieties and the differences there were highly significant ($P \leq 0.001$). Test varieties N29, N51 and N53 had mean smut infection rate percentage similar to resistant check, EA70-79. Alternatively, other test varieties had smut infection statistically similar to susceptible check, NCo376.

Results for R1 showed that, the level of mean smut infection rate percentage varied among test varieties; however there were not significantly different ($p \leq 0.05$). Test varieties N29, N38 and R 96/2454 had mean smut infection rate percentage lower than resistant check EA70-97, while varieties N50, R 95/2100, R 97/2168 and R 99/4065had mean smut infection rate percentage higher than susceptible check NCo376

Results for R 2 showed that, the level of mean smut infection rate percentage varied among test varieties; however, there were highly significantly different ($p \leq 0.001$). Test varieties 57, R 96/2454, R 96/814 and R 97/21689 had mean smut infection rate percentage lower than resistant check EA70-97, while varieties R 99/4065 and R 98/6092 had mean smut infection rate percentage higher than susceptible check NCo376

Table 2.2 Smut infection rate in four growing seasonsfor trial number 1

Variety	PC		R1		R2		R3	
	Smut (%)	Arcsine	Smut (%)	Arcsine	Smut (%)	Arcsine	Smut (%)	Arcsine
N29	0.5	2.32	0	5.7	0.25	4.01	0.25	4.01
N38	2.9	9.3	1.6	8.5	2.25	8.9	2.25	8.9
N43	5.9	12.79	7.3	15	6.6	13.89	6.6	13.89
N50	6.6	14.49	27.6	31.4	17.1	22.94	17.1	22.94
N51	0.7	3.68	11.1	15.8	5.9	9.74	5.9	9.74
N52	5.7	13.43	7.2	16.4	6.45	14.91	6.45	14.91
N53	0.7	3.68	7.1	16	3.9	9.84	3.9	9.84
R 95/2100	3	9.48	24.6	25.2	13.8	17.34	13.8	17.34
R 95/2204	3.3	8.23	9.2	17	6.25	12.61	6.25	12.61
R 96/2454	5.5	10.7	0	5.7	2.75	8.2	2.75	8.2
R 96/8149	1.6	7.19	16.2	20.2	8.9	13.69	8.9	13.69
R 97/2168	1.8	7.74	30.1	30.4	15.95	19.07	15.95	19.07
R 98/2431	14.2	21.21	21.4	27.6	17.8	24.4	17.8	24.4
R 98/6092	2.1	8.29	20	26	11.05	17.14	11.05	17.14
R 99/4065	8.3	16.39	26.8	31.3	17.55	23.84	17.55	23.84
EA70-79	1.7	5.47	6.5	14.6	4.1	10.03	4.1	10.03
NCo376	7.8	15.52	23.3	26.5	15.55	21.01	15.55	21.01
MEAN	**4.25**	**9.88**	**14.1**	**19.6**	**4.35**	**9.88**	**7.56**	**9.88**
LSD		**8.2**		**21.9**		**15.05**		**15.05**
CV (%)		**49.9**		**67**		**58.45**		**58.45**

Key; The smut resistance ratings in sugarcane are as follows: 0–3%, HR; 4–6%, R; 7–9%, R; 10–12%, MR; 13–25%, MS; 26–35%, S; 36–50%, S; 51–75%, HS; 76–100%, HS. HR, highly resistance; R, resistance; MR, moderate resistance; MS, moderate susceptibility; S, susceptibility; HS, highly susceptibility (Chao et al. (1990) and Xu and Chen (2001)

Smut Screening: Trial Number 2

A total of nineteen (19) varieties were tested for smut reactions in comparison with NCo376 and EA70-97; susceptible and resistant varieties, respectively.

Results for PC Table 2.3 indicated that there were highly significant differences ($P \leq 0.001$) among test varieties for their reaction to smut infection. Test varieties had smut infections at varying degrees including the resistant check. However, varieties CPCL02-6848, CPCL05-1791, R 96/2281, R 00/4055, CPCL05-1102, R 95/4216 and R 97/2225 had lowest mean smut infection rate percentage statistically similar to resistant check, EA70-97. On the other hand R 98/8115, R 93/4541, R 95/2202 and R 99/4064 scored higher mean smut infection rate percentage similar to susceptible check, NCo376.

Results for R1 showed that Varieties CPCL02-6848, CPCL051791, R004055, R 94/2129 and R 95/2202 had significant ($P<0.05$) lower smut infection than resistant check EA70-97, while varieties R 95/2202, R 95/4065 (R586), R 97/2225 and R 97/6177 scored significant ($P<0.05$) higher smut infection than susceptible check NCo376

Results for R 2 showed that, the level of mean smut infection rate percentage varied among test varieties; however there were highly significantly different ($p \leq 0.001$). Test varieties CPCL02-6848, CPCL05-1791, CPCLO 4-1566, R 94/2129, R004055 and R 95/4216, had mean smut infection rate percentage similar to resistant check EA70-97, while varieties R 95/2202, R 97/6177 and R 98/8115 had mean smut infection rate higher than susceptible check NCo376

Table 2.3: Smut infection rate in three growing seasons for trial number 2

Variety	**PC**		**R1**		**R2**		**AVERAGE**	
	Smut (%)	Arcsine	Smut (%)	Arcsine	Smut (%)	Arcsine	Smut (%)	Arcsine
CPCL02-6848	0	0	2.7	9.6	1.4	4.8	1.4	4.8
CPCL05-1102	0.5	2.4	8.5	15.6	4.5	9	4.5	9
CPCL05-1791	0	0	3.6	10.4	1.8	5.2	1.8	5.2
CP04-1566	7.6	15.5	9.7	18.1	8.7	16.8	8.7	16.8
R004055	0.2	1.5	3.8	12.4	2	7	2	7
R93/4541	15.6	22.6	12.1	18.6	13.9	20.6	13.9	20.6
R94/2129	4.6	11.9	14.1	14.4	9.4	13.2	9.4	13.2
R94/2129-1			3.1	10	3.1	10	3.1	10
R95/2087			7	11.4	7	11.4	7	11.4
R95/2202	12.8	19.8	23.3	24.5	18.1	22.2	18.1	22.2
R95/4065 (R586)	4.2	11.6	24.9	28.4	14.6	20	14.6	20
R95/4216	0.7	3.7	1.9	9.5	1.3	6.6	1.3	6.6
R96/2281	0	0	10.1	18.4	5.1	9.2	5.1	9.2
R97/0391	3.6	10.6	17	23.7	10.3	17.2	10.3	17.2
R97/2225	1.4	5.3	20.9	26.8	11.2	16.1	11.2	16.1
R97/6177	7.1	14.9	24.2	27.8	15.7	21.4	15.7	21.4
R98/2310	2.3	8.4	7.6	15.9	5	12.2	5	12.2
R98/4001	2.9	7.5	12.2	20.4	7.6	14	7.6	14
R98/8115	18.9	24.6	12.9	21.1	15.9	22.9	15.9	22.9
R99/4064	9.7	16.2	10.7	17.7	10.2	17	10.2	17
R99/4065	6.1	14.1	14.6	19.7	10.4	16.9	10.4	16.9
EA 7079	**0.9**	**4.4**	**6.2**	**12.3**	3.5	8.3	3.5	8.3
NCo 376	**15.6**	**21.2**	**14.4**	21.5	15	21.4	15	21.4
MEAN	5.5	10.3	11.6	17.7	8.5	14	8.5	14
LSD		6.6		**15.7**		11.2		11.2
CV%		38.9		53.6		46.3		46.3
P-Value				0.314				

Key; The smut resistance ratings in sugarcane are as follows: 0–3%, HR; 4–6%, R; 7–9%, R; 10–12%, MR; 13–25%, MS; 26–35%, S; 36–50%, S; 51–75%, HS; 76–100%, HS. HR, highly resistance; R, resistance; MR, moderate resistance; MS, moderate susceptibility; S, susceptibility; HS, highly susceptibility (Chao et al., 1990) and Xu and Chen, 2001)

Smut Screening: Trial Number 3

A total of twenty four (24) varieties were tested in smut screening trial against R 579, EA70-97 and NCo376 in PC stage.

Results for PC Table 2.4, showed that the mean smut reaction rate percentage were highly significant differences (P<0.001) in reaction to smut among test varieties; however, susceptible check had relatively lower mean smut infection rate percentage compared to some of the test candidates. The lower mean smut infection rate percentage was recorded in varieties B001250, B03110, R 96 96/2116, R 97/4029, R 94/0142, R 96/2569 closely followed by B80689, B89447 and R 585. On the other hand, highest levels of mean smut infection rate percentage were recorded in varieties R 96/8299, R 95/0017, R 581, R 91/2200 and R 98/4162.

Results for R1 indicated that mean smut infection rate percentage varied among test varieties, but there were not significantly different (p≤0.05) in reaction to smut among test varieties. However, susceptible check had lower mean smut infection rate percentage compared to test varieties except varieties R 94/0142 and R 96/8299 which had the lowest mean smut infection rate percentage.

Results for R2 showed that, the level of mean smut infection rate percentage varied among test varieties; however there were not significantly different (p≤0.05). Test varietiesB001250,B77602,R 91/2200,R 96/2569 and, R 97/4029 had mean smut infection rate percentage similar to resistant check R 579, while varieties R 93/6480, R 94/2129,R 95/0017,R 96/2116, R 96/8299 and R 98/4162 had mean smut infection rate percentage higher than susceptible check NCo376 ().

Table 2.4: Smut infection rate in three growing seasons for trial number 3

	PC		**R1**		**R2**		**AVERAGE**	
Variety	Smut %	Arcsine	smut%	Arcsine	smut%	Arcsine	smut %	arcsine
B001250	0	5.7	4	11.9	2	5.95	2	5.95
B00167	8.6	16.7	24	26.9	16.3	21.8	16.3	3.40
B03110	0	5.7	11.5	18.6	5.75	9.3	5.75	6.20
B77602	3.5	8.8	32.2	3 5.1	17.85	8.8	17.85	0.00
B80689	1.1	3.4	4.5	12.5	2.8	7.95	2.8	3.03
B89447	2.7	9	3.6	11.6	3.15	10.3	3.15	0.87
B98235	3.2	8.3	4.9	12.7	4.05	10.5	4.05	1.47
R 580	3.4	10.2	16.7	19	10.05	14.6	10.05	2.93
R 581	20.2	25.7	6.6	14.3	13.4	20	13.4	3.80
R 585	0.5	3.2	18.5	23.5	9.5	13.35	9.5	6.77
R 91/2200	15.9	22.4	7	15.1	11.45	18.75	11.45	2.43

R 92/4246	7.7	15.7	2	9	4.85	12.35	4.85	2.23
R 93/6480	5.3	13.2	6.9	15.2	6.1	14.2	6.1	0.67
R 94/0142	1.8	5.6	0	5.7	0.9	5.65	0.9	0.03
R 94/2129	4.9	10.7	2.1	9	3.5	9.85	3.5	0.57
R 94/6113	8.4	14.7	3.3	10.3	5.85	12.5	5.85	1.47
R 94/6447	0	5.7	3.7	11.7	1.85	5.85	1.85	3.90
R 95/0017	23.4	27.3	12.4	20.5	17.9	23.9	17.9	2.27
R 96/2116	0	5.7	1.5	8.4	0.75	4.2	0.75	2.80
R 96/2569	0.8	3.9	10.1	17.7	5.45	10.8	5.45	4.60
R 96/6538	2.5	7.4	6.7	12.9	4.6	10.15	4.6	1.83
R 96/8299	25.3	27.8	0	5.7	12.65	16.75	12.65	7.37
R 97/4029	0	5.7	7.4	13.4	3.7	6.7	3.7	4.47
R 98/4162	11.3	18.6	26.1	30.2	18.7	24.4	18.7	3.87
R 579	**4.6**	**9.4**	**1.5**	**8.5**	**3.05**	**8.95**	**3.05**	**0.30**
EA70-79	**1.6**	**4.2**	**1.5**	**8.4**	**1.55**	**6.30**	**1.6**	**4.2**
NCo376	**5.9**	**13.6**	**13.9**	**17.4**	**9.9**	**15.5**	**9.9**	**1.27**
MEAN	6.02	10.4	8.8	15.3	6.02	10.4	6.02	12.03
LSD		4.3		17.6		4.4		13.15
CV (%)		8.7		70.3		8.8		8.17

Key; The smut resistance ratings in are as follows: 0–3%, HR; 4–6%, R; 7–9%, R; 10–12%, MR; 13–25%, MS; 26–35%, S; 36–50%, S; 51–75%, HS; 76–100%, HS. HR, highly resistance; R, resistance; MR, moderate resistance; MS, moderate susceptibility; S, susceptibility; HS, highly susceptibility sugarcane (Chao *et al*. 1990 and Xu and Chen 2001**.**

Smut Screening: Trial Number 4

A total of twenty five (25) varieties were assessed for smut reaction against NCo376 and R 579; susceptible and resistant checks, respectively.

Results for PC on mean smut reactions percentage Table 2.5, indicated that, there were highly significant differences ($P<0.001$) among varieties tested. Lower mean smut infection rate percentage was recorded in varieties BBZ9503, BJ8231 and BR030003 which were similar to resistant check R 579. On the other hand, highest smut infection rate percentage was recorded in varieties B991186 followed by B991114, BR971011 and BBZ951049

Results for R1 indicated that, there were not statistically significant differences ($p\leq0.05$). However, varieties, BBZ951049, BRO30003, BR041001 followed by B991037, BJ8231, BR971014 and BR971007 scored lower mean smut infection rate percentage similar to resistant check R 579 (Table). Variety B99186, B991114, BBZ951049, BR93017 BJ8534 and BR08004 had higher mean smut infection rate percentage than susceptible check NCo376

Results for R2 showed that, the level of mean smut infection rate percentage varied among test varieties, however were highly significantly different (p≤0.001). Test variety BBZ951034, BR030003, B991037, BJ8231, BR971007, BR971014 and BJ8231 had smut infection rate percentage similar to resistant check R 579, while variety B99186, B991114, BBZ951049, BBZ951049, and BR971011and BR971011 had higher smut infection rate percentage than susceptible check NCo376

Table 2.Table 2.5: Smut infection rate in three growing seasons for trial number 4

	PC		**R1**		**R2**		**AVERAGE**	
Variety	Smut (%)	Arcsine	Smut (%)	Arc sine	Smut (%)	Arcsine	Smut (%)	Arcsine
B991037	2.2	7	1.1	7.8	1.65	7.4	1.65	7.4
B991114	26.8	28.7	18.9	26	22.85	27.35	22.85	27.5
B99186	27.9	30.1	37.4	38.2	32.65	34.15	32.65	34.5
BBZ92653	9.4	14.2	7.6	15.1	8.5	14.65	8.5	14.5
BBZ951034	0	5.7	0	5.7	0	5.7	0	5.7
BBZ951049	15.9	22.4	25.3	30.5	20.6	26.45	20.6	26.5
BJ78100	3.4	8.4	5.6	13.2	4.5	10.8	4.5	10
BJ8231	0	0	1.1	7.8	0.55	3.9	0.55	3.9
BJ8534	13	20.4	14.2	22.5	13.6	21.45	13.6	21.5
BJ8897	11.3	19.1	9.5	18.8	10.4	18.95	10.4	18.5
BR030003	0	0	0	5.7	0	2.85	0	2.85
BR041001	8.5	16.4	0	5.7	4.25	11.05	4.25	11.5
BR08004	8.9	16.1	14.6	22.2	11.75	19.15	11.75	19.5
BR08012	5	12.3	4.1	12.9	4.55	12.6	4.55	12
BR93017	6.6	14.7	20.4	27.5	13.5	21.1	13.5	21
BR96013	11.1	19	11.7	20	11.4	19.5	11.4	19
BR971007	0.7	3.7	2.6	10.4	1.65	7.05	1.65	7.05
BR971011	24.5	24.4	8.2	16.1	16.35	20.25	16.35	20.5
BR971014	1.2	6.2	1.7	8.6	1.45	7.4	1.45	7.4
DB8203	11.5	18.9	15.1	19.7	13.3	19.3	13.3	19
DB94177	11	18.8	5.5	14.6	8.25	16.7	8.25	16
DB9436	9.2	17.2	10.1	17.7	9.65	17.45	9.65	17.5
DB9526	6.3	14.2	6.8	15.8	6.55	15	6.55	15
M700/86	4	8.5	8.2	17.2	6.1	12.85	6.1	12.5
N41	3.99	9.98	6.8	16	5.395	12.99	5.395	12.9
R 579	0.41	2.12	18.5	23.5	9.455	12.81	9.455	12.1
NCo376	13.13	20.75	0	5.7	6.565	13.225	6.565	13.3
Mean		13.83	9.4	16.5	9.4	15.165	9.4	15.7
LSD		10.12		12.1		11.11		11.1
CV (%)		44.6		44.9		44.75		44.5

Key; The smut resistance ratings in sugarcane are as follows: 0–3%, HR; 4–6%, R; 7–9%, R; 10–12%, MR; 13–25%, MS; 26–35%, S; 36–50%, S; 51–75%, HS; 76–100%, HS. HR, highly resistance; R, resistance; MR, moderate resistance; MS, moderate susceptibility; S, susceptibility; HS, highly susceptibility (Chao et al. 1990) and Xu and Chen, 2001)

Smut Screening: Trial Number 5

Twenty four (24) varieties were tested for smut reaction against NCo376, N41 and R 579.

Results in PC Table 2.6, indicated that were highly significant differences ($P<0.001$) among tested varieties. Test varieties showed varying levels of their reaction to smut infection rate including the resistant variety. However, varieties BR00010, B01218, B991110, B99907, BJ8820 and BJ82156 had lowest smut infection statistically similar to resistant control. On other hand, varieties BOO713 and BOO111 scored higher smut infection higher than susceptible check

Results for R1 indicated that there were highly significant differences ($p\leq0.05$) among tested varieties. Test varieties had varying levels of reaction to smut infection; however, varieties BOO111 and BT7782 had lower mean smut infection rate percentage similar to resistant check R 579. While variety BOO713, B99907, BR00010, BR021002, BJ8820 and BR97001 had lower mean smut infection rate percentage than the susceptible check NCo376. Varieties B041291, KNB9180, KNB9180,B01218 and KNB9252 had higher mean smut infection rate percentage than susceptible check NCo376

Results for R 2 showed that, the level of mean smut infection rate percentage varied among test varieties; however there were highly significantly different ($p\leq0.001$). Test varieties BR00010, B99907, BT7782, B99907 and BR972001 had lower mean smut infection rate percentage than resistant check R 579, while varieties KNB9252, B00713, BT88404 andBT88404 had higher mean smut infection rate percentage than susceptible check NCo376

Table 2.6: Smut infection rate in three growing seasons for trial number 5

	PC		R1		R2		AVERAGE	
Variety	Smut%	Arcsine	smut %	Arcsine	smut %	Arcsine	smut %	arcsine
B00111	22.4	26.2	0	5.7	11.2	15.95	11.2	15.95
B00279	5.3	10.7	12.6	17.7	8.95	14.2	8.95	14.2
B00713	26.6	28.1	1	7.7	13.8	17.9	13.8	17.9
B0072	6.3	11.6	9	16.4	7.65	14	7.65	14
B01218	0.4	2.1	19.5	23.1	9.95	12.6	9.95	12.6
B041291	5.1	12.9	28.9	27.8	17	20.35	17	20.35
B991110	1.5	5.6	4.9	12.5	3.2	9.05	3.2	9.05
B99907	1.7	7	2.6	9.5	2.15	8.25	2.15	8.25
BBZ8257	5.5	10.9	8.3	14.8	6.9	12.85	6.9	12.85

BJ82156	2.6	7.4	7.3	16.2	4.95	11.8	4.95	11.8
BJ8820	1.1	4.9	3	9.9	2.05	7.4	2.05	7.4
BR00010	0	5.7	2.2	9.1	1.1	4.55	1.1	4.55
BR021002	4.6	9.7	1.7	8.5	3.15	9.1	3.15	9.1
BR96013	4.6	9.2	9.8	18.2	7.2	13.7	7.2	13.7
BR971004	10.8	18.1	3.2	11.1	7	14.6	7	14.6
BR972001	3.2	5.9	1.7	8.5	2.45	7.2	2.45	7.2
BT7782	3.3	10.1	0	5.7	1.65	7.9	1.65	7.9
BT88404	16.7	23.2	4.5	11.1	10.6	17.15	10.6	17.15
DB7869	6.7	14.4	9.5	14.3	8.1	14.35	8.1	14.35
DB8113	7.2	14.8	3.5	11.4	5.35	13.1	5.35	13.1
DB9633	5.6	11.1	8.3	13.6	6.95	12.35	6.95	12.35
KNB9180	5.1	12.8	28.9	31.4	17	22.1	17	22.1
KNB9211	3.8	7.9	5.1	11.6	4.45	9.75	4.45	9.75
KNB9218	3.3	9.3	10	17	6.65	13.15	6.65	13.15
KNB9252	2.4	6.9	18.4	22.4	10.4	14.65	10.4	14.65
R 579	**0**	**5.7**	**15.8**	**23.4**	**7.9**	**11.7**	**7.9**	**11.7**
NCo376	**13.8**	**19.8**	**4.8**	**12.7**	**9.3**	**16.25**	**9.3**	**16.25**
MEAN	6.3	11.1	8.3	14.5	7.3	12.85	7.3	12.85
LSD		11.2		15.3		38.25		38.25
CV%		61.2		64.4		64.4		64.4

Key; The smut resistance ratings in sugarcane are as follows: 0–3%, HR; 4–6%, R; 7–9%, R; 10–12%, MR; 13–25%, MS; 26–35%, S; 36–50%, S; 51–75%, HS; 76–100%, HS. HR, highly resistance; R, resistance; MR, moderate resistance; MS, moderate susceptibility; S, susceptibility; HS, highly susceptibility (Chao et al. (1990) and Xu and Chen (2001).

2.2.4 Discussion

The overall means of smut infection rate percentage for the five (5) experiments indicates that, many sugarcane varieties had smut infections but the level of infection was not much higher, this might be attributed with the long rains and cool weather conditions for the season 2019-2020, which did not favor high smut inoculation to sugarcane varieties.

The tested sugarcane variety exhibits value of smut whips which contributes for lower cane and sugar yields. (Silva *et al*., 2008) reported that number of millable cane and single stalk weight are the main contributing factors for cane and sugar yields. Varieties N29, N38, N53, R 95/2204, CPCL02-6848, CPCL051791, R 004055, R 94/2129-1, R 95/4216, B001220, B80689, B98447, R 94/0142, R 94/2129, R 94/6447, R 96/2116, R 96/6535, R 97/4029, B991037, BBZ951049, BJ78100, BJ8231, BR030003, BR971007, B991110, B99907, BJ8820 and BR00010 shows highly stable resistant to smut infection rate percentages than other varieties this might be attributed by the cultivars having a high level of field phenotypic resistance to smut disease with relatively little pathogen proliferation after smut infection (Caleb, 2008).

From this study, variety BBZ951049 and BR030003 indicates highly stable resistant to smut infection similar to resistant check varieties EA70-79 and R 579, while variety R 98/6092, R 95/2202,B991114,B99186, BBZ951011 and BR971011 shows high infection rate than the susceptible check variety NCo376. Magarey *et al (*2014) reported that, the infection rate of smut in a variety is mainly dependent on the races of the pathogen present and the environmental conditions (Xing, 2013).

According to results found in these five (5) experiments indicates some intermediate susceptible varieties which are; R 95/4065 (R586), R 97/2225, R 97/6177, R 96/2116, R 98/243, R 93/4162, R 98/8115, R 93/6480 and R 99186.These varieties shows that they are not resistant to smut infection during high inoculation pressure, this is an indicator that, they cannot have many crop cycles.

During the growth stages of the crops indicates that, the overall mean smut infection rate percentages affects the main cane yield components which are; sugarcane germination, stalk thickness, number of tillers, number of millable canes and stalk height per single stools which turns into glass-like growth habit and developing sugarcane smut whips which was supposed to be harvested as millable stalks for making sugar and its byproducts. Therefore, strict smut evaluation of resistant varieties are required for better yields of cane and sugar, whereby, the varieties having less than 4% smut recovery with 100t/ha cane yield should be selected for future to boast the farmers income and sugar industry.

2.2.5 Recommendations

Among 88 new varieties that were tested for resistance to smut, 28 indicate highly resistance to the disease when compared to check varieties. This suggests they can be deployed in sugarcane fields with high disease pressure and their yield will not be affected economically.

2.3 Preliminary Evaluation of New Varieties/Clones in Different Sugarcane Estates

Project Codes: SCB 2013/04, SCB 2015/03, SCB 2016/04, SCB 2016/05 2017/4, SCB 2017/03, SCB 2017/06
Principle investigator: A. Kachiwile, N. Mwakyusa, G. Mwasinga, R. Mlimi and C. Gwandu
Collaborators: Sugarcane Estates
Duration: 2013/14/15/16/17/18
Date of Completion: Ongoing

Project summary

Commercial sugarcane production in Tanzania is done in rainfed and irrigated conditions. The attainable yield of 70 – 80 TCH and 45 - 50 TCH are being experienced in the country under irrigation and rainfed conditions respectively (Chambi & Issa, 2010). This is generally very low productivity that actually translates to actual sugar production of less than 7 tons per hectare.
The key factors leading to low productivity include the use of old varieties which have lost vigour and succumbed to insect pests and diseases and further unfavorable weather and soil conditions. The aim of this project was to evaluate performance of newly introduced varieties in sugarcane estates of Tanzanian sugarcane. A total of 9 trials have been established: 2 at TPC, 3 at KSL and 4 at MSE in 2019/2020 season. 11 on-going preliminary variety trials at KSC, KSL, MSE and TPC have been harvested at different crop stages and out of those 26 promising sugarcane varieties and/or lines have been identified.

2.3.1 Introduction

Development of sugarcane varieties involves a series of stages. It starts by generating the population with genetic variability (either by crossing contrasting individuals or introduction of new varieties of known qualities) followed by evaluations across locations and selection of genotypes with superior qualities (Gazaffi et al., 2014). In Tanzania, preliminary variety trial is the second stage in sugarcane variety release pipeline after germplasm introduction and/or improvement. The stage involves three crop cycles: one plant cane (PC) and two ratoons (2R) whereas final selection is based on combined data analysis. At this stage candidate varieties are compared with commercial varieties for important traits such as per cent pure obtainable cane sugar (POCS), cane yield (tons of cane per hectare - TCH), sugar yield (tons of sugar per hectare - TSH) and tolerance/resistance to biotic and abiotic stresses. Identified superior genotypes are then passed to advanced stages until official variety release.

Objective

To evaluate performance of newly introduced varieties in sugarcane estates of Tanzanian sugarcane.

Output achieved

- 9 new preliminary variety trials established at different sugarcane estates
- 11 on-going preliminary variety trials harvested at different crop stages
- 17 promising sugarcane varieties (KQ228, N12, R 581, R 583, R 585, R 94/6113, N53, BR93017, R 98/6092, R00/4045, R 96/2454, R 96/2569, R 97/2168, R 97/4004, R 97/6177, R 99/4064&R 99/4065) and 9 lines (C105, C131, C138, C19, C33, C41, C5, C59&C8)

have been identified across estates.

2.3.2 Materials and Methods

The experiments were conducted in sugarcane estates fields of Kilombero, Kagera, Mtibwa and TPC. Varieties were planted in Randomized Complete Block Design (RCBD) with three to four replications each separated by 3 meters. Plots measured 4 rows by 10 meters. Important parameters collected during evaluation were stalk weight, sugar yield and quality attributes: brix, pol and purity cane. Sucrose content was calculated by multiplying TCH and sucrose content (%).

Statistical analysis

Data collected at different crop growth stage was subjected to analysis of variance using GenStat statistical package version 15.

2.3.3 Results

Kilombero Sugar Company (KSC) - Irrigated variety trials

Variety trials were established at KSC estate to test performance of candidate varieties under irrigated conditions. Results are reported below in different parameters: Sucrose content, polarization (POL), purity, annual tons cane per hectare (TCHA), and annual tons sugar per hectare (TSHA).

Field 381

The means for parameters studied are as presented in Table 2.7. Results for R1 indicated high significant differences ($P \leq 0.05$) among candidate varieties for both TCHA and TSHA. While, varieties R 99/4065, R 98/6092, R 93/4541, CPCL05-1102 and R 00/4045 had the highest TCHA and TSHA; candidates R 97/2225 had the lowest TCHA and TSHA.

Table 2.7: Preliminary sugarcane variety trial (Field 381)

VARIETY	POL	PURITY	SUCROSE	TCHA	TSHA
CPCL02-6848	18.5	66.0	11.8	86.5	8.7
CPCL05-1102	16.4	89.2	11.0	94.0	9.4
CPCL05-1791	14.7	87.0	9.8	60.2	6.0
N25	**15.6**	**91.4**	**10.6**	**79.7**	**8.0**
R00/4045	15.8	86.7	10.7	90.4	9.0
R579	**14.7**	**86.6**	**9.7**	**123.8**	**12.4**
R93/4541	14.8	86.5	9.8	105.2	10.5
R95/2100	16.5	89.8	11.1	64.0	6.4
R95/2202	12.8	82.1	8.2	85.6	8.6
R95/4216	16.0	90.3	10.9	58.5	5.9

R96/2281	15.3	83.7	9.9	94.2	9.4
R97/0391	11.9	79.7	9.1	62.8	6.3
R97/2225	14.6	86.2	9.6	48.3	4.8
R97/6177	15.2	87.7	10.1	63.3	6.3
R98/2310	13.6	85.6	8.9	89.1	8.9
R98/2431	16.5	90.3	11.2	64.0	6.4
R98/4001	14.5	82.6	9.2	82.8	8.3
R98/6092	14.3	87.2	9.5	120.1	12.0
R98/8115	14.1	88.3	9.4	54.0	5.4
R99/4064	13.7	84.2	8.9	64.0	6.4
R99/4065	15.1	87.1	10.0	120.8	12.1
MEAN	15.0	85.6	10.0	81.5	171.1
LSD (0.05)	3.7	18.2	2.7	37.6	3.8
S.E	2.2	11.0	1.6	22.8	2.3
CV (%)	14.9	12.9	16.5	27.9	27.9
P-VALUE	0.263	0.791	0.553	0.002	0.002

DoP: 13/12/2017 PHD: 02/10/2018 CHD: 29/10/2019 CC: R1

Field 219

The means for parameters studied are as presented in Table 2.8. Results for R1 indicated significant differences (P≤0.05) among candidate varieties for both TCHA and TSHA. While, varieties R 97/2168, N38, R 96/2454, N50, R 98/2431, R 98/6092 and N43 had the highest TCHA and TSHA; candidates R 94/2129 had the lowest TCHA and TSHA.

Table 2.8: Preliminary sugarcane variety trial (Field 219)

VARIETY	POL	PURITY	SUCROSE	TCHA	TSHA
N29	16.6	89.7	10.8	60.7	6.1
N38	16.1	88.1	10.1	98.7	9.9
N43	17.3	88.6	11.3	91.5	9.1
N50	17.0	87.8	10.7	95.3	9.5
N51	15.6	85.0	9.6	72.5	7.2
N52	14.8	86.3	9.3	86.6	8.7
N53	16.3	85.7	9.9	82.0	8.2
R94/2129	16.1	88.5	10.3	58.1	5.8
R95/2204	16.9	87.7	10.8	66.7	6.7
R96/2454	16.4	88.9	10.3	98.4	9.8
R96/8149	15.3	83.8	9.3	65.4	6.5
R97/2168	14.6	85.0	9.1	102.3	10.2
R98/2431	16.0	84.4	9.1	95.3	9.5
R98/6092	16.8	90.2	10.9	92.8	9.3

R99/4065	14.2	81.4	8.4	67.3	6.7
R 579	**17.1**	**87.1**	**10.9**	**126.1**	**12.6**
N25	**15.8**	**88.8**	**10.2**	**111.0**	**11.1**
MEAN	16.0	86.9	10.0	86.5	8.7
LSD (0.05)	3.4	7.3	3.0	33.7	3.4
S.E	2.0	4.4	1.8	20.3	2.0
CV (%)	12.7	5.1	18.0	23.4	23.4
P-VALUE	0.865	0.6	0.835	0.009	0.009

DoP: 27/11/2017 PHD: 16/10/2018 CHD: 04/12/2019 CC: R1

Field 332

The means for parameters studied are as presented in Table 2.9 Results for R1 indicated there was no significance difference at ($P \leq 0.05$) among tested varieties in all parameter. However, in absolute terms, variety R 97/6177, R 99/4064, R 00/4045 and R 98/2310 had higher both TCHA and TSHA. Contrariwise, varieties R 98/4001 had the lower TCHA and TSHA.

Table 2.9: Preliminary sugarcane variety trial (Field 332)

VARIETY	POL	PURITY	SUCROSE	TCHA	TSHA
N25	**15.1**	**88.7**	**10.4**	**124.4**	**12.4**
R 579	**16.8**	**91.4**	**11.8**	**115.4**	**11.5**
R00/4045	16.0	86.3	9.5	135.6	13.6
R93/4541	13.9	88.4	10.6	119.4	11.9
R95/2202	16.0	89.7	10.8	109.6	11.0
R95/4216	14.0	88.5	10.9	112.6	11.3
R97/6177	14.5	89.8	10.3	148.5	14.9
R98/2310	14.6	90.3	10.9	131.9	13.2
R98/4001	12.8	86.6	10.8	107.5	10.8
R98/8115	15.1	89.3	10.9	132.1	13.2
R99/4064	14.5	89.0	10.6	137.8	13.8
R99/4065	14.0	85.0	8.9	117.5	11.8
MEAN	14.8	88.6	10.5	124.4	12.4
LSD (0.05)	3.2	5.5	2.4	49.5	5.0
S.E	1.9	3.3	1.4	29.3	2.9
CV (%)	12.6	3.7	13.7	23.5	23.5
P-VALUE	0.435	0.544	0.629	0.83	0.83

DoP: 27/11/2017 PHD: 19/11/2018 CHD: 13/12/2019 CC: R1

Field 417

The means for parameters studied are as presented in Table 2.10. Results for R3 indicated significant differences (P≤0.05) among candidate varieties for both TCHA and TSHA. While, varieties R 96/2569 and CG00-092 had the highest TCHA and TSHA; candidates DB8203 and B041291 had the lowest TCHA and TSHA.

Table 2.10: Preliminary sugarcane variety trial (Field 417)

VARIETY	POL	PURITY	SUCROSE	TCHA	TSHA
B03110	17.1	90.5	11.6	66.3	6.6
B041291	14.3	82.8	9.1	58.5	5.8
B99114	19.8	92.4	13.6	63.5	6.3
BR9701011	14.5	84.0	9.4	88.4	8.8
CG00-092	15.1	84.9	9.8	92.9	9.3
CG96-52	17.0	89.6	11.5	75.9	7.6
CG99-087	17.2	91.1	11.7	64.8	6.5
CG99-125	17.2	85.1	10.6	72.0	7.2
CGSP98-12	14.4	83.5	9.2	64.2	6.4
DB8203	17.9	89.5	12.1	48.6	4.9
N25	**15.5**	**90.3**	**10.5**	**99.1**	**9.9**
R 580	18.3	91.5	12.5	86.4	8.6
R94/6447	15.3	86.0	10.1	65.3	6.5
R96/2569	14.9	84.6	9.6	95.0	9.5
R96/6538	15.7	88.8	10.6	89.2	8.9
R97/4029	15.2	85.8	9.9	71.0	7.1
MEAN	16.2	87.5	10.7	75.1	7.5
LSD (0.05)	3.2	6.6	2.6	24.9	2.5
S.E	1.9	4.0	1.5	14.9	1.5
CV (%)	11.9	4.5	14.4	19.9	19.9
P-VALUE	0.04	0.055	0.038	0.005	0.005

DoP: 25/09/2015 PHD: 16/11/2018 CHD: 24/12/2019 CC: R3

Kilombero Sugarcane Company (KSC) - Rainfed variety trials

Variety trials were established at KSC estate to test the performance of varieties under rainfed conditions. The varieties tested include 570, R 581, R 583, R 92/4246, N12, N47, TZ93-KA-120 and TZ93-KA-122. They were evaluated against NCo376.

Field 130

The means for parameters studied are as presented in Table 2.11. Results for R3 indicated high significant differences (P≤0.05) among candidate varieties for both TCHA and TSHA. While, varieties R 94/6113, TZ93-KA-120, R 583 and R 581 had the highest TCHA and TSHA; candidates R 92/4246 had the lowest TCHA and TSHA. Generally, the yields were above to the lowest yield potential of 70 TCHA.

Table 2.11: Preliminary sugarcane variety trial (Field 130)

VARIETY	POL	PURITY	SUCROSE	TCHA	TSHA
R 581	15.7	87.2	10.5	137.1	13.7
R 583	14.7	80.6	9.2	138.7	13.9
N12	16.7	89.6	11.5	131.3	13.1
N47	16.7	90.7	11.4	125.5	12.6
R92/4246	16.1	86.8	10.7	89.3	8.9
R94/6113	17.2	90.9	11.7	162.7	16.3
TZ93-KA-120	17.0	91.0	11.6	154.5	15.5
TZ93-KA-122	18.2	90.2	12.3	111.8	11.2
R 570	17.1	90.0	11.6	129.9	13.0
NCO376	**16.8**	**88.9**	**11.3**	**97.9**	**9.8**
MEAN	16.5	88.4	11.1	131.4	13.1
LSD (0.05)	4.2	8.9	3.4	29.7	3.0
S.E	2.9	6.1	2.4	20.5	2.0
CV (%)	17.4	6.9	21.1	16.0	16.0
P-VALUE	0.915	0.421	0.847	<.001	<.001

DoP: 30/12/2015 PHD: 12/10/2017 CHD: 19/10/2019 CC: R3

Field 670

The means for parameters studied are as presented in Table 2.12. Results for R2 indicated high significant differences (P≤0.05) among candidate varieties for all parameters except purity (0.05). Varieties R 94/6113 and R 581 had the highest TCHA and TSHA in rainfed condition; candidates TZ93-KA-122 and N12 had the lowest TCHA and TSHA.

Table 2.12: Preliminary sugarcane variety trial (Field 670)

VARIETY	POL	PURITY	SUCROSE	TCHA	TSHA
N12	21.0	91.4	14.4	43.9	4.4
N47	21.9	93.1	15.2	53.5	5.3
NCO 376	**21.9**	**91.9**	**15.0**	**53.9**	**5.4**
R570	23.2	93.3	16.1	49.4	4.9
R581	21.1	93.6	14.6	72.4	7.2
R583	22.2	93.3	15.4	58.7	5.9
R92-4246	21.1	92.9	14.5	46.9	4.7
R94/6113	20.9	92.6	14.4	88.8	8.9

TZ93KA-120	20.1	91.8	13.7	61.2	6.1
TZ93KA-122	20.5	92.0	14.0	32.6	3.3
MEAN	21.4	92.6	14.7	56.1	5.6
LSD (0.05)	0.9	1.5	0.7	21.5	2.1
S.E	0.6	1.0	0.5	14.8	1.5
CV (%)	2.9	1.1	3.3	26.4	26.4
P-VALUE	<.001	0.054	<.001	0.001	0.001

DoP: 27/09/2016 PHD: 21/11/2018 CHD: 04/10/2019 CC: R2

Field 622

The means for parameters studied are as presented in Table 2.13. Results for R3 indicated significant differences (P≤0.05) among candidate varieties for all parameters except purity (0.452). Varieties TZ93-KA-120 had the highest TCHA and TSHA in rainfed condition; candidates R 92/4246 and N12 had the lowest TCHA and TSHA.

Table 2.13: Preliminary sugarcane variety trial (Field 622)

VARIETY	POL	PURITY	SUCROSE	TCHA	TSHA
N12	19.3	92.0	13.3	47.3	4.7
N47	20.2	93.4	14.0	67.8	6.8
NCO376	**19.0**	**93.2**	**13.1**	**56.8**	**5.7**
R570	20.0	93.7	13.9	64.8	6.5
R581	17.5	91.4	11.8	61.3	6.1
R583	18.9	91.6	12.9	49.5	5.0
R92/4246	17.2	91.8	11.8	42.1	4.2
TZ93-KA-120	18.9	91.9	12.9	70.5	7.0
TZ93-KA-122	20.2	93.4	14.0	52.5	5.3
MEAN	19.0	92.5	13.1	56.9	5.7
LSD (0.05)	1.1	2.7	0.9	17.7	1.8
S.E	0.8	1.8	0.6	12.2	1.2
CV (%)	4.1	2.0	5.0	21.3	21.3
P-VALUE	<.001	0.452	<.001	0.033	0.033

DoP: 06/12/2015 PHD: 19/12/2018 CHD: 29/10/2019 CC: R3

Field 664

The means for parameters studied are as presented in Table 2.14. Results for R1 indicated there was no significance difference at (P≤0.05) among candidate varieties for purity, TCHA and TSHA. However, in absolute terms, variety R 581and TZ93-KA-120 had higher both TCHA and TSHA. Contrariwise, varieties R 92/4246 had the lower TCHA and TSHA.

Table 2.14: Preliminary sugarcane variety trial (Field 664)

VARIETY	POL	PURITY	SUCROSE	TCHA	TSHA
N41	20.2	92.9	13.9	70.0	7.0
N47	19.7	92.0	13.5	69.2	6.9
NCO 376	**19.4**	**90.5**	**12.9**	**82.9**	**8.3**
R570	19.4	90.2	13.2	84.7	8.5
R581	18.1	90.6	12.3	79.1	7.9
R583	18.7	88.0	12.3	67.0	6.7
R92/4246	15.5	87.3	10.3	62.2	6.2
TZ93-KA-120	19.3	89.3	13.2	73.9	7.4
TZ93-KA-122	19.3	90.6	13.1	65.8	6.6
MEAN	18.8	90.2	12.7	72.8	7.3
LSD (0.05)	2.2	5.0	1.8	18.1	1.8
S.E	1.5	3.4	1.2	12.4	1.2
CV (%)	8.1	3.8	9.6	17.0	17.0
P-VALUE	0.011	0.411	0.018	0.167	0.167

DoP: 29/12/2017 PHD: 14/01/2019 CHD: 14/12/2019 CC: R1

Tanganyika Planting Company (TPC) - Irrigated variety trials

Field L3N (VT39)

Fourteen varieties (7N and 7R) were tested against N25 and R579 in variety trial number 39 at PC stage. Statistical results are presented in Table 2.15. Results showed significant differences (P>0.05) for all traits except purity. Varieties with highest pol were R98/6092 (17.6%), R98/2431 (17.3%) and R95/2204(17.2%). Contrarily lowest pol was recorded on varieties N52, N38 and N29. In terms of fibre content (%), the best variety was R95/2204 followed by R99/4065 and N51. Varieties R579, R97/2168 and N25 were the least performers for this trait. Test variety N53 had the highest TCHA followed by control varieties R579 and N25 meanwhile test varieties R95/2204, N29 and R96/8149 performed poorly. The test variety N53 was also the best in terms of TSHA followed by R579 and R98/2431. Lowest TSHA was recorded in variety R96/8149 followed by N51 and N29.

Table 2.15: Preliminary sugarcane variety trial VT39 (Field L3N)

VARIETY	%POL	%FIBRE	%PURITY	TCHA	TSHA
N29	15.2	11.9	89.1	131.7	17.2
N38	14.3	12.0	85.3	158.5	19.2
N43	16.0	12.0	88.7	138.1	18.8
N50	16.0	12.2	88.6	155.6	21.0
N51	15.5	14.0	87.6	132.5	17.0
N52	14.1	11.8	85.0	167.5	20.0

N53	16.9	13.2	89.4	180.0	25.4
R95/2204	17.2	15.1	88.6	132.4	18.5
R96/2454	16.2	13.1	85.8	164.7	22.3
R96/8149	16.7	12.7	85.9	113.1	16.0
R97/2168	16.8	11.6	88.6	140.5	20.2
R98/2431	17.3	11.7	89.0	156.0	23.1
R98/6092	17.6	12.4	90.6	135.6	20.2
R99/4065	16.5	14.9	87.3	135.8	18.2
N25	**15.2**	**11.6**	**88.1**	**169.4**	**22.1**
R579	**15.8**	**11.2**	**86.5**	**172.4**	**23.4**
MEAN	16.2	12.7	87.8	145.9	19.8
LSD (0.05)	1.8	1.0	4.0	23.6	4.0
S.E	1.3	0.7	2.8	16.6	2.8
CV (%)	7.9	5.6	3.2	11.1	14.0
P-VALUE	0.006	<.001	0.209	<.001	<.001

DoP: 01/08/2018 CHD: 24/08/2019 CC: PC

Field L3N (VT35)

Ten varieties (1B, 1BJ, 1BR, 1CGPS, 2CPCL, 3DB and 1R) were tested against N25 and R579 in field trial 35 at R1 stage. The information on statistical analysis are presented in (Table 2.16). Statistically, there was significant differences ($P<0.05$) for all parameters evaluated except for purity (%) which indicated no significant differences ($P>0.05$).The highest pol (%) was recorded in test varieties CPCL97-0393, B991037 and CPCL00-6131 while test varieties BJ78100, BR93017 and DB9526 were the least. For fibre content (%), best performers were test varieties CPCL97-0393, R98/4162 and CPCL00-6131 while the worst was control variety R579 followed by test varieties DB9526 and DB7869. The highest TCHA was recorded in variety R 579 followed by N25 and test variety BR93017 whereas least performers were test varieties B991037, BJ78100 and CPCL97-0393. A similar trend was observed in TSHA.

Table 2.16: Preliminary sugarcane variety trial VT35 (Field L3N)

VARIETY	%POL	%FIBRE	%PURITY	TCHA	TSHA
B991037	17.7	14.0	89.8	102.1	15.0
BJ78100	15.9	12.2	88.8	105.0	14.2
BR93017	15.3	11.6	87.9	149.3	19.3
CGPS98-09	17.3	13.2	88.1	131.9	19.1
CPCL00-6131	17.7	14.3	89.6	124.8	18.1
CPCL97-0393	17.7	17.3	90.5	107.2	14.9
DB7869	17.3	11.6	89.6	124.7	18.5
DB9436	16.8	14.2	88.7	131.2	18.3

DB9526	14.6	11.2	85.9	132.3	16.7
R98/4162	16.1	15.8	89.7	125.2	16.1
N25	**17.1**	**12.6**	**91.1**	**161.3**	**23.3**
R579	**17.5**	**11.0**	**89.4**	**177.2**	**26.7**
MEAN	16.7	13.5	88.9	123.4	17.0
LSD (0.05)	1.7	1.1	3.1	28.3	4.3
S.E	1.1	0.8	2.2	19.7	3.0
CV (%)	6.8	5.7	2.4	15.0	16.3
P-VALUE	0.004	<.001	0.155	<.001	<.001

DoP: 21/07/2017 PHD: 10/08/2018 CHD: 20/08/2019 CC: R1

Field L3N (VT31)

Twelve varieties (7R and 5CG) were tested against N25 and R 579 in field trial 31 at TPC in the third ratoon (R3). The information's on statistical analysis are presented in Table 2.17. Statistically, there was significant differences ($P<0.05$) for all parameters evaluated except for purity (%) which indicated no significant differences ($P>0.05$). The highest pol (%) was recorded in test varieties CG98/46, CG-SP98/12 and control variety R 579 while test varieties CG98/32, R 95/0017 and R 94/6113 were the least. For fibre content (%), best performers were test varieties CG98/32, CG98/46 and R 94/6447 while the worst was testvariety CG98/10 followed by control variety R579 and R 580. The highest TCHA was recorded in variety R 579 followed by test variety R 94/6113 and N25 while least performers were test varieties CG98/32, CG-SP98/12 and CG98/46. The varieties performed in a similar trend with regards to TSHA.

Table 2.17: Preliminary sugarcane variety trial VT31 (Field L3N)

VARIETY	%POL	%FIBRE	%PURITY	TCHA	TSHA
R 580	11.4	11.4	87.4	196.8	22.7
R 581	11.7	12.6	89.3	157.5	18.4
CG98/10	11.0	10.6	86.6	152.2	16.7
CG98/32	10.5	14.5	86.8	111.3	11.6
CG98/46	13.9	14.1	88.7	134.8	18.5
CG98/47	10.5	12.0	88.6	153.1	16.2
CG-SP98/12	13.1	13.1	89.3	132.5	17.2
R 92/4246	10.5	12.5	88.2	162.4	17.1
R 93/6480	12.1	13.2	91.5	162.7	19.7
R 94/6113	10.2	11.7	84.9	210.6	21.5
R 94/6447	12.0	13.9	88.7	161.5	19.3
R 95/0017	10.4	11.9	87.3	161.9	16.7
R 579	**12.3**	**11.0**	**90.1**	**215.8**	**26.5**
N25	**12.1**	**11.6**	**90.5**	**210.1**	**25.6**

MEAN	11.4	12.6	88.1	158.1	18.0
LSD (0.05)	1.6	1.5	4.6	22.5	4.2
S.E	1.1	1.0	3.2	15.7	29.5
CV (%)	9.8	8.4	3.6	9.5	15.4
P-VALUE	<.001	<.001	0.333	<.001	<.001

DoP: 10/01/2015 PHD: 10/07/2018 CHD: 21/07/2019 CC: R3

Field L3N (Clones developed from fuzz)

Forty three lines (developed from fuzz) were tested against N41 and R 579 in field trial L3N at TPC in the plant cane stage. The information's on statistical analysis are presented in Table 2.18. Statistically, there was significant differences (P<0.05) for two field data set: TCHA and brix (%).

The highest brix (%) was recorded in test lines C135, C137 and C91 while test lines C47, C126 and C108 were the least. For the case of TCHA, best performers were test linesC138, C131 and C105 while the worst was test lines were C125, C108 and C126.

For the case of lab performance, the highest pol (%) was recorded in lines C25, C11 and C1 while lowest in C24, C22 and C64. The highest purity (%) was recorded in lines C108, C105 and C87 whereas lowest in C24, C22 and C45. Lines with highest fibre content (%) were C111, C85 and C2 while lowest was on lines C125, C136 and C114.

Table 2.18: Preliminary sugarcane lines trial (Field L3N)

	FIELD			LAB				
CLONE	**TCHA**	**%BRIX**	**DIAMETER**	**%POL**	**%BRIX**	**%PURITY**	**%FIBRE**	**EC**
C131	72.4	12.4	2.6	14.2	16.6	85.5	13.4	4.5
C105	69.3	9.3	3.0	11.9	12.3	97.0	13.3	10.2
C138	80.3	12.5	3.4	11.2	14.7	76.3	12.6	7.5
C111	61.5	13.1	3.1	14.7	17.2	85.5	17.4	4.8
C127	65.1	13.1	2.5	11.9	13.5	88.2	11.6	6.1
C11	49.3	14.4	2.8	15.9	18.0	88.4	13.4	3.0
C115	55.9	11.5	3.6	12.9	14.5	89.0	12.4	5.2
C25	40.0	12.4	2.1	17.6	19.1	92.2	12.6	3.0
C1	42.4	13.6	2.9	15.6	17.2	90.5	12.0	2.9
C80	49.0	11.3	2.9	12.4	13.3	93.0	13.2	5.9
N41	**58.2**	**10.6**	**2.6**	**12.3**	**14.8**	**83.1**	**9.9**	**4.0**
C116	45.4	13.8	3.8	14.9	17.3	86.3	14.2	8.2
C91	49.7	14.6	3.4	13.4	16.2	83.0	12.3	3.8
C124	58.3	14.4	3.2	10.4	13.8	75.0	12.7	3.8
C137	47.0	15.6	2.8	12.7	16.0	79.1	13.6	3.6
C135	41.3	15.8	2.7	13.2	15.7	84.0	14.5	3.0
C47	61.1	7.5	3.0	10.2	13.3	76.9	13.1	4.4

C114	51.2	11.1	2.7	11.5	14.7	78.0	9.6	6.0
C87	37.0	10.3	2.1	11.7	12.3	94.9	13.6	5.8
C2	45.9	12.4	2.3	13.3	17.3	77.1	16.5	3.5
C50	52.9	11.0	2.2	10.5	13.6	77.1	10.5	6.0
C110	50.9	11.5	3.0	10.9	14.2	76.6	12.0	7.8
C51	57.9	12.5	3.2	8.3	11.5	72.5	12.9	5.7
C100	57.4	10.7	2.8	8.7	12.2	71.4	10.8	5.0
R 579	**39.8**	**12.9**	**3.4**	**11.4**	**14.7**	**77.5**	**11.3**	**4.4**
C61	49.0	12.9	2.8	9.4	13.8	68.0	12.1	6.9
C134	36.0	12.9	2.9	11.6	15.0	76.5	11.2	3.2
C113	33.9	12.4	2.8	11.4	14.4	79.3	12.0	4.5
C108	19.2	8.0	2.2	13.0	13.2	98.2	13.3	4.3
C5	45.9	10.7	3.0	9.2	12.8	72.0	10.1	6.0
C133	37.6	14.6	2.8	10.2	14.2	72.4	13.0	3.0
C85	30.0	10.8	2.2	13.0	16.5	79.0	16.6	5.4
C99	25.7	12.6	2.2	13.0	16.3	79.5	12.1	7.3
C136	43.1	9.5	2.5	8.6	12.3	70.0	8.9	4.6
C22	62.5	8.8	3.3	4.9	9.2	52.6	10.4	7.8
C107	36.3	9.0	3.6	7.4	11.2	65.8	10.5	6.2
C103	35.8	10.3	2.2	7.2	10.9	65.5	14.9	6.9
C16	35.1	12.2	2.1	6.8	10.6	64.6	13.0	6.9
C112	34.6	10.6	2.5	7.3	11.5	63.5	11.0	2.9
C45	38.2	10.2	2.0	6.8	11.3	60.6	11.6	6.0
C64	33.4	10.6	2.0	6.6	10.8	60.9	12.3	6.2
C109	25.9	11.7	2.6	7.1	11.2	63.1	9.6	5.4
C126	20.6	7.9	2.6	7.7	10.9	70.4	11.4	7.5
C24	45.3	9.3	2.5	4.7	9.7	48.2	10.7	6.5
C125	16.0	10.1	2.3	8.4	12.0	69.9	8.5	5.1
MEAN	**45.4**	**11.6**	**2.7**	**10.8**	**13.9**	**77.0**	**12.4**	**5.4**
LSD (0.05)	31.0	4.0						
S.E	19.1	2.4						
CV (%)	42.1	21.2						
P-VALUE	0.039	0.011						

DoP: 17/01/2019 CHD: 26/01/2020 CC: PC

Field E11 (VT36)

Seven varieties (3CG, 2Q, 1N and 1R) were tested against N25 and N47 in field trial 36 at R1 stage. The information on statistical analysis are presented in Table 2.19. Statistically, there was significant differences ($P<0.05$) for all parameters evaluated. The highest pol (%) was recorded in control variety N25 followed by test varieties Q190 and CG00-028. Contrariwise test varieties N36, CG97-100 and R 85/1334 were the least. For fibre content (%), surprisingly the best performer was control variety N25 followed by test varieties CG00-028 and CG00-129 while the worst were test varieties KQ228, R 85/1334 and N36. Purity wise, the best performer was control variety N25 followed by test varieties CG00-028 and Q190 whereas test varieties R 85/1334, N36 and CG97-100 under performed. The highest TCHA was recorded in control varieties N47 and N25 followed by test variety R 85/1334 whereby least performers were test varieties CG00-028, CG00-129 and CG97-100. A similar trend was observed in terms of TSHA.

Table 2.19: Advanced sugarcane variety trial VT36 (Field E11)

VARIETY	%POL	%FIBRE	%PURITY	TCHA	TSHA
CG00-028	18.5	13.8	93.5	125.5	23.2
CG00-129	18.3	13.6	91.7	127.5	23.3
CG97-100	16.5	13.3	90.0	139.5	23.0
KQ228	20.0	14.5	94.1	178.7	35.6
N36	17.3	12.1	90.3	146.8	25.4
Q190	18.6	12.9	92.5	153.7	28.6
R 85/1334	15.6	12.5	88.3	170.2	26.5
N25	**16.5**	**12.6**	**89.5**	**149.0**	**24.7**
N47	**16.9**	**12.9**	**90.7**	**182.1**	**30.8**
MEAN	17.8	13.3	91.5	148.8	26.5
LSD (0.05)	1.1	0.8	1.7	15.8	3.0
S.E	0.7	0.6	1.2	10.9	2.1
CV (%)	4.1	4.3	1.3	7.1	7.7
P-VALUE	<.001	<.001	<.001	<.001	<.001

DoP: 14/12/2017 PHD: 14/12/2018 CHD: 04/12/2019 CC: R1

Mtibwa Sugar Estates (MSE) – Irrigated variety trials

Field H6

Fifteen varieties (7N and 8R) were tested against N25 in field trial H6 at PC stage. Results presented in Table 2.20 revealed that there was statistically significant differences (P<0.05) for all parameters evaluated except purity (%). The highest pol (%) was recorded in testvarieties R96/8149, N38 and control varietyN25. On other hand, test varieties R99/4065, N51 and R98/2431 did not perform well. Regarding sucrose content (%), test varieties N38, R96/8149 and N29 were the best while test varieties R99/4065, N51 and R98/6092 were the least for the trait. Based on TCHA, the highest yield was recorded on test variety N53 followed by R97/2168 and R96/2454. To the contrary test varieties R98/6092, R95/2204 and N51 yielded lowest. The highest TSHA was obtained in test variety N53 followed by N38 and N50 meanwhile lowest yield was on R98/6092 followed with N51 and R95/2204.

Table 2.20: Preliminary sugarcane variety trial (Field H6)

VARIETY	%POL	%PURITY	%SUCROSE	TCHA	TSHA
N29	17.8	84.9	17.1	77.7	13.3
N38	18.1	88.4	17.4	91.2	15.8
N43	17.5	86.5	16.5	82.0	13.6
N50	17.4	85.9	16.8	89.8	15.1
N51	15.1	84.4	14.8	71.9	10.4
N52	17.0	85.6	16.1	84.5	13.6
N53	17.5	84.3	16.2	108.0	17.5
R 95/2100	17.4	84.1	16.3	90.0	14.7
R 95/2204	16.9	84.1	15.7	66.3	10.5
R 96/2454	17.3	81.4	15.3	92.4	14.3
R 96/8149	18.2	85.9	17.3	74.4	12.8
R 97/2168	17.8	83.8	16.1	92.4	15.0
R 98/2431	16.1	83.6	15.8	91.9	14.4
R 98/6092	16.7	84.0	15.3	64.2	9.8
R 99/4065	14.3	83.3	13.7	83.7	11.5
N25	**18.0**	**85.6**	**16.6**	**82.3**	**13.8**
MEAN	17.0	84.7	16.0	84.0	13.5
LSD (0.05)	2.0	4.0	1.9	19.1	3.2
S.E	1.2	2.4	1.1	11.4	1.9
CV (%)	7.1	2.8	6.9	13.6	14.2
P-VALUE	0.018	0.258	0.025	0.006	0.001

DoP: 24/02/2018 CHD: 19/07/2019 CC: PC

Field C7AA

Six varieties (3Q, 2N and 1R) were tested in advanced stage against N25, R 570 and R 579 in field trial C7AA at PC level. Information on statistical analysis are presented in Table 2.21. Among the selected attributes, statistical significant differences ($P \leq 0.05$) only exhibited in Pol (%). The highest pol (%) was recorded in test varieties Q208, KQ228 and N36 whilst lowest on Q220 followed by R 85/1334 and R579.Although other parameters were not significant ($P \geq 0.05$), nevertheless the highest TCHA was on N36 followed by R 85/1334 and KQ228 whereas lowest on N41 followed by R 579 and Q208. Based on TSHA, highest yield was on N36 followed by KQ228 and R 85/1334 while varieties N41, R579 and R570 had the lowest yield

Table 2.21: Advanced sugarcane variety trial (Field C7AA)

VARIETY	%POL	%PURITY	%SUCROSE	TCHA	TSHA
KQ228	21.8	82.4	19.2	87.7	16.8
N36	20.4	84.4	18.8	111.1	20.7
N41	19.6	84.4	18.4	61.0	11.2
Q208	22.2	84.1	19.6	75.7	14.8
Q220	18.2	76.1	16.3	83.0	13.5
R 85/1334	18.2	80.6	17.1	93.9	16.4
R 570	**19.8**	**81.0**	**17.8**	**75.9**	**13.3**
N25	**20.2**	**82.9**	**18.1**	**85.6**	**15.5**
R579	**18.6**	**83.7**	**17.2**	**67.3**	**11.6**
MEAN	20.1	82.0	18.2	85.4	15.6
LSD (0.05)	1.9	6.3	2.1	45.6	8.4
S.E	1.1	3.7	1.2	26.3	4.9
CV (%)	5.6	4.5	6.6	32.0	32.7
P-VALUE	0.003	0.196	0.069	0.5	0.416

DoP: 28/09/2018 CHD: 10/10/2019 CC: PC

Mtibwa Sugar Estates (MSE) – Rainfed variety trials

Field 1AB

Six varieties (1N and 5R) were tested against NCO376, R 579 and R 570 in field trial 1AB at PC stage. Trial results are presented in Table 2.22. Among selected parameters there was statistically significant differences (P<0.05) only on TCHA and TSHA. The highest TCHA was recorded in test varieties R 585, R 96/2569 and R 97/4004, perversely; lowest yield was on N12 followed by R 579 and NCO376. A similar trend was observed for TSHA.

Table 2.22: Preliminary sugarcane variety trial (Field 1AB)

VARIETY	%POL	%PURITY	%SUCROSE	TCHA	TSHA
R585	17.6	83.7	16.3	64.4	11.4
R96/2569	16.6	81.2	14.8	57.5	9.4
R97/4004	17.2	82.6	15.4	48.3	8.3
R96/2116	15.8	80.6	14.5	44.3	7.0
R97/4029	16.6	80.8	14.8	44.0	7.3
N12	15.4	79.2	14.0	32.5	5.0
R 570	**17.7**	**83.2**	**16.1**	**42.2**	**7.4**
R 579	**17.4**	**83.4**	**16.1**	**37.6**	**6.6**
NCO376	**17.2**	**81.0**	**15.6**	**39.7**	**6.8**
MEAN	16.7	81.6	15.1	47.6	8.0

LSD (0.05)	1.6	5.0	1.5	15.8	2.6
S.E	1.1	3.4	1.1	10.8	1.8
CV (%)	6.7	4.2	6.9	23.8	23.3
P-VALUE	0.084	0.582	0.057	0.010	0.003

DoP: 04/07/2018 CHD: 12/07/2019 CC: PC

Field K7B

Five varieties (1N, 2R and 2TZ) were tested against NCO376and N41 in field trial K7B at PC stage. Trial results (Table 2.23) indicated no significant differences (P>0.05) among traits measured. Despite this, the highest TCHA was recorded on line TZ93-KA-120 followed by varieties R 570 and NCO376. On other hand, lowest TCHA was on variety N41 followed by R 581 and line TZ93-KA-122.

Table 2.23: Advanced sugarcane variety trial (Field K7B)

VARIETY	%POL	%PURITY	%SUCROSE	TCHA	TSHA
N41	15.2	81.8	14.2	59.8	8.3
N47	16.2	81.8	14.8	66.8	9.9
R 581	13.4	79.7	12.5	63.7	7.9
R 570	15.0	80.2	13.8	76.9	10.5
TZ93-KA-120	13.9	78.8	12.8	81.6	10.5
TZ93-KA-122	16.4	80.6	14.9	64.5	9.6
NCO376	**14.7**	**81.4**	**13.5**	**69.9**	**9.4**
MEAN	15.0	80.5	13.8	14.9	9.4
LSD (0.05)	2.0	8.7	2.1	18.5	2.1
S.E	1.1	4.9	1.2	10.4	1.2
CV (%)	7.5	6.0	8.6	15.0	12.6
P-VALUE	0.054	0.981	0.176	0.212	0.120

DoP: 24/11/2018 CHD: 03/02/2020 CC: PC

Kagera Sugar Ltd (KSL) - Rainfed variety trials

Field FR2A

Eight varieties (6N and 2R) were evaluated against Co617 and N41 in field FR2A at PC stage. Trial results are shown in Table 2.24. They indicate that there was significant differences (P<0.05) only in brix level (%).The highest brix was on variety R570 followed by N29 and N12 while lowest performance was on variety N52 followed by N51 and N50. Regarding TCHA, variety N47, N12 and R581 outpaced others whereby the least variety was N41 followed by R 570 and N29. With attention to TSHA, the best performer was variety N47 followed by N12 and R581 and contrarily lowest yield was on variety N41 followed by N52 and N51.

Table 2.24: Preliminary sugarcane variety trial (Field FR2A)

VARIETY	BRIX	TCHA	TSHA
Co617	**19.46**	**80.98**	**15.81**
N12	19.9	104.91	20.95
N29	20.02	72.09	14.45
N41	**18.9**	**63.91**	**12.18**
N47	18.94	111.76	21.16
N50	18.39	78.94	14.57
N51	18.24	78.63	14.08
N52	16.68	83.74	13.97
R570	20.21	70.25	14.15
R581	19.86	95.3	18.91
MEAN	19.06	84.051	16.023
LSD (0.05)	2.019	40.11	8.101
S.E	1.177	23.38	4.723
CV (%)	6.2	27.8	29.5
P-VALUE	0.044	0.302	0.283

DoP: 12/01/2018 CHD: 18/03/2019 CC: PC

Field BR5C (Clones developed from fuzz)

Seventy one lines (developed from fuzz) were tested at KSLin field BR5C at plant cane stage. Results are indicated in Table 2.25. The highest brix (%) was recorded in test lines C28, C54 and C53 while test lines C92, C15 and C38 were the least. For the case of TCHA, best performers were test lines C19, C5 and C7 while the worst lines were C91, C70 and C92. In terms of TSHA, line C28 performed the best followed by C33 and C19 and to the contrarily the least yield was on line C92 followed by C70 and C15.

Table 2.25: Preliminary sugarcane lines trial (Field BR5C)

CLONE	HEIGHT (cm)	BRIX%	TCHA	TSHA
C19	260	19.6	60.0	11.8
C28	268	22.4	54.5	12.2
C52	287	19.2	47.1	9.0
C87	287	16.6	45.5	7.5
C7	256	16.2	56.3	9.1
C2	271	16.5	45.4	7.5
C84	270	18.1	42.6	7.7

C1	247	20.5	49.3	10.1
C24	266	14.5	43.7	6.4
C4	249	19.3	46.3	8.9
C37	269	17.1	39.0	6.7
C99	264	19.3	38.9	7.5
C13	247	17.2	46.9	8.0
C59a	225	19.2	53.9	10.4
C5	215	19.5	57.1	11.1
C20	232	19.1	47.9	9.2
C58	251	19.1	39.4	7.5
C50	253	14.7	40.2	5.9
C67	254	19.0	37.1	7.1
C69	247	17.9	40.7	7.3
C65	236	18.5	44.3	8.2
C64	232	17.7	45.0	8.0
C16	244	18.1	39.4	7.1
C34	219	20.3	47.4	9.6
C51	211	20.1	50.7	10.2
C77	238	16.3	40.9	6.6
C33	193	21.5	56.2	12.1
C11	231	18.7	41.4	7.8
C86	213	17.7	49.8	8.8
C12	243	17.6	36.3	6.4
C85	240	16.5	37.1	6.1
C31a	222	17.9	44.0	7.9
C31b	232	17.9	38.0	6.8
C43	224	16.9	41.8	7.1
C38	218	14.0	45.6	6.4
C44	202	15.3	50.2	7.7
C49	221	18.6	39.8	7.4
C59b	211	17.1	44.3	7.6
C14	213	16.6	43.3	7.2
C10	209	21.8	42.0	9.1
C35	199	19.4	47.4	9.2
C63	221	17.1	38.8	6.7
C81	214	17.8	40.9	7.3
C62	220	18.6	35.0	6.5
C42	194	18.1	45.9	8.3
C53	209	21.8	37.1	8.1

C61	209	16.8	39.7	6.7
C56	201	18.9	41.9	7.9
C80	201	17.7	40.4	7.1
C54	183	21.8	45.0	9.8
C100	186	18.5	45.7	8.5
C8	187	15.0	47.3	7.1
C68	213	18.9	33.3	6.3
C26	189	16.9	42.6	7.2
C66	184	15.1	43.4	6.6
C21	179	19.2	42.6	8.2
C40	163	17.6	50.0	8.8
C89	159	18.5	50.7	9.4
C22	189	17.7	38.0	6.7
C48	177	19.0	42.0	8.0
C27	163	16.3	48.9	8.0
C83	150	19.5	48.4	9.5
C46	177	16.8	37.9	6.4
C94	178	18.4	35.5	6.5
C36	176	16.0	37.5	6.0
C15	172	13.4	38.9	5.2
C41	165	19.2	37.0	7.1
C47	167	16.9	36.9	6.2
C59	143	19.0	44.6	8.5
C88	159	18.3	36.6	6.7
C91	164	20.3	25.7	5.2
C70	134	15.1	32.1	4.9
C92	82	8.5	32.6	2.8
MEAN	**212**	**18**	**43**	**8**

DoP: 12/01/2018 CHD: 18/03/2019 CC: PC

Kagera Sugar Ltd (KSL) - Irrigated variety trials

Field AP8D (Clones developed from fuzz)

Sixty nine lines (developed from fuzz) were tested at KSLin field AP8D at plant cane stage. Results are indicated in Table 2.26. The highest brix (%) was recorded in test lines C83, C12 and C4 while test lines C87, C27 and C15 were the least. For the case of TCHA, best performers were test lines C59, C46 and C8 while the worst lines were C94, C81 and C92. In terms of TSHA, line C59 performed the best followed by C41 and C12 and to the contrarily the least yield was on line C87 followed by C81 and C94.

Table 2.26: Preliminary sugarcane lines trial (Field AP8D)

CLONE	HEIGHT (cm)	BRIX %	TCHA	TSHA
C1	265	20.9	57.9	12.1
C26	276	19.3	54.3	10.4
C27	283	12.6	57.0	7.2
C2	257	19.2	60.1	11.5
C51	253	16.2	62.7	10.2
C44	271	21.3	51.0	10.9
C16	245	19.4	61.8	12.0
C12	238	22.2	61.4	13.7
C8	236	20.0	64.2	12.9
C40	256	18.8	56.6	10.6
C84	286	17.4	45.9	8.0
C50	234	19.1	64.1	12.3
C52	246	17.6	60.0	10.6
C46	229	19.6	64.3	12.6
C43	248	20.8	54.3	11.3
C91	245	20.4	53.6	11.0
C28	239	15.2	59.8	9.1
C47	230	21.8	56.0	12.2
C70	267	19.2	42.4	8.1
C38	251	17.0	50.3	8.6
C7	212	20.1	62.6	12.6
C59	184	20.8	70.5	14.6
C34	232	20.4	52.3	10.6
C35	220	20.4	56.8	11.6
C54	239	19.9	49.9	9.9
C41	199	21.7	63.7	13.8
C6	226	22.0	53.0	11.6
C56	230	18.6	53.4	9.9
C68	232	17.9	52.9	9.5
C37	242	16.7	49.6	8.3
C31a	219	17.2	58.0	10.0
C58	232	18.7	51.3	9.6
C11	224	18.5	54.3	10.0
C66	243	20.7	44.8	9.2

C13	220	20.6	52.0	10.7
C61	215	20.0	54.0	10.8
C4	188	22.0	61.1	13.4
C48	225	17.4	50.3	8.8
C14	221	18.9	49.8	9.4
C20	207	21.4	53.1	11.4
C5	203	19.8	55.4	11.0
C31b	219	21.6	47.5	10.2
C22	212	13.8	54.4	7.5
C19	198	21.3	52.4	11.2
C77	231	19.1	41.1	7.9
C21	198	19.3	54.0	10.4
C33	206	20.9	49.2	10.3
C85	207	18.8	48.6	9.1
C88	220	20.1	39.5	7.9
C15	195	13.3	52.7	7.0
C42	171	16.4	58.3	9.5
C53	166	21.8	54.6	11.9
C69	204	18.8	42.4	8.0
C24	158	17.8	60.9	10.8
C64	159	18.7	59.4	11.1
C87	210	11.7	44.1	5.1
C36	179	19.4	49.2	9.5
C83	184	23.1	43.7	10.1
C62	161	18.2	55.4	10.1
C86	185	18.1	45.3	8.2
C92	199	20.3	37.9	7.7
C67	185	18.6	43.2	8.1
C65	192	19.9	39.3	7.8
C80	190	19.0	40.4	7.7
C63	159	19.8	51.5	10.2
C49	165	18.9	46.4	8.8
C89	161	19.0	47.3	9.0
C81	191	19.1	33.5	6.4
C94	163	20.0	32.4	6.5
MEAN	**216.5**	**19.1**	**52.3**	**10.0**

DoP: 12/01/2018 CHD: 18/03/2019 CC: PC

2.3.4 Discussion

Kilombero Sugar Company (KSC)

Various sugarcane varieties were evaluated based on respective parameters in R1 to R3 stages. Tone cane per hectare (TCH) and tone sugar per hectare (TSH) are important sugarcane parameters as they provide an insight towards selecting elite sugarcane variety for commercial purposes. From the current experimental data at preliminary and advanced evaluation stages of at KSC, there is an insight that better varieties for both rainfed and irrigated conditions are going to be identified.

Under irrigation conditions the TCH and TSH ranged between 48.0– 149.0 and 4.8 – 15.0t/Ha respectively. Varieties R97/6177, R99/4064, R00/4045, R99/4065 and R98/6092 were the best performers across trials. For the case of rainfed conditions, TCH and TSH ranged from 33.0 – 163.0 and 3.0 – 16.0 t/Ha respectively. The best performing varieties were R94/6113, TZ93-KA-120, R 583, R 581 and R 570. Therefore these outstanding varieties are recommended for further evaluations to check their stability.

Tanganyika Planting Company (TPC)

Variety evaluations at TPC were conducted under full irrigation schedule. We evaluated numerous varieties and lines at PC, R1 and R3 stages. At PC stage, variety N53 and lines C131, C105 and C138 were superior for combined TCH and TSHA quantities. These provide a bright future to obtain better commercial variety to the sugar industry in the country. However, stability of their performance need to be further studied at least to an additional one crop cycle so to ascertain these traits. Prominent varieties in term of combined TCH and TSHA at R1 and R3 stages were BR93017 and R 94/6113 respectively. The varieties can be recommended for evaluation in advanced stages prior to commercial release. Moreover, the highest TCHA and TSHA yields experienced at the estate might have been due to good agronomic practices such as irrigation, weed management and fertilization.

Mtibwa Sugar Estate (MSE)

Varieties N53, N36, R 85/1334, R97/2168, R96/2454 and KQ228 showed to produce more combined TCHA and TSHA compared to the rest varieties tested in irrigated culture for this reported period in plant cane stage. Superior quality of newly introduced varieties (from open quarantine): N53, R97/2168 and R96/2454 are encouraging and if the trend continues can be recommended for advance evaluation before commercially released. Though this performance is not conclusive, tremendous yield of varieties N36 and R 85/1334 further cements that they are promising future commercial varieties in Tanzania as they are evaluated at national level prior to commercialization. The brilliant performance of variety KQ228 indicates its potential for registration in upcoming national performance trial (NPT).

For rainfed trials, varieties TZ93-KA-120, R 570, N47, R585, R96/2569 and R97/4004 were the best in combined TCHA and TSHA suggesting they can easily adapt to drought environment. If this trend continues for these varieties except TZ93-KA-120, R 570 and N47 (already under NPT) they can be recommended for advance evaluation before commercially released.

Kagera Sugar Ltd (KSL)

Varieties N47, N12, R581and lines C19, C33 and C5 proved to produce more combined TCHA and TSHA compared to other varieties tested in rainfed scheme in this season. This is proposing, they can easily adapt to drought environment and hence if trends continue can be recommended for advance evaluation before commercially released. In the same way, elite lines C59, C41 and C8 were superior under irrigated conditions.

2.3.5 Recommendation

Based on overall performance, varieties KQ228, Q208, Q190, R 94/6113, R 581 and R583 are the future prospect for forthcoming DUS and NPT registration.

2.4 National Performance Trials

Project Codes: SCB 2016/05, 2017/4, 2017/5
Principle investigator: TOSCI
Collaborators: TARI Kibaha & Estates: KSC, TPC, MSE & KSL
Duration: 2016/17 - 2021

Project summary

National performances Trials (NPT) are designed to test new plant varieties for performance compared to varieties currently in the market. Aim is to allow regulatory authority, TOSCI, to evaluate before they release as improved varieties. In this work, six varieties which include rainfed (TZ93-KA-120, TZ93-KA-122, R 570 and N47) and irrigated (N36 and R 85/1334) varieties were planted in different sugarcane estates. Final reportsfor both rainfed and irrigated varieties have been submitted to TOSCI for official variety release considerations.

2.4.1 Introduction

National performances Trials (NPT) are designed to test new plant varieties for performance compared to varieties currently in the market. The trials are done across the country at specific agro-ecological zones where the full potential of the sugarcane varieties can be expressed.

NPTs are designed to determine the agronomic potential of a new variety before it is released for commercialization. Candidate varieties are planted alongside existing varieties (checks) and performance gauged to ensure only superior varieties are released.

Tanzania Official Seed Certification Institute (TOSCI) is mandated to monitor and evaluate these trials in collaboration with TARI Kibaha. Candidate varieties are tested for Distinctiveness, Uniformity and Stability (DUS) for a minimum of two seasons. DUS tests are conducted by TOSCI in selected areas depending on the recommended areas for the variety. Once the tests are complete, the Variety Release and Seed Certification Committee evaluate the data in order to make recommendations for release. It is important that a reasonable number of commercial varieties with different genetic background are deployed to avoid monoculture system which has for many years been the case in the Tanzanian sugar industry. Hence, we found it is important to evaluate varieties in both irrigated and rainfed condition in various agro-ecologies where sugarcane is grown.

Objective

To verify performances of the new varieties under NPT compared to those currently in the market, in order to determine their potentiality before commercially released.

Specific Objectives

1) Performance evaluation of new varieties tested under national performing trials with commercially available varieties in the market

2) To identify potential new varieties for release at national level

Output achieved

Final report submitted to TOSCI for official variety release consideration.

2.4.2 Materials and Methods

The experiments were laid out under irrigation system in all fields both at TPC and KSC estates. The experiment details were as hereunder:

Plot size: 10 m x 4 row with a net plot size of 8 m x 2 rows

Treatments: (i) Test irrigated varieties N36 and R 85/1334 with N25and R 579 as checks at TPC, KSC, KSL and MSE

(ii) Test rainfedvarieties TZ93-KA-120, TZ93-KA-122, R 570 and N47with NCo376 andCo617as checks at KSC, KSL and MSE

Design: Trials were set in RCBD at TPC and 4 x 4 Triple lattice design at KSC, KSL and MSEwith four replications

Cultural practices: Irrigation, fertilization and weeding as per commercial field recommendation

Data collected: Cane yield (TCH), sugar yield (TSH), sucrose (%) and reaction to insect pests and diseases

2.4.3 Recommendations

Improved varieties are the corner stone for sustainable development of sugar industry. It is required that the industry has to have and strategically plant a range of varieties with diverse qualities to cater for stresses like drought, pest and disease outbreaks resulting to large yield and economic losses. Apart from plant variety, seedcane quality control (such as hot water treatments) and adherence to good agronomic practices are key for optimum productivity of new varieties.

2.5 Rapid Seedcane Multiplication

Project code: SCB 2017/07
Investigators: A. Kachiwile, N. Mwakyusa G. Mwasinga and R. Mlimi
Duration: 2019/20
Completion: Ongoing

Project summary

Sugarcane production in Tanzania is done by large-scale and small-scale farmers. Small-scale farmers contribute forty percent of total cane crushed per annum. However, their contribution is likely to decrease due to low productivity caused by several factors including prevalent of pests and diseases resulting from use of poor quality planting materials. Thus, a large proportion of the farmers use traditional, poor quality seedcane resulting in poor yields. A total of 10 sugarcane varieties (NCo376, R579, N41, R570, N25, N30, TZ-93-KA-122, R 583, N47 and TZ-93-KA-120) that were sourced from TARI Kibaha were used for rapid seedcane multiplication. The aim of the project is to increase sugarcane productivity in Tanzania through improved access and deployment of healthy seed canes. 23,904 seedlings produced from ten sugarcane varieties.

2.5.1 Introduction

Sugarcane is a perennial crop, as once a new crop is planted it is harvested repeatedly for up to five seasons or more. Being vegetative propagated and practice of ratooning which is necessary for economic optimization, permits systemic pathogens to survive, multiply and spread from one crop to the next. Also, the perennial nature of the crop and the fact that it is usually grown as a monoculture favours the build-up of diseases.

A properly designed seed production system is must i.e. systems through which seed borne diseases are eliminated or its spread is minimized and at the same time quality, vigour and production potential of a variety could be maintained over a longer period. The benefit of improved sugarcane varieties cannot be realized until enough healthy seed is produced and supplied to farmers for growing on large scale (Karuppaiyan& Ram, 2012).

Sugarcane production in Tanzania is done by large-scale and small-scale farmers. Small-scale farmers contribute forty percent of total cane crushed per annum. However, their contribution is likely to decrease due to low productivity caused by several factors including prevalent of pests and diseases resulting from use of poor quality planting materials. Thus, a large proportion of the farmers use traditional, poor quality seedcane resulting in poor yields. Moreover, they rely on very old, degenerated and low genetic potential varieties; namely, NCo376 for KSC and MSE, and Co617 for KSL mill areas (Chambi& Isa, 2010). These varieties have are susceptible to several diseases including smut. Use of seedcane from the commercial crop has been responsible for rapid multiplication of a large number of diseases and pests such as smut, ratoon stunting, stalk borers and white scale which adversely affect cane yield and quality.

Inadequate availability of quality seedcane, poor seedcane replacement rate and poor quality canes has adversely contributed to low sugarcane productivity and sugar recovery. The importance of enhancing smallholder farmers' access to quality seedcane can play a role in raising sugarcane productivity. To maximize yield potential for all sugarcane varieties, it is essential that plantings be made with seedcane that is free of pests and diseases. To accomplish this, healthy seed-cane nurseries should be established with seedcane of recommended varieties from a heat treatment program or from seedcane that has been produced by tissue culture.

Objective

To increased sugarcane productivity in Tanzania through improved access and deployment of healthy seed canes.

Achieved Output

23,904 seedlings produced from ten sugarcane varieties.

2.5.2 Materials and Methods

A total of 10 sugarcane varieties (NCo376, R579, N41, R570, TZ-93-KA-120, N25, N30, TZ-93-KA-122, N47 and R583 that were sourced from TARI Kibaha were used for rapid seedcane multiplication activity that took place at the station from November 21, 2019 to January 23, 2020.

Preparation of growth media

A mixture of forest soil, sand and farm yard manure was sterilized 3hours; after cooling the soil was potted in polythene. For each variety, a single eye bud was planted per polythene bag of 4 inches polythene bags. Routine irrigation was done. Pesticide (Gladiator) was applied i.e. 25cc/15L of water to control termites. Sprouting of each variety was recorded seven days after planting. At four weeks, a compound fertilizer (N17:P17:K17) was applied at a rate 5g per seedling.

2.5.3 Results

Establishment of the seedlings after planting at TARI Kibaha is as presented in Table 2.27. The establishment rate ranged from 74.3 to 93.3%. The highest establishment was observed in variety TZ-93-KA-122 (93.3%) followed by N41 (90.7%) and NCo376 (88.1%). To the contrary, the lowest establishment was on varieties N47 (74.3%).

Table 2.27 Seedcane establishment from single bud multiplication method at TARI Kibaha

Variety	No. Stalks	No. Buds planted	Disposition (%)	No. Established settings	Establishment rate (%)
NCo376	2139	15000	54	13210	**88.1**
R579	5	35	0.13	29	**82.9**
N41	873	6120	22	5551	**90.7**
R570	927	6500	23	5700	**87.7**
R583	4	30	0.11	23	**76.7**
N25	4	30	0.11	24	**80**
N30	4	30	0.11	25	**83.3**
TZ-93-KA-120	4	30	0.11	26	**86.7**
TZ-93-KA-122	4	30	0.11	28	**93.3**
N47	5	35	0.13	26	**74.3**
Total	**3,969**	**27,840**	**100**	**23,904**	**NA**

2.5.4 Discussion

The differences in establishment among the varieties are thought to be due to their genetic variations, high genetic variation may promote long-term population persistence by allowing adaptations to changing environmental conditions (Lavergne and Molofsky, 2007; Bock et al., 2015).

2.5.5 Recommendation

There is a need of awareness creation for farmers to use of right methods and procedures for seed production. With the right practice adoption and usage of good quality seed not only the farmers but the sugar millers too benefits as good seed cane will give good yield and so does high sugar recovery. The existing farmer's practice of conventional method can effectively be replaced by bud chip method in sugarcane in the existing farming situation for higher productivity and profitability.

2.6 Sugarcane Germplasm Conservation for Sustainable Sugarcane SectorDevelopment

Project code: SCB 2017/08
Investigators: A. Kachiwile, N. Mwakyusa, G. Mwasinga, R. Mlimi and C. Gwandu
Collaborators: Agronomy section
Duration: 2019/20
Completion: Ongoing

Project summary

Germplasm conservation conserves the genetic traits of endangered and commercially valuable species. Such conservation serves as the link between the acquisition and utilization of plant genetic resources and includes all the means by which plant genetic resource is stored and preserved. Sugarcane germplasm are concerned for the project. The aim of the project is establishment and conservation of sugarcane germplasm of both improved and locally sugarcane varieties. 320 sugarcane cultivars including 41 local sugarcane cultivars have been collected and conserved at TARI Kibaha for future application in the breeding program.

2.6.1 Introduction

The sugar industry of Tanzania is so far dependent on introduction of exotic varieties which are not suitably adapted to various agro-ecologies and local growing conditions. In light of the rapidly increasing commercial sugarcane plantation areas in the country, the demand for improved varieties that suit various agro-ecologies are increasing. Under such situations, there will be a continuous demand for broad genetic base sugarcane varieties that are high yielding and stable under abiotic and biotic stresses. TARI Kibaha is in course of starting crossing program, which is long overdue, to produce its own improved varieties.

The observed substantial variation of landraces and verities would enable sugarcane breeders to design and practice breeding and selection programs to improve the sugarcane crop. The development of high yielding and stable varieties requires a continuous supply of new germplasm as a source of desirable gene complexes. The availability of such germplasm requires the identification of areas of diversity of commercial importance in growing sugarcane, especially in the local landraces growing within the variable agro-ecologies of Tanzania. Therefore, germplasm collection and conservation of sugarcane cultivars is worthwhile since it will broaden the genetic base and provide locally adapted genes for improvement in the breeding program of the crop.

Objective

To establish and conserve germplasm collection of improved and locally collected sugarcane varieties available in Tanzania

2.6.2 Materials and methods

A total of 279 sugarcane imported varieties were collected from different estates in Tanzania 41 local sugarcane clones were collected from different sugarcane locality and planted at TARI Kibaha. Varieties were planted in two-row plot, having a spacing of 1.5m and length of 10m, each plot was planted with 50 setts.

2.6.3 Results

A total of 320 sugarcane varieties collection and conserved at TARI Kibaha.

2.6.4 Discussion

Germplasm collection and conservation of sugarcane landraces/varieties are worthwhile since this can broaden the genetic base and provide locally adapted genes for improvement of the crop. In spite of the great importance of Tanzania sugarcane landraces for the germplasm genetic base improvement and utilization in the breeding program, there is a need to broden collection areas to capture more diverse sugarcane characteristics and to increase the pool of germplasms conserved for future use.

2.6.5 Recommendation

In spite of this small collection established but it has not covered all important sugarcane growing areas in Tanzania. Therefore, there is a need to ensure readily availability of genetic resources for future crop improvement and it can be archived by collecting more cultivars from diverse agro ecological zones of the country and abroad.

2.7 An efficient protocol for large scale production of sugarcane through micro-propagation.

Project code: 2019/08
Principle investigator: A. Kachiwile, N. Mwakyusa, G. Mwasinga, R. Mlimi, and C. Gwandu
Location: TARI-Kibaha

Duration: 2019/2020

Project summary:

Sugarcane is an important cash crop of Tanzania. It constitutes a major source of edible sugars. Sugar is a highly placed commodity in consumer products. Day by day increasing use of sugar and its relevant products have created a challenging situation for sugarcane researcher and growers. The most important of which is the non availability of disease free elite stock for seeding and lack of implementation of advance technologies in sugarcane propagation. Malik (1990) reported that yield potential of sugarcane varieties is deteriorating day by day due to segregation, susceptibility to diseases, insects, admixture, changes adaphic and climatic environment. Moreover, the lack of rapid multiplication procedures has long been a serious problem in sugarcane breeding programs as it takes 10-15 years of work to complete a selection cycle. Recently, TARI-Kibaha in order to ensure quality and disease free planting materials has developed an efficient protocol for large scale production of sugarcane through micro-propagation.

2.7.1 Introduction

Sugarcane (Saccharumofficinarum L.), the major source of sugar and alcohol, is a crop of prime importance owing to its high agro-economic (Naz, 2003) and global importance as a high valued multipurpose agro-industrial cash crop. Thus, much research has been focused on sugarcane crop improvement through conventional breeding and recently through biotechnological approaches (Suprasana, 2010). In the conventional propagation method where nodal sections with two or three nodes or sets are used as planting material have a wide-ranging of limitations. The seed multiplication rate is very slow, usually 1:10 (Ali *et al.*, 2008) which makes the spread of a newly released variety too slow to scale up to commercial level (Khan, 2006) and can result in degeneration before commercialization (Bahera*et al.*, 2009). Additionally, sugarcane stocks can be infected by various pathogens without exhibiting any symptoms and may result in epidemics. Moreover, the conventional propagation method in sugarcane requires large quantity of seed (1.2-1.5 tonnes/ha) and land demanding (seedcane demands 10% of the next planting plan) (Jalaja *et al.*, 2008). Besides the costly transport of the bulky cane cuttings, harbor many pests and diseases with accumulation of disease over vegetative cyclesleading to further yield and quality decline over the years and hence increase cost of production. Generally, the conventional method of sugarcane planting material propagation is wasteful in terms of time and money. In spite of its various limitations, the conventional propagation method is exclusively used for propagation of sugarcane planting materials in the Tanzania Sugar Estates. The present research work was under taken by keeping in view the importance of tissue culture technology in sugarcane improvement and establishment of efficient protocol for mass scale propagation of healthy, disease free and premium quality planting material through micro-propagation to enhance the yield.

Objective

Establishment of efficient protocol for mass scale propagation of healthy and quality planting material through micro-propagation to enhance the yield of sugarcane in Tanzania

Specific Objectives

1. To identify and validate the best hormones concentrations for mass propagation of healthy and quality planting material of sugarcane.

Expected output

An efficient protocol for large scale production of sugarcane through micro-propagation has been developed.

2.7.2 Material and Methods

Apical portion from the shoot of sugarcane were excised from screen house growing plants.
Then brought in the laboratory for surface sterilization, explants were first washed with running tap water, then treated with house hold detergent for five minutes. This was followed by second washing with tap water to remove all the traces of detergent. The explants were then treated with 10% Sodium hypochlorite solution for 15 minutes. After discarding Sodium hypochlorite, the explants were washed three times with sterilized distilled water to remove all the traces of Sodium hypochlorite. The sterilized explants were then inoculated by proper dissecting and sizing the meristem (0.5-1.0 cm) on MS (Murashige& Skoog, 1962) medium supplemented with different concentrations of BAP either alone or in combination with Kinetin or GA3. For multiplication of induced shoots hormonal concentration was decreased and shoots multiplication was observed after 28 days of shoot induction. For *Invitro* rooting MS medium containing different concentrations of NAA and IBA was used either alone or in combination with each other. Sucrose 3% was used in all the media.The pH of the medium was adjusted to 5.74 with 0.1 N solution of NaOH or HCl.
The shoot apical meristem of different sizes was cultured on MS medium supplemented with different concentrations and combinations of BAP and kinetin either alone or in combination with each other or GA3. Cultures were maintained under fluorescent light having 2500 lux light intensity. The incubation temperature was 26°C ± 1°C with 16 hour light and 8 hour dark period in every 24 hour cycle. First sub-culturing was done after four weeks and rest sub-culturing after two weeks.

2.7.3 Results

Shoot formation from apical meristem

The criterion of good growth for newly formed shoots from apical meristem was based on the production of broad and dark green colour leaves, healthy stems and number of small germinating buds at the base of stem (Table 2.28).

From Table 1 it is evident that best results for shoot formation were obtained in MS 2 medium (MS medium containing 1.0 mg/l of BAP). In this medium all explants showed shoot proliferation response within 28 days with maximum number of 6.0 shoots per explants (Figure 2.1).

Table 2.28: Effects of different hormones concentration on shoot initiation of sugarcane.

Media	Composition	Concentration	Explants cultured	Average shoot per length (cm)
SM1	BAP	0.5mg/l	6	4.58±0.42
SM2	BAP	1mg/l	6	6.00±0.97
SM3	BAP	1.5mg/l	6	4.77±0.33
SM4	BAP	2mg/l	6	4.28±0.27
SM5	BAP	(2 + 0.5)mg/l	6	5.76±0.68
SM6	BAP +Kin	(1+1.5)mg/l	6	3.50±0.35
SM7	BAP +Kin	(1.5+ 0.25)mg/l	6	3.60±0.53
SM8	BAP +Kin	(0.5+0.5)mg/l	6	4.60±0.64
SM9	BAP + GA3	(2+0.5)mg/l)	6	2.60±0.24
SM10	BAP + GA3	(1.5+0.25)mg/l	6	5.50±0.38
SM11	BAP + GA3	(0.5+0.5)mg/l	6	5.80±1.24

Figure 2.1: In vitro shoot formation on MS medium containing BAP (1mg/l).

Rooting formation

The regenerated shoots were used for root induction in root forming media. MS medium supplemented with four (4) different auxin concentrations was used. Best root formation response was obtained in SMR 1 medium i.e., MS medium containing NAA (1.0 mg/l) (Table 2.29). At this concentration 100% shoots formed roots within 8 days of inoculation with average root length 7.20 cm and 11.73 average roots per explants (Figure 2.2).

Table 2.29: Effects of different hormones concentration on root initiation of sugarcane

Media codes	Hormones (Concentration)	Number of explants	Averageroots lengths (cm)	Average roots number/explants
SMR1	NAA (1mg/l)	15	7.20 ±1.44	6.40±0.73
SMR2	NAA (2mg/l)	15	5.31±0.93	11.73±2.28
SMR3	NAA (3mg/l)	15	4.68±0.52	11.13±1.21
SMR4	NAA (4mg/l)	15	3.28±0.39	8.00±1.73

Figure 2.2: Effects of hormones concentration on roots formation in the media containing NAA (2mg/l).

Multiple shoot formation

After four (4) weeks of shoot growth, actively growing shoots were transferred to fresh medium in jars for further growth and proliferation with six (6) different hormones concentrations was used. The best shoot multiplication response in was obtained in SMS 6 medium i.e. MS medium containing Kin (1mg/l) and IBA (2mg/l) (Table 2.30). In this medium 7.27 cm average shoots length and was obtained after four weeks of sub-culturing (Figure 2.3).

TABLE 2.30: Effects of different hormones concentration on multiplication of sugarcane

Media codes	Hormones (Concentration)	Number of explants	Average shoots lengths (cm)	Average shoots number/explants
SMS1	NAA (1mg/l)	10	1.3±0.74	3.07 ± 0.52
SMS2	NAA (2mg/l)	10	1.4±0.82	2.95±0.398
SMS3	NAA (3mg/l)	10	1.4±0.82	3.42 ±0.16
SMS4	NAA (4mg/l)	10	1.3±0.74	2.64±0.33
SMS5	Kin + IBA (1mg/l + 1mg/l)	10	1.7±0.99	4.55±0.37

SMS6	Kin + IBA (1mg/l + 2mg/l)	10	2.0±1.14	7.27±0.74

Figure 3: Effects of hormones concentration on shoot multiplication of sugarcane on Kin + IBA (1mg/l + 2mg/l).

Validate of the best hormones concentrations for mass propagation of healthy and quality planting material of sugarcane.

The best Media performed on the experiment one for initiation (roots and shoots) and multiplications were validated. On effects of different hormones concentration on shoot initiation of sugarcane on validation the best media was BAP + GA3 (0.5mg/l+0.5mg/l) with 6.91cm the average shoots lengths (Table 2.31 and 2.32). Also, effects of different hormones concentration on multiplication of sugarcane on validation the best media was NAA (1mg/l) with 7.21cm Average roots lengths (Table 2.33).

Table 2.31: Effects of different hormones concentration on shoot initiation of sugarcane.

Media codes	Hormones (Concentration)	Number of explants	Average shoots lengths (cm)
SM2	BAP (1mg/l)	10	6.17±0.43
SM3	BAP (1.5mg/l)	10	4.37±0.35
SM5	BAP +Kin (2 mg/l +0.5 mg/l)	10	6.33±0.47
SM8	BAP + kin (0.5mg/l+0.5mg/l)	10	3.01±0.26
SM10	BAP + GA3 (1.5mg/l+0.25mg/l)	10	5.88±0.28
SM11	BAP + A3(0.5mg/l+0.5mg/l)	10	6.91±0.90

Figure 2.4: In vitro shoot formation on the best MS medium containing BAP +GA3 (0.5 +0.5mg/l).

Table 2.32: Effect of different hormones concentration on root initiation of sugarcane

Media codes	Hormones (Concentration)	Number of explants	Average roots lengths (cm)	Average roots number/explants
SMR1	NAA (1mg/l)	15	7.21±1.44	6.20±0.35
SMR4	NAA (4mg/l)	15	3.35±0.36	11.47±1.45

Figure 2.5: In vitro root initiation on the best MS medium containing Kinetin (1mg/l) and IBA (1mg/l).

Table 2.33: Effects of different hormones concentration on multiplication of sugarcane

Media codes	Hormones (Concentration)	Number of explants	Average shoots lengths (cm)	Average shoots number/explants
SMS 5	Kin + IBA (1mg/l + 1mg/l)	10	6.82±1.02cm	2.3±0.26
SMS 6	Kin + IBA (1mg/l + 2mg/l)	10	8±0.69cm	1.8±0.29

Figure 2.6: In vitro shoot multiplication on the best MS medium containing Kin (1mg/l) and IBA (1mg/l) after one week.

2.7.4 Discussion

The present study demonstrated the effect of phytohormones for shoot, root formation and multiplication. It has identified the best media composition for shoot (0.5mg/l + 0.5mg/l of BAP and GA3), root formation (NAA (2.0 mg/l)) and multiplication (Kin + IBA (1mg/l + 2mg/l)). The study indicates that micro-propagation is not only feasible but it can be used as the helpful tool for rapid multiplication of disease free, high yielding and premium quality planting materials of highly adapted, genetically stable and newly released varieties of sugarcane.

2.7.5 Recommendation

A complete protocol for the in vitro propagation of sugarcane has been developed which will help researchers in micro-propagation of sugarcane. It is further suggested economic analysis of the use of tissue culture for rapid sugarcane improvement to reveal the cost/benefits of use of this technology.

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3.0 AGRONOMY AND PHYSIOLOGY

3.1 Evaluation of existing agronomic package to selected sugarcane varieties in out-growers fields of Kilombero sugar mill area

Project Code:	AP 2013/03/02
Investigators:	Kalimba. H. F, L. Lwiza, M, Mziray, R. Pachi and Msita, H. B.
Collaborators:	LAO's, VAEO's
Duration:	6 seasons starting 2013/14-2019/2020
Remark:	Ending
Reporting period:	2019/2020

Project Summary

Sugarcane (*Saccharum officinarum*) is an important commercial crop in Tanzania. It is the main source of sugar produced for domestic consumption and export. The average sugarcane yield in outgrowers fields has remained low (30-40 tons/ha) below the attainable yield potential of more than 100 tons/ha. NCo376 is the only variety cultivated by out growers at Kilombero and Mtibwa this variety is highly susceptible to a number of diseases especially smut. In order to recommend new sugarcane varieties for outgrowers under rainfed environment, trials were established to assess three promising varieties (N47, N12, and R570) against NCo376. Preliminary results revealed two promising varieties (N47, R 570) can now be recommended for OG under rainfed cultivation.

3.1.1 Introduction

Sugarcane (*Saccharum officinarum*) is an important commercial crop in Tanzania. It is the main source of sugar produced for domestic consumption and export. In Tanzania its production is concentrated mainly in three regions of Morogoro, Kagera and Kilimanjaro. Currently, most sugarcane is grown in estates, owned by the sugar processing factories and also small scale growers known as cane growers.

Kilombero mill area have about 8500 active registered OG who supply about 43% of sugarcane crushed at Kilombero 1(K1) and Kilombero 2(K2) factories (SBT, 2017). Average sugarcane yield in OG fields is about 40 tons/ha (Chongela 2015). This is low compared to the attainable yield potential of more than 100 tons/ha (SBT, 2017). According to survey conducted to small scale sugarcane producers it was observed that lack of improved varieties was among the major factors contributing to low sugarcane production (Mtunda *et al*., 1998). Other factors included low level of field management particularly poor management of weeds, low level of fertilization and sometimes moisture stress due to unreliable rainfall with the latter being major reliance in OG cane production. At Kilombero only one variety (NCo376) is grown by Outgrowers, the variety which is very susceptible to smut disease. The long existence of NCo376 to Outgrowers is due to the fact that most of the new varieties being evaluated do not exhibit wide adaptability like NCo376. It was therefore important to screen new varieties which are adaptive to drought and also resistance to smut.

Objective

1. To test new promising varieties with the existing agronomic package under rainfed condition in OG fields

Specific Objectives

1. To determine performance of tested varieties on existing management packages

Output

1. Two promising varieties for rainfed condition identified

3.1.2 Materials and Methods

The experiment was laid down to test the existing agronomic package to selected varieties at Kilombero mill area. Three varieties were tested N12, N47 and R 570 against standard check NCo376 in replicated trial from 2013/14 to 2017/18 (phase I). Thereafter two varieties N47 and R 570 were selected as promising varieties under rainfed condition and proceed to on farm trials or large block in 2018/19 to 2019/20 (phase II).Variety N12 was dropped due to high incidence of smut (Annual Technical Report, 2017)

1st Phase experimentation: Experiment comprised of four treatments namely R 570, N12, N47 and NCo376 as a standard check, designed in Split plots in RCBD with three replications. Main factors were two management levels:
(1) The recommended practice (RT) which was 100 kg N ha^{-1} + 100 kg K ha^{-1} +25 kg P ha^{-1} and 4 lit Volmuron ha^{-1}
(2) Farmers' practices (FP) which varied from farmer to farmer but usually averaged to 30 kg of nitrogenous fertilizer without Phosphate and potash, without fertilization in ratoon management.
Each variety was tested against the selected management packages in different sites at Kilombero mill area (K1and K2). Phosphate fertilizers were applied at planting while Nitrogenous and Potash fertilizers were applied three months after planting
Plot size: Six rows of 10 m long spaced at 1.2 m, comprising two centre rows of test varieties and two guard rows of NCo376 variety on each side.

2nd Phase experimentation (Large block trials): Large blocks comprising of three acres each, three varieties R 570, N47 and NCo376 were planted each variety occupying one acre at every location.
Data collected: Data on yields (stalks number, stalks weight, purity % and sucrose %,) were collected during harvest at the age of 10-12 months.

Data analysis: Data were subjected to ANOVA using GenStat statistical package version 16, Means were compared using LSD at P=0.05.

3.1.3 Results

2017/18 trials (R1): Four trials were established in November 2017 at Sonjo, Nyange, Kitete and Mfilisi. Results for three sites are presented in Table 3.1.

Tons of Cane per hectare (TCH): Results presented in Table 3.1 indicated that, R570 had higher TCH for both recommended and farmers' practices compared to other varieties. Variety N12 had the least TCH levels (54.0) in farmers practices compared to other varieties tested. In general all the tested varieties had performed above the standard variety **NCo376** under recommended practice.

Table 3.1: Results of TCH from different varieties grown under two management practices in OG fields at Kilombero

	Nyange			**Kitete**			**Mfilisi**		
	FP	**RP**	**VM**	**FP**	**RP**	**VM**	**FP**	**RP**	**VM**
R570	**89.4**	**101.2**	**95.3**	**94.4**	**119.6**	**107.0**	77.4	113	95.2
N12	**54.0**	93.5	73.7	83.5	124.0	103.8	100.5	131.3	115.9
N47	94.5	88.1	91.3	81.5	91.4	86.5	79.1	99.5	89.3
NCo376	76.2	83.1	79.7	87.2	108.7	98.0	110.8	114.9	112.9
Mean	78.5	91.5		86.7	110.9		92.0	114.7	
CV %	**22.40**			**31.60**			**26.30**		
LSD (0.05)	**29.45**			**73.90**			**47.91**		
P (0.05)	**0.254**			**0.598**			**0.215**		

Tons Sugar per hectare (TSH): Results presented in Table 3.2 did not differ significantly although the highest TSH of 19.6 was observed from variety N12 in recommended practices at Kitete while the lowest TSH was observed from the same variety (N12) in Farmers practices at Nyange. On average variety R570 had higher TSH followed by N47.

Table 3.2: Results of TSH from different varieties grown under two management practices in OG fields at Kilombero

	Nyange			**Kitete**			**Mfilisi**		
	FP	**RP**	**VM**	**FP**	**RP**	**VM**	**FP**	**RP**	**VM**
R570	11.3	12.8	12.0	13.7	17.7	15.7	8.0	10.7	9.35
N12	**6.3**	10.0	8.1	12.2	**19.6**	15.9	10.2	13.2	11.7
N47	11.4	10.2	10.8	12.3	14.1	13.2	6.9	9.8	8.35
NCo376	8.5	9.8	9.2	12.9	16.4	14.6	11.0	11.8	11.4
Mean	9.4	10.7		12.8	16.9		9.0	11.4	10.2

CV %	**31.10**	**32.60**	**27.50**
LSD (0.05)	**4.88**	**11.50**	**4.76**
P (0.05)	**0.619**	**0.784**	**0.308**

2016/17 trials (R2): Eight sites were established in January and March 2016 at Mang'ula, Kitete mradini, Itete mgudeni, Kungurumwoga, Msolwa station, Msolwa ujamaa and Nyamamba. The results presented here are for R2 crop cycle.

Tons of cane per hectare (TCH): Results are presented in Table 3.3. Based on the results the performance of each variety were not significant (P>0.05) from one another. The highest TCH of 131.3 was recorded in variety N12 under RT at Nyamamba and lowest 66.6 in variety N47 under FP at Nyange.

Table 3.3: Results of TCH from different varieties grown under two management practices in OG fields at Kilombero

	Nyange			**Nyamamba**		
	FP	**RP**	**VM**	**FP**	**RP**	**VM**
R570	74.3	77.3	76.0	77.4	113.0	95.2
N12	67.9	84.0	75.9	100.5	**131.3**	115.9
N47	61.7	76.6	69.1	79.1	99.5	89.3
NCo376	89.4	94.3	91.8	110.8	114.9	112.9
Mean	73.3	83.1		92.0	114.7	
CV %	**28.40**			**26.30**		
LSD (0.05)	**36.26**			**47.90**		
P (0.05)	**0.858**			**0.215**		

Tons Sugar per hectare (TSH): Results presented in Table 3.4 indicated that the average TSH for N12 was higher compared to other tested varieties. Nyamamba field recorded the highest TSH than Nyange.

Table 3.4: Results of TSH from different varieties grown under two management practices in OG fields at Kilombero

	Nyange			**Nyamamba**		
	FP	**RP**	**VM**	**FP**	**RP**	**VM**
R570	6.2	7.6	6.9	8.0	10.7	9.3
N12	6.6	8.7	7.7	10.2	13.2	11.7
N47	5.9	7.6	6.7	6.9	9.8	8.3
NCo376	8.7	9.6	9.1	11.0	11.8	11.4
Mean	6.8	8.4		9.0	11.4	
CV %	**25.50**			**27.50**		

LSD (0.05)	**4.14**	**4.50**
P (0.05)	**0.955**	**0.308**

2015/16 trials (R3)

Eight sites were established in December 2015 at Kitete, Kielezo, Mbwade, Mtakanini, Kungurumwoga, Msolwa ujamaa, Miwangani and Mkula. Results for four sites are presented in Table 3.5.

Tons of cane per hectare: High yield in TCH was observed in both FP and RP in almost all the experimental sites. N12 recorded the highest level of TCH of 182.1 and 180.8 in both FP and RP respectively at Kitete site. R 570 recorded the least TCH levels of 57.1 at Mtakanini.

Table 3.5: Results of TCH from different varieties grown under two management practices in OG fields at Kilombero

	Mtakanini			**Kitete**			**Deco**			**Kungurumwoga**		
	FP	**RP**	**VM**	**FP**	**RP**	**VM**	**FP**	**RP**	**VM**	**FP**	**RP**	**VM**
R570	57.1	73.8	65.5	105.9	121.3	113.6	112.0	144.5	128.3	101.4	110.2	105.8
N12	59.9	78.9	69.4	182.1	180.8	181.4	93.4	127.1	110.3	96.7	110.8	103.8
N47	70.3	83.3	76.8	64.5	109.4	87.0	91.7	115.1	103.4	108.7	116.9	112.8
NCo376	99.4	98.3	98.9	71.6	98.8	85.2	101.0	133.9	117.5	117.9	111.2	114.6
Mean	71.7	83.6		106.0	127.6		99.5	130.2		106.2	112.3	
CV %	**24.50**			**25.30**			**21.80**			**21.90**		
LSD (0.05)	**29.14**			**46.40**			**54.80**			**41.15**		
P (0.05)	**0.163**			**0.598**			**0.982**			**0.887**		

Tons Sugar per hectare (TSH): Results are presented in Table 3.6. Generally RT recorded higher TSH compared to FP in almost all sites. On average N12 had higher TSH (27.9) compared to other tested varieties including NCo376

Table 3.6: Results of TSH from different varieties grown under two management practices in OG fields at Kilombero

	Mtakanini			**Kitete**			**Deco**			**Kungurumwoga**		
	FP	**RP**	**VM**	**FP**	**RP**	**VM**	**FP**	**RP**	**VM**	**FP**	**RP**	**VM**
R570	9.0	10.0	9.5	16.5	18.7	17.6	16.4	20.6	18.5	14.6	16.2	15.4
N12	9.1	10.6	9.9	27.9	27.6	27.7	14.0	17.9	16.0	16.1	16.0	16.0
N47	9.4	8.9	9.1	10.2	17.0	13.6	13.6	16.4	15.0	15.1	17.4	16.2
NCo376	10.5	15.4	13.0	10.2	14.6	12.8	14.5	17.8	16.1	18.1	15.6	16.8
Mean	9.5	11.1		16.4	19.5		14.6	18.2		16.0	16.3	
CV %	**27.30**			**25.10**			**20.20**			**24.20**		

LSD (0.05)	**4.80**	**7.10**	**9.03**	**6.46**
P (0.05)	**0.309**	**0.601**	**0.981**	**0.726**

2014/15 trials (R4): Eight sites were established in 2014 at Kungurumwoga, Mbwade, Mang'ula, Sonjo, Msolwa ujamaa and Kidatu. Results for three sites are presented in Table 3.7

Tons of cane per hectare (TCH): Generally RP performed better compared to FP in almost all the sites. R 570 recorded the highest TCH of 120.9 at Mbwade while N12 recorded the lowest TCH of 47.4 at Kungurumwoga. However, the observed differences were not significant from one another (P< 0.05).

Table 3.7: Results of TCH from different varieties grown under two management practices in OG fields at Kilombero

	K'mwoga			**Mbwade**			**Sonjo**		
	FP	**RP**	**VM**	**FP**	**RP**	**VM**	**FP**	**RP**	**VM**
R570	56.2	77.0	66.6	100.5	120.9	110.7	89.6	93.2	91.4
N12	47.4	63.9	55.7	92.8	110.2	101.5	82.9	91.4	87.1
N47	45.6	70.0	57.8	80.4	113.2	96.8	59.2	63.9	61.6
NCo376	55.1	54.4	54.8	80.4	118.3	99.4	69.5	101.3	85.4
Mean	51.1	66.3		88.5	115.7		75.3	87.5	
CV %	**28.40**			**24.00**			**24.80**		
LSD (0.05)	**32.89**			**52.50**			**46.68**		
P (0.05)	**0.824**			**0.959**			**0.402**		

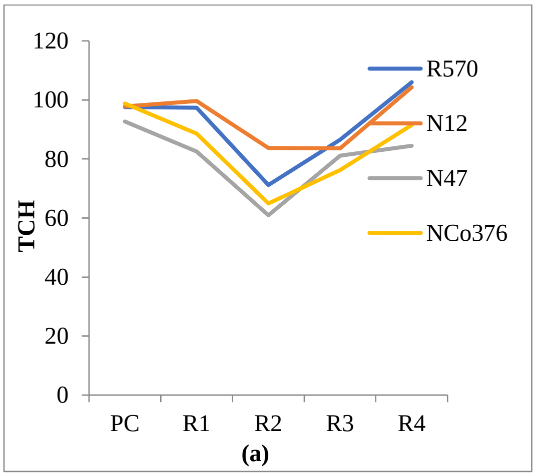
Tons sugar per hectare (TSH): Results in Table 3.8 revealed that TSH levels ranged from 5.2 to 18.2. On average variety R570 recorded higher TSH (18.2) compared to other tested varieties including the standard check NCo376.

Table 3.8: Results of TSH from different varieties grown under two management practices in OG fields at Kilombero

	Kmwoga			**Mbwade**			**Sonjo**		
	FP	**RP**	**VM**	**FP**	**RP**	**VM**	**FP**	**RP**	**VM**
R570	7.9	11.2	9.6	13.1	18.2	15.6	8.3	9.1	8.7
N12	7.0	10.7	8.9	13.0	15.8	14.4	7.6	8.5	8.0
N47	6.9	10.3	8.6	12.6	16.3	14.5	5.2	6.3	5.8
NCo376	6.2	7.8	7.0	11.9	16.9	14.4	6.1	9.4	7.8
Mean	7.0	10.0		12.7	16.8		6.8	8.3	
CV %	**28.40**			**29.10**			**25.40**		
LSD (0.05)	**4.98**			**8.07**			**4.05**		
P (0.05)	**0.868**			**0.959**			**0.219**		

Yield responses of tested varieties across seasons.

Tons cane per hectare: Results for four cropping cycles for two management levels are presented in Figure 1(a) and 1(b). Based on the results there was a decrease in yield (TCH) under FP for all the varieties from R1 to R2. From R2 to R3 yield of R 570 increased while others remained almost constant. From R3 to R4yields of R 570 and N47 remained constant while that of N Co376 increased. N12 continued to drop significantly from R3 to R4.
For RT yields of all varieties decreased from R1to R2, but there was a slight increase in TCH for R 570 and N12 from R2 to R3. From R3 to R4 TCH for all varieties increased subsequently.



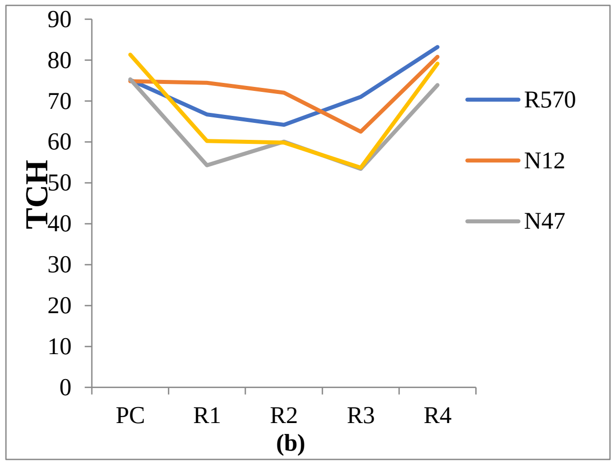


Figure 3.1 Yield (TCH) of tested varieties vs crop cycles in two management levels Where a=RT, b=FP

3.1.4 Discussion

Replicated trials: The presented results revealed that all tested varieties performed better in terms of yield (TCH) when compared to standard variety NCo376. Variety N12 despite the fact that it is performing better was terminated because is very susceptible to smut disease next to NCo376. The decrease in cane yield from ratoon 1 to ratoon 2 might have been attributed to long dry spell which was experienced during that season. Fluctuation in weather might have affected the growth of sugarcane and subsequent cane yields (TCH). TSH is the product of TCH and sucrose percent therefore the decrease or increase of one or both of these parameters automatically affect TSH accordingly (Gilbert *et al.*, 2005).

Two varieties (N47 and R 570) had undergone the second phase of evaluation where they were planted in large blocks (one acre each) for two seasons for further evaluation in order to come up with a viable recommendation.

Second phase experimentation (Large blocks trials):

2018/19 Large blocks (PC): Three blocks each comprising of three acres were established at Kiberege, Msolwa and Kungurumwoga at Kilombero and two blocks were established at Kisala and Kwadori at Mtibwa in January 2018. Variety planted include N47, R 570 and NCo376 Results for these trials are presented in Table 3.9. R 570 recorded the highest TCH and TSH levels at Mtibwa and Kilombero respectively. NCo376 recorded the lowest TCH and TSH levels for both sites Mtibwa and Kilombero.

Table 3.9: Results of TSH and TCH for three varieties in out-growers fields at Mtibwa and Kilombero

	Mtibwa		Kilombero	
Treatments	**TCH**	**TSH**	**TCH**	**TSH**
NCo376	**173.24**	**27.25**	**134.9**	**13**
N47	199.12	31.14	136.28	13.25
R570	**219.35**	**34.89**	**176.79**	**16.99**
CV	8.9	8.8	22.1	18.6
LSD (0.05)	83.59	11.78	57.12	4.64
P ≤ 0.05	0.26	0.2	0.21	014

2017/18 blocks (R1): Four blocks each comprising of three acres were established at Mang'ula, Mbwade, Ruhembe and Mfilisi in Kilombero.

Tons of cane per hectare (TCH): Results are presented in Table 3.10. Generally the two tested varieties R 570 and N47 performed higher than the standard variety NCo376. Variation in variety yield was observed from one site to another. For example at Mang'ula N 47 performed higher than the standard check while at Mbwade N47 was the lowest among others.

Table 3.10: Results of TCH from selected varieties grown in large block fields at Kilombero.

Variety	Mang'ula	Mbwade	Ruhembe
R570	104.0	95.7	127.3
N47	118.8	67.9	78.3
NCo376	93.5	85.4	72.9

Tons of sugar per hectare: Results on TSH levels are presented in Table 3.11. The levels ranged from 7.1 to 12.2. All the tested varieties recorded TSH above NCo376. R 570 had higher TSH compared to other varieties.

Table 3.11: Results of TSH from selected varieties grown in large block fields at Kilombero

Variety	Mang'ula	Mbwade	Ruhembe

R570	11.2	9.4	12.2
N47	10.3	7.1	7.6
NCo376	9.1	8.2	7.1

Large block trials: Sugarcane varieties may show wide variations in their yielding ability when grown over varied environments or agro-climatic zones. The results for 2018/19 and 2017/18 large block trials revealed that there were variations in variety yields for some sites which attributed by the existing micro climates (soil, temperature, rainfall, vegetation). Gilbert *et al.* (2005) reported on the adoption of the variety, productivity and total production of the crop as a result of changes in environments.

The tested varieties however, have shown a wide adaptability in rainfed environment compared to standard check **NCo376.** This implies that the two varieties (R 570 and N 47) are more suitable for use under rainfed environment.

3.1.5 Conclusion and Recommendation

This study has revealed that varieties R570 and N47 will be provisionally recommended for cane growers' fields under rainfed environment. The data for release have been submitted to TOSCI.

3.2 Strategies for management of Striga weed in sugarcane fields at Kilombero mill area in Tanzania

Project Code: AP 2017/03/04
Investigators: Kalimba. H. F, L. Lwiza, M, Mziray, R. Pachi and Msita, H.B.
Collaborators: Estate Agronomist
Date of commencement: 2017/18
Planned end date: On going
Reporting period: 2019/2020

Project Summary

Striga are obligate root parasite flowering plants which range from almost completely parasitic to almost totally autotrophic. They attack several food crops, mainly cereals, but also some broad-leaved crops such as cowpea. Three species are *S. hermonthica, S. asiatica and S gesneroides* have been reported to cause serious damage to crops. In recent years *Striga* has been observed in some sugarcane fields of Kilombero and Mtibwa milling areas the levels are likely to increase. Identification of the species was done and it was found that two species *S. hermonthica* and *S. asiatica* exist at Kilombero and 62% of the sugarcane field are infested therefore two trials were set at TARI Kibaha the first trial was to identify the source and the second was on the control or management. Results from the first trial no *Striga* emerged from any water source collected, the second trial is still on preliminary stage no data had been collected and will be reported later.

3.2.1 Introduction

Striga species generally known as witch weeds are obligate root parasites which range from almost completely parasitic to almost totally autotrophic. They attack several food crops, mainly cereals, not only this but also some broad-leaved crops such as cowpea. Though precise crop loss estimates are difficult to determine, complete crop failures caused by *Striga* have been recorded. *Striga* spp. derives their nutrients from host plants and exerts phytotoxic effects on their host. These retard growth and lower yields. In Tanzania, *Striga* weeds have been reported mainly in cereal crops such as sorghum, maize, finger millet and rice (Ramaiah, *et al.,* 1983). Riches (2003) reported yield loss of 30 – 90% in sorghum, Tanzania. There are about 41 *Striga* species in the family Orobanchaceae of these, three species: *S. hermonthica, S. asiatica* and *S. gesnerioides* have been reported to cause the serious damage to crops (Ramaiah, *et al.,* 1983). The symptoms of attack by *Striga* may be apparent, sometime before the weed emerges. At early stages, symptoms are indistinguishable from those caused by drought for example wilting and curling of the leaves but they are strong indicators if they occur when the soil is still moist (Nail *et al*., 2014). The infected plant may also show stunting from quite an early stage and pronounced scorching of the leaf borders and finally of the whole leaf area may occur at a later stage. Crop yield loss due to *Striga* attacks can vary depending on density, soil fertility, rainfall distribution, host species and variety grown. In recent years, *Striga* has been observed in some of the sugarcane fields in Tanzania. Therefore, an urgent assessment of the levels and distributions is required for proposing best management strategies of *Striga*. The study conducted by Kanampiu *et al*., (2003), indicated that single management practice can be effective in controlling *Striga* spp. However, an integrated management approach offers the best possibility for reducing impact at the farm level. Reports on *Striga* spp management suggested the combined use of cultural, agronomic practices, herbicides, host plant resistance, fertilization, trap cropping, germination stimulants and biological control (Kroschel 1999).

Objective

1. To identify *Striga* species, frequency, distribution and determine its appropriate integrated weed management for sustainable sugarcane production in Tanzania.

Specific objectives

1. To determine species and sources of *Striga* in sugarcane fields
2. To determine frequency and distribution of *Striga*in sugarcane fields
3. To determine appropriate integrated weed management (IWM) for *Striga*

Output

1. Species and sources of *Striga*sppin sugarcane fields were identified

2. Information on the frequencies and distribution of *Striga*sppin sugarcane fields were determined
3. Different control methods for *Striga* in sugarcane fields will be determined.

3.2.2 Materials and Methods

To determine sources and species of *Striga* spp in sugarcane fields: Selected farms reported to have *Striga* spp were randomly surveyed in in different fields of Kilombero estate and out-growers in 2018/19 and 2019/20 seasons. *Striga* spp samples were taken in those fields infested with *Striga* spp and identification of species was done using description made by Ramaiah *et al.,* (1983). In order to determine the sources of *Striga* spp at Kilombero sugarcane fields, water samples were collected from four sources namely Sanje (source1), Msolwa (source 2), Nyamvisi (source 3) and Ruaha (source 4) interring to the river which is used for irrigation. Furthermore, the water sample were viewed under dissecting microscope (Leica, DM 2500, Leica Microsystems CMS GmbH, Wetzler, Germany) at 40× magnification to observe the existence of *Striga* spp weed seeds. The pot experiment was set in complete randomized design (CRD) with five treatments and three replications to observe the existence of *Striga* spp. The water samples were poured into small pots containing sterilized soil, thereafter sugarcane sets were planted. The trial was established in April, 2020 under controlled environment at TARI Kibaha.

Table 3.12: Treatments details from sampled water

Treatment No	Treatment details
1	Water from source 1
2	Water from source 2
3	Water from source 3
4	Water from source 4
5	Control

Data collection and analysis: Data on germination, frequency and weed density were collected and subjected to ANOVA using Genstat program.

To determine frequency and distribution of *Striga* spp: The same methodology applied in specific objective I was used. Then field reported to have *Striga* spp were counted and *Striga* spp identification were identified using a field guide for *Striga* spp identification. Thereafter soil samples were collected for establishment of pot experiment for determination of integrated weed management under the controlled environment. In order to determine the frequency and distribution of *Striga* spp, total of 227 fields were counted so as to know the number of fields which had *Striga* spp and those which had not.

The total number of 327 fields were randomly surveyed, 100 were from the cane-growers farms and 227 in estate. Therefore, frequency was calculated according to (Thomas, 1985)

Data collection and analysis: Data on weed count were collected and weed frequency were calculated using the following formula:

Frequency was calculated as follows: $F_k=(\sum Yi/n) * 100$

Whereby

$F_k =$ weed frequency of the species k

Yi = 1 (present) 0 (Absence) of the specie k in field i

n= number of fields

Establishment of an integrated management of *Striga* spp: The pot experiment was set in a complete randomized design (CRD) with six treatments and three replications at TARI Kibaha in April 2020. The soil samples were collected from fields infested with *Striga* spp at Kilombero (Ruhembe fields 112, 124, 113; Ruaha 514, 525, 516, 535 and Msolwa 304). Soils were mixed to get a composite sample then put into pots and sugarcane sets were planted. The details of experiment are summarized in Table 3.13.

Table 3.13: Treatments details for management of *Striga* spp experiment

Treatment No	Description
1	Infested soil alone
2	Infested soil + Phosphate fertilizer
2	Infested soil + nitrogenous fertilizer
4	Infested soil + Manure/filter mud
5	Infested soil + dissolved urea 20 kg/ha sprayed direct
6	Infested soil + Phosphate fertilizer +Nitrogenous fertilizer

Data collection and analysis: Data on germination were collected; frequency and weed density will be collected and subjected to ANOVA using Genstat program version 16.

3.2.3 Results

During the survey, two weeds were frequently observed in MCP and OG fields. Morphologically those weeds were in similar resemblense to *Striga spp*. as illustrated in figure 3.2 below.

Figure 3.2: *Striga* species found in sugarcane fields at Kilombero mill areas

During the field survey, observation of *Striga* seeds in sugarcane fields using nacked eyes was difficult. Also, preliminary results for collected water sample from different irrigations subjected under dissecting microscope indicated the absence of *Striga spp* seeds.

Results from field survey observed that, 141 fields were infested with *Striga* spp making a frequency of 62% for estate while for cane growers 2 fields were infested with a frequency of 2%. Evaluation of pot experiment for determination of Integrated Weed Management (IWM) for *Striga*spp using soil collected from fields infested with *Striga* is ongoing. However, the planted sets on pots containing soils from areas infested with *Striga* germinated at 100% in two weeks after planting.

3.2.4 Discussion

The two *Striga* species identified in the sugarcane fields were maybe from different sources of water used for irrigating sugarcane fields, human activities, wind and contaminated soils. This is because the water, wind and human activities are the common agents for spread of *Striga* weed seeds (Sibhatu, 2019). Also, the survey was not able to see Striga seeds using nacked eyes because of the extremely small size of Striga seeds, about 0.2 X 0.3mm (Sibhatu, 2019).

The high frequency of *Striga* infestation was observed in the estate fields, this might be due to high mechanization and source of irrigation water used in sugarcane farming in the estate (Rugaimukamu, 2000).

3.2.5 Conclusion and Recommendations

The identified *Striga* species in the sugarcane fields call upon immediate intervention due to the yield losses that might be caused by this weed. Therefore, application of nitrogenous fertilizers including the use of mineral fertilizer, farm yard manure, rotation and intercropping of leguminous plants is recommended to minimize the impacts. On the other hand, the frequency of *Striga* in estate can be avoided by sanitation on the farm implement and observe quality water source for irrigation.

3.3 Integrated weed management strategies for sugarcane production at Kagera mill area

Project Code: AP 2017/03/06
Investigators: Kalimba. H. F., M, Mziray, R. Pachi and L. Lwiza
Collaborators: Estate Agronomist
Date of commencement: 2017/18
Planned end date: On going
Reporting period: 2019/2020

Project Summary
Improper weed management can cause a sugarcane yield losses up to 45% within the first six weeks after weed germination. Hand hoe weeding, mechanical weeding and herbicides are common methods used in controlling weeds. On the other hand, proper use of herbicides is considered as an effective and quick method of controlling many weed species (Fute, 1990). However continuous use of herbicides can cause some weeds to build resistance and also weed shift (Cardoso, 1997). Preliminary results from this research revealed that combination of different method can be effective in controlling different weed species for more than ten weeks. Therefore, integrated weed control methods is recommended for sustainable and effective weed control. Also, economic analysis will be carried out so as to identify which method is cost effective to be adopted.

3.3.1 Introduction

Sugarcane is grown in well drained fertile soils, with good supply of moisture and nutrients In addition, sugarcane receives dressing of nitrogen, phosphorus and potassium. Such condition favors an intense and rapid growth of wide range of weed species (Cardoso, 1997). Weed competition in the initial stages of crop growth can be so severe and that plants remain stunted and final yields are a mere fractional of the true potential (Fute, 1990). Losses up to 45% have been reported in sugarcane fields when weeds were not controlled within the first six weeks (Isa and Kalimba, 2000). This is due to the fact that emergence and early growth of sugarcane is inherently slow and considerable time elapse between planting and development of foliage cover, hence the crop competes very poorly with weeds (Isa and Kalimba, 2000; Fute, 1990). For these reasons weed infestations is considered as a major constraint in the achievement of yield potential in sugarcane production.

Hand hoe weeding, mechanical weeding and use of herbicides are common methods used in controlling weeds in sugarcane fields (Isa and Kalimba, 2000). Disking and interrow cultivation methods are also practiced, however the methods do not solve the problem fully as they do not remove weeds within the crop rows (Isa, 2000). Proper use of herbicides is considered as an effective and quick method of controlling many weed species (Fute, 1990).

In all estates during the rainy season weed growth becomes vigorous and intense which require constant application of control measures. Manual weeding during this period has also many limitations including labour availability due to high labour demand for planting and weeding of annual crops (Mtunda *et al*, 1998). Moreover, some weed species such as *Cyperus spp, Commelina spp* are not easily killed by tillage alone due to high soil moisture. On the other hand tillage operations, manual or mechanical, are rendered ineffective and costly. Due to this TARI Kibaha conducted this project to come up with effective Intergrated Weed Management (IWM) for managing weeds in sugarcane. Although herbicides is seen to be the most effective method of weed control continuous use of herbicides can cause some weeds to build resistance and also weed shift (Cardoso, 1997). Therefore, an integrated weed control methods is recommended for sustainable and effective weed control

Objective

To assess different integrated weed management methods used for weed control in sugarcane fields for improved sugarcane production.

Specific objectives

1. To identify commonly weeds and species found in sugarcane fields.
2. To identify commonly weed control methods used in sugarcane fields.
3. To determine efficiency of different weed control methods in sugarcane fields.

Outputs

1. Commonly weeds and species in sugarcane fields of Kagera mill areas will be known.
2. Different commonly used herbicides types, combinations and rates for Kagera OG will be known.
3. Different efficient integrated weed management methods in sugarcane fields will be developed.

Materials and methods

Specific objectives I and II: Survey was conducted to identify common weeds and methods used to control those weeds. Survey was carried out in Kagera mill area randomly using open ended questions and physical observation in order to identify weeds and control methods in the estate and cane growers' fields. Thereafter, weed species in each plot will be identified using WIKWIO (2014) system.

Specific objective III: The experiment was designed and laid out to test selected integrated weed management. The Randomized Complete Block Design (RCBD) with nine treatments and three replications were used. Plots size was four rows of 10 m spaced at 1.2 m. The treatments details are identified in Table 3.14 Treatments were applied two weeks after planting.

Table 3.14: Treatment details

Treatment	Detail
1	Diuron 3lit/ha + Paraquat 1lit/ha
2	Sugarcane trashes
3	Sugarcane trashes + Metribuzin 2.4lit/ha
4	Metribuzin 1.6 lit/ha+ Diuron 3lit/ha + Paraquat 1lit/ha
5	Metribuzin 1.6lit/ha + Diuron 3lit/ha + Paraquat 1lit/ha + hand hoe
6	Hand hoe (2)
7	Estate standard(Acetochlor 4.8L/ha,Ametryn 4.8l/ha, metribuzine 1,9L/ha and Surfactant)
8	Weed check
9	Weed free check

Fixed quadrates in each plot were randomly established by throwing of a 50 cm x 50 cm quadrant and the area where it felt was marked by fixing pegs at the corner. Weeds were counted within these quadrates at three weeks intervals and recorded by species. Assessment on effective control was based on direct comparison between treated and untreated plots, to get percentage control and then converted to a 1 to 9 logarithmic scale as in accordance to (Werner, 1981) Where 1 = complete control, 4.5 = Just an acceptable control and 9 no control at all. Then, weed control efficiency was calculated using the following formula: $WCE = \frac{X - Y}{X} * 100$

Where WCE = Weed control efficiency

X = weeds count in unweeded plot

Y = weeds count in treated plot

Data collection and analysis: Data on number of common weeds were collected and counted in each plot. Percentage of weed management efficiency was transformed using angular transformation and subjected into statistical analysis of variation (ANOVA) using Genstat statistical package version 16, whereby the coefficient of variation was determined and used as a measure of consistence between treatment effects.

3.3.3 Results

Three common weeds namely grasses, broad leaves and sedges were identified in sugarcane fields. The exercise to identify weed species will be done in the following season (2020/2021).
The results showed that, most cane growers' were not using herbicides while the estates were using different herbicides including acetochlor, chlorimuron, surfactant, Ametryn and metribuzine. The results in broadleaves (Table 3.15) showed that, there were no significant differences among treatments. However, treatment 3 performed better at 3 weeks after treatment, treatments 5 and 7 at 6 weeks after treatments and treatment 1 at 9weeks after treatments with efficiency above 70. On the other hand, treatments 5 and 7 at 9 weeks after treatment their efficiencies were below 70.

Table 3.15: Results of tested herbicide on broadleaves at Kagera mill area

	3 WAT		6 WAT		9 WAT	
Treatments	**% Control**	**Transformed data**	**% Control**	**Transformed data**	**% Control**	**Transformed data**
1	99.30	85.29	98.00	81.88	96.40	**79.04**
2	97.20	80.44	97.00	80.00	94.00	75.76
3	99.80	**87.21**	96.40	79.14	90.20	71.78
4	99.40	85.58	96.40	79.14	93.30	75.03
5	99.30	85.08	100.00	**90.00**	87.10	68.93
6	97.50	80.88	93.30	75.00	93.10	74.84
7	97.50	80.85	100.00	**90.00**	87.40	69.20
8	0.00	5.74	0.00	5.74	0.00	5.74
9	**100.00**	**90.00**	**100.00**	**90.00**	**100.00**	**90.00**
CV %		**3.90**		**19.00**		**8.90**
LSD (0.05)		**5.43**		**24.46**		**10.42**

The results in grasses (Table 3.16) indicated that, there were no significant differences among treatments. However, all treatments at 3, 6 and 9 weeks after treatments application performed better with efficiency above 70.

Table3.16: Results of tested herbicide on grasses at Kagera mill area

	3 WAT		6 WAT		9 WAT	
Treatments	**% Control**	**Transformed data**	**% Control**	**Transformed data**	**% Control**	**Transformed data**
1	99.00	84.30	93.00	81.88	99.50	86.23
2	99.30	85.08	100.00	90.00	100.00	90.00
3	99.90	**88.94**	100.00	90.00	100.00	90.00

4	99.30	85.28	100.00	90.00	100.00	90.00
5	99.60	86.55	100.00	90.00	100.00	90.00
6	99.80	87.84	93.30	75.00	99.90	87.90
7	99.30	84.95	100.00	90.00	100.00	90.00
8	0.00	5.74	0.00	5.74	0.00	5.74
9	100.00	90.00	100.00	90.00	100.00	90.00
CV %		**3.00**		**11.90**		**2.90**
LSD (0.05)		**4.23**		**16.13**		**4.08**

The results in sedges (Table3.17) showed that, there were no significant differences among treatments. However, all treatments at 3, 6 and 9 weeks after treatments application performed better with efficiency above 70.

Table 3.17: Results of tested herbicide on sedges at Kagera mill area

	3 WAT		**6 WAT**		**9 WAT**	
Treatments	**% Control**	**Transformed data**	**% Control**	**Transformed data**	**% Control**	**Transformed data**
1	100.00	90.00	100.00	90.00	100.00	90.00
2	99.90	89.01	97.00	80.00	99.9	87.90
3	100.00	90.00	96.4	79.10	99.6	85.99
4	100.00	90.00	96.4	79.10	98.7	83.58
5	100.00	90.00	100.00	90.00	100.00	90.00
6	99.90	88.94	100.00	90.00	100.00	90.00
7	99.90	87.99	100.00	90.00	100.00	90.00
8	0.00	5.74	0.00	5.74	0.00	5.74
9	100.00	90.00	100.00	90.00	100.00	90.00
CV %		**1.60**		**13.70**		**5.50**
LSD (0.05)		**2.41**		**18.25**		**7.61**

3.3.4 Discussion

Three common weeds identified in sugarcane growing areas. According to (Rugaimukamu 2000 and Isa, 1996), broadleaves, grasses and sedges are the common weeds available is sugarcane growing areas. Identification of common weed specie will be carried out in the coming season.

Generally, all treatments methods were able to control the identified weeds for more than ten weeks except treatments five and seven which controlled broad leaves for six weeks (Table3.15) This is due to the fact that, after 8 weeks the crop will have already developed canopy cover sufficient to suppress emerging weeds. Similarly, (Rugaimukamu 2000 and Isa, 1996) study on weed management observed that, any method which can control weeds for more than eight weeks can be recommended for use in sugarcane. However, all treatments were good in controlling grasses and sedges.

Efficiencies on different methods for weed control in sugarcane fields were good and therefore the integrated weed management methods can be recommended for use in sugarcane growing areas.

3.3.5 Conclusion and recommendations

This research indicated that, all tested Integrated Weed Management (IWM) treatments methods can control the observed common weeds to an acceptable level and therefore can be recommended for use in weed management in sugarcane fields.

3.4 Evaluation of different levels of fertilizers for improved sugarcane productivity at Kagera mill area

Project code:	AP2016/03/03
Investigators:	Lwiza L. M., Kalimba H, Pachi R, Mziray, M. and Msita H. B,
Collaborators:	Outgrowers, LAO, DAICO
Duration:	6 seasons starting 2016/17-2021/2022
Remark:	On going
Reporting period:	2019/2020

Project Summary

Fertilizers are crucial input in sugarcane production. There is a clear correlation between increased production and use of fertilizers. Most farmers rely on estimation and past experience when deciding on fertilizer rates. Outgrowers in Kagera mill area are faced by the problem of low yield due to inappropriate fertilization. In order to establish fertilizer recommendations, a trial with twelve treatments (different fertilizer rates) was conducted. Phosphate and potash fertilizers were applied at planting while nitrogen was applied three months after planting. Preliminary results indicated no significant difference in most of the treatments hence screening of the best performing treatments in each zone was done. Trials for screened treatments have been established and data collection is continuing.

3.4.1 Introduction

Sugarcane is a tropical plant that requires warm, humid climate for good growth (Saleem et al., 2012) it grows between latitude 30^0 N and 35^0 S in a wide variety of soil types ranging from sandy loam to heavy clay (Nazir, 1994). It is an important commercial crop and it is the main raw material for sugar produced in Tanzania for both export and domestic consumption (Tarimo, 1998).

Currently most sugarcane is grown in estates owned by the sugar processing factories (SPF) as well as contract growers (CG). The productivity in outgrowers' fields in Tanzania has remained low below the attainable yield potential of more than 70- 100tons per hectare (SBT, 2016). Among other factors, imbalanced use of fertilizers has led to the decline in productivity in most of the outgrowers fields within the country. Moreover, continuous planting of sugarcane in the same field depletes soil nutrients. For instance, a crop having yield of 100 t/ha removes 207 kg N, 30 kg P_2O_5 and 233 kg K_2O from the soil (Jagtap et al, 2006). Therefore, these nutrients must be added in adequate quantities in the root zone of the crop to obtain higher yield. Among those Nitrogen (N) is primary nutrient limiting sugarcane production (Wiedenfeld and Enciso, 208), others include Phosphorus (P) and Potassium (K). Outgrowers in Kagera mill area are faced with the same problem of low sugarcane productivity within their fields; they contribute less than 8% of the total cane crushed at the factory. Poor soil fertility and inadequate fertilization are the main challenges. This called for establishment of fertilizer trials in outgrowers' fields of Kagera mill area in order to establish specific recommendation packages for sugarcane farming.

Main Objective

1. Establishment of specific fertilizer recommendation rates for sugarcane production in Kagera Mill areas

Specific objectives

1. To determine soil properties in selected sugarcane field in different zones of Kagera mill area
2. To test different rates and combination of fertilizers in selected sugarcane fields

Achieved output

1. Data on physical and chemical properties of the soil in different fields of Kagera mill areas was known and reported in annual progress report (Annual Technical Report, June 2017).

2. Specific fertilizer recommendation in different zones available

3.4.2 Materials and methods

Location: The experiments were conducted in OG fields of Kagera latitude S11^{0}13.06' and longitude E 31^{0}16.327 and about 1300 m asl. Rainfall in the area is bimodal (October – November and March May) whereby the mean annual rainfall is about 1500 mm and the mean temperature is 20^{0}C.

Specific objective 1: To determine soil properties in selected sugarcane field in different zones of Kagera mill area

Before trial establishment, four zones (Kasambya, Nsunga, Bubale and Kyaka) were selected as study area where 12 soil samples from each zone were collected to make total of 48 samples. The collected soil samples were sent to Lancop Lab in United Kingdom for analysis to get data on physical and chemical properties of the soil (Technical report 2016-17, 2017-18).

Specific objective 2: To test different rates and combination of fertilizers in selected sugarcane fields

Experimental design: The Experiment was laid in a Randomized Complete Block Design, Plot size of 48m^2 comprising of four rows of 10 m long spaced at 1.2 m.

Treatment details: Twelve (12) treatments were used during the onset of the trial. Thereafter, the treatments were screened to four (4) based on yield performance in each zone compared to control and standard check.

Table 3.18: Treatments details used during the onset of fertilizer trial in Kagera mill area

No	Treatments	Nutrients levels (kg/ha)		
		N	P	K
1	T1	100	25	100
2	T2	100	50	100
3	T3	100	75	100
4	T4	100	100	100
5	T5	125	25	125
6	T6	125	50	125
7	T7	125	75	125
8	T8	125	100	125
9	T9	150	25	150
10	T10	150	50	150
11	T11	150	75	150
12	T12	150	100	150

Table 3.19: Description of selected treatments for further evaluation in fertilizer trial at Kagera mill area

No	Treatments	Nutrients levels (kg/ha)		
		N	P	K
1	T1	0	0	0
2	T2	100	25	100
3	T3	100	75	100
4	T4	125	50	125
5	T5	150	25	150
6	T6	150	75	150

Notebene: T1= Control; T2=Standard check

Fertilizer application: Phosphate fertilizer was applied at planting; Nitrogen and Potash were applied in two split three and six months after planting. Other nutrients including Ca, Mg, S, and Bo were added in all the treatments.
Data collected and to be collected: Data on number of stalks, stalk weight, quality parameter (Brix) were collected, TCH was calculated using the following formula
TCH = (Stalk weight x Number of stalks/ha)/10,000
Data analysis: Data collected were subjected to Analysis of Variance (ANOVA) using GenStat statistical package version 16.0 and means differences among treatments were compared using Least Significant Difference (P=5%).

3.4.3 Results

Following the analysis of soil samples it was observed that most of the soils are sandy loam to loam with acidic to slightly acidic reaction. The soils are medium in N and K but deficient in P. (Technical report 2017-18)

2016/17 Trial (R1): Eight sites were selected for experimentation; seven sites were planted in November 2016. Results are presented in Table 3.20

Tons of cane per Hectare (TCH): Preliminary results on TCH indicated that, there is no significant difference among the treatments in most of the sites. The significant difference was only observed at Nsunga. Each treatment performed differently in each zone. Treatment 4 performed better at Kyaka, treatment 10 at Nsunga, treatment 2 at Bubale and treatment 8 in Kasambya as shown in Table 3.20.

Table 3.20: Results of TCH to applied fertilizer in OG fields at Kagera

Treatments	Kyaka	Bubale	Nsunga	Kasambya
1	213.0	175.0	136.0	182.7
2	133.0	**236.0**	288.0	157.9
3	317.0	223.0	207.0	158.8
4	**204.0**	194.0	233.0	147.7
5	143.0	203.0	244.0	167.1
6	138.0	208.0	297.0	179.7
7	103.0	191.0	266.0	179.4
8	144.0	178.0	215.0	**199.5**
9	186.0	164.0	**298.0**	158.4
10	121.0	215.0	415.0	192.9
11	128.0	158.0	245.0	178.6
12	142.0	170.0	184.0	194.6
CV %	**30.5**	**32.4**	**25.9**	**28.8**

LSD (0.05)	**112.7**	**106.0**	**110.5.0**	**85.3**
p (0.05)	**0.045**	**0.904**	**0.006**	**0.970**

2017/18 trial (PC): Eight sites were selected for experimentation but only 7 trials were established in October/November 2017 at Nsunga (1), Kasambya (3) Bubale (1) and Kyaka (2).

Tons of cane per Hectare: Results on TCH levels are presented in Table 3.21. From the results, the performance of the applied treatments was different from each site. Significant difference ($p \leq 0.05$) to applied treatment (9) was only observed at Kyaka. In General treatment 9 ($N_{150}P_{25}K_{150}$) performed better as compared to other treatments across all the sites. In terms of treatment, treatment 9 had performed better at Kyaka, treatment 11 at Kasambya and treatment 12 at Nsunga.

Table 3.21: Results of TCH to applied fertilizer in OG fields at Kagera

Treatments	Kasambya1	Kasambya2	Kasambya3	Kyaka1	Kyaka2	Nsunga
1	202.6	121.3	159.5	270.4	277.3	143.3
2	218.6	178.9	119.3	263.1	287.8	151.9
3	**225.6**	170.1	126.9	210.7	142.2	199.3
4	158.2	216.2	171.2	226.1	212.5	147.8
5	175.5	261.7	134.9	215.9	238.9	137.7
6	213.7	256.4	146.6	261.0	210.0	163.8
7	172.5	312.0	142.7	221.7	236.4	152.4
8	207.3	316.2	114.6	222.8	219.5	155.2
9	191.9	305.3	127.4	**292.8**	**368.8**	190.3
10	180.0	367.7	115.1	211.1	174.7	201.8
11	166.0	**394.0**	**216.0**	172.0	189.9	153.1
12	202.6	371.6	135.6	159.2	235.9	**209.5**
CV %	**24.9**	**21.0**	**25.9**	**28.5**	**30.2**	**15.0**
LSD (0.05)	**81.22**	**97.06**	**62.55**	**148.62**	**158.54**	**42.40**
p (0.05)	**0.78**	**0.001**	**0.11**	**0.81**	**0.352**	**0.011**

2018/19 Trial (PC): Eight sites were planted September/October 2018 at Nsunga (2), Kasambya (2) Bubale (2) and Kyaka (2). Results on TCH levels are presented in Table 3.22

Tons of cane per Hectare

No significant difference observed among treatments; however treatment 4 performed better at Kyaka, treatment 9 at Kasambya and treatment 12 at Bubale. Nsunga had the lowest levels compared to others.

Table 3.22: Results of TCH to applied fertilizer in OG fields at Kagera

Treatments	Kyaka K	Kyaka M	Kasambya M	Kasambya S	Bubale N	Bubale K	Nsunga B
1	194.0	210.0	**116.1**	**139.8**	333.0	235.0	70.6

2	209.0	**201.0**	162.5	199.7	301.0	246.0	78.2
3	230.0	272.0	155.2	199.1	318.0	274.0	60.9
4	**245.0**	**339.0**	174.1	168.4	342.0	286.0	71.0
5	203.0	255.0	202.5	198.8	293.0	228.0	75.7
6	246.0	244.0	195.4	174.6	311.0	233.0	57.0
7	216.0	253.0	182.0	213.3	273.0	230.0	**55.6**
8	156.0	263.0	**220.5**	239.1	**285.0**	**290.0**	71.5
9	221.0	241.0	214.2	**249.3**	297.0	**204.0**	69.5
10	234.0	254.0	212.6	241.2	324.0	250.0	82.3
11	225.0	289.0	126.2	151.6	309.0	274.0	70.1
12	193.0	278.0	119.1	186.0	**357.0**	269.0	**86.1**
CV %	**30.8**	**25.2**	**22.7**	**24.2**	**25.7**	**26.2**	**27.5**
LSD (0.05)	**111.60**	**110.30**	**66.58**	**80.60**	**136.00**	**111.50**	**32.94**
P (0.05)	**0.91**	**0.55**	**0.02**	**0.02**	**0.99**	**0.89**	**0.73**

2019/20 Trial (PC): Six (6) sites were planted October/November 2019 at Nsunga (2), Kasambya (2) and Bubale (2). Results in number of tillers for three (3) sites are presented in Table 3.22 Based on the results in Table 3.23 each treatment had performed differently in each site. Productivity (tiller count) in relation to the applied treatments was significantly higher at Kasambya compared to other sites. Generally treatment 5 ($N_{150}P_{25}K_{150}$) among others performed well while treatment 1 ($N_0P_0K_0$) was the least.

Table 3.23: Results of tillers to applied fertilizer in OG fields at Kagera

Treatments	Kasambya	Bubale	Nsunga
1	292,383	110,234	172,709
2	458,428	122,173	**247,959**
3	413,446	**136,057**	261,007
4	**405,393**	**121,063**	316,818
5	**517,571**	**121,063**	**330,979**
6	478,697	129,115	330,701
CV	**13**	**13.2**	**32.1**
LSD	**102,972**	**29,491**	**164,343**

3.4.4 Discussion

The presented results are still preliminary since the trial is on-going. Many factors might have been contributed to the observed results. For instance results for 2016/17 (R1) revealed that a combination of $N_{100}P_{100}K_{100}$ at Kyaka, $N_{150}P_{50}K_{150}$ at Nsunga, $N_{125}P_{100}K_{125}$ at Kasambya and $N_{100}P_{25}K_{100}$ had a substantial yield of Sugarcane in each zone. The observed difference in yield in some of the treatments might be due to differences in soil pH, soil erosion and flooding. These results are in contrast with results reported by Gana (2008) that application of N more than 120 kg N ha-1 indicates no significant difference between tillers number, stalk length and cane yield. The difference between our results and his results can be due to differences in environment and soil status of the area where two studies were conducted. Since there was no observable difference in yield for some of the treatments, the treatments were redesigned to four treatments. The preliminary results in the redesigned experiment showed that, treatment 5 performed better across zones while treatment 1 (control) had the least performance.

3.4.5 Conclusion and Recommendations

Since the preliminary results from the study revealed that each treatment performed differently in each zone. Slight difference was observed among treatments hence the decision to screen the best treatment in each zone was made. The trial for redesigned treatments is on progress in the fourth cycle.

3.5 Effects of green harvesting versus burning on soil properties, growth, yield of sugarcane and determination of cost benefit analysis in Tanzania

Project code: AP2019/03/03
Principal investigators: M.Mziray, L.Lwiza, H.Kalimba, R.Pachi, M.Kinyau and Msita, H. B
Collaborators: Estate Agronomists
Date of commencement: 2019/2020
Reporting date: 2019/2020

Project summary

The study on the effects of sugarcane green harvesting and pre harvesting burning in Tanzania was implemented at Mtibwa and Kilombero estates. Six trials were conducted, 3 at Mtibwa and 3 at Kilombero and a total of 36 samples were collected for preliminary analysis of the basic nutrients and microbial activity before harvesting. Results indicated that both Mtibwa and Kilombero soils from experimental areas are acidic.

3.5.1 Introduction

In Tanzania, sugarcane is traditionally burned prior to harvest in order to eliminate leafy non sucrose containing material so that it does not have to be transported and milled (Wiedenfeld, 2009). However, burning of sugarcane can be detrimental to soil structure and nutrient availability due to the loss of soil organic matter as well as microbial activity (Ball-Coelho., *et al*. 1993). Also, burning of sugarcane contributes in the depletion of air quality on adjacent areas (Wiedenfeld, 2009) (Wiedenfeld, 2009) (Wiedenfeld, 2009) (Wiedenfeld, 2009). On the other hand, modern harvesters can separate trash from the millable cane much more efficiently.

Adopting green-cane harvest with a trash-blanket has various benefits which include: increase in nutrient conservation, suppressing weeds and reduce preemergent herbicide use, reduce tillage and soil erosion as well as soil moisture conservation (Kingston *et al*., 2005). Other advantages mentioned by Richard (2003) are; provision of fresher cane to the factory, improved soil health, increase in soil organic matter, nutrient recycling, increase in the population of beneficial micro organisms, reduced weed-infestation levels as well as increased yield and sucrose content in 3rd ratoon in Brazil (Ball-Coelho *et al*. 1993). However, little attention has been paid to the impacts associated with sugarcane burning In Tanzania. Therefore, this study is going to compare the effects of green harvest and pre-burning harvest on soil properties, sugarcane yields, and determination of cost benefit analysis.

Objective

Assessment of the effects of green harvesting and pre-harvest burning for sustainable sugarcane production in Tanzania

Specific objectives

1. To characterize the soil before and after initiation of the study.
2. To determine yields and quality of sugarcane for tested treatments.
3. To evaluate the cost benefit analysis for tested treatments.

Output

1. 6 trials were set (3 at KSC and 3 at MSE)
2. 36 soil samples were collected for analysis of preliminary soil characteristics before application of treatments

Materials and methods

The study was conducted in the sugarcane estate fields of Kilombero and Mtibwa with six experiments, 3 at Kilombero and 3 at Mtibwa.

A total of 36 composite soil samples were collected from three estates at a depth of 0-30cm for initial determination of soil fertility. For each estate, six 6 soil samples were collected per site. In order to make one composite sample, soil samples were randomly collected from five points using a spade. The five subsamples were thoroughly mixed and from a mixture, 1kg of the composite sample was taken and labelled. The samples were air dried, powdered and sieved through 2.0mm sieve at TARI Kibaha and sent to TARI Mlingano for analysis of the basic parameters such as pH, electrical conductivity and available Nitrogen(N), Phosphorus(P) and Potassium(K) following procedures described by Okalebo *et al*., (1993)

Each experiment was designed using a Randomized Complete Block Design (RCBD) with two treatments replicated three times. Total experimental area is 1acre comprised with two plots. Plot size is comprised with 20 cane rows of 120 m long, spaced at 1.8 m. The space between treatments is 2m. (Treatment, T1= burning the crop prior to harvest and T2= harvesting green and returning the leaves on tops of the soil surface**)**

Mtibwa trials were established in fields; 4C (b), F8 (a) and L10 planted on 11/09/2019, 17/09/2019 and 5/10/2019 respectively. Fields L10 and 4C (b) were planted with variety R 579 while F8 (a) was planted with variety R 570. On the other hand, Kilombero trials were established in fields 364 planted on 23/08/2019 with variety N25, Field 425 planted on 9/10/2019 with variety N25. And field 510 planted on 15/09/2019 with variety R 579.

Data collection and analysis: Data on soil were collected for analysis of the initial properties of soil from experimental areas. Also, yield and growth data will be collected from the two treatments and a pairways comparison method will be used to analyse the data using t-test. The Cost benefit analysis will be calculated using the following formular:

$$\text{CBR} = \frac{(B0 - C0)}{(1 - r)0} + \frac{(B1 - C1)}{(1 - r)1} + \frac{(B2 - C2)}{(1 - r)2} + \cdots \ldots \ldots \ldots \ldots \ldots \frac{(Bn - Cn)}{(1 - r)n}$$

$$CBR = \sum_{t=0}^{t=n} \left(\frac{(Bn - Cn)}{(1 - r)n} \right)$$

Where: Bt= Total benefits in season t, Ct= Total costs in season t, r = Discount rate, n= Number of periods (in this case, season) considered for the analysis, (1+r) t= Discount factor for season and CBR=Cost Benefit Ratio

3.5.3 Results

Results on soil characteristics indicated the highest pH value of 6.7 in field F8 (a) and lowest 5.7 in fields 4C (b) and L10 at Mtibwa. For Kilombero experimental areas, highest pH was 6.5 in fields 425 and 510 and lowest was 4.3 in field 425 (Table 3.24 and 3.25). However, the lowest soil pH value was observed in field 425 at Kilombero.

Table 3.24: Soil analysis results for Mtibwa experimental areas

Replication	Treatment	Field	pH(H2O)	EC

1	Burning	4C(b)	6.3	0.52
1	Burning	**4C(b)**	**6.5**	0.10
1	Burning	**4C(b)**	**5.7**	0.15
1	Green harvest	4C(b)	6.0	0.23
1	Green harvest	4C(b)	6.4	0.14
1	Green harvest	4C(b)	6.2	0.10
2	Burning	F8(a)	6.0	0.58
2	Burning	F8(a)	6.7	0.43
2	Burning	F8(a)	6.2	0.11
2	Green harvest	F8(a)	6.1	0.46
2	Green harvest	F8(a)	6.1	0.19
2	Green harvest	F8(a)	6.2	0.18
3	Burning	**L10**	**5.7**	0.48
3	Burning	L10	6.2	0.13
3	Burning	L10	5.9	0.19
3	Green harvest	L10	6.2	1.33
3	Green harvest	L10	6.4	0.16
3	Green harvest	L10	5.9	0.14

Notebene: Standard soil pH required for optimum sugarcane yield ranges between 5-8.5

Table3.25: Soil analysis results for Kilombero experimental areas

Replication	Treatment	Field	Ph(H20)	EC
1	Burning	364	6.2	0.17
1	Burning	364	5.5	0.19
1	Burning	364	5.9	0.16
1	Green harvest	364	6.0	0.19
1	Green harvest	364	5.9	0.15
1	Green harvest	364	5.8	0.13
2	Burning	425	5.7	1.45
2	Burning	425	5.6	0.66
2	Burning	425	5.9	0.33
2	Green harvest	**425**	**6.5**	0.65
2	Green harvest	425	5.7	1.09
2	Green harvest	**425**	**4.3**	2.85
3	Burning	510	5.8	0.16
3	Burning	510	5.7	1.15
3	Burning	510	5.4	0.13
3	Green harvest	510	5.8	0.13

3	Green harvest	**510**	**6.5**	0.16
3	Green harvest	510	5.7	1.05

Notebene: Standard soil pH for sugarcane cultivations is between 5 and 8.5

3.5.4 Discussion

Preliminary results on determination of soil nutrients from green harvesting experimental areas observed that, soil pH from Mtibwa and Kilombero ranged between 4.3 and 6.5. The range felt within the standard pH of 5 to 8.5 for sugarcane production but below 7. This revealed that, both soils of Mtibwa and Kilombero are acidic but favorable for sugarcane farming. However, the lowest pH from Kilombero field 425 felt below the standard range (Table 3.25). This is implying that, soil sample from Kilombero field 425 is strongly acidic. This is according to laboratory guide for soil analysis and results interpretation as described by Okalebo *et al*., (1993).Similarly, the study on soil characterisation in sugarcane fields observed a strongly acid soil and the study suggested the application of liming, the application of calcium carbonate (limestone) to reduce acidity level in soil (Sullivan, 2017) .

3.5.5 Conclusion and recommendations

Preliminary results for assessment of the initial soil nutrients from Mtibwa and Kilombero experimental areas indicated the presence of acidic in soils. Therefore, the use of lime is recommended in order to reduce acidity level in soils. On the other hand, data collection on sugarcane yields, growth and soil properties to compare the effects of the two treatments is ongoing.

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4.0 ENTOMOLOGY

4.1 Study of seasonal insect population fluctuations influenced by weather changes and crop management practices in all estates and out grower's fields

Project Number: CPE2019/01
Principal Investigators: Nguvu, G., Yusuph, A., Urassa, F. and Mwinjumah, M.
Collaborators: Estate Agronomists, SBT and DAICOs
Reporting Period: 2019/2020

Project summary
This study aimed at monitoring major sugarcane insect pest population fluctuations influenced by weather changes and crop management practices. Surveys were conducted in selected fields at all estates and out-growers' fields to determine the incidence and severity of sugarcane stalk borers (*Eldana saccharina*), yellow sugarcane aphids (*Sipha flava*), white scale insect (*Aulacaspis tegalensis*) and white grubs (*Cochliotis melolonthoides*). Only 25% of surveyed MCP fields were free from YSA, however, the severity was very low as more than 75% of the infested field had severity below the economic threshold. Similar trends were observed to other pests and to out-growers' fields. Weather has been observed to play a major role this year as all estates experienced reasonably heave rainfalls from September 2019 until reporting time. Despite of the extent of infestation (severity) being low, wider incidence indicates hazards of pest outbreaks whenever conducive environment occurs, therefore care should be taken to monitor fields by introduction of traps and harvest matured infested crop soon as season starts.

4.1.1 Introduction

A wide range of insect pests such as stem borers, termites, white-grubs, scale insects, mealy bugs, army-worm and grasshoppers feed on sugarcane at various stages of its growth and cause significant yield losses (Sathe *et al.*, 2009). Many are only occasional feeders, but in most regions where this crop is grown insect pests are of significant factor in the economics of sugarcane production (James, 2004). In Tanzania, sugarcane stem borer, white scale, sugarcane white grubs and Yellow Sugarcane Aphid are the key insect pests which feed on sugarcane (TARI-Kibaha, 2017). Other insects are usually classified as occasional or sporadic pests.

Factors which determine insect population and level of damage they cause on the crop include weather, varieties, natural enemies, agronomic practices and new invasions by exotic insect pests (Sathe *et al.,* 2009). Most of insect prefer dry weather with medium to high temperature (25-35^{o}C) to flourish but rains tend to mechanically wash them and hence their populations checked. Varieties grown also influences insect pest population build up; susceptible varieties will attract insect pests while those known to be resistant will repel. Presence or absence of natural enemies also has an impact in insect pests' population dynamics as these natural enemies depend on particular insect pests as their food (predators), host (parasitoids) or infect the pest (entomopathogens). Crop management practices influence insect population build up by either favoring or hindering their development.

Therefore, this study aimed at understanding the current insect pest status, spread and seasonal trends in population build up in correlation with weather changes and crop management practices. The information will be useful in establishing immediate and future effective strategic management measures. Also, the results will be used to advise growers on what time to make necessary decision on management actions.

Main Objective

To establish the seasonal trends of sugarcane insect pest for designing of effective strategic management measures in Tanzania.

Specific Objectives

a) Monitoring the seasonal abundances of major sugarcane insect pest of Tanzania and assessing their damage.

Outputs achieved

194 (131 estate, 91 out growers) fields surveyed for incidence and severity of sugarcane stem borers and white scale insects 184 (142 estates, 42 out-growers) fields surveyed for incidence and severity of YSA

4.1.2 Materials and Methods

Fields selection for survey: Surveys were conducted in selected fields to assess insect pest populations and extent and intensity of damage caused by these insects on sugarcane in the estates and out growers (OG) fields. All estates growing sugarcane and their respective out-growers' fields were surveyed at least ones in each quarter; Mtibwa, Kilombero, Kagera and TPC. Fields surveyed were preselected according to their location/zone, variety grown and crop age, so as to have representative fields in each category.

Field scouting for stalk borers and white scales insects: For white scale and stalk borer assessment, a total of fifty stalks were sampled in each field except in some OG fields or multiplication blocks and variety trials in which twenty five or less stalks were taken for assessment of sugarcane stalk borer and white scale. Sampling points followed X-diagonal; all 4 angles and centre of the field. In each sampling point, 10 stalks were randomly selected and uprooted. Selected stalks were counted its internodes before being dissected for examination of larvae of stalk borers. Internodes with white scale infestation were also counted prior the dissection with the focus on the upper/top most 10 internodes. Field infestation was determined by calculating the percentage of infested stalks for white scales and stem borers separately;

Field Infestation (%) = (number of infested or bored stalks/number of examined stalks) X100%

Field scouting for YSA: In scouting of YSA the surveyed fields were randomly divided into sampling units following a zigzag method while each sampling unit represented 2 hectare. In each sampling unit a portion of 50m was randomly selected for assessment. Assessment was done for both rows which made a total of 100 stalks assessed. For each stalk, assessment was done by examining presence of colonies of YSA, therefore even when a single colony of YSA where present that stalk was recorded as infected. Field infestation was determined by calculating the percentage of infested stalks of all sampling units;

Field Infestation (%) = (infested stalks/assessed stalks) X 100%

To assess damage caused by sugarcane insect pest

Assessment of damage caused by stalk borers: Assessment for damage was done by following the procedure described in field scouting section above. Extent of damage was determined by calculating percentage of internodes bored against total number of internodes of all stalks;

Damage (% internodes bored) = (internodes bored/total number of internodes) X 100%

Assessment of damage caused by white scale insects: Assessment for damage was done by following procedure described in field scouting section above. The upper/top most 10 internodes were examined for white scale cover index (WSCI). White scale cover index has been categorized in 3 levels; None (0%), Low (<50%) and High (>50%). Therefore, each stalk was examined for level of establishment and respective score recorded. Then, the WSCI for each category was determined by calculating number of stalks of the particular level against total stalks count;

(eg.) Low infestation (%) = (stalks with <50% cover/total stalks) X 100%

Therefore, fields were considered as none, low or heavily damaged depending on the highest percentage scored between the WSCI.

4.1.3 Results

Yellow sugarcane aphid incidences at MCP and OG fields

A total of 36 fields which was equal to 25% of the fields surveyed at MCP had 0% infestation, while for OG it was 20 fields which were equal to 48% of the total fields surveyed for YSA. Although many fields (75%) recorded incidences of YSA at MCP fields, their intensity were very low (Figure 1). More than 75% of the fields had incidences of below 20% infested stool which is the economic threshold for many estates. Lower incidences of YSA this year has been linked with the drastic weather change whereby prolonged intense rainfalls have been recorded. Rainfall tend to lower aphid density although it depends on the amount and duration of rainfall, time of its occurrence, amount and exposure of aphids to rainfall, and wind speed (Kaakeh, 1993).

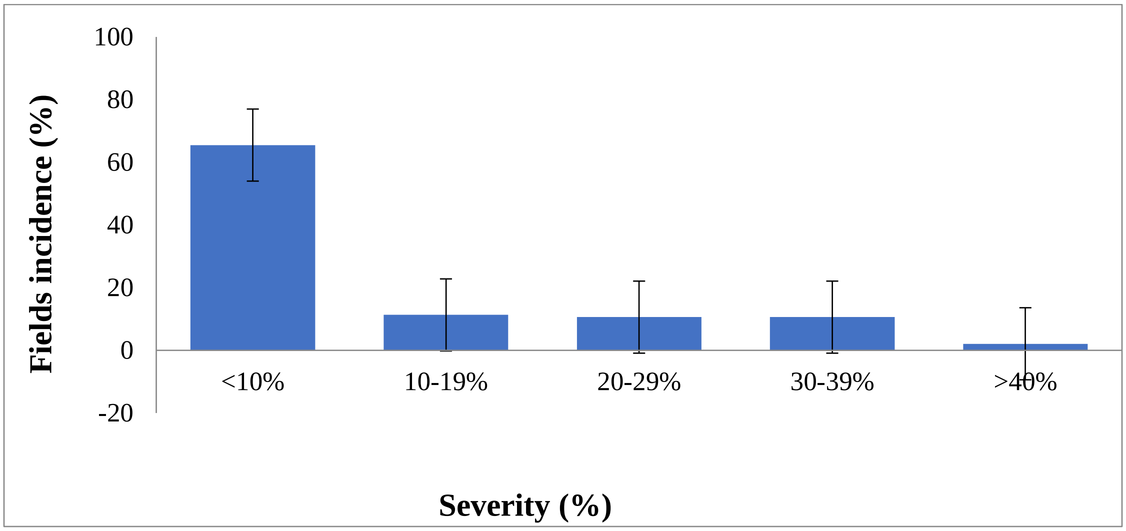

Figure 4.1: Fields incidence for YSA at MCP fields

Similar trend of data were recorded for out-growers' fields, with higher number of fields (83%) having low YSA incidences of below 20% stools infested (Figure 2). Although most of the farmers don't know this pest and hence not knowing its control measures, still there farms were clean. This indicated that, weather played a major role in this year's YSA status especially from September 2019 up to reporting time April 2020.

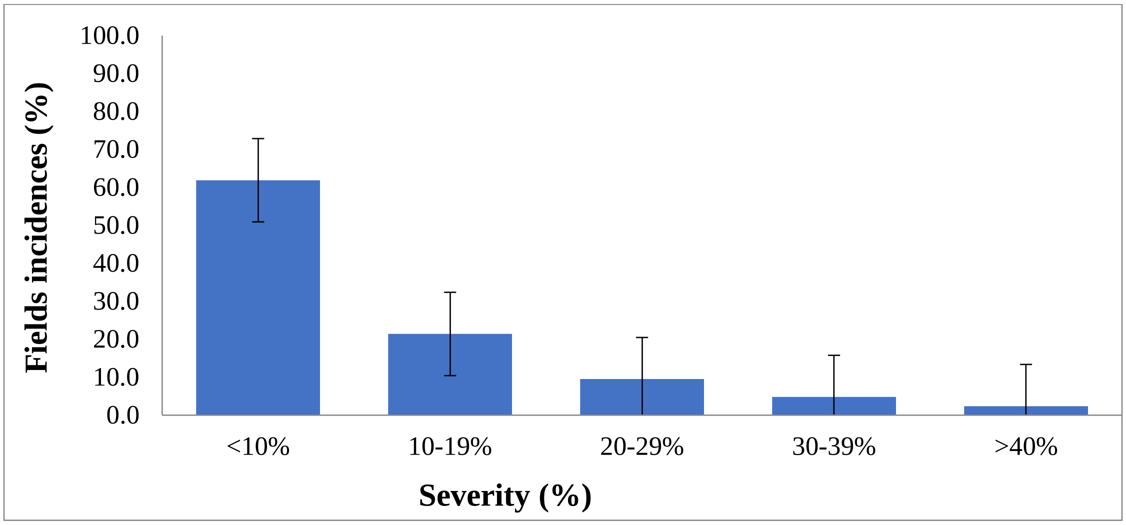

Figure 4.2: Fields incidence for YSA at OG fields

Generally, YSA incidences in the year 2019/2020 started to decrease from September when rains commenced. Therefore, despite of different control measures that took place, weather played a significant role in lowering pest pressure.

Influence of Varieties on YSA incidence

In all sites it was observed that variety had influence on YSA incidence level. There were some of the varieties seemed to be mostly preferred by the pest. Although there were a number of varieties grown at estates, it was possible to categorize some of the most common varieties which appeared in all estates. Categorization was based on the average infestation of the varieties in all estates and out-growers' fields.

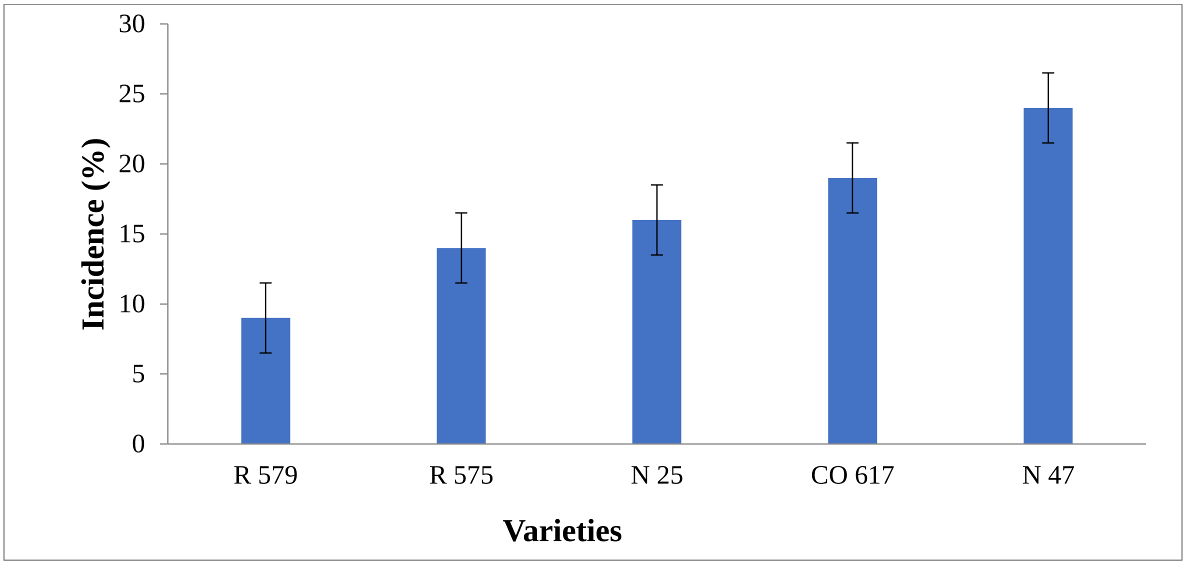

Figure 4.3: Relationship between Varieties and Incidence

Most of the fields with R 579 and R 575 varieties that were surveyed seemed to have low YSA infestations level as compared to other varieties like N25 and N47. Figure 3 shows that R 579 was the least infested variety with 9% average infestation and N47 was highly infested with 24% average infestation. However, all the varieties had an overall average infestation level below the economic threshold.

Sugarcane stalk borer incidences and severity at MCP and OG fields

From the surveys conducted between July 2019 and March 2020 at all estates MCP fields, the sugarcane stalk borer fields' infestation was at 69% and that of out-growers was at 66%. This generally meant that severity of sugarcane stalk borer insect at all estates and out-growers' fields were low (Table 4.1 and 4.2 below) despite of the fact that in most fields sugarcane stalk borers incidences were recorded. Figure 4.1stipulates the relationship observed between sugarcane stalk borer incidence and its severity. Although only 31% of the fields were free from the pest yet the level of infestation/severity was very low to cause significant damage.

The extent of infestation (severity); number of bored internodes as compared to total number of internodes indicated that 19% and 8% of the MCP and OG fields respectively had infestation above the threshold level of 4% internodes bored. This indicates that currently the status of damage is low, however there is a potential of massive outbreak if weather will be conducive for pest multiplication as their incidence have been widely observed.

Table 4.1: Incidences of sugarcane stalk borers at MCP and OG fields at all estates

Parameter	Severity (Bored Internodes) %						
	0	1	2	3	4	>4	**Total**
	MILLER CUM PLANTERS						

No. of fields	40	32	25	9	11	14	**131**
Field incidence (%)	30.5	24.4	19.1	6.9	8.4	10.7	**100**
Bored stalks (%)	2.5	13	24	42	46	63	**23**
Average age (m)	12	12	11	9	9	12	**11**
			OUT-GROWERS' FIELDS				
No. of fields	45	7	4	3	1	4	**64**
Field incidence (%)	70.3	10.9	6.3	4.7	1.6	6.3	**100**
Bored stalks (%)	4	10	28	44	64	42	**12**
Average age (m)	13	7	14	14	18	12	**13**

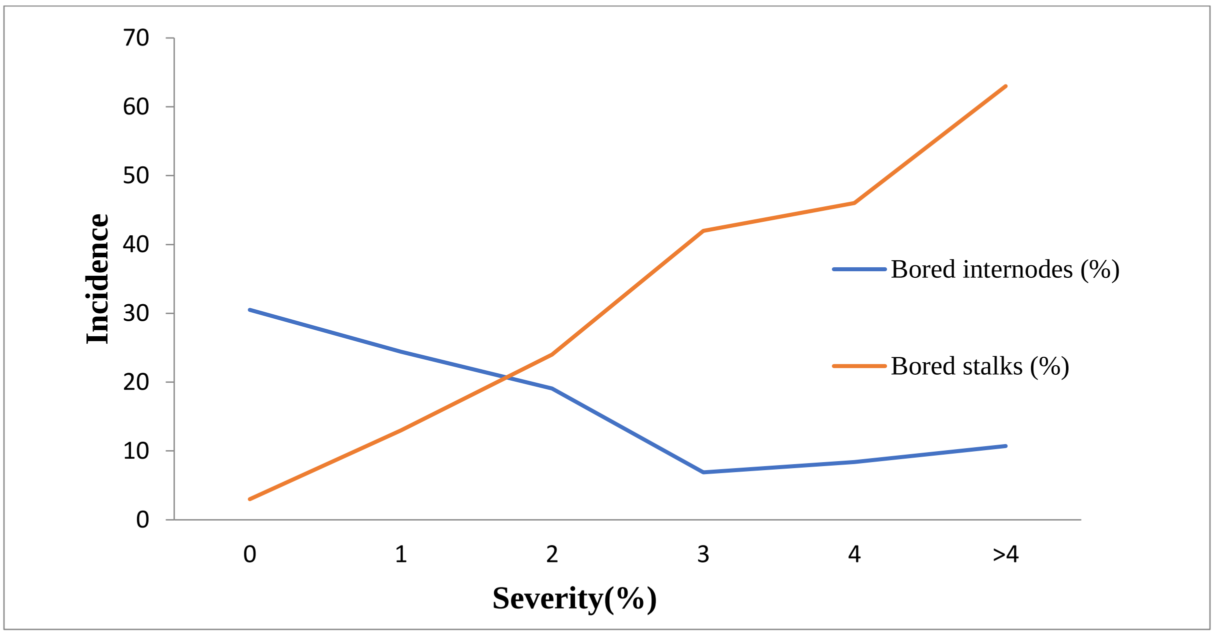

Figure 4.4: Relationship between field incidence and severity

Sugarcane white scales insect incidences and severity at MCP and OG fields

A total of 131 and 64 fields were surveyed for white scale insects at MCP and OG fields respectively. About 92% of the fields at MCP were not infested with white scale insects, while 39% were infested at low level with an average of 21% white scale cover index (WSCI). For out-growers' fields, 57% of them were free from white scale insects and 7% only were infested with 10% of the white scale cover index. Therefore, in summary white scale insects infestation has been observed to be very low in terms of field incidence and severity (WSCI) in all estates and out-growers' fields.

Table 4.2: Incidence and Severity of white scale insects at MCP and OG fields

Parameter	Category of Infestation			Total
	None (0%)	**Low (<50%)**	**High (>50%)**	

	MILLER	CUM	PLANTERS	
No. of fields	92	39	0	**131**
Field incidence (%)	70.2	29.8	0	**100**
Severity (%)	0	21	0	**21**
Average age (m)	11	13	0	**11**
		OUT GROWERS		
No. of fields	57	7	0	**64**
Field incidence (%)	89.1	10.9	0	**100**
Severity (%)	0	10	0	**10**
Average age (m)	13	15	0	**13**

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Relationship between Varieties and Stalk Borers Incidence and Severity

Different varieties have been observed to have certain relationships with sugarcane stalk borers; some were mostly preferred and others were least preferred by the pest. Results on incidences and severity from MCP and OG fields have been plotted on figure 4.5 below. Fields with R 570 were the least invaded amongst all the varieties and fields with N47 were the most infested ones with 4% and 33% of stalks being bored respectively. This was also true to severity whereby fields with variety R 570 average severity were below 1% and those with variety N47 were above 4% internodes bored.

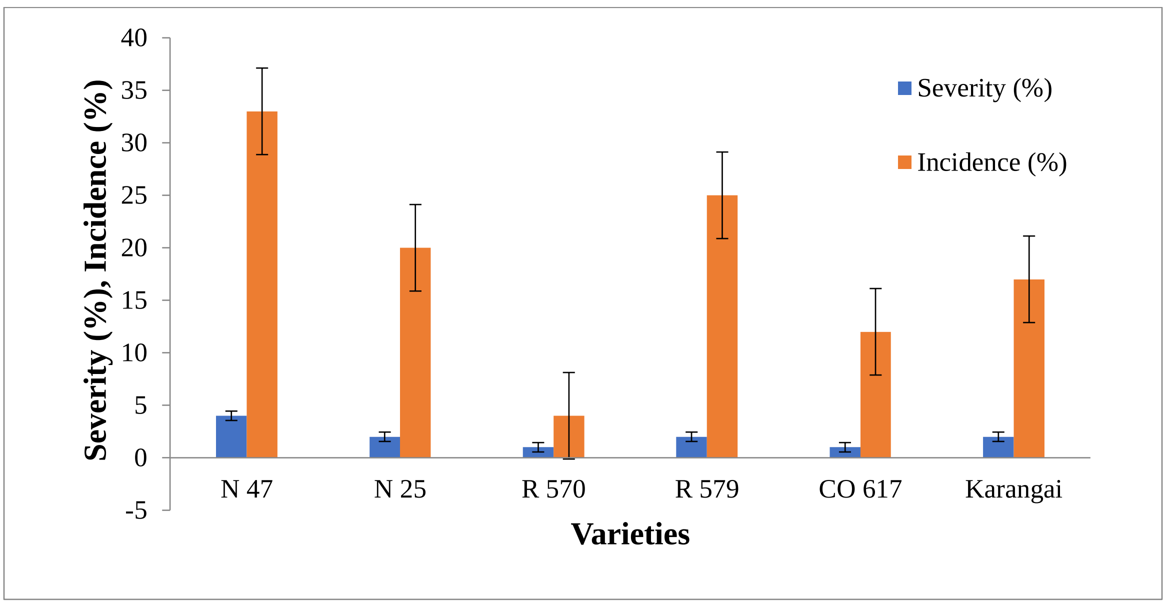

Figure 4.5: Relationship between Varieties and Stalk Borers Incidence and Severity

4.1.4 Discussion

Three of the major insect pests of sugarcane (sugarcane stalk borers, white scale insects and yellow sugarcane aphids) were recorded in all surveyed sites. Although the field incidences were widely

spread, the infestation levels (severity) were very low. Recorded infestations levels were very low due to several factors, one being the crop management practices implemented, varieties grown in many fields being those showing resistance to insect pests like R 579, but also the period when surveys were concentrated was accompanied with prolonged rains which are known to reduce pest infestations. This has well been observed also by Sathe, *et al.,* (2009) who mentioned weather as one of the factors which plays a major role in pest population fluctuation.
It has been noticed that rainfall patterns play a significant role in insect population build up. Rain intensity, duration and distribution have impact in insect population fluctuation. Heavy rainfall; high intensity, longer duration accompanied with high wind speed tends to lower insect density (Kaakeh, 1993). This year 2019/2020 has experienced more rains compared to many years. There have been floods in most sites especially from September, and up to the reporting time (April) in many areas floods are still there as it is continuing to rain. This has been a major reason for having low insect infestations in most cases. Data from Estates' weather stations showed that in that period MSE received total rain of about 1738.1 mm and the least was TPC with 665.81mm, rainfall was heavy enough to washout insects in the fields and reduce their population and this could be the major reason for low incidence of insect pest.

Different population buildup of insect pest indicates enhanced colonization, reproductive potential and substantial survival relative to varieties. Differences in aphid densities on different varieties can as well be attributed to nutritional quality of the host plant in terms of limiting essential nutrients (Auclair 1989, Smith 2005) and other factors impacting overall biotic potential (Akbar *et al*. 2010).

4.1.5 Conclusion and Recommendation

- Although major insect pests of sugarcane have been widely observed, the intensity of infestation (severity) has been very low due to number of reasons; the increased use of less susceptible varieties like R 579, improving management practices recommended by TARI-Kibaha researchers like the use of neonicotinoids in controlling YSA and lastly is the contribution of weather whereby prolonged rainfalls reduced pest pressure in most cases.
- Despite of the current low severity of sugarcane stalk borers in all estates and out-growers' fields, its incidence is relatively high and widely spread, that is many fields have been infested with the pest at low level. This indicates a great potential of pest outbreak whenever conducive weather may occur, therefore, fields which have matured crop need to be harvested when season starts and others need to be closely monitored and when necessary insecticide applied.
- Improved monitoring tools need to be introduced; lure traps, light traps and pitfall traps so as to reduce manpower in manual insect scouting and lower costs of production.

4.2 Evaluation of white scale insects damage and sugar loss in selected varieties

Project code: CPE 2018 /02
Principal investigators: G. Nguvu, A. Yusuph, F. Urassa and M. Mwinjumah
Collaborators: KSC
Reporting date: 2019/20
Funding donor: SIDTF

Project Summary

The sugarcane white scale *Aulacaspis tegalensis* (Zehntner) (Homoptera: Diaspididae) is one of the most important pests in sugarcane in Tanzania. The white scale is a stem pest which usually reduces juice quality of infested sugarcane. White scale damage in sugarcane estates has been reported to cause about 30% sugar loss in heavily infested fields. Information on yield losses and determination of appropriate control measures are important for proper management recommendations. The objective of the present study was to develop protocol for an artificial inoculation technique and later adopted for establishment of high white scale insect pressure necessary for screening of new sugarcane varieties. Results showed low white scale establishment in all varieties which is likely to be attributed by inoculation technique and/or environmental factors. Yield and quality parameters showed insignificancy as well, therefore, improvement of the inoculation method and management practices of the ratoon crop will be observed to reduce sources of insignificancy.

4.2.1 Introduction

The sugarcane white scale *Aulacaspis tegalensis* (Zehntner) (Homoptera: Diaspididae) is one of the most important pests in sugarcane in Tanzania which, if not managed, can cause up to 30 % crop losses (Katundu and Mtambo, 2004).
Together with biological and cultural methods, use of resistant varieties is an important component of white scale management. Therefore, resistance to white scale is one of the factors which must be considered in the selection of new varieties.
The previous results of research conducted at TPC and KSC based on natural insect infestation have shown that assessment of white scale infestation in small plots of replicated trials has not been able to provide substantial information on how test varieties would respond to potential insect damage in large scale production.
In the proposed experiment a new inoculation technique has been used to ensure establishment and sustained pest pressure during the selection process of new sugarcane varieties.

Main Objective

To provide quantitative information on risk potential of white scale in each of the new varieties pre and post release.

Specific objectives

1. To assess the establishment of white scale on test sugarcane varieties after artificial inoculation.
2. To determine the effect of white scale on sucrose and ton cane per hectare (TCH) of different sugarcane varieties.

Achieved Outputs

One variety potentially showing anti xenosis to white scale identified.

4.2.2 Materials and Methods

Location: The experiment was conducted at KSC; Field 434.

Treatments: Sugarcane varieties namely TZ93-KA-120, TZ93-KA-122, R 85/1334, B80689, KQ228 and EA70-97 as tolerant standard and MN1 and N25 as susceptible controls.

White scale inoculums source: White scale eggs were collected from sugarcane stalks of infested fields and sieved. A small spatula full amount of eggs were inoculated and covered with a screen of netting material on four stalks of each variety per plot.

The design of the experiment: Randomized Complete Block Design (RCBD) with 8 treatments and 5 replications and plot size of 4 rows X 10m.

Data collected: White scale infestation (% stalk infested; white scale cover (WSCI), juice quality analysis (Brix; Purity; Pol; Sucrose) and yield parameters (TCH; TSH)

4.2.3 Results

White scale establishment: The preliminary results (Table 4.3) indicate that the establishment of white scale in the inoculated stalks was so poor that only 13.1 % of the inoculated stalks had low level of white scale infestation and none in the high category. However, in this trial variety B 80689 appeared to have been potentially most susceptible with the white scale establishment of 20% of the inoculated stalks, similar to MN1. The standard resistant check variety EA70-97 had 0% white scale establishment and variety TZ93-KA–120, with white scale establishment on only 5% of the inoculated stalks, and could tentatively be considered resistant to the insect pest.

Table 4.3: Percentage of inoculated stalks of test varieties in different categories of white scale cover

	Categories		
Variety	**None (0%)**	**Low (<50%)**	**High (51%- 100%)**
TZ 93KA - 120	95	5	0
TZ 93KA - 122	85	15	0

R 85/ 1334	85	15	0
B80689	80	20	0
KQ228	85	15	0
EA 70-97	100	0	0
N25	85	15	0
MN1	80	20	0
MEAN	**86.9**	**13.1**	**0**

Cane and sugar yields: At harvest, representative stalk samples of each variety were taken to the laboratory for final juice quality analysis. The test varieties (B80-689, R85/1334, and TZ-122) have got high purity content range from 90.45 to 91.18 compared to susceptible varieties (MN1 and N25) which have low purity content of 90.31 and 90.15 respectively. Also in pol % the test variety B80-689, have high pol % of 19.89 compared to susceptible varieties which have low pol % of 18.91% and 19.82 % (Table 4.4).

The standard check variety EA70-97 has purity and yield of 88.53 and 46.7 respectively which is lower than the susceptible varieties though during the white scale establishment the variety had no infestation.

Table 4.4: Juice quality and cane yield of test varieties at harvest

Variety	Brix	Pol %	Purity	TCH	TSH
B80-689	21.81	19.89	91.18	48.9	10.7
KQ-228	22.02	19.81	89.87	55.1	12.1
R85/1334	21.16	19.18	90.61	50.4	10.7
TZ93-KA-120	19.79	17.78	89.84	46.1	9.1
TZ93-KA-122	20.29	18.35	90.45	47.9	9.7
EA70-97	21.47	19.14	88.53	46.7	10.0
MN1	21.96	19.82	90.31	50.8	11.2
N25	20.96	18.91	90.15	46.4	9.7
MEAN	**21.2**	**19.1**	**90.1**	**49.0**	**10.4**
SE	**1.31**	**1.27**	**3.45**	**2.89**	
CV%	**6.2**	**6.6**	**3.9**	**5.9**	
LSD (p=0.05)	**1.92**	**1.87**	**5.11**	**5.06**	

In cane yield the test varieties KQ-228 and R85/1334 has got yield of 55.1 and 50.4 respectively compared to susceptible variety N25 which has yield of 46.4 and in the white scale establishment the varieties were infested the same at 15% white scale establishment.

4.2.4 Discussion

From the present study, white scale insects did not prove to cause significant ($P \geq 0.05$) reduction in sugarcane quality parameters (pol%, brix, purity) and yield (TCH). This could be attributed to low white scales establishment after the inoculation. Low white scale establishment could be attributed by either the method used for inoculation or environmental factors. There was no significant difference between the varieties in quality and yield loss. This was mainly attributed by low establishment of white scale. Wains *et al*., (2010) also reported higher pest population causes yield loss and quality.

4.2.5 Conclusion and Recommendation

Differences in pest densities on different varieties can be attributed to nutritional quality of the host plant in terms of limiting essential nutrients (Auclair 1989, Smith 2005) and other factors impacting overall biotic potential (Akbar *et al.* 2010).

From the results discussed, it is difficult to draw conclusion on which variety performed better than the others as their differences were insignificant and trend of results did not show correlation. Therefore, management must be improved in the ratoon crop to minimize errors and come up with concrete recommendations.

4.3 The Effectiveness of prophylactic soil treatment and foliar applications of locally available insecticides for yellow sugarcane aphids control

Project code: CPE 2018/04
Principal investigator: G. Nguvu, A. Yusuph, F. Urassa and M. Mwinjumah
Collaborators: KSC
Reporting date: 2019/20
Funding donor: SIDTF

Project summary

This trial was carried out at Kilombero Sugar Estate fields in one site (field 325) as ratoon to confirm last year's results. Treatments were arranged in randomized completely block design (RCBD) replicated four (4) times. Modes of insecticide application were soil and foliar, applied at most two times on entire season. Results have indicated that on the average; Attackan (8 WAP), Actara (8 WAP), Drone (8 WAP), Attackan (8 + 12 WAP), Actara (8 + 12 WAP) and Drone (8 + 12 WAP) have all indicated percentage reduction 58.5% to 74.3% of Yellow Sugarcane Aphids (YSA) control. Neonicotinoids insecticides (Attackan, Drone and Actara) are highly effective in reduction of YSA population and damage on sugarcane.

4.3.1 Introduction

The Yellow Sugarcane Aphid (YSA), *Sipha flava* (Forbes) (Homoptera: Aphididae) invaded Tanzania in May, 2016 when the country had no registered insecticides for its control. Sugarcane growers in Kilombero have desperately used different insecticides which have been locally available but have no sugarcane label in controlling YSA. Among the products used by cane growers were Attackan 350 SC, Actara 250 WG which belongs to Neonicotinoids; and Piricab 50 WDG and Abanil 18 EC which belongs to carbamate and microbial families respectively.

Neonicotinoids insecticides act on the post-synaptic nicotinic acetylcholine receptors in the central and peripheral nervous systems, resulting in excitation and paralysis, followed by death of insect (Tomizawa and Casida, 2003). Many of these compounds are sufficiently xylem mobile to be suitable for soil application.

Carbamate insecticides are both acetylcholinesterase inhibitors, interfering with the transmission of nerve impulses across the synaptic gap between two nerve cells by preventing the breakdown of the predominant neurotransmitter, acetylcholine (Tomizawa and Casida, 2003). This results in tetanic paralysis that destroys the ability of insects and other organisms to respond to external stimuli.

Thus it was important for researchers to test these insecticides to determine their efficacies in the control of YSA so that they can also be included in the registration of chemicals recommended for management of YSA in Tanzania.

Main Objective

To find suitable prophylactic and augmentative insecticides for soil and foliar applications for sustainable YSA management that has minimal impact on natural enemies.

Specific Objectives

a) To test the efficacy of insecticides available in local Agricultural Inputs Stores for YSA control
b) To study the effect of the tested insecticides on YSA natural enemies.

Achieved Outputs

Insecticides effective in controlling YSA have been preliminary recommended.

4.3.2 Materials and Methods

For this season, investigation was carried out in field 325 only for establishment of the trials at KSC for ratoon stage. Randomized Complete Block Design was employed with four replications. As a prophylactic treatment, Attackan 350 SC (imidacloprid) was used at the rate of 2.0 L/ha at planting. As augmentative treatments, Attackan 350 SC (2.0 L/ha), Actara 250 WG (thiamethoxam) at 800 g/ha) and Drone 222 SL (acetamiprid) at 1.35 L/ha were tested by foliar application. Since the above three (3) insecticides belong to the group of neonicotinoids, alternatively, Pirimicab (Piricab 50 WDG) at 396 g/ha and Abamectin (Abanil 18 EC) at 300ml/ha, insecticides which belong to the carbamate and microbial families, respectively were also included in the trials. Foliar applications were fixed at approximately eight (8) weeks after planting (WAP) and 12 WAP.

The total number of treatments were twelve which are: Attackan (soil), Attackan (8 WAP), Abamectin (8 WAP), Actara (8 WAP), Drone (8 WAP), Pirimicab (8 WAP), Attackan (8 WAP + 12 WAP), Abamectin (8 WAP + 12 WAP), Actara (8 WAP + 12 WAP), Drone (8 WAP + 12 WAP), Pirimicab (8 WAP + 12 WAP), Control. The plot size was four (4) rows by ten (10) meter and space between plots was two (2) meter.

Statistical analysis: Data were analyzed using Genstat statistical package by one-way ANOVA and means were separated by Duncan's Multiple Range Test (DMRT).

4.3.3 Results

There were significant difference among the insecticides in reducing the infestation of aphids and damage of leaves per treated plots (Fig. 4.7 and 4.8 and Table 4.6 and 4.7). Means aphid numbers in neonicotinoids insecticides treated plots were significantly lower than carbamates and untreated plots on all sampling dates. Attackan, Actara and Drone were very effective at 8 and 8 + 12 WAP. Attackan and Actara (8 +12 WAP) caused high aphid mortality 74.3% and 58.5% respectively. Neonicotinoids were reported as effective insecticides against aphids through their vapor and systemic action, respectively (Tolmay 2006; Robert, 2008). This report agrees with Shafique *et al.*, 2016 who also reported neonicotinoids as the most effective insecticide against aphids.

Plots treated with neonicotinoids insecticides had lower leaf damage than the carbamates and untreated ($P<0.05$) (Table 4.9). The lowest leaf damage was recorded in plots treated with Attackan (8 + 12 WAP) followed by Actara (8 + 12 WAP). The insecticides Abamectin and Pirimicab had higher levels of leaf damage. Tesfaye and Alemu (2015) applied carbamates against Russian Wheat aphid and observed relatively higher score of leaf damage in treated plots.

Table 4.5: Mean number of predators per stool in different treatments and sampling dates

	Sampling Periods					
Treatments	**10 WAP**	**12.2 WAP**	**14WAP**	**16.2 WAP**	**18.1 WAP**	**20.1 WAP**
Attackan (soil)	0.252	0.125	0.789	0.698	0.312	0.071
Attackan (8)	0.29	0.222	0.38	0.39	0.042	0.09
Abamectin (8)	0.12	0.108	0.89	0.91	0.062	0.098
Actara (8)	0.27	0.078	0.402	0.629	0.054	0.102
Drone (8)	0.398	0.105	0.555	0.642	0.051	0.09
Pirimicarb (8)	0.305	0.278	0.567	0.424	0.353	0.187
Attackan (8 + 12)	0.302	0.288	0.342	0.318	0.051	0.06
Abamectin (8 + 12)	0.341	0.388	0.854	0.31	0.102	0.049
Actara (8 + 12)	0.122	0.172	0.521	0.461	0.048	0.03
Drone (8 + 12)	0.431	0.111	0.428	0.464	0.052	0.021
Pirimicarb (8 + 12)	0.364	0.332	0.522	0.418	0.278	0.099
Control	0.467	0.398	0.657	0.554	0.105	0.098
Means	**0.305**	**0.217**	**0.576**	**0.518**	**0.126**	**0.083**
SE	**0.1077**	**0.1166**	**0.1858**	**0.1757**	**0.1165**	**0.0431**
LSD	**0.1136**	**0.098**	**0.3218**	**0.283**	**0.0271**	**0.016**
CV %	**35.28**	**53.70**	**32.28**	**33.91**	**92.61**	**52.02**

Table 4.6: Average number of YSA colonies per stalk in different treatments and sampling dates

	Sampling Periods					
Treatment	**10 WAP**	**12.2 WAP**	**14 WAP**	**16.2 WAP**	**18.1 WAP**	**20.1 WAP**
Attackan (soil)	0.368	0.402	0.578	0.207	0.079	0.051
Attackan (8)	0.399	0.145	0.283	0.098	0.065	0.02
Abamectin (8)	0.532	0.627	0.534	0.332	0.18	0.098
Actara (8)	0.301	0.29	0.619	0.159	0.142	0.036
Drone (8)	0.36	0.048	0.365	0.254	0.205	0.032
Pirimicarb (8)	0.27	0.626	0.758	0.341	0.135	0.112
Attackan (8 + 12)	0.39	0.058	0.202	0.126	0.003	0.001
Abamectin (8 +12)	0.305	0.654	0.529	0.111	0.09	0.09
Actara (8 + 12)	0.215	0.29	0.34	0.065	0.094	0.001
Drone (8 + 12)	0.353	0.234	0.438	0.054	0.016	0
Pirimicarb (8 +12)	0.423	0.53	0.466	0.3	0.135	0.039
Control	0.356	0.658	0.496	0.234	0.186	0.109
Means	**0.356**	**0.380**	**0.467**	**0.190**	**0.111**	**0.049**
SE	**0.0806**	**0.2342**	**0.1540**	**0.1024**	**0.0646**	**0.0427**
LSD	**0.2853**	**0.3518**	**0.4139**	**0.2666**	**0.2135**	**0.1284**
CV %	**22.65**	**61.61**	**32.94**	**53.85**	**58.28**	**87.01**

Table 4.7: Mean % infested leaves per stalk in different treatments and sampling dates

	Sampling Periods					
Treatment	**10 WAP**	**12.2 WAP**	**14 WAP**	**16.2 WAP**	**18.1 WAP**	**20.1 WAP**
Attackan (soil)	19.24	17.84	21.84	14.02	13.26	11.31
Attackan (8)	19.58	13.64	14.13	12.82	10.4	8.74
Abamectin (8)	19.3	17.36	18.2	19.57	17.16	14.33
Actara (8)	17.54	12.56	13.39	14.94	12.99	8.19
Drone (8)	18.44	13.98	15.73	8.74	10.06	9.43
Pirimicarb (8)	19.68	17.42	18.1	17.05	14.37	11.11
Attackan (8 + 12)	18.2	11.38	10.72	11.02	8.94	7.96
Abamectin (8 + 12)	23.55	16.23	17.46	19.6	15.22	12.28
Actara (8 + 12)	14.99	11.42	12.2	13.08	9.98	7.94
Drone (8 + 12)	17.68	12.9	13.92	12.89	9.13	7.94
Pirimicarb (8 + 12)	21.46	15.88	16.43	15.88	13.07	12.28
Control	18.89	19.45	15.56	14.4	12.12	12.12
Mean	**19.046**	**15.005**	**15.640**	**14.501**	**12.225**	**10.303**
SE	**2.102**	**2.710**	**3.035**	**3.209**	**2.589**	**2.202**
LSD	**7.361**	**7.518**	**7.909**	**9.636**	**6.154**	**7.702**
CV %	**11.04**	**18.06**	**19.41**	**22.13**	**21.18**	**21.37**

Table 4.8: Mean % damage on leaves per stalk in different treatments and sampling dates

	Sampling Periods					
Treatment	**10 WAP**	**12.2 WAP**	**14 WAP**	**16.2 WAP**	**18.1 WAP**	**20.1 WAP**
Attackan (soil)	24.1	25.0	27.4	23.9	19.4	15.4
Attackan (8)	20.4	12.6	13.0	19.9	16.6	11.2
Abamectin (8)	25.8	23.8	25.5	25.8	20.5	16.2
Actara (8)	20.1	12.9	15.7	17.5	13.8	9.1
Drone (8)	23.3	15.4	16.3	13.4	15.2	7.4
Pirimicarb (8)	24.7	20.8	23.2	20.3	20.2	14.8
Attackan (8 + 12)	19.9	12.8	13.0	7.9	6.6	4.4
Abamectin (8 + 12)	24.0	22.0	23.2	24.4	21.7	13
Actara (8 + 12)	20.9	13.5	15.0	17.7	12.4	4.5
Drone (8 + 12)	21.2	10.8	15.4	17.5	11.9	5.4
Pirimicarb (8 + 12)	25.5	19.4	21.1	20.6	14.3	11.5
Control	23.3	15.7	16.6	13.2	12.5	9.9
Mean	**22.766**	**17.051**	**18.783**	**18.508**	**15.425**	**10.233**
SE	**2.151**	**4.903**	**5.036**	**5.187**	**4.442**	**4.189**
LSD	**14.44**	**12.33**	**8.631**	**15.07**	**13.69**	**12.81**
CV %	**9.45**	**28.75**	**26.81**	**28.03**	**28.80**	**40.94**

The neonicotinoids have seen to show superiority in controlling YSA population compared to carbamates. Attackan, Actara and Drone applied foliar at 8 WAP and 8 + 12 WAP have all shown significant reduction of YAS colonies, percentage infested leaves as well as percentage damage on leaves (Figure 4.7, 4.8 and 4.9). Similar observations were recorded previously. Therefore, it can be confirmed that the neonicotinoids can be effectively used in controlling YSA. Foliar application has shown significant reduction of YSA population as compared to soil application. Application of neonicotinoids at 8 WAP has shown comparable effects on controlling YSA as application at 8 + 12 WAP.

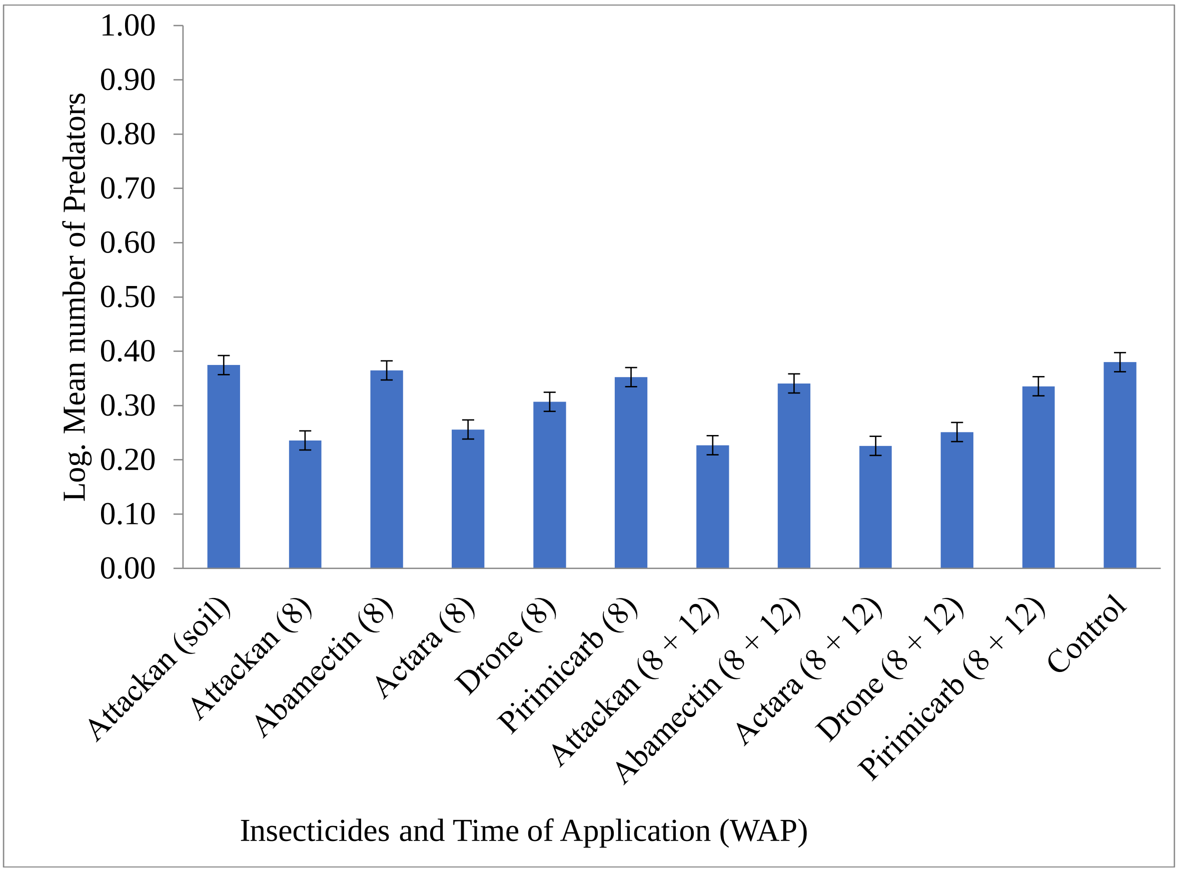

Figure 4.6: The Effects of Insecticides and Time of Application on Predator Population

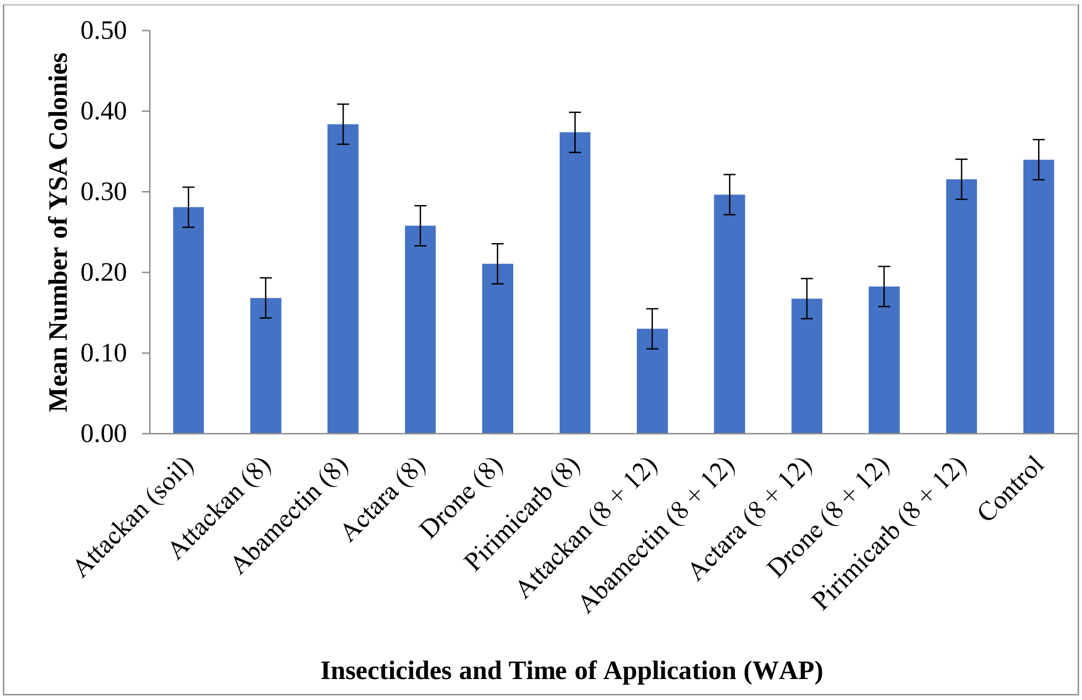

Figure 4.7: The Effects of Insecticides and Time of Application on YSA Population

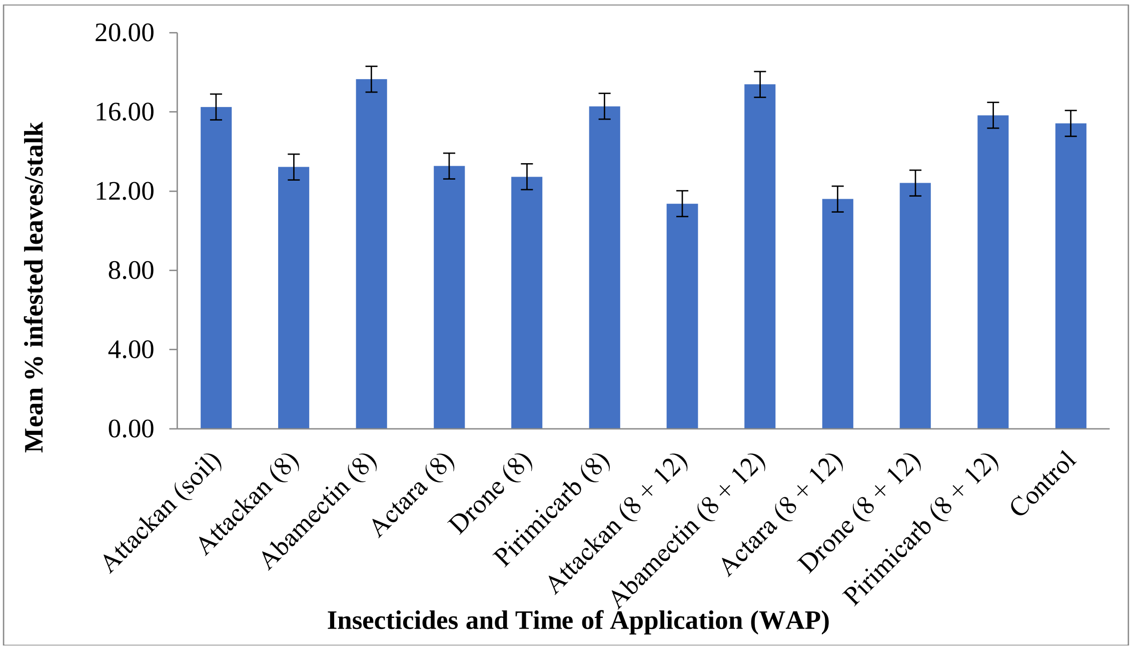

Figure 4.8: The Effects of Insecticides and Time of Application on % Infested Leaves

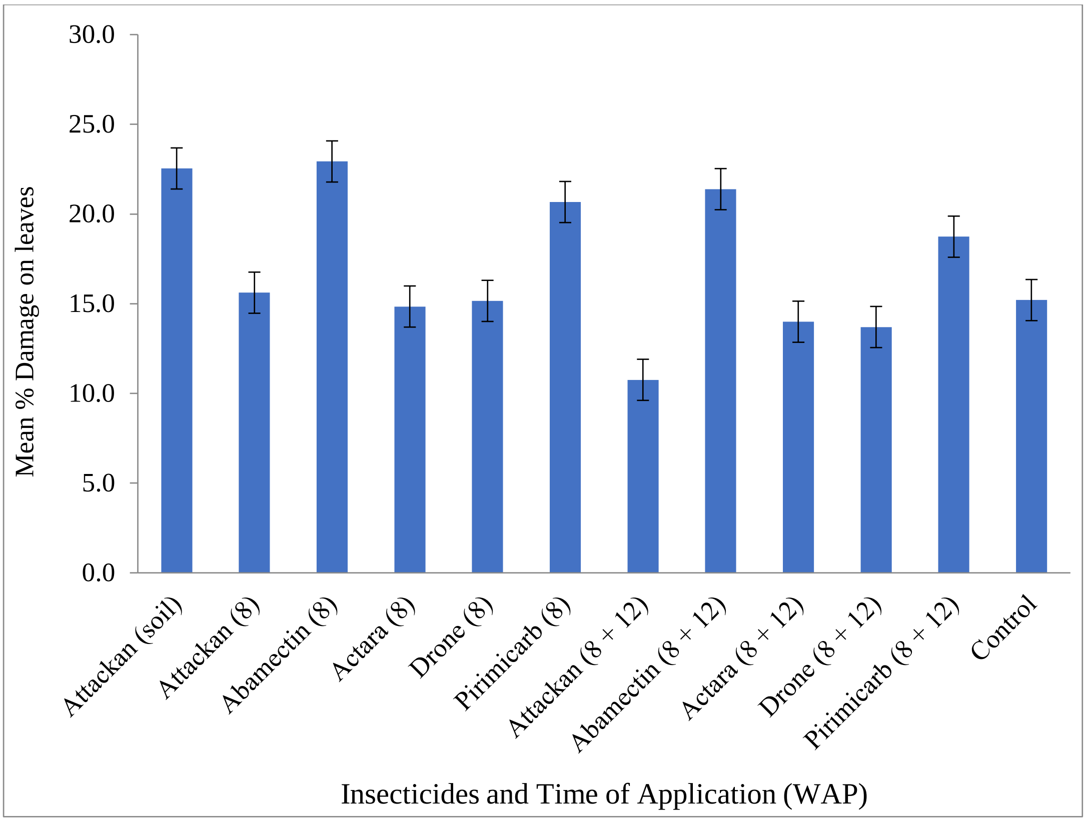

Figure 4.9: The Effects of Insecticides and Time of Application on % Damage on Leaves

When the tested parameters were combined to deduce the overall performance amongst the insecticides and time of application the results were as stipulated in table 4.10 below. The neonicotinoids; Attackan, Actara and Drone performed the best respectively at 8 + 12 WAP.

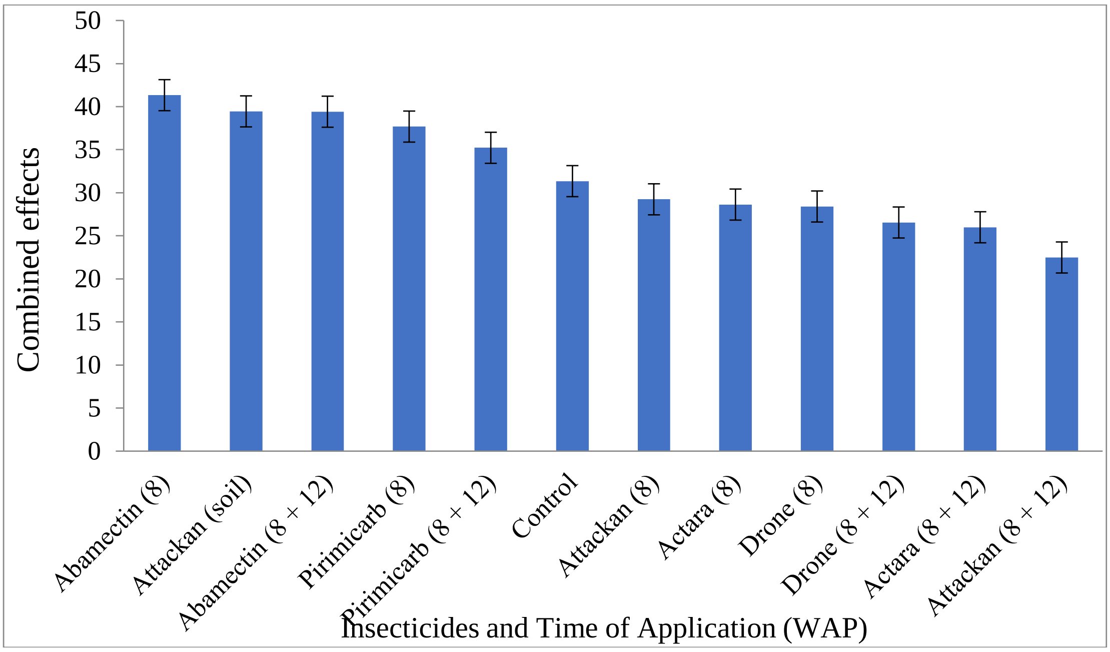

Table 4.10: Ranking of Effect of Insecticide and Time of Application to YSA control

4.3.4 Discussion

Results showed similar trends with those of previous seasons in a number of parameters tested. When compared to the control, the neonicotinoids group performed better in reducing number of YSA colonies, leaf infestation and leaf damage. Effectiveness of controlling YSA was between 58.5% and 74.3%. However, neonicotinoids had detrimental effects to natural enemies as they also reduced their population especially when used twice.

Upon ranking treatments performances compared to the control, all neonicotinoids applied foliar had better combined effects than the control as opposed to carbamates and soil application of Attackan which had lower combined effect compared to the control.

Contrary to last year's results which ranked Drone (8 + 12 WAP) as overall better performer amongst the treatments, this year it was Attackan (8 + 12 WAP) a better performer amongst the treatments. On the other hand the top three better performers Attackan, Actara and Drone (both at 8 + 12 WAP) had insignificant difference among them. Therefore, single application may be sufficient enough in reducing YSA population, as well as preserving natural enemies for further control of the pest.

4.3.5 Conclusion and recommendation

The study has confirmed Neonicotinoids significant effect on controlling YSA when applied foliar. Single application of neonicotinoids can be effective enough for lowering YSA and minimize detrimental effects to natural enemies.

4.4: Evaluation of resistance of sugarcane varieties to Yellow Sugarcane Aphid infestation in cages

Project code: CPE 2019 /06
Principal investigators: G. Nguvu, F. Urassa, A. Yusuph and M. Mwinjumah
Collaborators: TARI-Kibaha sugarcane breeding section
Reporting date: 2019/20
Funding donors: SIDTF

Project summary

YSA is one among the key insect pest causing damage to Sugarcane in Tanzania. The infestation occurs in all varieties grown in all areas though the damage varies from one variety to another. Due to this fact we intended to study the reaction of selected commercial and varieties in advanced stages of evaluation. This experiment was conducted in the screen house at TARI-Kibaha. Varieties R 85/1334, R 579, CG96-52, BR971004 and line TZ93-KA-120 showed promising resistance to YSA.

4.4.1 Introduction

The Yellow Sugarcane Aphid (*Sipha flava*) has become one of the most damaging pests of sugarcane in all the major sugarcane growing areas of Tanzania. This insect causes damage to sugarcane by direct feeding on the sap and injection of a toxin which causes leaf discoloration, necrosis and death, thereby reducing the photosynthetic area of the plant. Early YSA infestation on the sugarcane crop may cause reduction in tillering. Increased populations of YSA may eventually damage all mature leaves on plants < 6 months old which can reduce sugarcane yield at harvest time by 20% (Nuessly and Hentz, 2002). Experience from TPC and other infested areas have shown that different varieties react differentially to YSA damage. Therefore instead of relying on chemical control alone host plant resistance may be important in IPM programme in YSA management.

Specific objectives

a) To determine the effects of YSA on plant growth.
b) To study the population build-up of YSA in the test varieties.

Outputs achieved

Preliminary results indicated promising YSA resistance on varieties R 85/1334, R 579, CG96-52, BR971004 and line TZ93-KA-120

4.4.2 Materials and Methods

Location: The experiment was implemented in a screen house at TARI Kibaha.
Research design and data collection: RCD with 4 replications. Each replicate had16 varieties and/or lines arranged randomly.YSA was collected from infested fields and inoculated in potted sugarcane plants kept in screen house at TARI-Kibaha. 10 colonies were inoculated at the beginning to all tested varieties and progress followed up.

4.4.3 Results

Preliminary results obtained after the analysis show similar trends to some varieties/clones tested. Tables 4.8 to 4.10 show a summary of relationship between varieties and YSA infestation in different parameters.

Variety R 85/1334 showed superiority in having the least average number of clones of YSA per stalk while TZ93-KA-122 had the highest average number of YSA colonies per stalk (Figure 4.10). The overall weekly mean number of clones of YSA per stalk showed a decreasing trend with time from 0.993 to 0.289 from first to sixth week respectively (Table 4.8) although individually the varieties/lines responded differently with other recording fluctuations while others showed constant number of YSA colonies with insignificant variations.

Similar observation was recorded on percentage of infested leaves, whereby variety R 85/1334 had the lowest average percentage infestation of 23.7% and TZ93-KA-122 had 92.3% average percentage infestation (Figure 4.11).

On percentage leaf damage, varieties R 85/1334 and TZ93-KA-122 were the least damaged and the most damaged with an average percentage leaf damage of 8.5% and 75% respectively (Figure 4.12).

Table 4.8: Relationship between varieties and number of YSA colonies per stalk

Varieties	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI
BR971004	1.041	1.041	0.270	0.226	0.151	0.000
CG00-100	1.041	1.007	0.435	0.732	0.260	0.000
CG00-28	1.041	1.041	0.521	0.521	0.260	0.260
CG00-92	1.041	0.781	0.260	0.260	0.260	0.260
CG96-52	0.822	0.781	0.336	0.000	0.260	0.000
CG-SP-98-16	1.031	1.031	0.521	0.671	0.435	0.260
N19	0.971	1.041	0.435	0.992	0.521	0.732
N25	0.992	1.041	0.260	0.260	0.260	0.260
N36	1.007	1.041	0.260	0.260	0.226	0.000
N41	1.041	1.041	0.781	1.041	0.992	0.781
N47	0.892	0.958	0.771	0.771	0.705	0.771
R 570	0.992	0.781	0.455	0.510	0.486	0.260
R579	0.992	1.041	0.260	0.000	0.000	0.000
R 85/1334	0.897	0.521	0.151	0.000	0.000	0.000
TZ93-KA-120	1.041	1.041	0.411	0.195	0.000	0.000
TZ93-KA-122	1.041	1.041	0.791	1.041	1.041	1.041
MEAN	**0.993**	**0.952**	**0.432**	**0.468**	**0.366**	**0.289**
LSD (0.05)	**0.147**	**0.385**	**0.571**	**0.570**	**0.560**	**0.511**
S.E	**0.103**	**0.270**	**0.401**	**0.400**	**0.393**	**0.358**
CV (%)	**10.4**	**28.4**	**92.8**	**85.6**	**107.4**	**123.9**
P-VALUE	**0.091**	**0.245**	**0.454**	**<.001**	**0.006**	**<.001**

Table 4.9: Relationship between varieties and percentage infested leaves

Varieties	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI
BR971004	0.758	1.000	0.200	0.083	0.127	0.000
CG00-100	1.000	1.000	0.233	0.271	0.438	0.063
CG00-28	0.846	0.813	0.417	0.146	0.175	0.250
CG00-92	0.513	0.750	0.083	0.250	0.250	0.313
CG96-52	0.950	0.417	0.146	0.250	0.250	0.250
CG-SP-98-16	0.908	0.771	0.338	0.233	0.400	0.350
N19	0.800	1.000	0.875	0.708	0.658	0.438
N25	0.771	1.000	0.286	0.150	0.250	0.250
N36	0.838	0.867	0.178	0.125	0.063	0.000
N41	0.650	1.000	0.788	0.875	0.708	0.688
N47	0.831	0.825	0.538	0.538	0.625	0.563
R 570	0.763	0.700	0.417	0.313	0.350	0.308
R579	0.938	0.750	0.250	0.050	0.000	0.000
R 85/1334	0.914	0.375	0.050	0.042	0.042	0.000
TZ93-KA-120	0.825	1.000	0.188	0.125	0.125	0.125
TZ93-KA-122	0.742	1.000	1.000	0.938	0.900	0.958
MEAN	**0.815**	**0.829**	**0.374**	**0.318**	**0.335**	**0.285**
LSD (0.05)	**0.2971**	**0.4395**	**0.4239**	**0.4304**	**0.4806**	**0.4813**
S.E	**0.2086**	**0.3086**	**0.2977**	**0.3022**	**0.3374**	**0.338**
CV (%)	**25.6**	**37.2**	**79.6**	**94.9**	**100.7**	**118.7**
P-VALUE	**0.215**	**0.081**	**<.001**	**<.001**	**0.009**	**0.006**

Table 4.10: Relationship between varieties and percentage damaged leaves

Varieties	1 WAI	2 WAI	3 WAI	4 WAI	5 WAI	6 WAI
BR971004	0.375	0.425	0.188	0.300	0.000	0.200
CG00-100	0.388	0.400	0.375	0.550	0.200	0.213
CG00-28	0.475	0.413	0.238	0.225	0.125	0.200
CG00-92	0.663	0.550	0.250	0.225	0.200	0.213
CG96-52	0.250	0.100	0.075	0.125	0.200	0.113
CG-SP-98-16	0.513	0.613	0.300	0.363	0.325	0.313
N19	0.250	0.313	0.775	0.800	0.863	0.575
N25	0.438	0.400	0.238	0.175	0.188	0.188
N36	0.463	0.450	0.200	0.188	0.288	0.000
N41	0.300	0.338	0.700	0.750	0.738	0.625
N47	0.425	0.463	0.388	0.513	0.575	0.550
R 570	0.300	0.213	0.463	0.388	0.388	0.400
R579	0.438	0.300	0.000	0.000	0.000	0.000
R 85/1334	0.225	0.100	0.088	0.100	0.000	0.000
TZ93-KA-120	0.525	0.525	0.063	0.150	0.063	0.000
TZ93-KA-122	0.513	0.475	0.900	0.838	0.863	0.913
MEAN	**0.409**	**0.380**	**0.327**	**0.355**	**0.313**	**0.281**
LSD (0.05)	**0.238**	**0.264**	**0.418**	**0.423**	**0.408**	**0.413**
S.E	**0.167**	**0.185**	**0.293**	**0.297**	**0.287**	**0.290**
CV (%)	**40.8**	**48.8**	**89.6**	**83.5**	**91.5**	**103.1**
P-VALUE	**0.029**	**0.008**	**0.001**	**0.002**	**<.001**	**<.001**

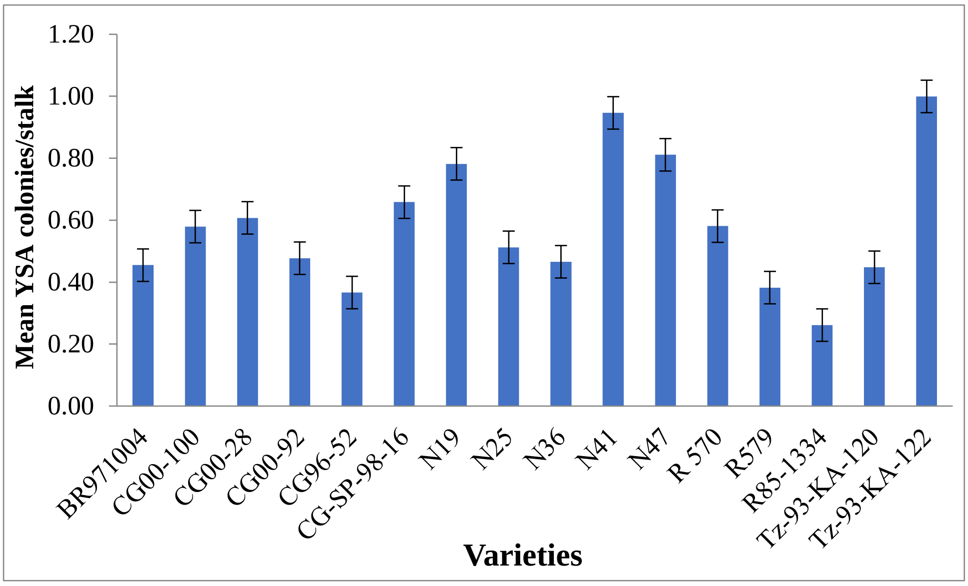

Figure 4.10: Mean YSA colonies/stalk in different varieties

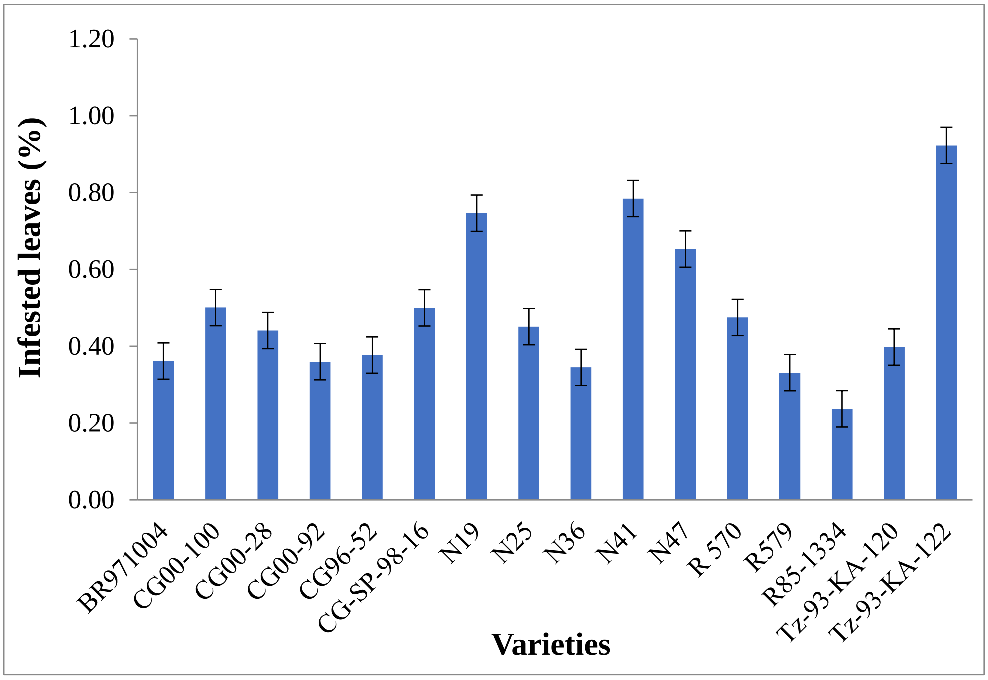

Figure 4.11: Mean percentage infested leaves/stalk in different varieties

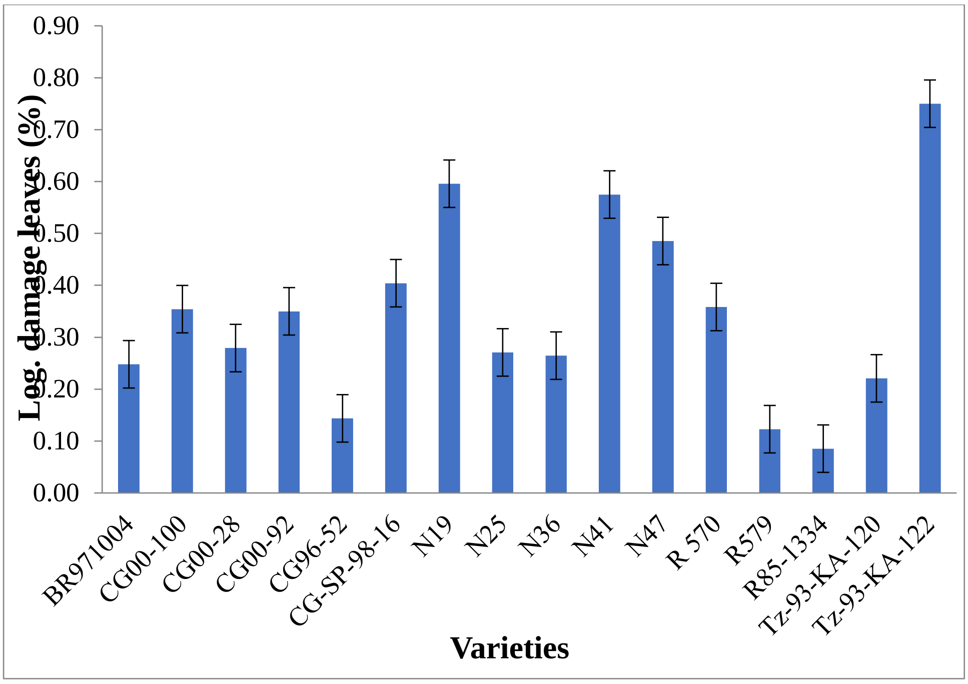

Figure 4.12: Mean percentage damaged leaves/stalk in different varieties

When the tested parameters were combined to deduce the overall performance amongst the varieties/clones the results were as stipulated in table 4.13 below.

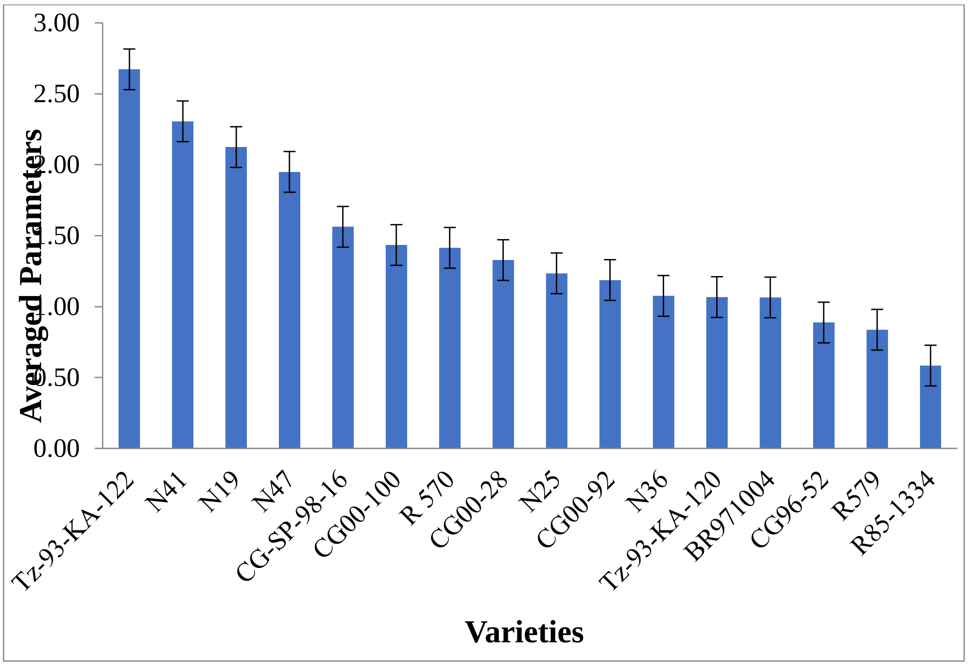

Figure 4.13: Ranking of varieties' performance against YSA population and damage

4.4.4 Discussion

Host plant resistance to insect pests is a major component of integrated pest management (IPM) in sugarcane (Reay-Jones *et al*. 2003, Posey *et al*. 2006). Because sugarcane is perennial and three to five crops are typically harvested from each planting, judicious cultivar selection can be crucial to long-term production (Posey *et al*. 2006). One of the major insect problem in

Tanzania sugarcane has been the sugarcane stalk borer, *Eldanasaccharina*, which has been the focus of varietal resistance efforts, but aphid outbreaks have recently become increasingly common (TARI Kibaha, 2018).

This study aimed at understanding the host plant resistance against *S. flava* for recently released sugarcane varieties and for lines which are on release pipeline. Parameters tested showed a relatively similar trend against tested varieties with variety R 85-1334 scoring the highest and TZ93-KA-122 scoring lowest.

4.4.5 Conclusion and Recommendation

This year's results have shown that the varieties R 85-1334, R 579 and TZ93-KA-120 are resistant to YSA infestation by recording reduced number of the pest infestation and damage. Therefore, when choice of variety to grow is governed by ability of the variety to resist YSA infestation, then these varieties can be considered.

However, these results are only preliminary, and this trial is repeated for second and third cycles and five top performers will be taken for field trials.

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5.0 PATHOLOGY AND NEMATODE

5.1 Assessment of smut disease on sugarcane fields in Tanzania

Project Number: CCP 2018/01/01
Principal Investigators: M. Masunga, B. Kashando, Y. Mbaga and R. Polini
Collaborators: Estate Agronomists and DAICO's (Missenyi, Manyara, Kilombero, TPC and Mvomero)
Reporting Period: 2019/2020
Remarks: On going

Project summary

Sugarcane smut is a fungal disease caused by *Sporisorium scitamineum*, is one of the most severe disease causing significant yield loss in sugarcane production. The objective of this work was to assess the incidence of smut disease on sugarcane varieties on estates and out growers' fields during dry and wet seasons. A total of 400 (222 out-growers & 178 estate) fields comprising 15 sugarcane varieties (CO 617, N25, N41, N47, R579, N19, R570, N12, N32, NCO376, R575, M2256/88, M700/86, N30, and R85/1334) from plant cane to 5th ratoon crop with age ranging one to five month were assessed for smut incidence during dry and wet season both on estate and out growers. For this season (2019/2020), 84% of fields from out-growers and 49% from fields from estates were found to have smut below the economic threshold level for smut disease. Also, there was a variation on the incidence of smut on sugarcane varieties across estates (KSC, KSL, MSE, TPC and Manyara Sugar). The higher smut incidence was observed on variety NCO 376, CO 617 & R575 and ratoon crop was mostly affected by smut as compared with plant cane. Similarly, during dry period the incidence of smut on sugarcane fields was higher and lower on wet season across sites. Therefore, strengthening disease management is recommended to reduce the spread of the disease both on estate and out grower's fields.

5.1.1 Introduction

Sugarcane smut is a systemic disease caused by a pathogen *Sporisorium scitamineum*, which is one of the most severe fungal diseases affecting sugarcane production worldwide (Su et al., 2016).The most recognizable diagnostic feature of sugarcane infected with smut is the emergence of a long and elongated whip. The whip morphology differs from short to long, twisted and multiple whips. Affected sugarcane plants may tiller profusely with spindly and more erect shoots with small narrow leaves (i.e., the cane appears ‘‘grass-like’’) with poor cane formation (Sundar et al., 2012). The main source of transmission is planting infested seedcane and wind (Nzioki et al., 2010) and in Tanzania, the disease is widespread in all sugarcane fields.

The disease is being controlled by use of resistant varieties and rouging of infested seedcane. However, routine monitoring of the disease is very important to control spread of the disease. Therefore, in 2019/2020 a survey was conducted to nearly all sugarcane growing areas both estates and out growers to check the prevalence of smut disease on sugarcane fields and recommend on appropriate measure for the control.

Objective

Monitoring spread of smut disease on sugarcane fields to contribute to increased sugarcane productivity

Specific

1. To assess the incidence of smut disease on sugarcane varieties on estates and out growers' fields during dry and wet seasons.

Outputs

1. 15 sugarcane varieties assessed for incidence of smut disease on estates and out growers.
2. 400 (178 estates and 222 out growers) sugarcane fields assessed for smut incidence.
3. 5 Crop cycles (Plant cane (PC), R1, R2, R3 and R4) assessed for smut incidence for out growers.
4. 2 seasons evaluated for prevalence of smut for dry and wet season.

5.1.2 Materials and Methods

To assess the incidence of smut disease on sugarcane varieties on estates and out growers' fields during dry and wet seasons.

A Survey was conducted from August, 2019 to March, 2020 to five (5) sugarcane estates (Kilombero Sugar Company (KSC), Mtibwa Sugar Estate (MSE), Kagera Sugar Limited (KSL), Tanganyika Plantation Limited (TPC) and Manyara Sugar (MS) and out-growers' fields at Kagera, Mtibwa, Kilombero and Manyara.

A total of fifteen (15) sugarcane varieties; CO 617, N25, N41, N47, R579, N19, R570, N12, N32, NCO376, R575, M2256/88, M700/86, N30, and R85/1334 from 1 -5 months and plant cane to 5th ratoon was selected.

The assessment was done by dividing the field area by two to obtain the number of sampling points and each point had ten rows of 50 meters. The sampling points depended on the size (ha) of the field and each sugarcane stool was inspected carefully in every row for the presence of smut and recorded on data sheet.

$$\text{Percentage smut incidence} = \frac{\text{Total number of smutted stools in a field}}{\text{Total number of stools per field}} \times 100$$

On commercial fields smut infestation level greater than 4% meaning the disease is above economic threshold and uprooting and replanting is the only management option. Below 4 % roughing is recommended.

Also data on weather parameters (Rainfall, Temperature and Relative Humidity) were obtained from meteorological stations at Kilombero, Mtibwa, Kagera, and TPC estates respectively during the surveyed months. The dry period (August-October, 2019) and wet period (January to March, 2020)

Data collected

- ❖ Data on smut incidence on sugarcane varieties across sites

- Data on smut incidence on sugarcane crop cycles on different varieties
- Weather data for dry and wet season.

5.1.3 Results

Smut incidence on sugarcane estates

Incidence smut on sugarcane varieties across estates: Kagera Sugar Limited (KSL) - The smut incidence on both seasons (dry and wet) was generally low for all varieties assessed (figure 5.1&5.2). During wet season, the fields planted varieties N25 and N47 had no smut infestation while variety Co 617 had smut incidence 0.32% followed by variety N41 with 0.07%, the lowest smut incidence was 0.02% recorded in variety R579 (figure 5.1). Similar trend was also observed during dry period whereby, varieties N41 and N25 had no smut infestation while variety Co 617 had smut incidence of 1.05% (Figure 5.2). The low smut incidence observed at KSL could be due strengthened smut management strategies including early rouging of smut and use of resistant varieties such as N47.

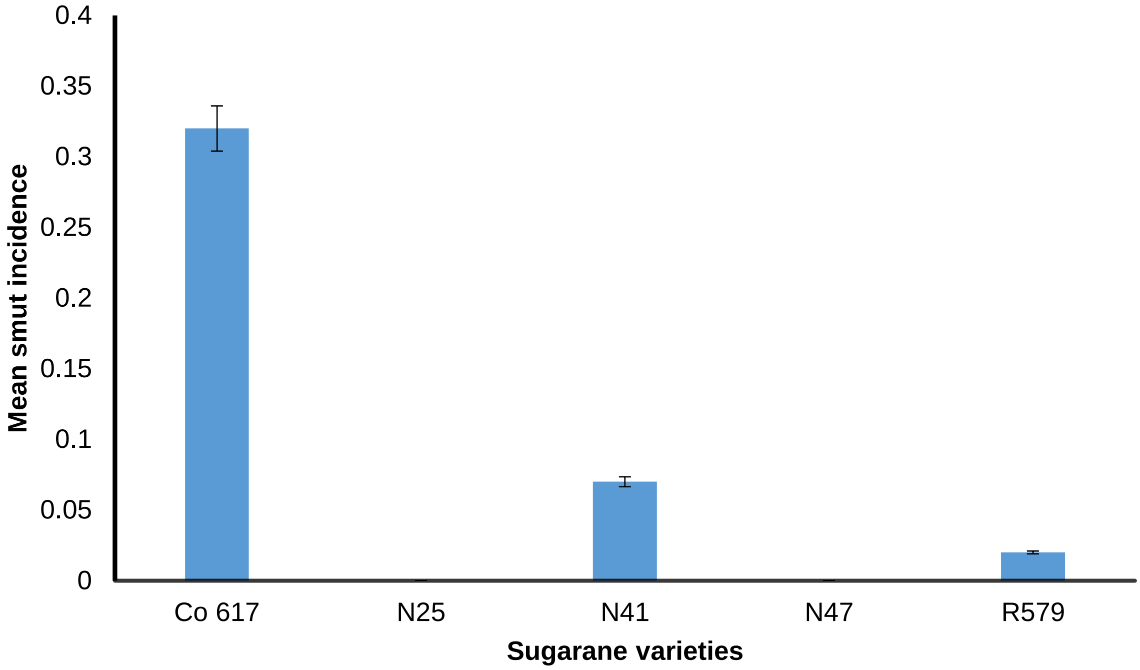

Figure 5.1: Smut incidence on sugarcane varieties during wet season at KSL

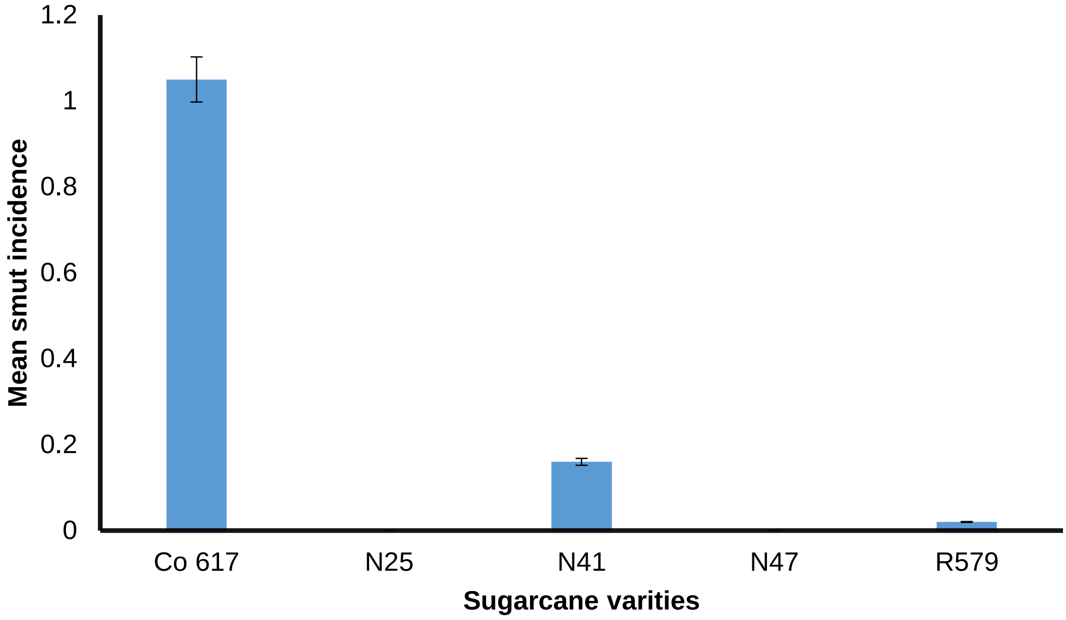

Figure 5.2: Smut incidence on sugarcane varieties during dry season at Kagera

Mtibwa-Seven sugarcane varieties were assessed, higher smut incidence percent was on NCO 376 (3.2%) and R579 had the lowest percent of smut incidence (0.07) figure 5.3. Generally, the incidence of smut was low because most of the surveyed fields had low incidence of smut < 2%. This indicated that the estate strengthened the smut management and increased fields with resistant varieties.

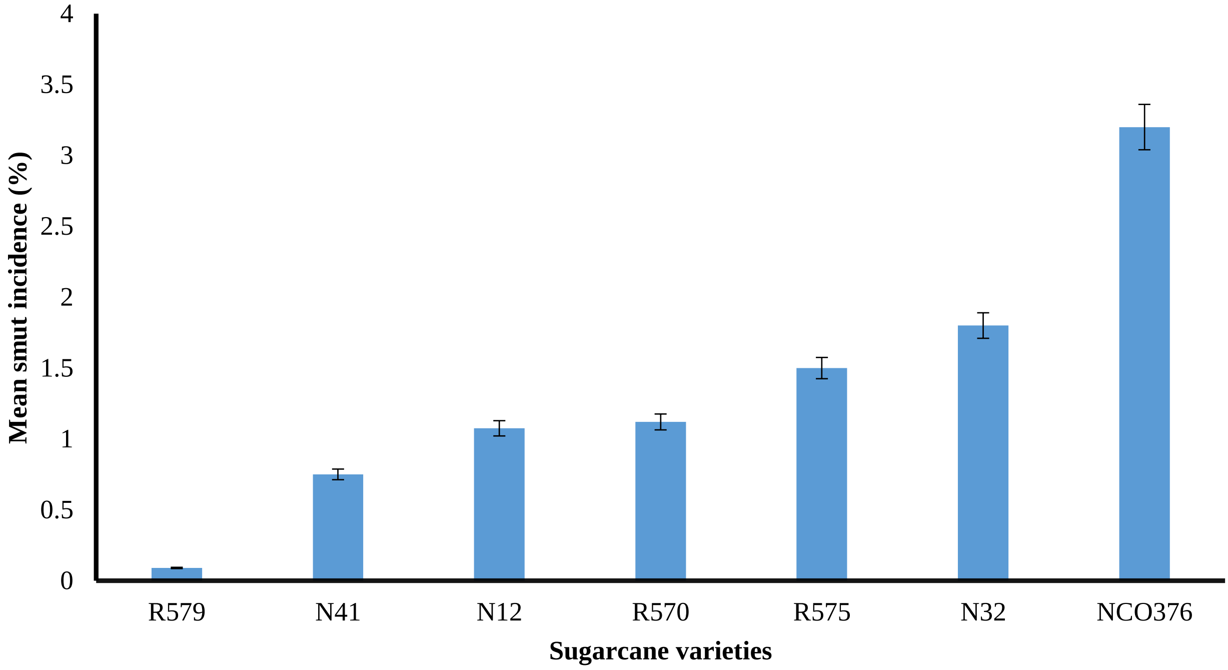

Figure 5.3: Incidence of smut on sugarcane varieties at MSE

TPC- A total of eight sugarcane varieties were assessed for smut infestation, four varieties M700/86, N19, R579 and R85/1334 had no smut infestation (figure 5.4). The highest percentage of smut incidence was observed on R575 (2.9%) followed by N30 (1.75%). This result implies that smut disease is well managed at the estate but also increased fields with resistant varieties.

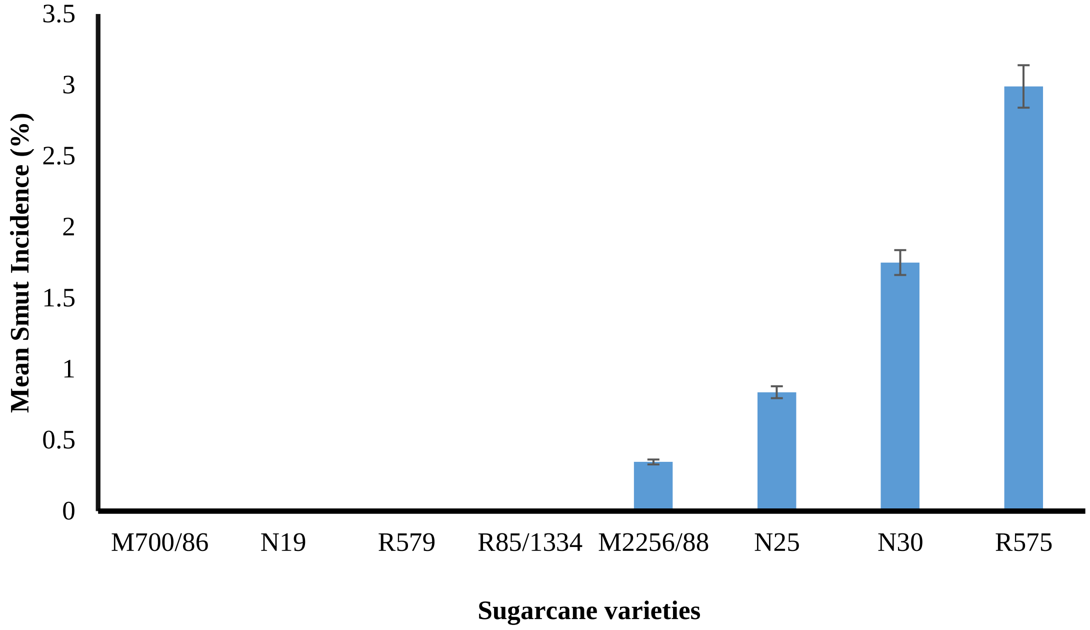

Figure 5.4: Smut incidence at TPC on sugarcane varieties

KSC- N25 had higher smut incidence of 3.2% followed by N41 (1.94%) while other varieties N19, R570, R579 had smut incidence of 0.6%, 0.2% and 0.1 % respectively (figure 5.5). Generally, the incidence of smut at estate was low due to proper management of smut such as early rouging of infected smut stools, use of clean seedcane as well as use of resistant varieties.

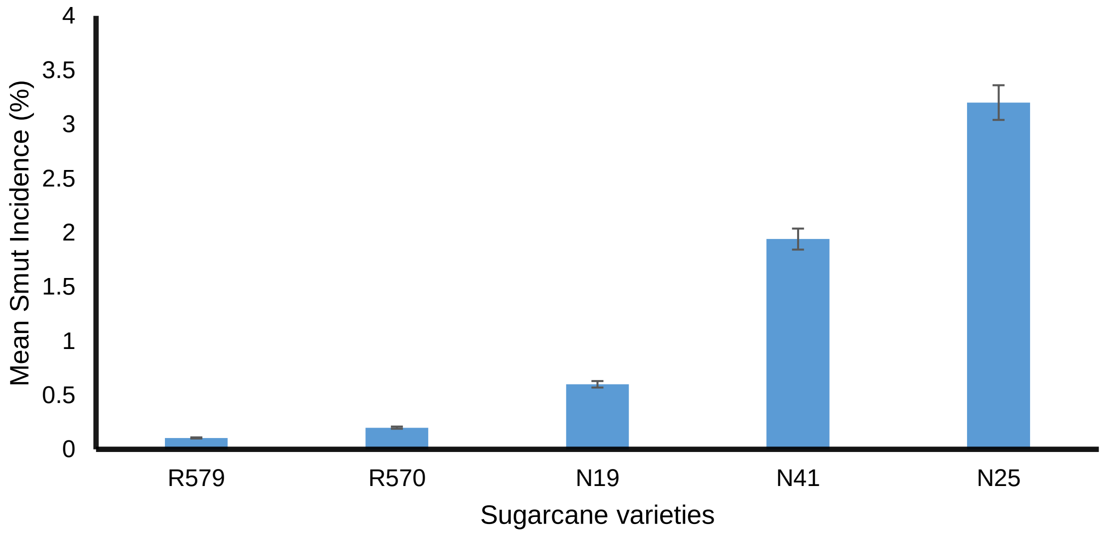

Figure 5.5: Smut incidence at KSC on sugarcane varieties

Manyara sugar- three cultivars Kisumu, TPC nyeupe and Karangai had smut incidence of 2.8%, 1.8% and 0.36% respectively. Karangai implies to be resistant to sugarcane smut which suggests being potential for breeding of resistance varieties against smut disease (figure 5.6)

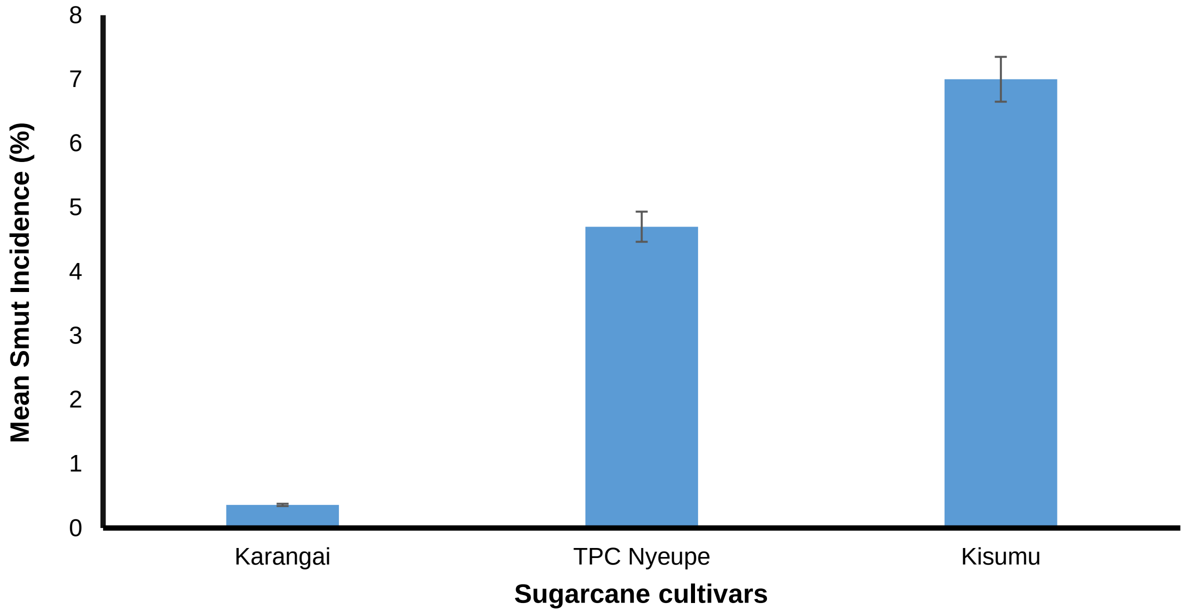

Figure 5.6: Smut incidence on sugarcane cultivars at Manyara Sugar

B) Smut incidence on out growers' fields

Sugarcane Smut Incidence over Crop Types on different locations: The survey data on smut incidence over the sugarcane crop types (plant cane, first, second, third and fourth ratoons) indicated that as the ratoon increases the smut incidence also increases. At Kagera, there was significant different on smut incidence on plant cane and on third to fourth ratoon on variety CO 617 (figure5.7). Similarly, for Mtibwa and Kilombero the incidence of smut was increasing as ratoon was increasing on Variety NCO 376 (figure 5.8). The same trend was also observed at Manyara on Karangai cultivar the highest smut incidence was on fourth ratoon crop (figure 5.9)

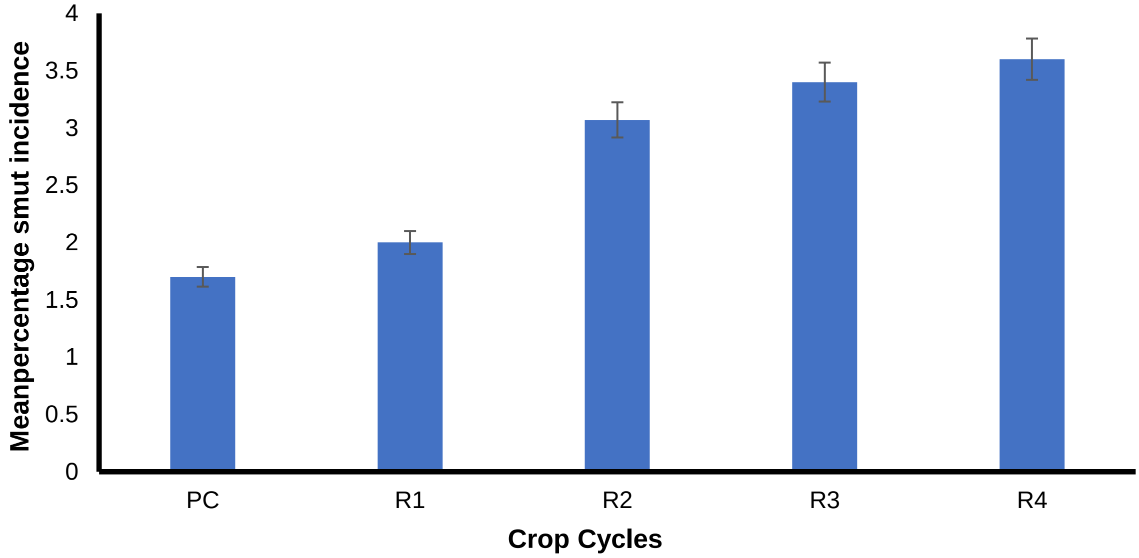

Figure 5.7: Smut incidence over crop cycles in CO 617 Kagera out growers fields

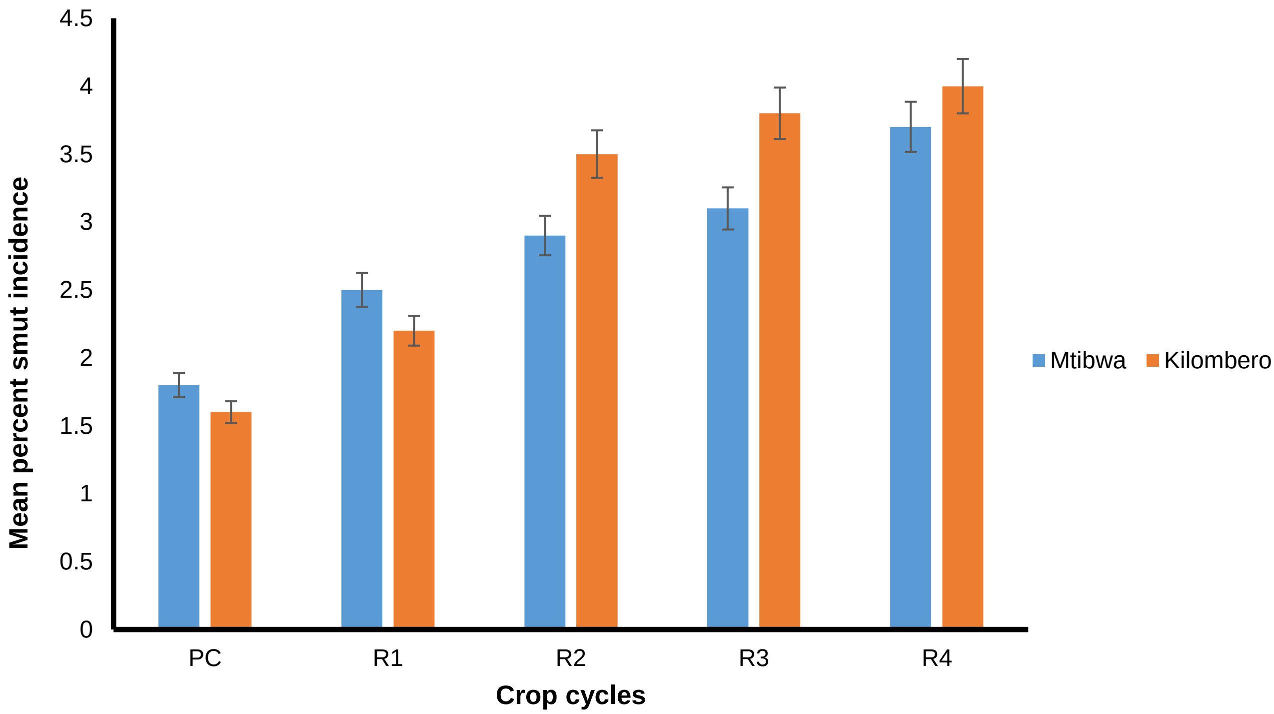

Figure 5.8: Smut incidence over crop cycles on NCO376 variety at Mtibwa and Kilombero out-growers fields

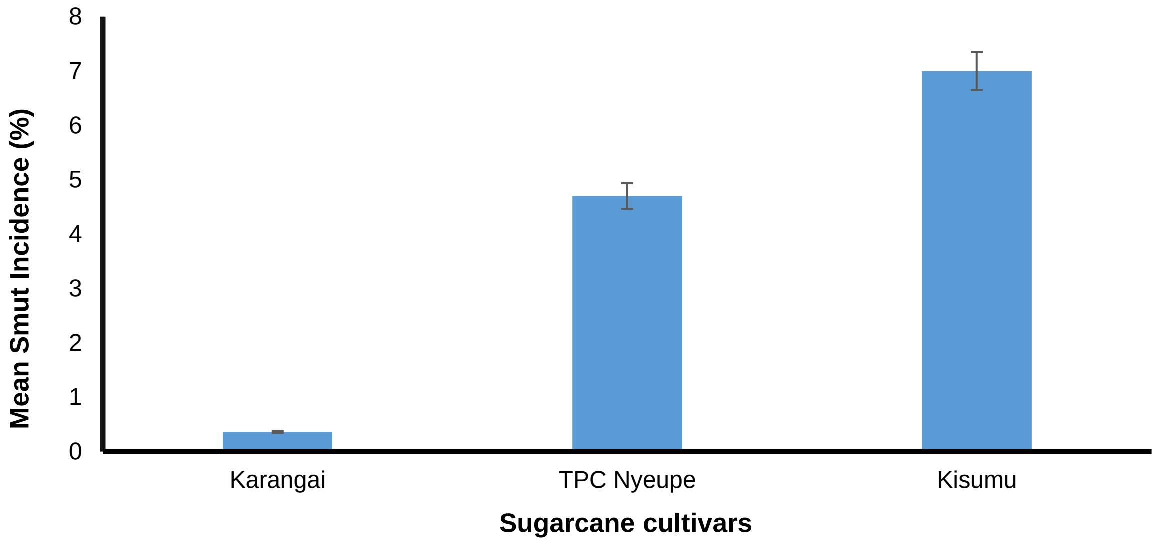

Figure 5.9: Smut incidence over crop cycles in Karangai cultivar in Manyara out-growers fields

Incidence of smut on sugarcane out-grower's fields during dry and wet season: During dry period a high incidence of smut was observed on outgrowers fields for all locations on both varieties NCO 376 and Co 617. At Kagera incidence of 3.8% and low incidence during wet season 1.1% on variety CO 617 (Figure 5.10). At Mtibwa and Kilombero outgrowers fields, Variety NCo376 had the smut incidence of of 3.8% and 3.3% respectively during dry season and 1.1% (Kilombero) and 2.1% (Mtibwa) during wet season (figure 5.11). Similarly, for Manyara smut incidence 2% and 0.7% were observed on cultivar Karangai during dry and wet season respectively (figure 5.12).

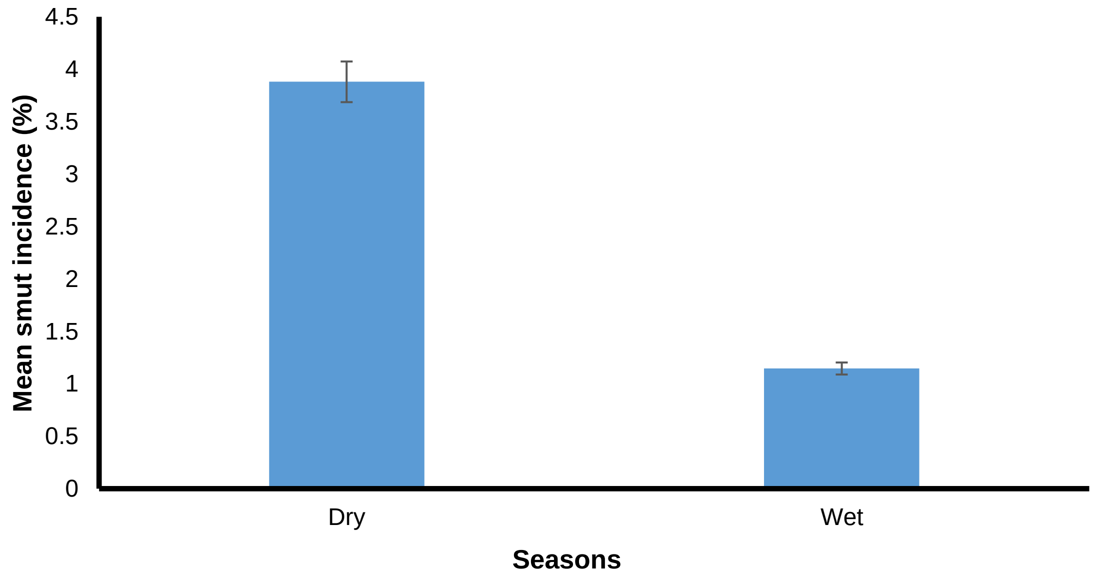

Figure 5.10: Percentage incidence of smut on sugarcane variety Co 617 on two different seasons

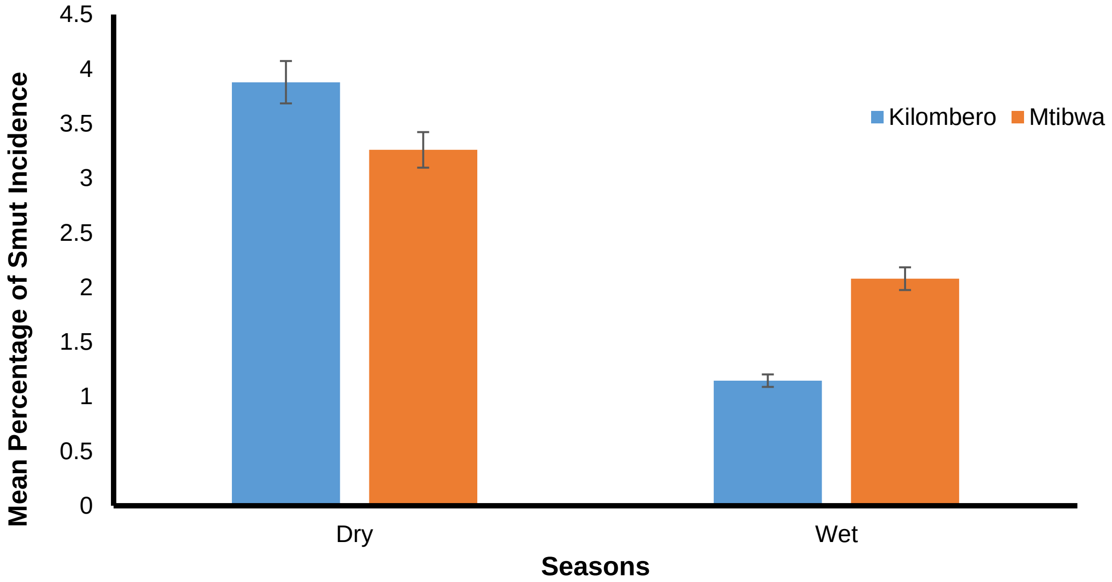

Figure 5.11: Smut incidence on NCO 376 sugarcane variety on out growers field at Kilombero and Mtibwa

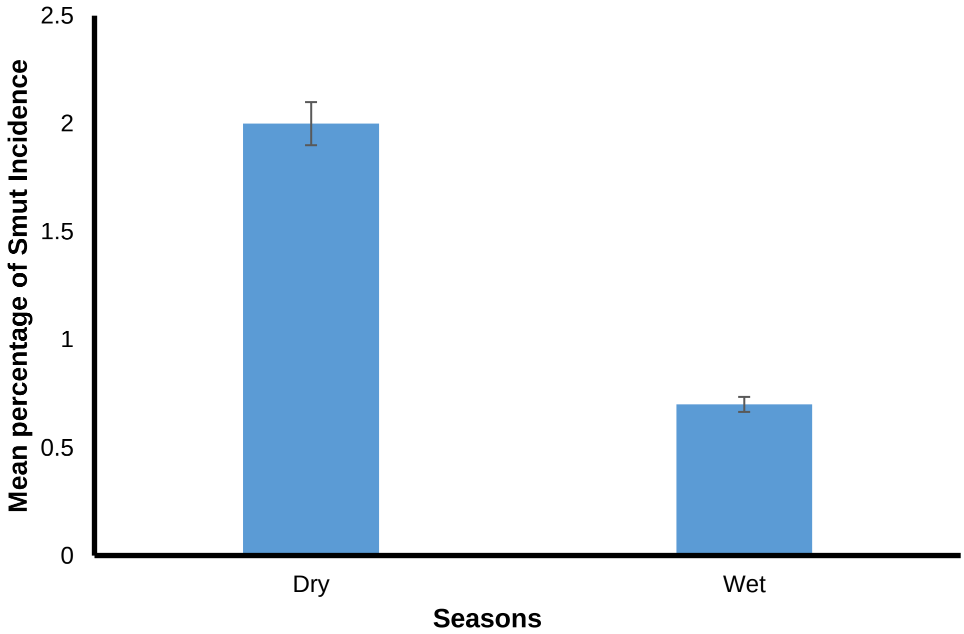

Figure 5.12: Smut incidence on Out-growers fields on Karangai cultivar at Manyara

5.1.4 Discussion

Generally, the incidence of smut disease on sugarcane varieties varied among five estates that were surveyed in 2019/2020. Out of 15 sugarcane varieties, 3 (NCO 376, CO617 & R575) were mostly infested with smut as compared with other varieties across estates. Similarly, studies conducted in other countries indicated that NCO 376 and CO 617 are susceptible to smut disease (Zekarias et al .,2011). Also, smut incidence on variety R575 at TPC was higher (2.9%) as compared to MSE 1.5 % which could be due to difference in ecological conditions between two estates. According to Sundar et al. (2012) the difference in smut incidence among the varieties across the estates could be attributed to the differential reaction of the varieties to the disease and environmental factors.

The incidence of smut disease over crop type showed there was an increase of smut infestation as ratoon was increasing. The survey from out grower's field on variety NCO 376 and Co 617, showed that low smut incidence was on plant cane and first ratoon; but the incidence increased in fourth ratoon at Kagera, Mtibwa, Kilombero and Manyara. Similarly, studies conducted in different countries confirmed that ratoons are the most susceptible crop types to sugarcane smut than plant cane as sugarcane smut is a systemic disease, and thus its incidence might get increased in successive ratoons because of the increase in amount of inoculum (McFarlane et al., 2007). In addition, Akalach and Touil (1996) reported that percentage of affected stools increased from 23% in the plant cane crop to 85 and 98% in the first and second ratoon crops, respectively.

Also, weather parameters observed to have directly related to the incidence of smut in sugarcane fields at Kagera, Kilombero and Manyara. The results from out grower's field indicated that there were higher incidences of smut during dry season as compared to wet period. A study by Mehra and Sahu (2015) reported that on dry season smut dispersal is very high as compared to wet period as there is low spore dispersal due slow shedding of spores resulting into low smut incidence. Therefore, weather parameter (dry) plus susceptibility of the variety favours the development of the disease.

The higher incidence of smut on outgrowers fields is contributed by different factors such as variety (NCO 376 & Co 617) which have high yield but very susceptible to smut but also poor management of the disease. During the survey it was observed that smutted stool was not properly rogued. Studies indicated that smut can be contained in some susceptible varities by the intensive application of field control measures including regular field monitoring and roguing of smutted stools, elimination of volunteers before replanting Nzioki *et al*.,(2010) .

Poor availability of clean planting materials to outgrowers also accelerated the incidence of smut on outgrowers as compared to estates. Since smut is a systemic disease and its control is through the use of resistant varieties and hot-water treatment of seedcane at 50°C for 2 hours to eliminate the pathogen. Estates have the capacity to perform this procedure so farmers rely on estate for getting clean planting materials. Nevertheless, transportation costs from estate to their viccinity hinders outgrowers to use clean planting materials instead majority source planting materials from neighours and own fields of which are of poor quality. Additionally, farmers are not aware on the quantitative effect of smut in yield and economic loss of which contributed to not properly manage their fields.

5.1.5 Conclusion and recommendations

Smut disease is still prevalent on both estates and out grower's fields with varying incidences across locations hence strengthening disease management is recommended to reduce the spread of the disease. Also, increasing accessibility of clean planting materials to out growers by establishment of seed cane nearby farmers will encourage the use of clean planting materials by farmers. Beside, a study on yield loss due to smut is suggested so as to provide farmers with the information on the quantitative effect of smut on sugarcane yield (tones per hectare) and economic loss which will help farmers understand the losses caused by the smut disease later will adhere to management practices.

5.2 Distribution and identification of plant parasitic nematodes in sugarcane growing areas in Tanzania.

Principal Investigators: B. Kashando, M. Masunga, Y. Mbaga R. Polini and N. Luambano.
Collaborators: Estate Agronomists and DAICO's (Missenyi, Kilombero, and Mvomero)
Reporting Period: 2019/2020
Remarks: Ended

Project summary

The specific objectives of this study were (1) to identify population dynamics of plant parasitic nematodes in sugarcane growing areas in the roots and soil. (2) To understand variation of common plant parasitic nematodes of sugarcane as influenced by rainfall. A survey for assessment and sampling for plant parasitic nematodes associated with sugarcane in soil and root samples were accomplished at Kagera Sugar Limited, Mtibwa Sugar Estate, Tanganyika Planting Company (TPC) and Kilombero Sugar Company. Similar assessments and sampling were conducted in the out grower fields except for TPC**.** GPS coordinates per sampling fields were taken and subjected to QGIS to obtain the distribution map per agro-ecological area. Nematodes extraction, identification and counting were done at TARI Kibaha nematology laboratory.

Thirteen genera of plant parasitic nematodes were found in association with the roots and soil of sugarcane, these were; *Pratylenchus, Meloidogyne, Rotylenchulus, Tylenchus, Tylenchorhynchus, Longidorus***,** *Helicotylenchus, Criconema, Trichodorus, Xiphinema, Scutellonema, Paralongidorus, and Aphilenchoides*. The most dominant was *Pratylenchus* followed by *Meloidogyne*. *Pratylenchus* population in samples varied from one place to another and from roots to soil due to the migratory mode of feeding of this genus. The highest numbers of *Pratylenchus* at Kagera sugar estate were 486/100 ml and 1222/5 grams in soil and root samples respectively while in out growers' fields, the highest numbers were 396/100 ml for soil and 350/5 grams for roots. At Mtibwa Sugar Estate soil samples, the highest numbers of *Pratylenchus* were 520/100 ml and 873/5 grams for soil and roots respectively, but in out growers' fields, the highest numbers of *Pratylenchus* were 500/100 ml and 27/5 grams for soil and root respectively. For TPC, the highest numbers of *Pratylenchus* were 162/100 ml and roots 330/5 grams respectively. For Kilombero Sugar Company, the highest *Pratylenchus* numbers were 442/100 ml and 1550/5 gram for soil and root samples respectively. For out growers' fields around Kilombero, the highest numbers of *Pratylenchus* were 374/100 ml and 230/5 grams in soil and roots samples respectively. Nematodes were isolated from 100 ml and from 5 grams of soil and root sub samples respectively.

The population of *Pratylenchus* in the roots increased with increasing rainfall and vice versa. In the soil, population of nematodes decreased when there was high rainfall. This is because heavy rainfall cause flooding in the fields and washed away the nematodes from the soil or it can kill them in case of inundation.

5.2.1 Introduction

Sugarcane production favour growth of abundant genera of plant parasitic nematodes as reported by Bond *et al*., (2000). The pathogenic nematodes to sugarcane depend on the mode of feeding either sedentary endoparasite, (*Meloidogyne*), migratory endoparasite (*Pratylechus*) or semi endoparasites (*Rotylenchulus*) (Bond *et al.*, 2000). Also majority of ectoparasites feeds on roots of sugarcane including *Tylenchorhynchus*, *Xiphinema, Longidorus, Paralongidorus, Scutellonema Hemicycliophora*, *Trichodorus,* and *Helicotylenchus* (Cadet *et al*., 2002). The population dynamics in the fields varies from one point to another but in sugarcane the mono culturing system of cropping and increase of number of crop cycle of cane stalks increase population and diversity of plant parasitic nematodes (Bond *et al*., 2000).
The presence of nematodes in the sugarcane fields has been reported to cause losses of about 20-30% as described by Cadet *et al* (2003). Monitoring and identification of plant parasitic nematodes in sugarcane is important in understanding their distribution patterns. The obtained information is appropriate for designing suitable management strategies to increase yields and avoids losses associated with nematodes.
However the minimum population of plant feeding nematodes have little damaging effect on plant growth (Spaull & Cadet, 2003). Previous survey indicated the presence of plant parasitic nematodes in sugarcane growing areas of Tanzania and *Pratylenchus* was found to dominate other genera of nematodes which are pathogenic to sugarcane crop. Therefore, this study was undertaken to estimate and identify population dynamics of plant parasitic nematodes in various conditions such as the cropping season, crop cycles and varieties susceptibility to nematodes in relation to age of sugarcane crop.

Objectives
Determination of abundance and distribution of plant parasitic nematodes in the sugarcane growing areas
Specific objectives

1. To assess the population dynamics of plant parasitic nematodes in sugarcane growing areas in the soil and roots.
2. To determine the variation of common plant parasitic nematodes as influenced by mean rainfall and temperature

Outputs

1. A single map on distribution pattern of plant parasitic nematodes per estate for the year 2019/20 established.
2. Key plant parasitic nematodes determined for future management strategies.
3. The influence of *Pratylenchus* nematodes in relation to mean rainfall and mean temperature at Mtibwa, Kilombero and TPC determined.

5.2.2 Materials and Methods

Sampling: Soil and root samples were collected at Kagera Sugar Limited, Mtibwa Sugar Estate, Tanganyika Planting Company (TPC) and Kilombero Sugar Company plantations. Similar assessments and sampling were conducted in the out growers fields except for TPC Figure 5:13. However, sampling was done two times at Mtibwa, Kilombero and TPC during dry season and wet seasons to study the effect of nematodes distribution caused by changing in rainfall and temperature. The sampling was repeated in the same fields to assess the variation of nematodes in the same crop cycle.

GPS coordinates for each sampling field were taken and subjected to QGIS to obtain the distribution map per agro-ecological area. The collected samples were from different varieties with various crop cycles and age. Information of each field was recorded per sample for further analysis and documentations in the nematology laboratory at TARI Kibaha.

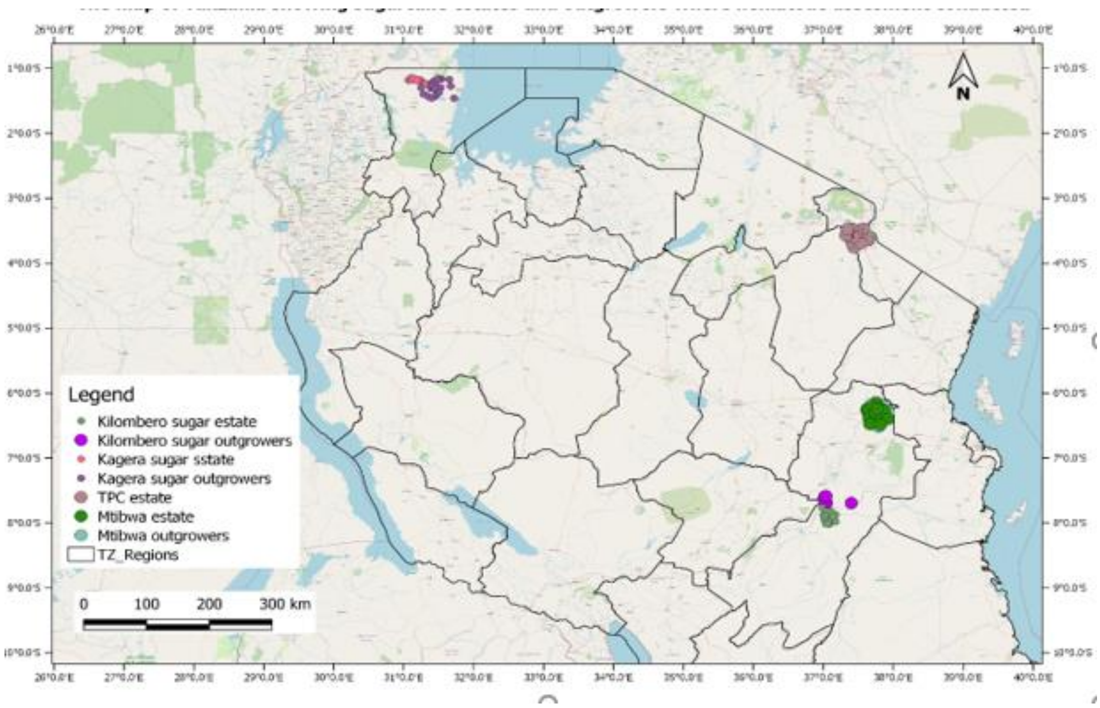

Figure 5:13; Map of Tanzania indicating area were sampling for nematodes assessment was done.

Nematodes extraction: Nematodes were extracted from 100 ml and 5 grams of each soil and root sub samples respectively. The extraction of nematodes was done by using modified Baermann technique as described by Coyne *et al*. (2007). The identification and enumeration of nematodes genera were done by using compound microscope (Leica DM 2500, Leica Microsystems, US) connected to a camera (GX CAM High Chrome – S, Version 8.5, GT Vision Ltd, UK) for images capturing.

Data collection and analysis: Number of each genus of plant parasitic nematode was recorded and the mean number per volume of water was calculated using MS Excel (2016).

5.2.3 Results

To assess population dynamics of soil and roots parasitic nematodes in sugarcane growing areas in the year 2019/2020

KSL and OG fields: The areas which were sampled for nematodes assessment are indicated in the map (Figure 5:14) for Kagera sugar estate and out- grower fields.

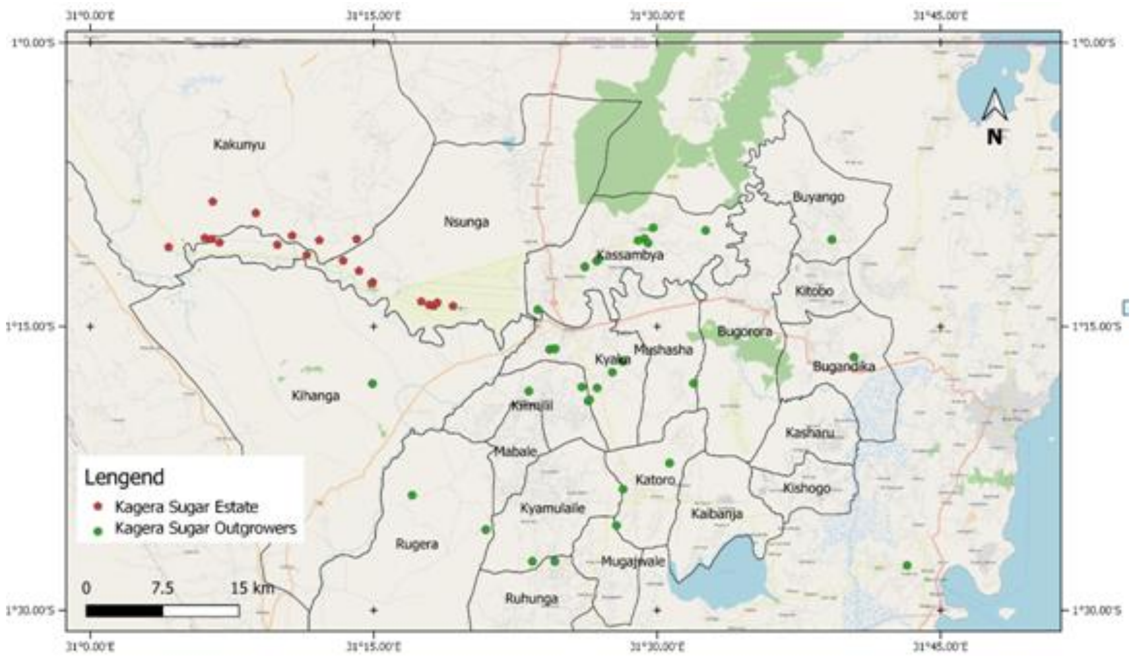

Figure 5:14: Sampling points for nematodes assessment at Kagera Sugar and out-grower fields.

Soil samples: Population dynamics were observed to fluctuate in the soil from one sampled point to another in the sugarcane fields in the estates. *Pratylenchu*s, *Meloidogyne*, *Tylenchus*, *Criconema* and *Helicotylenchus*, were present in the soil samples (Figure 5:15).

However, the key pests found were *Pratylenchu*s followed by *Meloidogyne* in most sampled fields, example fields IR13C with first ratoon had the highest number of *Pratylenchus* followed by H15B.

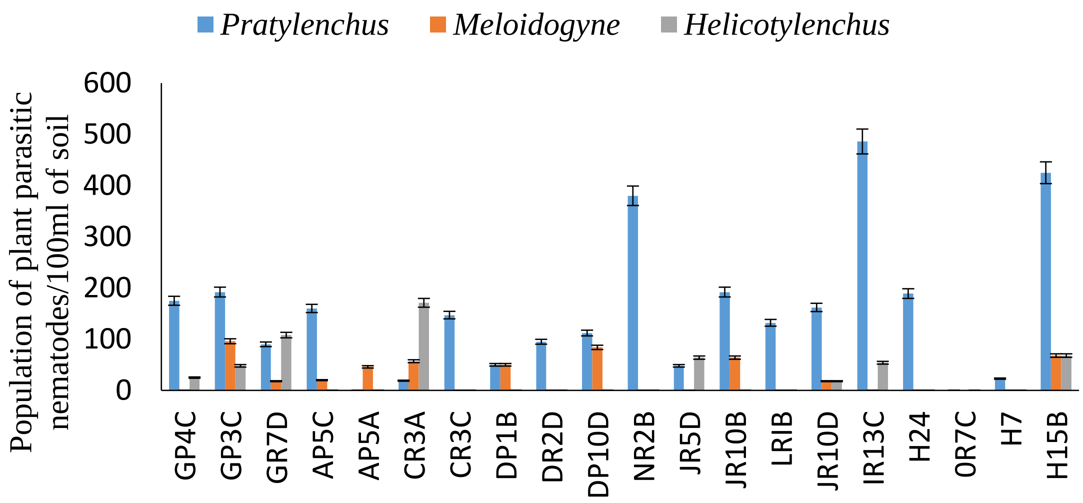

Figure 5:15: Key plant parasitic nematodes isolated from sugarcane fields at Kagera sugar/100ml of soil

Roots samples: The *Pratylenchus* and *Meloidogyne* were present but the most dominant genus was *Pratylenchus* in the field IR13C with first ratoon. Despite the fluctuation in their number, none of the samples was plant parasitic nematodes free (Figure 5:16).

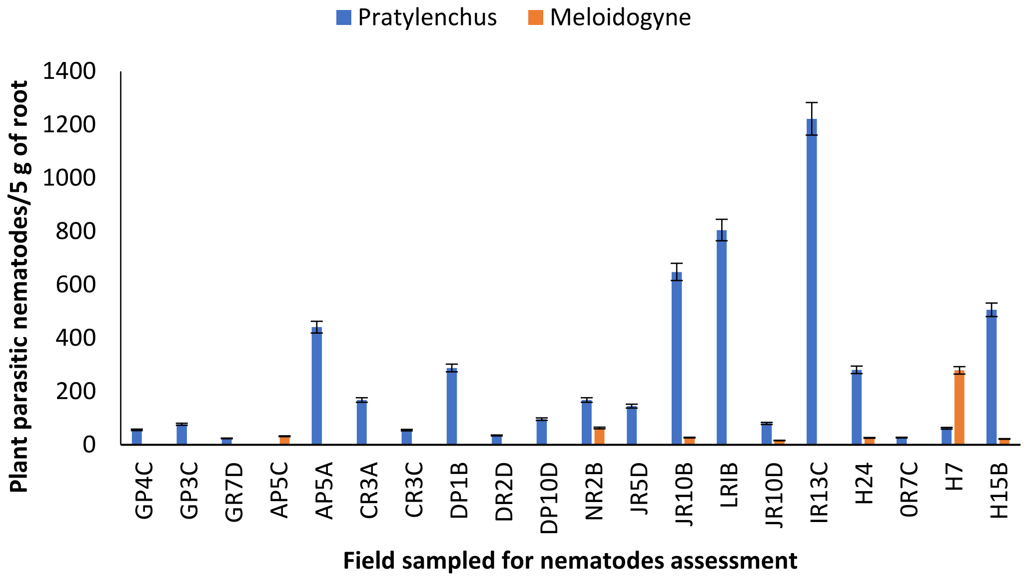

Figure 5:16: Key plant parasitic nematodes extracted from sugarcane root/5 grams sampled at Kagera sugar

Out-growers' fields at Kagera

Soil samples: Ten plant parasitic nematodes found; *Pratylenchus*, *Meloidogyne*, *Helicotylenchus*, *Tylenchus*, *Criconema*, *Aphilenchoides*, Trichodorus, *Scutellonema*, *Hemicycliophora* and *Xiphinema*. The most abundant nematode was *Pratylenchus* followed by *Meloidogyne* in the field (Figure 5:17).

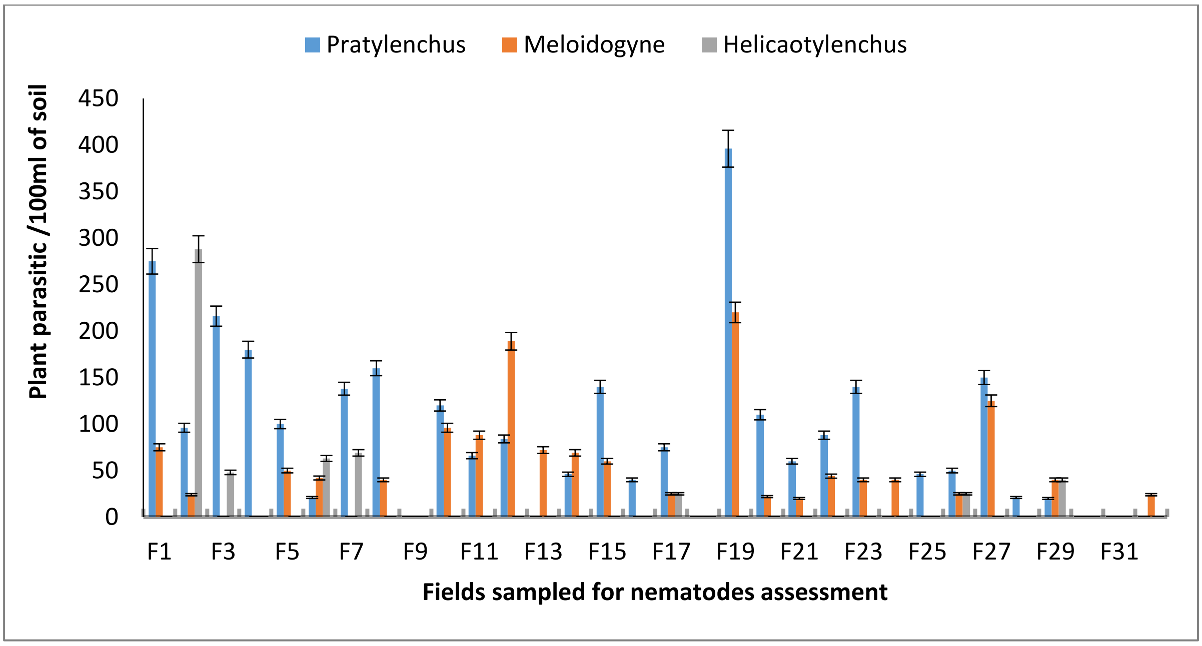

Figure 5:17 Nematodes distribution in the soil at Kagera in the out-grower fields

The roots samples: Majority of fields had *Pratylenchus* and *Meloidogyne* although in low levels seen not to cause significant damage except one field that had 350 *Pratylenchus* (Figure 5:18).

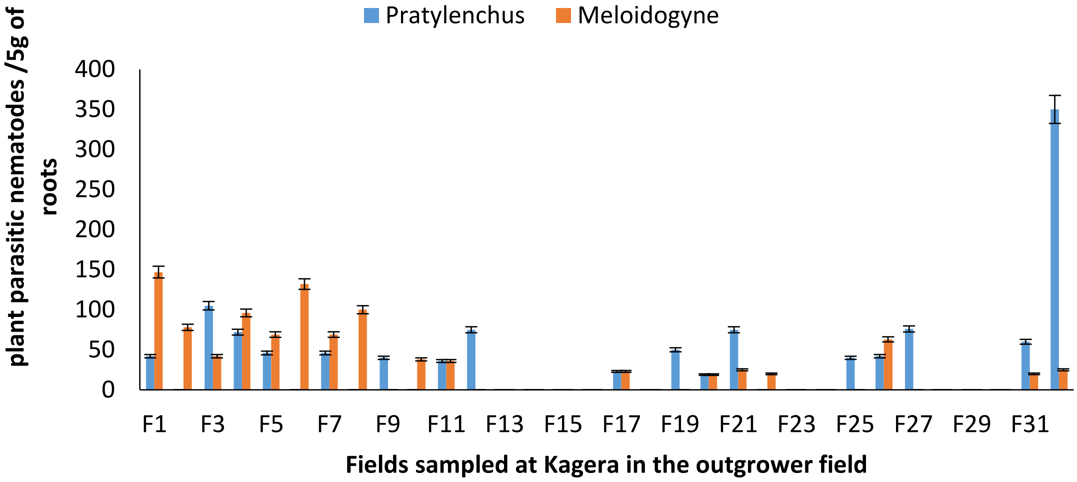

Figure 5:18 Nematodes distribution in the roots per sampled field at Kagera in the outgrowers fields

Mtibwa Sugar Estate and Out-grower: The areas which were sampled for nematodes assessment are shown in the map (Figure 5:19) for Mtibwa sugar estate and out-growers fields.

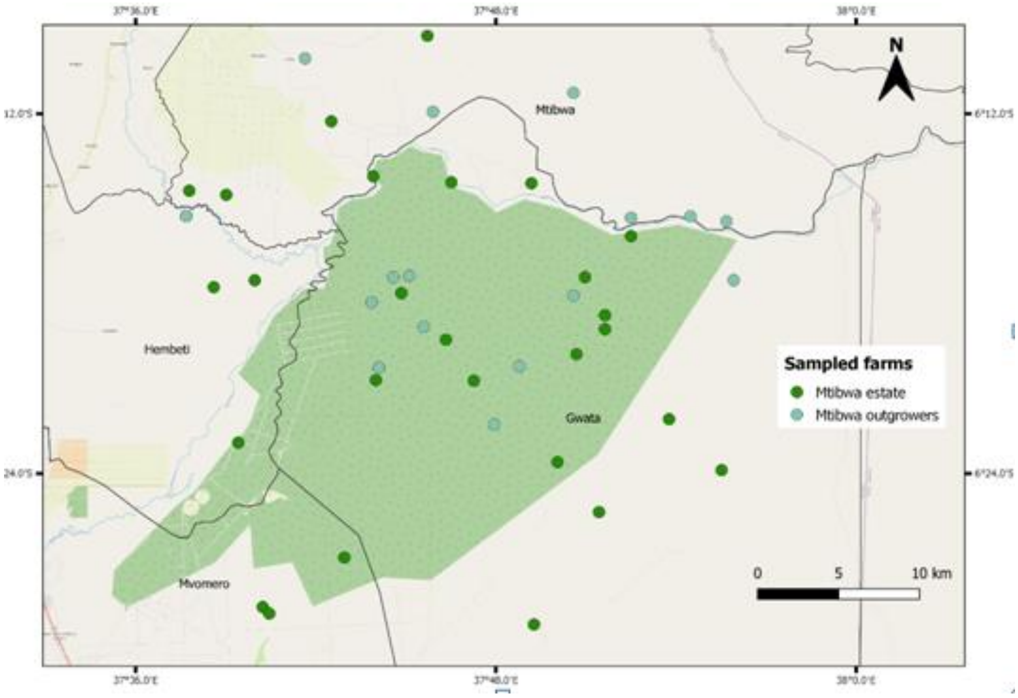

Figure 5:19 sampling point for nematodes assessment at Mtibwa Sugar Estate and out-growers fields

Soil samples: Nine genera of plant parasitic nematodes namely *Pratylenchus*, *Meloidogyne*s, *Xiphinema*, *Scutellonema*, *Trichodorus*, *Tylenchorhynchus*, *Paralongidorus*, *Helicotylenchus* and *Aphilenchoides*, were isolated from soil samples. However only five (5) were important to sugarcane (figure 5:20) and the most dominant genus was *Pratylenchus* in field 2Aa.

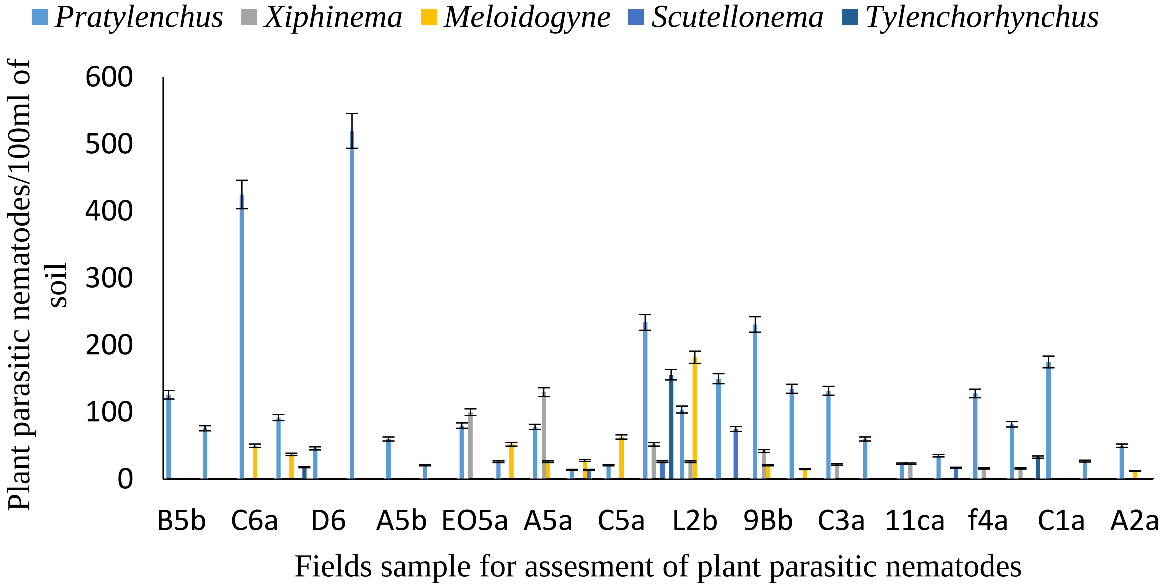

Figure 5:20: Nematodes distribution in the soil per sugarcane field at Mtibwa Sugar Estate

Roots samples: Field C1a with plant cane had (873) *Pratylenchus*, this was the field with the highest population compared to other sampled areas. Additional plant parasitic isolated include *Meloidogyne*, *Trichodorus*, and *Aphilenchoides*, but the most dominant were *Pratylenchus* and *Meloidogyne* (figure 5:21).

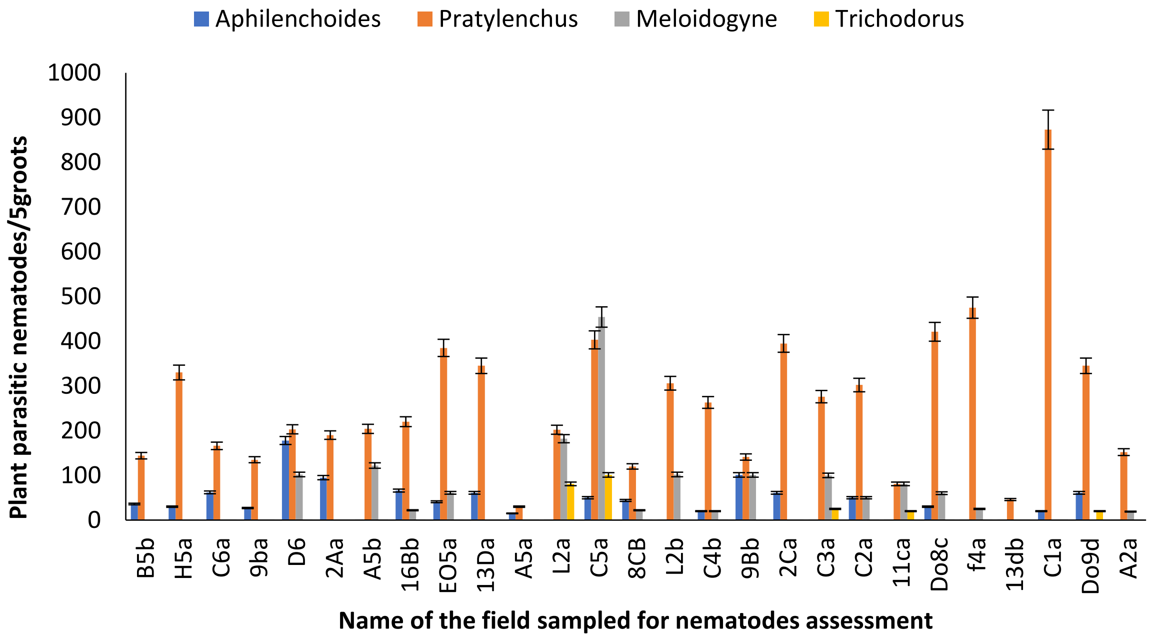

Figure 5:21: Nematodes distribution in the roots per sugarcane field at Mtibwa Sugar Estate

The outgrower at Mtibwa Sugar

Soil samples: The five nematodes genera found in the soil were *Meloidogyne*, *Pratylenchus*, *Criconema*, *Helicotylenchus* and *Tylenchus*. The most dominant was *Pratylenchus* in most fields especially five fields with population ranged between 200 and 500 *Pratylenchus* (Figure 5:22).

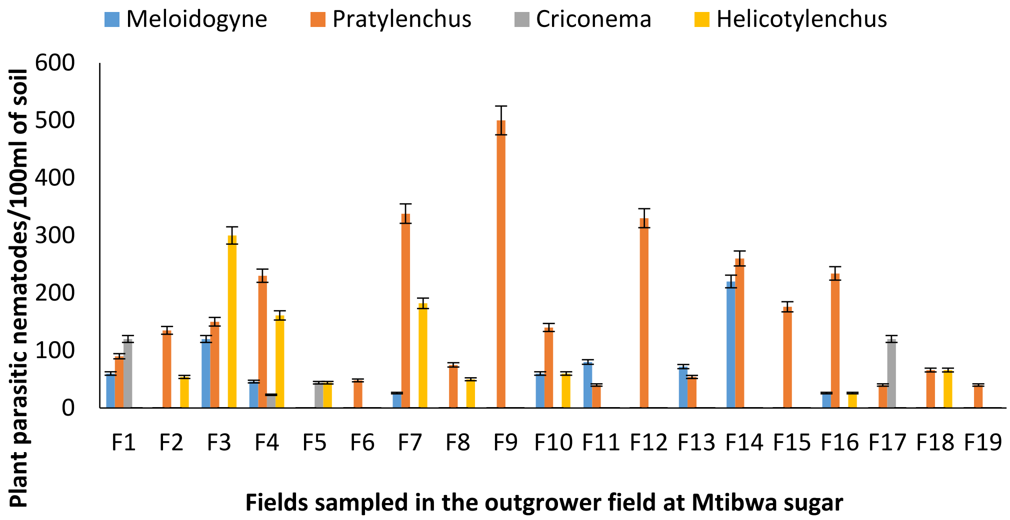

Figure 5:22: Nematodes distribution in the soil at Mtibwa in the out-grower fields

Roots samples: The *Meloidogyne*, *Pratylenchus* and *Helicotylenchus* genera were present but only four fields were found to have *Pratylenchus* between 200-300 population/5g of roots (Figure 5:23).

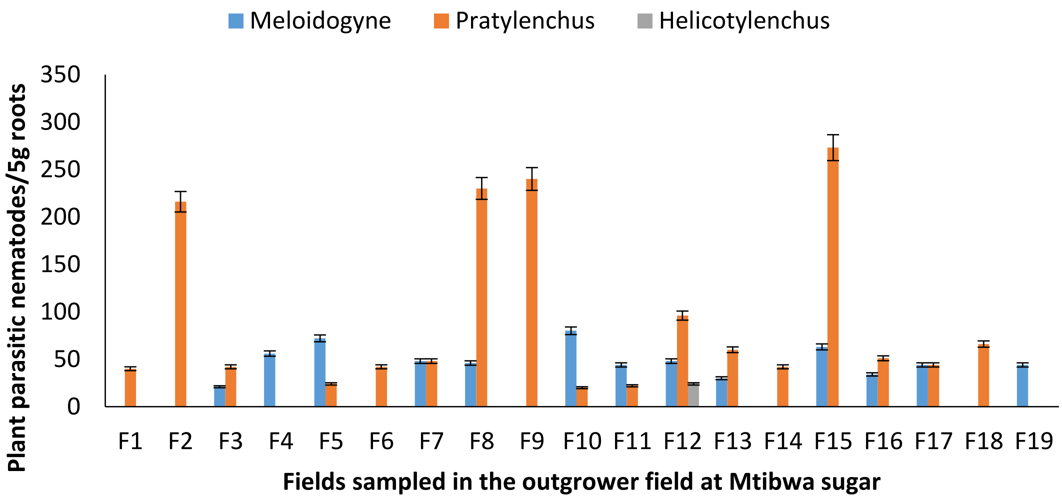

Figure 5:23: Nematodes distribution in the roots at Mtibwa in the out-grower fields

Tanganyika Planting Company (TPC) Limited: The areas which were sampled for nematodes assessment were indicated in the map (Figure 5:24) for TPC.

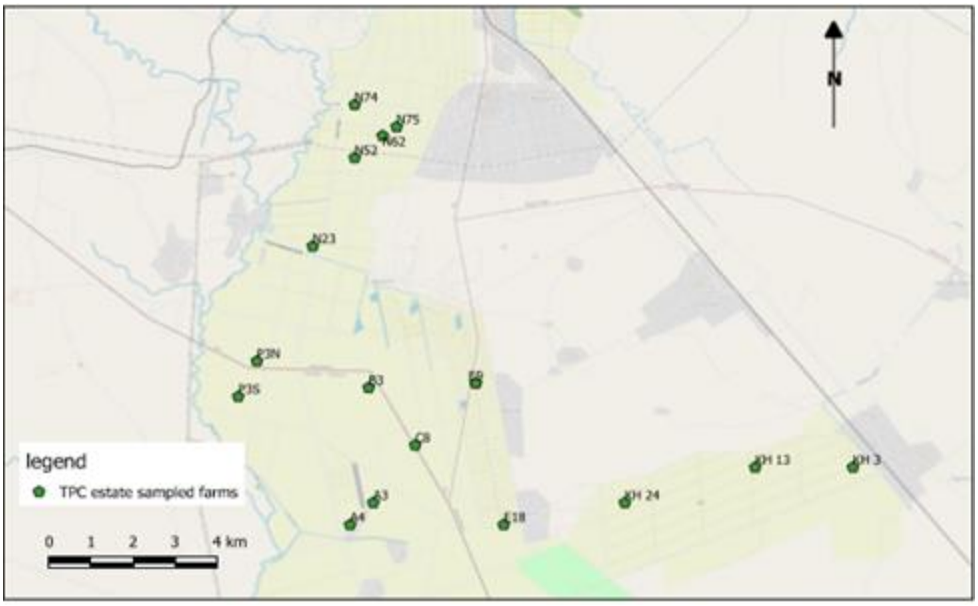

Figure 5:24 sampling point for nematodes assessment at TPC Limited.

Soil samples at TPC: The plant-parasitic nematodes isolated included *Pratylenchus*s, *Rotylenchulus*s, *Tylenchus*, *Trichodorus* and *Hemicycliophora*. However, the population densities of all the isolated nematodes were below 200 per 100ml of soil (figure 5:25).

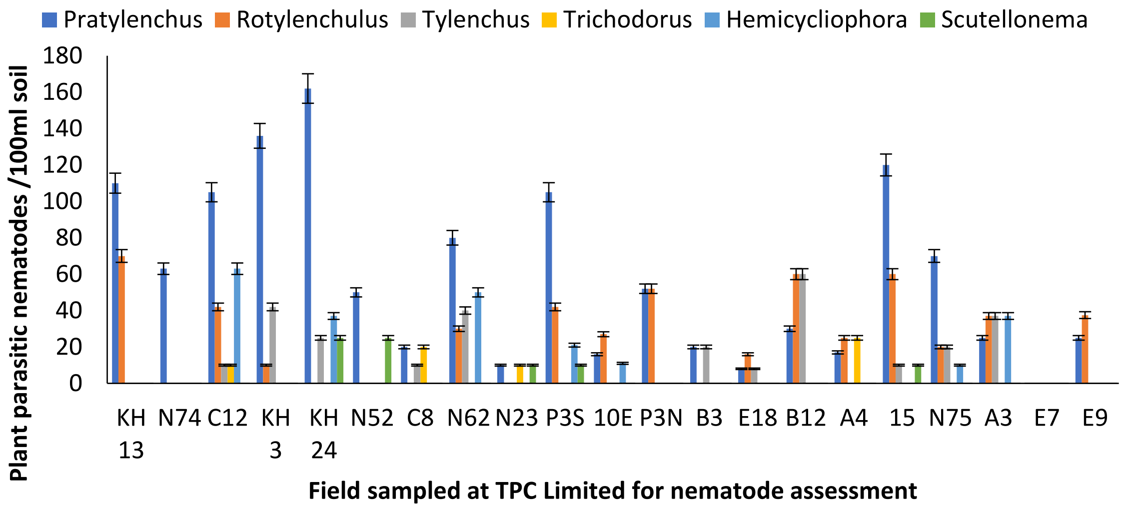

Figure 5:25: Plant parasitic nematodes isolated in the soil from sugarcane fields at TPC Limited.

The roots samples: Three genera of plant parasitic nematode found include *Pratylenchus*, *Rotylenchulus* and *Hemicycliophora*. The most abundant population of plant parasitic nematodes was 330 counts per 5grams of roots which was found in field 10E (figure 5:26).

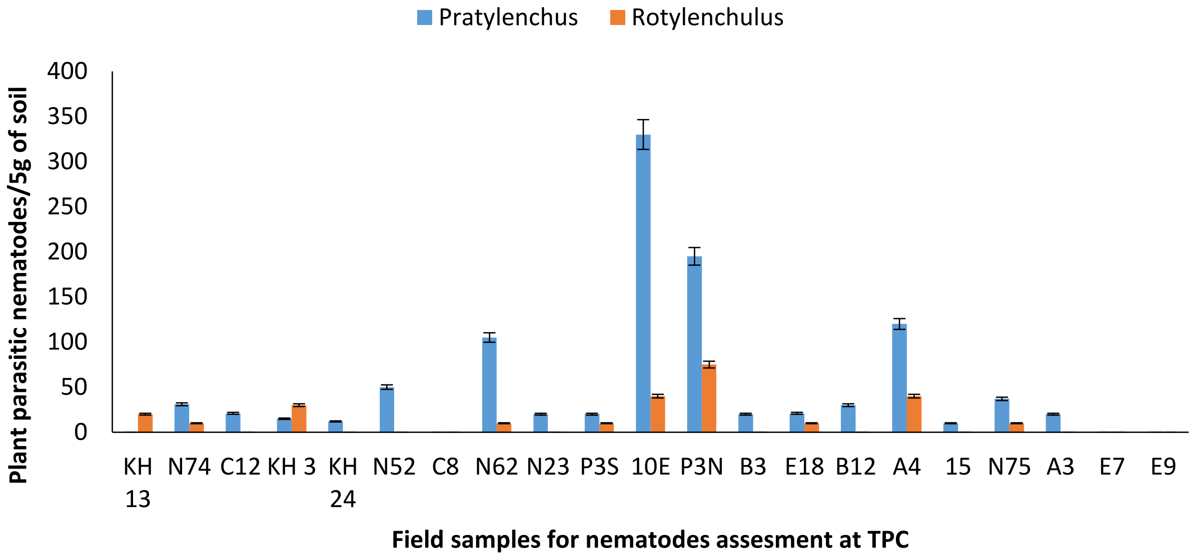

Figure 5:26: Plant parasitic nematodes isolated in the roots from sugarcane fields at TPC Limited.

Kilombero Sugar Company and out-growers fields: The areas sampled for nematodes assessment indicated in the map (Figure 5:27) for Kilombero Sugar Company and out-grower fields.

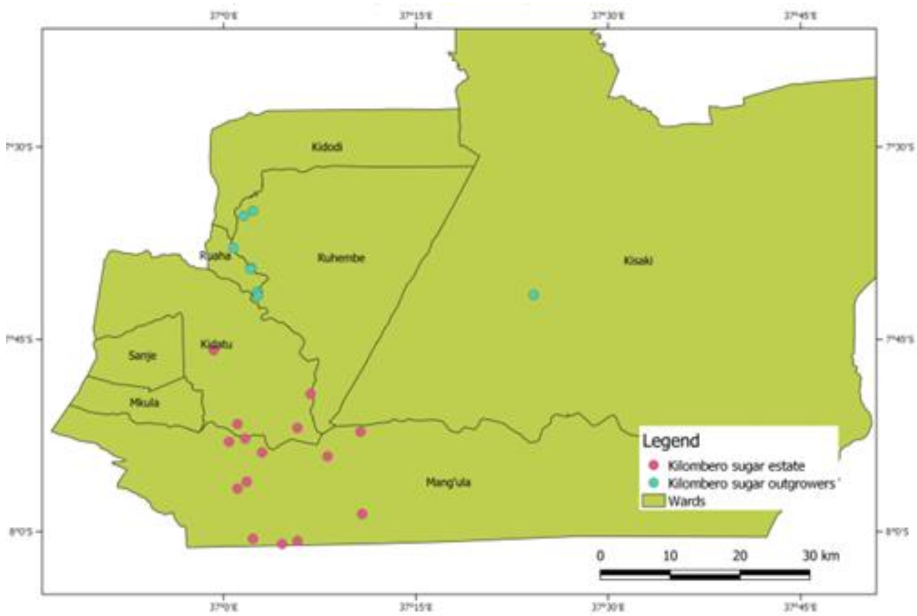

Figure 5:27: Sampling point for nematodes assessment at KSC and out-growers.

Soil samples: Five genera of plant parasitic nematodes found in the soil of sugarcane field at Kilombero Sugar Company were *Pratylenchus*, *Meloidogyne*, *Helicotylenchus*, *Tylenchus* and *Trichodorus*. Each sugarcane field was found to be infested with different levels of plant parasitic nematodes, but only *Pratylenchus* dominated all fields and the highest number was found to be 442 in field F456 (Figure 5:28).

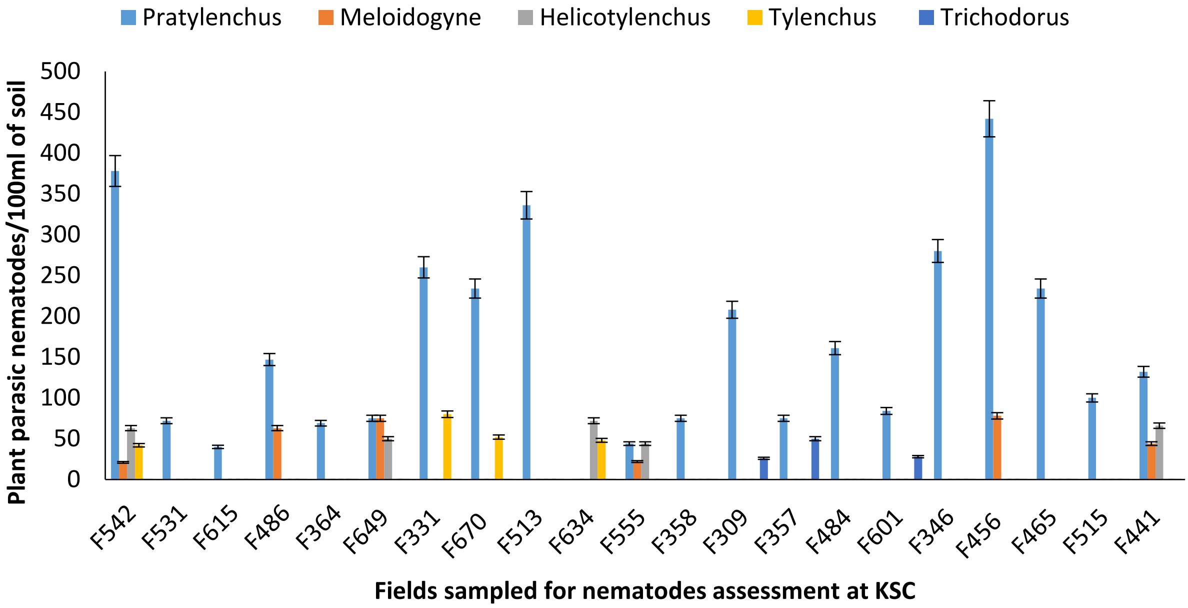

Figure 5:28: Plant parasitic nematodes isolated in the soil from sugarcane fields at KSC

Root nematodes: Two genera of plant parasitic nematodes namely; *Pratylenchus* and *Meloidogyne*. were found in the roots. In field F364, the roots were heavily affected with *Pratylenchus* with a population count of 1550 per 5grams of roots (Figure 5:29). The field was in the fourth ratoon at the time of sampling and aged 13 months therefore the number of ratoon support the higher number of nematodes in the sugarcane roots compared to other sampled fields at KSC.

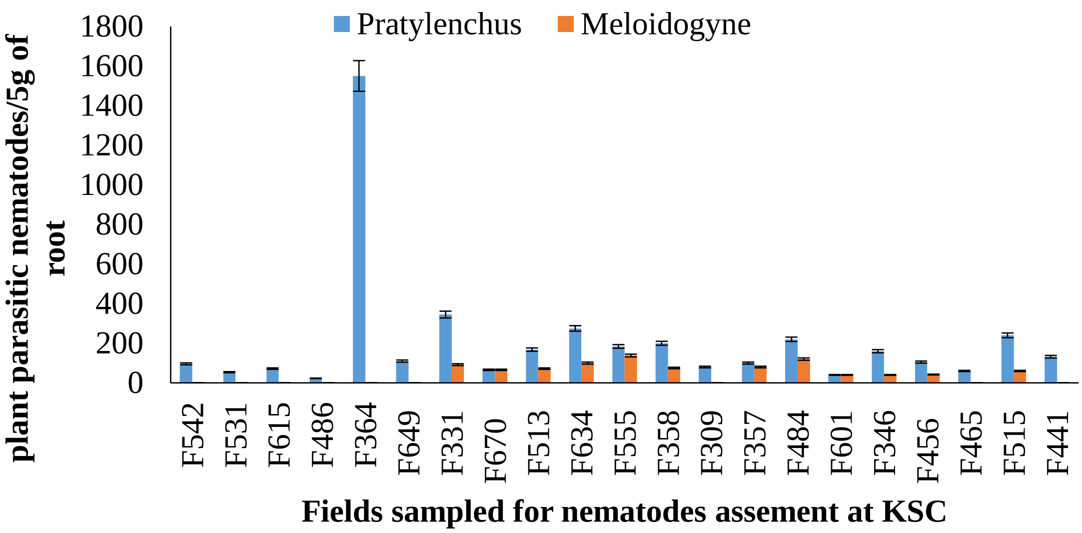

Figure 5:29: Plant parasitic nematodes isolated from roots in sugarcane fields at KSC.

Kilombero out-grower fields

Soil samples: Six genera of plant parasitic nematodes namely; *Pratylenchus*, *Meloidogyne*, *Longidorus*, *Criconema*, *Helicotylenchus* and *Tylenchus* were found in the soil. The most abundant was *Pratylenchus* and four fields have population between 200 and 374 of *Pratylenchus* (Figure 5:30) among sampled sugarcane fields..

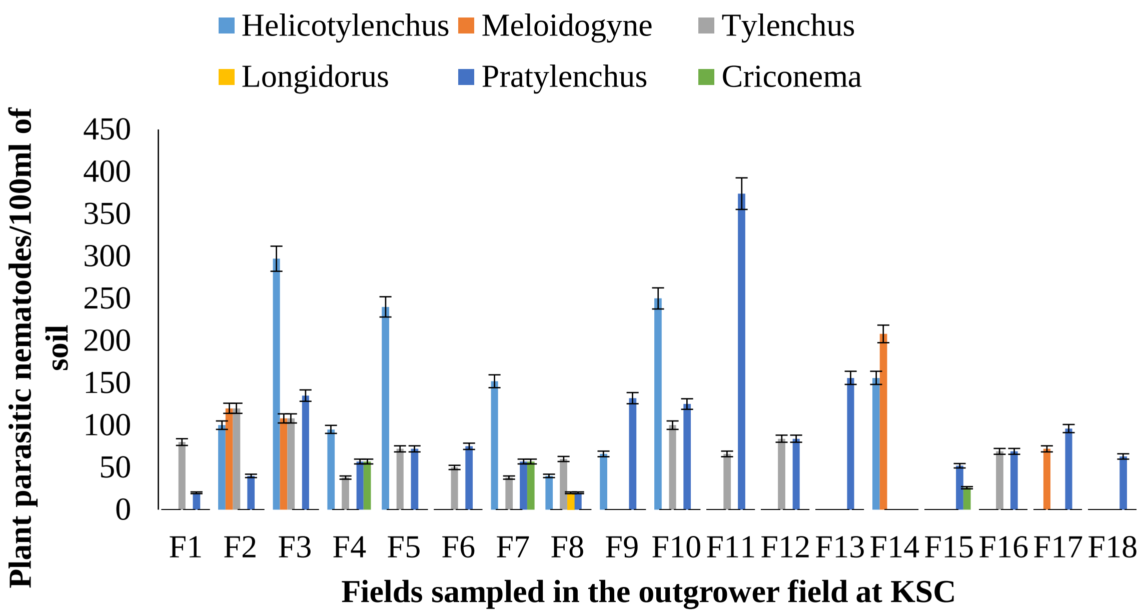

Figure 5:30: Plant parasitic nematodes isolated from the soil in sugarcane fields at Kilombero in the out-growers fields

Root samples: In root samples, only *Pratylenchus* and *Meloidoyne* were extracted and their population counts were below 250 per 5 gram of roots in all sampled fields (Figure5:31).

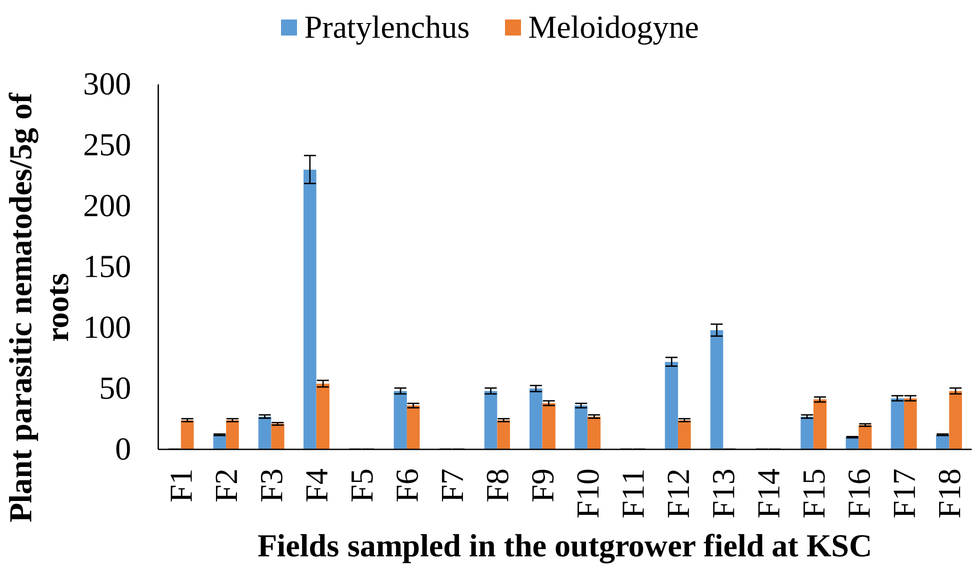

Figure 5:31: Plant parasitic nematodes isolated from roots in sugarcane fields at Kilombero in the out-growers fields

Objective 2: To determine the variation of common plant parasitic nematodes as influenced by mean rainfall and temperature.

The asynchronous repetitions of nematodes assessment in the same sugarcane fields to determine the variation of different plant parasitic nematodes was accomplished in 2019/20 at

MSE, KSC and TPC. The common genus of nematodes which was isolated in different areas and dominated almost all of the plant parasitic nematodes was *Pratylenchus.* The fluctuations in *Pratylenchus* population in the soil and roots were depending on the amount of rainfall in particular areas.

Mtibwa Sugar Estate: The *Pratylenchus* population count in the roots was 310 in June 2019 while in the soil was 220, the mean rainfall and mean temperature were 2.2 mm with of 25.05°C respectively. But, on January 2020 the mean rainfall at MSE recorded at 346.4 mm with a population count of 873 in the sugarcane roots while in the soil *Pratylenchus* population count was 520.There was no significant difference in temperature in June 2019 and January 2020 however, the amount of rainfall at Mtibwa favoured the multiplication of *Pratylenchus* more in the root than in the soil.

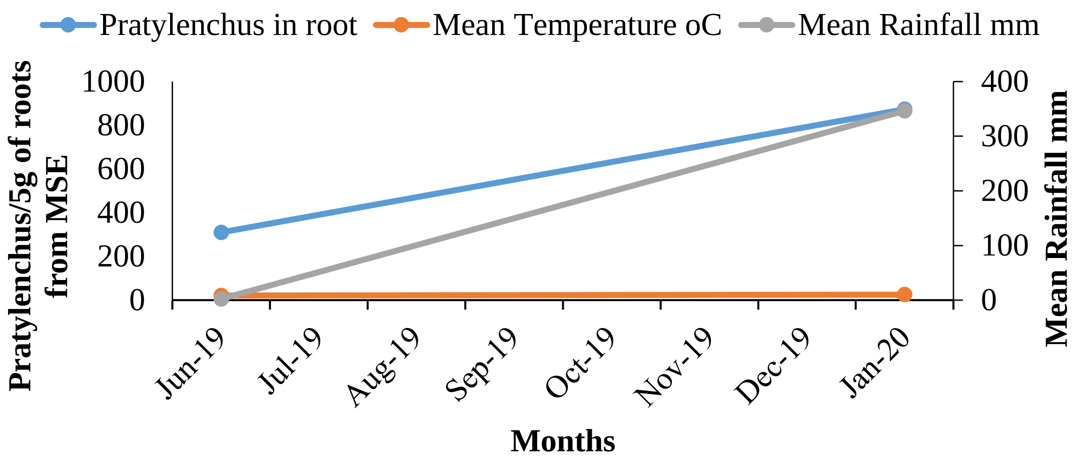

Figure 5:32: Effect of change in rate of rainfall and response of Pratylenchus in the roots of sugarcane at MSE

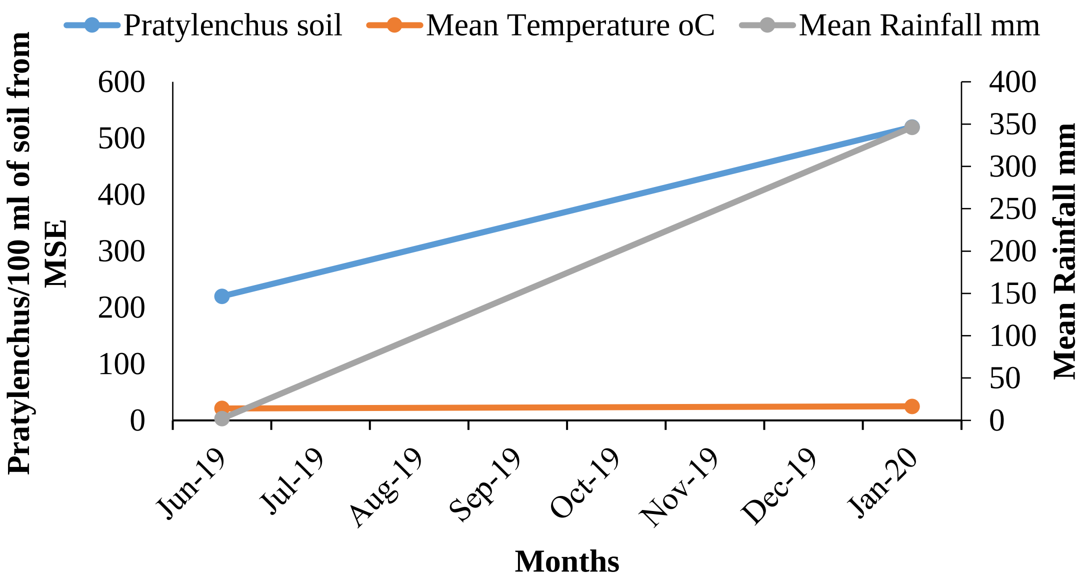

Figure 5:33: Effect of change in rate of rainfall and response of Pratylenchus in the soil in sugarcane field at MSE

Kilombero Sugar Company: According to weather data from KSC in June 2019, there was no rainfall at KSC and the population count of *Pratylenchus* was 470 in the roots while in the soil, isolated *Pratylenchus* were 442. When the mean rainfall reached 8.6 mm in March, 2020 the population of *Pratylenchus* in the roots sharply increased to 1550 while in the soil was slightly increased to 442.

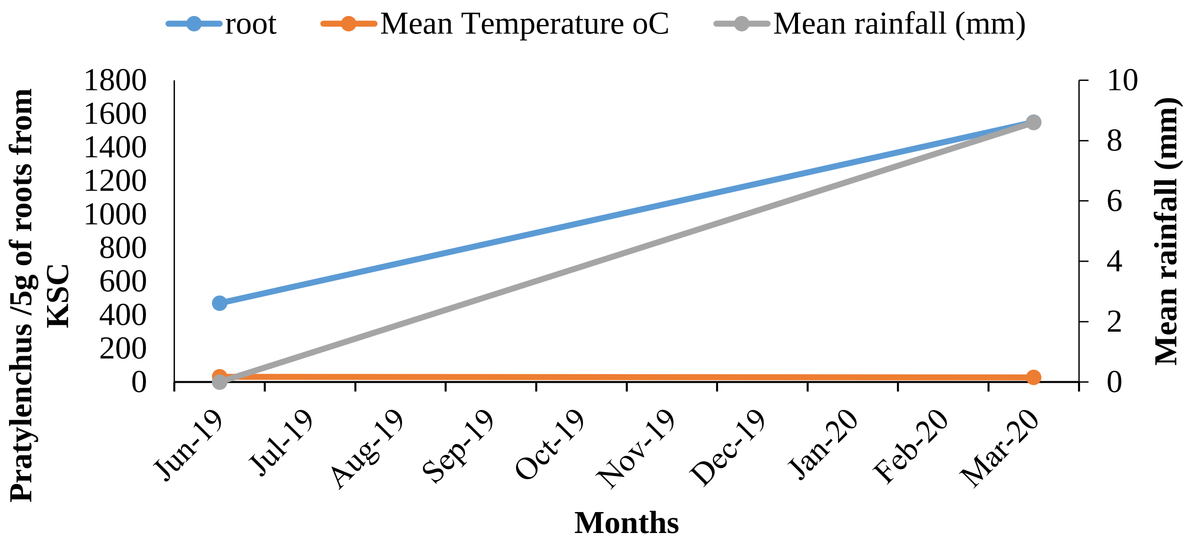

Figure 5:34: The effect of change in rate of rainfall and response of Pratylenchus in the roots of sugarcane at KSC

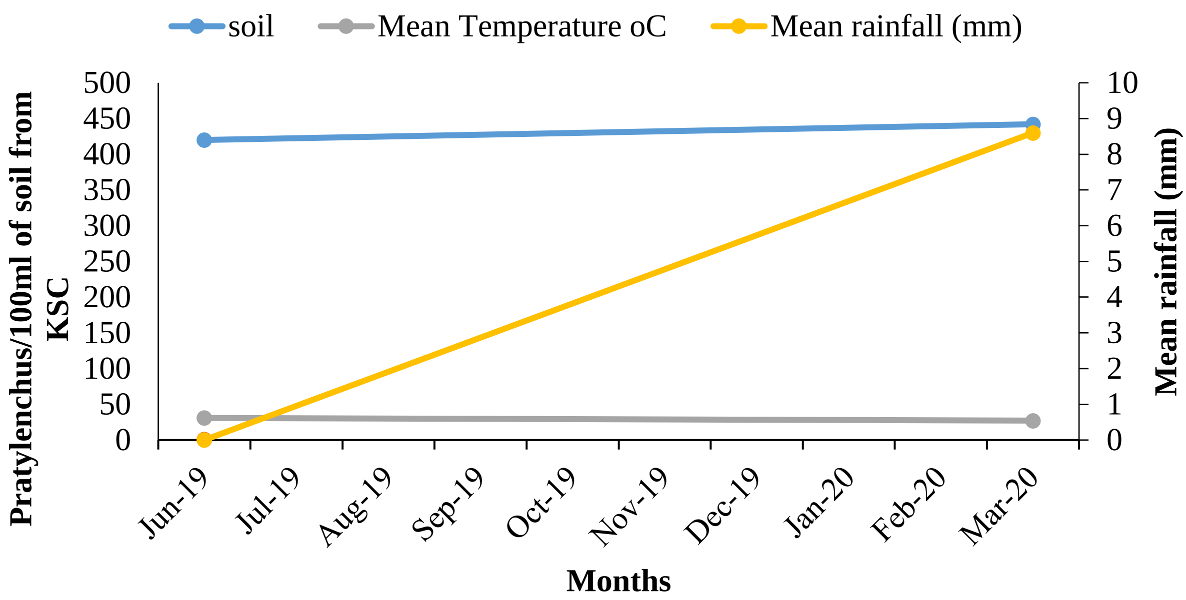

Figure 5:35. The effect of change in rate of rainfall and response of Pratylenchus in the soil in sugarcane field at KSC

Tanganyika Planting Company (TPC): In August 2019 there was no rainfall at TPC and the population of *Pratylenchus* in the soil was zero but in the root were 210. Once the mean rainfall recorded 1.22mm in February 2020 at TPC, the number *Pratylenchus* slightly increased in the soil up to 162 and in the root sample to 330.

Generally, the population of *Pratylenchus* in the roots increased with increased rainfall and decrease in the soil at the same time. The heavy rainfall cause flooding in the field which washed away the nematodes in the soil or it killed them in case of inundation. In the roots the number of *Pratylenchus* increased probably due development of roots system after having enough water and continued with growth. The process which could give chance to *Pratylenchus* inside the roots to multiplied and continues with the life cycle in the new developed plant cell in the roots of sugarcane.

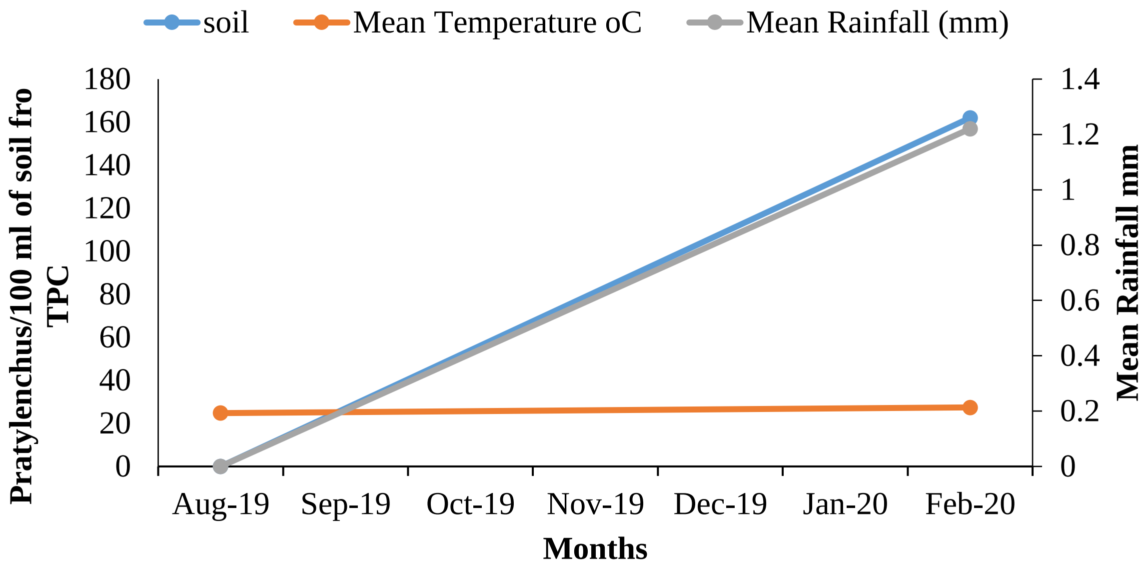

Figure 5:36. The effect of change in rate of rainfall and response of *Pratylenchus* in the soil in sugarcane field at TPC

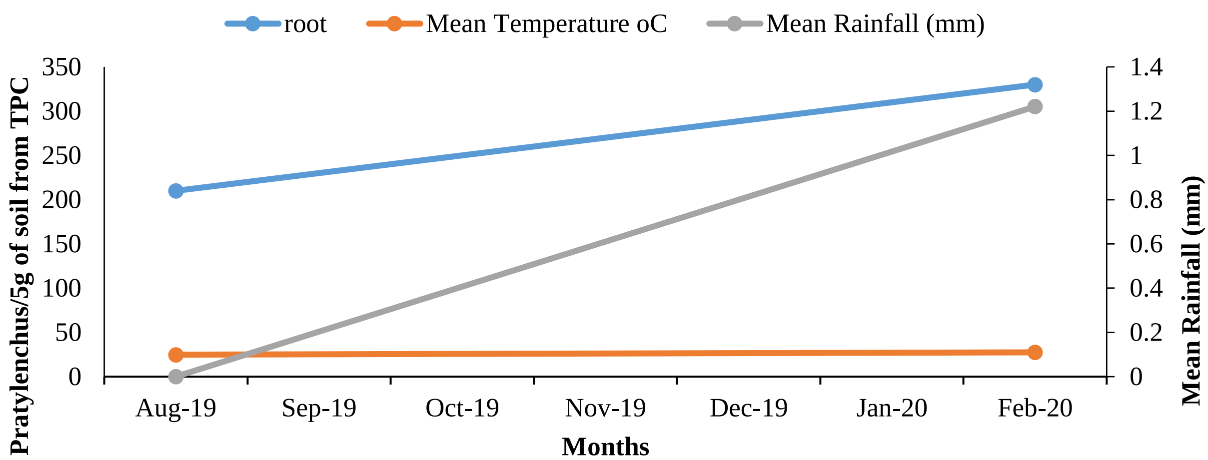

Figure 5:37. The effect of change in rate of rainfall and response of Pratylenchus in the soil in sugarcane field at TPC

5.2.4 Discussions

Pratylenchus and *Meloidogyne* are the key nematodes pest of sugarcane in all sugarcane growing area in Tanzania, similar results was reported in other sugarcane fields in Brazil Noronha *et al.,* (2017). According to Fontana *et al.,* (2015) the presence of *Meloidogyne* and *Pratylenchus* were observed to have competition once they are present in the roots. This was influenced by the virulence of nematodes to host and the susceptibility or tolerance of different varieties. Not only this but also the effect of mode of feeding of the nematodes can contributes on the population dynamics. Most of the sedentary endoparasitic nematodes like *Meloidogyne*, the females are inside the roots and the juveniles can either present in the roots or soil depend on the stage of life cycle. The migratory endo-parasitic nematodes example *Pratylenchus* can either be found in the roots or in the soil and the ecto-parasitic nematodes example *Xiphinema* are found in the soil (Crow, 2005).

The numbers of nematodes in a particular genus have impact on sugarcane production depend on the number of ratoons. Sheet, (2014), reported that presence of *Pratylenchus* in plant cane and first ratoon are supposed to be less than 300 however, for old ratoon the number supposed to be 900+. Additionally, the threshold of *Meloidogyne* is 200 for plant cane and first ratoon while for old ratoon the threshold for *Meloidogyne* is 600+.

The effect of rainfall causes the decrease of nematodes in the field, more effective in the soil; therefore management of *Pratylenchus* in the field is suitable by applying inundation before planting. The flooding methods can be successful used to manage nematodes except for some nematodes such as *Hirschmanniella* spp, a common nematodes parasitizing rice.

5.2.5 Conclusion and Recommendation

Key plant parasitic nematodes of sugarcane in Tanzania are *Pratylenchus Meloidogyne* and *Rotylenchulus* (TPC only). Despite the effect caused by the mentioned nematodes other plant parasitic nematodes which feed as ecto-parasitic nematodes are *Helicotylenchus, Tylenchus*, *Criconema*, *Aphilenchoides*, T*richodorus*, *Scutellonema Hemicycliophora* and *Xiphinema.* Therefore, weeding should be done and avoid planting maize in the same field with sugarcane because maize is also the best host for *Pratylenchus*.

Fields with *Pratylenchus*, *Meloidogyne* and *Rotylenchulus,* the filter cake and sugarcane molasses can be applied to suppress the population of these nematodes. For the fallow fields flooding for two weeks can be used as a simple method to manage nematodes in the soil.

5.3. Establishing suitable integrated nematode management methods for plant parasitic nematodes affecting sugarcane in Tanzania.

Project Number: CPP 2018/02/03
Principal Investigators: Beatrice Kashando, Renifrida Polini, Yeremia Mbaga Minza Masunga and Dr Nessie Luambano
Collaborators: Estate agronomists
Status: Ongoing

Project summary
To ensure effective management of plant parasitic nematodes in sugarcane production the use of IPM is important. The specific objective was to develop effective integrated methods for management of PPN nematodes affecting sugarcane. The integrated pest management (IPM) trial established in 2019 at Kagera Sugar Ltd (KSL) in field IR14F to test effect of Sunn hemp, Mucuna beans, Lab lab, Foxamyl and Filter cake against plant parasitic nematodes. The population of *Pratylenchus, Meloidogyne* and *Xiphinema* were controlled in the soil and roots in the plots applied with treatment compare to negative control.

5.3.1Introduction

Plant-parasitic nematodes feed on plant using spear-like mouth structure that helps to puncture plant roots and obtain nutrients. Crop which are infected with nematodes, reduce yield and quality (Wanga et al., 2007). Sugarcane is one of the cash crops which are affected by different nematodes. The presence of different crop cycle increase survive of different species of nematodes depend on soil type (Cadet.et al,, 2002, and Steven *et al*., 2014).
In sugarcane production nematodes can cause significant yield losses of about 20%-30% in susceptible variety in plant cane due to *M. javanica* and *P. zeae* Noronha and others.. Not only this but also *Pratylenchus zeae*, in heavily infested soil it can cause up to 50% yield losses (Wanjohi et al., 2006). Therefore, there is the need to control plant parasitic nematodes in agriculture production however the most used are commercial nematicides which are expensive and can be harmful to the environment by producing residual toxicity. Therefore this create the need of using leguminous plants as a green manure of which it promotes and improve physical and chemical conditions of the soil (Santana et al., 2016).
Previous surveys (TARI report) conducted at KSL presented occurrence of several nematodes in fields characterized with sand soils. These species included *Meloidogyne, Pratylenchus, Hoplolaimuss, Tylenchus, Helicotylenchus* and *Xiphinema*. The two most damaging nematodes are *Pratylenchus* and *Meloidogyne* were most abundant compare to other nematodes which isolated in the sugarcane fields at Kagera sugar, which could cause potential yield losses.
Therefore, the trial was established to investigate the suitable integrated pest management approach which can be used to control plant parasitic nematodes in the sugarcane fields. Also to determine the best management practices that will be used to minimize yield losses associated with nematodes in sugarcane crop.

Overall Objective

Establishing effective integrated strategies for managing PPNs affecting sugarcane production in Tanzania

Specific objectives

- ❖ To develop effective integrated methods for management of PPN nematodes affecting sugarcane

Achieved Output

At least two integrated methods developed and recommended for management of PPN in sugarcane.

5.3.2Material and Methods

The integrated pest management (IPM) trial was started on 3 January 2019 at Kagera Sugar Ltd (KSL) in field IR14F to test the effect of Sunn hemp, Mucuna beans, Lab lab, Foxamyl and Filter cake against plant parasitic nematodes.

Experimental design: Design 6 x 4 randomized complete block design (RCBD) was used with 5 treatments and a control.

Plot Size and Experimental area: Plot size was 41sqm (10m row length by 4.1m width) with 4 rows of Cane. Dual row spacing (m) 1.7*0.7*1.7, spacing between plots was 2.0 m and spacing between replications was 1.7 m. Total number of plots were 24 and experimental area was 1842.6 sqm.

Test product (Materials used)

Table 5:3.Tested treatment in the IPM trial at Kagera Sugar Limited

Treatment	Description	Scientific name	rate/Ha
T1	Sunn hemp	*Clotararia juncea*	10
T2	Mucuna Beans	*Mucuna pruriens*	1
T3	Lab lab	*Lablab purpureus*	6
T4	Foxamyl		30
T5	Filter cake (pressmud)		30
T6	Control (No treatment)		

Sugarcane planting and application of treatments: Soil samples were collected from each plot five core by using soil auger to a depth of 20 cm and kept in plastic bag well labeled before execution of the trial. The samples were then sent to the nematology laboratory at TARI-Kibaha and nematodes extracted by using modified Baeman technique (Coyne et al., 2007). Information on available nematodes will be used to screen on the effectiveness of selected nematodes management strategies. Clean sugarcane variety N41 from Hot Water Treated (HWT) was planted and the treatment selected for nematodes management were applied in as per design and layout plan.

Rates of different treatment used

Sunn hemp: 38.75g of sunn hemp was applied per plot which consist four cane rows. In each row of 10 meter and 9.69 g was spread along single cane row.

Mucuna pruriens**:** Plots with treatment number 2, at interval of 20 cm *Mucuna pruriens* was planted, and space between Mucuna pruriens lines is 60cm.

Lablab purpureus**:** Plots with treatment number 3, at interval of 20 cm *Mucuna pruriens* was planted, and space between Mucuna pruriens lines is 60cm.

Foxamly Granule nematicides: 93g of Foxamly Granule nematicides was applied per plot which consist four cane rows. In each row of 10 meter 23.25 g was spread along single cane row.

Filter cake: 93kg of Filter cake was applied per plot which consist four cane rows. In each row of 10 metre 23.25 kg was spread along single cane row.

Data collection and analysis: Prior to planting soil sampling were done, three months after planting data on soil and roots were collected and the organic amendments were incorporated in the soil per plot. Three month after incorporation of the amendment, sampling was done. Yield data will taken during harvesting.

5.3.3Results

The effect of applied IPM in the soil: In the soil before planting we found the presence of *Pratylenchus, Meloidogyne, Helicotylenchus, Scutellonema and Paralongidorus*.

***Pratylenchus**:* The organic amendments were effective to *Pratylenchus* after incorporating into the soil while foxamly and filter cake the effect acted soon after adding in the soil see figure 5:38. The effect of *Mucuna pruriens* was higher after incorporating compared to before incorporation. The filter cakes were having significant effect higher than positive control (Foxamly) in controlling *Pratylenchus* in the soil.

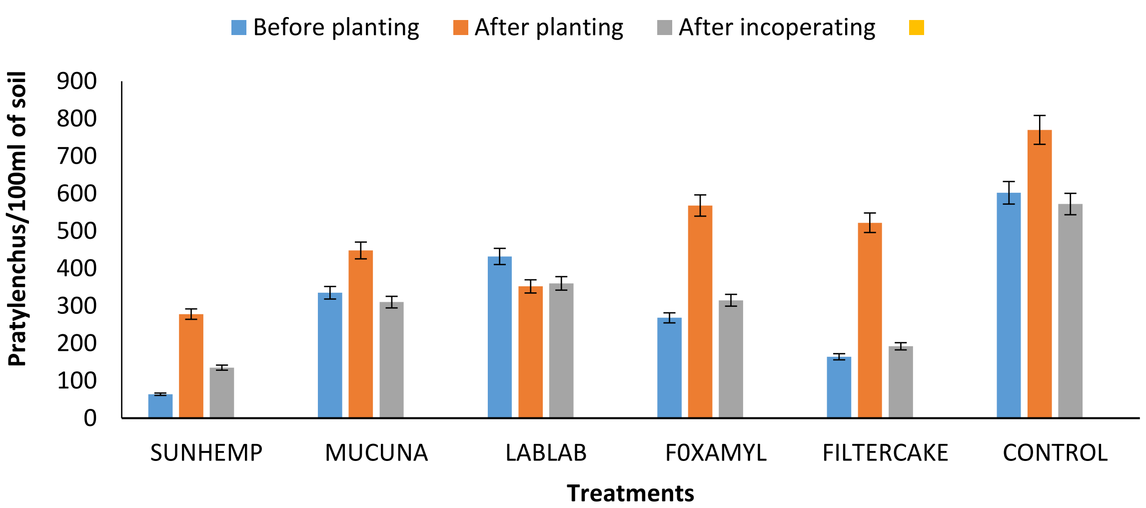

Figure 5:38 Fluctuation of Pratylenchusspp /100 of soil in the sugarcane field before planting (blue colour) after planting (orange colour) and after incorporating organic amendment in the soil (grey colour).

Meloidogyne*:* The organic amendments were not having significant effect at to *Meloidogyne* however the filtercake was having significant effect on suppressing the population of *Meloidogye*after incoperation in the soil compare to positive and negative control (Figure 5:39).

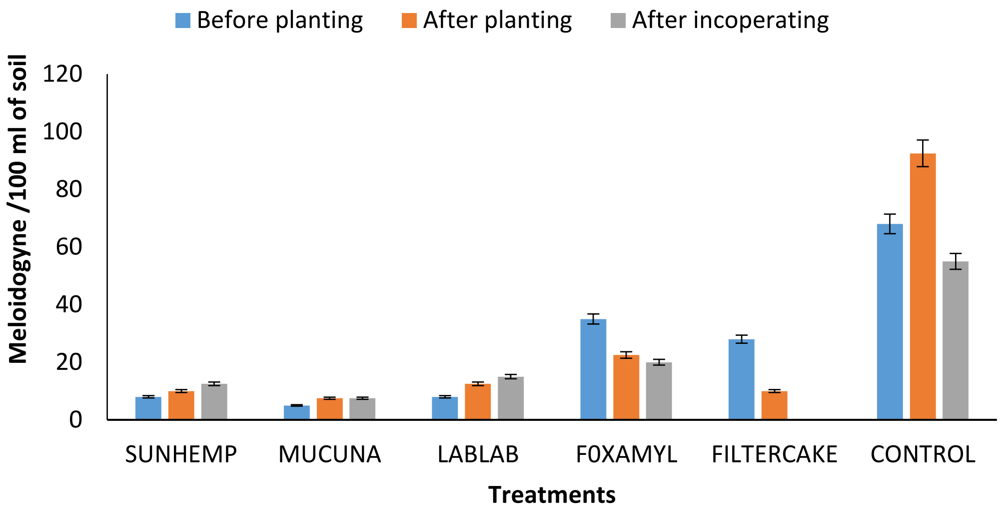

Figure 5:39. Fluctuation of Meloidogyne /100 of soil in the sugarcane field before planting (blue colour) after planting (orange colour) and after incorporating organic amendments in the soil (grey colour).

Xiphinema*:* The plots treated with lab lab there were no *Xiphinema* before planting of sugarcane but after planting the population increase. This is because, *Xiphinema* sense the presence of food from sugarcane root and move around sugarcane root rhizosphere. Thus why soil sampled at this point *Xiphinema* was isolated. Despite of this finding lablab and filter cake were effectively control *Xiphinema* compare to positive (Foxamyl) and negative control figure 5:40

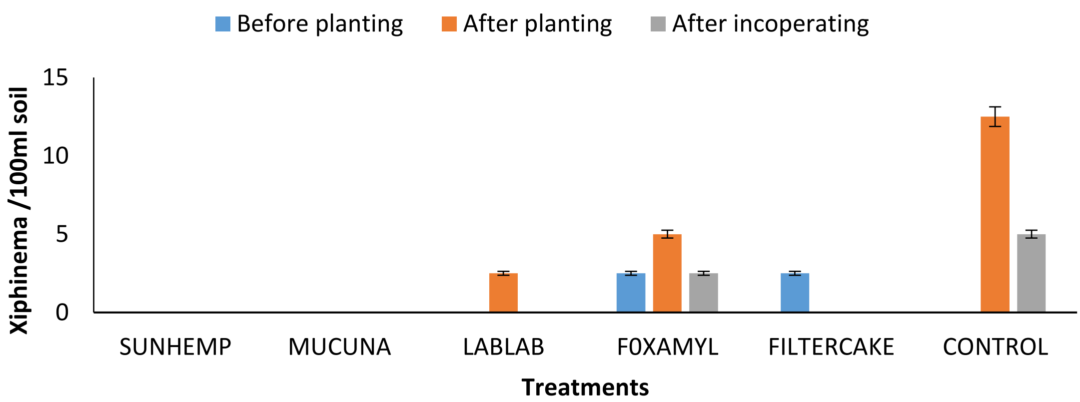

Figure 5:40. Fluctuation of Xiphinema in the sugarcane field

The effect of applied IPM in the Roots

Pratylenchus*:* The population of density of *Pratylenchus* was reduced in all treated plots with different level of percentage decreased. The organic amendments were effective lower the population of *Pratylenchu*s as follows: The filter cake performs slightly better than *Mucuna pruriens* and *Lablab purpureus* compare to positive (Foxamyl) and negative control (figure5:41).

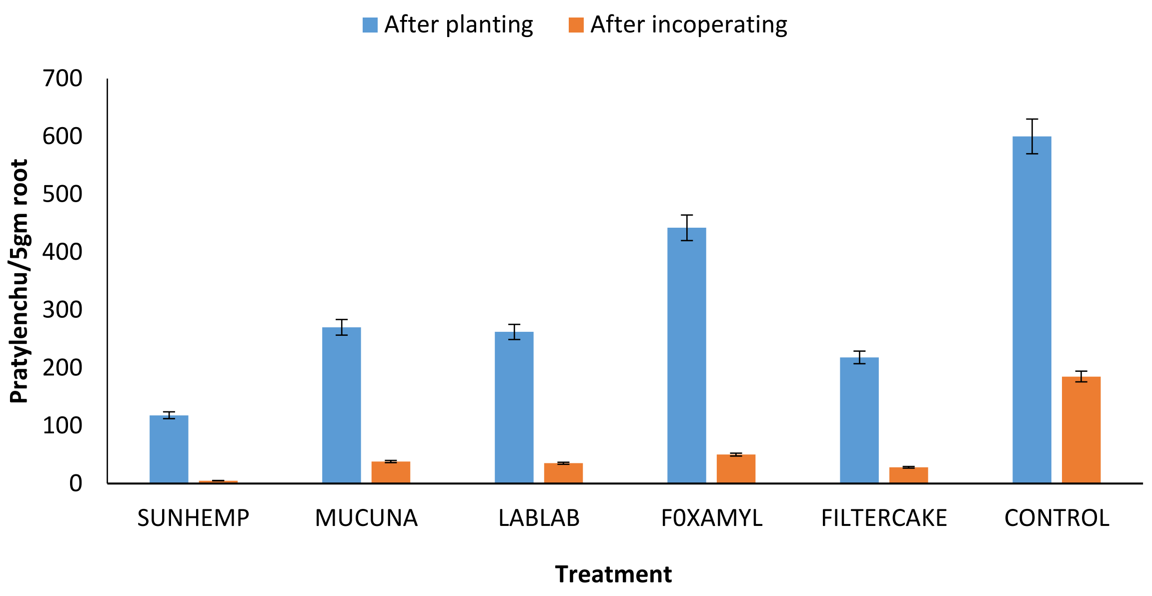

Figure5:41. Fluctuation of *Pratylenchus* in the sugarcane field

Meloidgyne*:* The sun hemp, filter cake and foxamly were effectively managing the population of *Meloidogyne* in the roots compare to negative control (Figure 5:42).

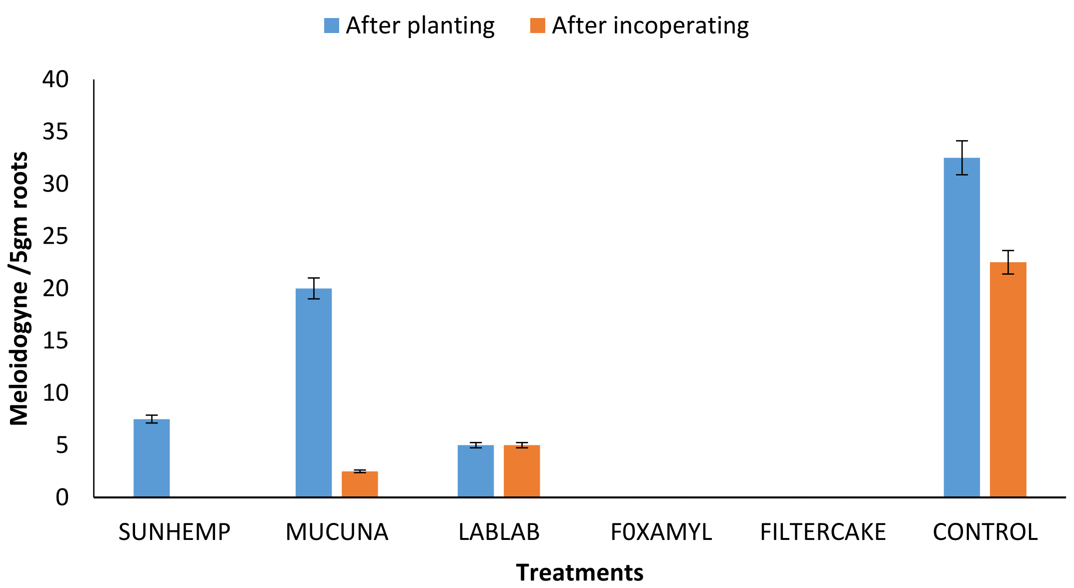

Figure 5:42. Fluctuation of *Meloidogyne*spp in the sugarcane field

5.3.4Discussion

The tendency of nematodes to be attracted by source of food in the soil to the roots is associated with emmerging young roots of sugarcane and start feeding which lead to increase in number. The effect of organic ammendment in controlling population density of *Meloidogyne* and *Pratylenchus* in the soil appear to perform better because filter cake can be added as an amendment to areas with sand soil to reduce nematode damage on sugarcane ·Crow, 2005. Also, by adding organic matter to sandy soil, filter cake can improve plant tolerance and make nematode damage less severe.

Meloidogyne and *Pratylenchus* were reduced in the roots similar finding were reported by Krueger & Mcsorley, (2014) However for *Pratylenchus* the best way of observing efficient of any treatment is to consider soil and root population at a sampling point due to migratory nature of this genus (Zasada *et al*., 2010).

For the case of *Xiphinema* have tendency of going deep in the soil up to 25cm when there is no crop in the field or when it is too hot not only this but also *Xiphinema* prefer undisturbed soil as described by Hooper., (1975). This information supports our finding because in the control no treatment was added and the population density increase sharply after planting and slightly decreased possibly due to normal agriculture practice which disturb the population density.

Therefore, the preliminary results indicated that, amendments work well after incorporating in the soil rather than immediately after planting, this means the chemical which are released in the soil have nematicide effect to the key nematodes pest of sugarcane.

5.3.5 Conclusion and Recommendation

The Sunn hemp, Mucuna beans, Lab lab, and Filter cake can be used to suppress the population of plant parasitic nematodes, and for best results the combined treatments can be used to manage plant parasitic nematodes. The combination of Mucuna beans, and Filter cake or filter cake with sunn hemp can be used to control PPN in the sugarcane fields.

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6.0 TECHNOLOGY TRANSFER

6.1 Strategies to improve extension services to sugarcane growers through Farmers Field School (FFS) in Kilombero and Mtibwa

Project Number: TT 2019/01
Principle Investigators: John Msemo, Diana S. Nyanda, Magreth Kinyau and Ambilikile Mwenisongole.
Collaborators: Farmers, VAEO's, DAICO, LAOs, KSE and Farmers' organizations
Reporting period: 2019/2020
Remark: Ongoing

Project summary
Farmer field school (FFS) consist of groups of people with a common interest, who get together on a regular basis to study the "how and why" of a particular topic. One key factor in the success of the FFS has been that there are no lectures, all activities are based on experiential (learning-by-doing), participatory and hands-on work. The main objective was to enhance sugarcane production technologies for improved productivity through farmer field schools, specifically aim **t**o establish areas for FFS as a training centre in selected villages and to empower farmers with knowledge and skills of sugarcane production practices**.** During 2018/2019 one FFS was established at Lumango village in Kilombero district. The results showed that the yield from farmer field school (FFS) was higher as compared to farmers practice. The yield of FFS practice was 110 ton cane per hectare (TCH) and the yield of farmer practice was 70 TCH. Furthermore, a total of 478 farmers (258 males and 220 female) and other stakeholder learned through FFS approach and started to practice technologies adopted in their fields. In a year of 2019/2020, three FFS were established at Kilombero and Mtibwa mill areas whereby a total of 47 farmers which comprises 19 males and 28 females were participated and trained on new technologies developed by TARI Kibaha.

6.1.1 Introduction

Building capacity of sugarcane growers in enhancing agricultural knowledge and skills is the basic goal of agricultural extension services which finally improves farm productivity, income and living standard. Several agriculture extension methods from top down to more participatory have been used in Tanzania. These are farmer to farmer extension method, individual methods, group extension methods that involve demonstrations, field days and farmer field school (FFS). FFS is considered as a forum or a school with no walls around which is used for capacity building of farmers to adopt new technologies for sustainable agriculture.
It is a group-based adult learning approach that teaches farmers how to identify and solve problems independently, sometimes called "schools without walls". It's a learning approach that emphasizes problem solving and discovery based learning. FFS aims to build farmers' capacity to analyze their production systems, identify problems, test possible solutions, and eventually encourage the participants to adopt the practices most suitable to their farming systems (FAO, 2013). Improving decision making capacity of farming communities and stimulating local innovation for sustainable agriculture (Braga *et al* 2011). The advantage of

this method is that, through group interactive activities, farmers get a chance to improve their decision-making capacity, leadership and communication skills (Nduru, 2011). It is a participatory approach to extension, whereby farmers are given opportunity to make a choice in the methods of production through discovery based approach.

Farmers decide to adopt new technology methods according to their capacity and adoption is higher when farmers observe and follow the results and when learn necessary skills before applying in their fields. TARI Kibaha made use of FFS extension methods as it combines both learning and doing.

Main objective

To enhance sugarcane production and productivity through farmer field schools

Specific Objectives

1. To establish FFS in order to empower farmers with knowledge and skills of sugarcane production practices.

Achieved Outputs

1. A total of 47 farmers (19 male and 28 female) trained on sugarcane practices at Kilombero mill area.
2. A total of 478 farmers (258 males and 220 female) and other stakeholders learned through FFS approach in Kilombero mill area

6.1.2 Methodology

Site selection and participants: Field school sites were selected near the community where farmers live so that they can easily attend weekly and maintain studies. The area of each field school was one acre for group study. The land for FFS was acquired through voluntary basis from the member of the groups and will be used as school field for training. Farmers that participated in FFS were selected through village meeting by listing of those village households that express interest in participating and fulfil the selection criteria. Each group comprised of 20-25 persons with common interest that can support each other, both with their individual experience and strengths.

Training materials: The input for training like seedcane, fertilizers, and herbicides as well as training materials such as notebooks, pencils, erasers, files, ream of paper and maker pen were provided by TARI-Kibaha.

Farmer’s traits and training: Selection of farmers was based on the fact that the farmer/member must be sugarcane growers and able to attend the class session each week in the field selected. Farmers were trained by using curriculum of 26 sessions. The farmers were able to participate in all training session which were essential in sugarcane production from site selection, land preparation, planting, weeding, fertilizer and herbicides application up to harvest and post-harvest management. Also, they observed and record all the important things like insect pest, weeds and diseases.

Figure 6.1: FFS farmers at Kwadori receiving sugarcane inputs

6.1.3 Results

A total of 13 farmers (7 males and 6 female) Kilombero mill area in village of Lumango learnt on recommended sugarcane production practices in 2018/2019. FFS approach was used to increase their awareness (Table 6.1). During the study it was revealed that the yield from FFS practice was higher as compared to farmers practice, the yields of FFS was 110 TCH and the yield of farmer practice was 70 TCH (Figure 6.2).

Table 6.1: Topics covered in FFS training

S/N	Topic covered
1	Site selection
2	Land preparation
3	Planting
4	fertilizer applications
5	Weeding management
6	Pest and disease control
7	Harvesting
8	Post harvesting management
9	Safety

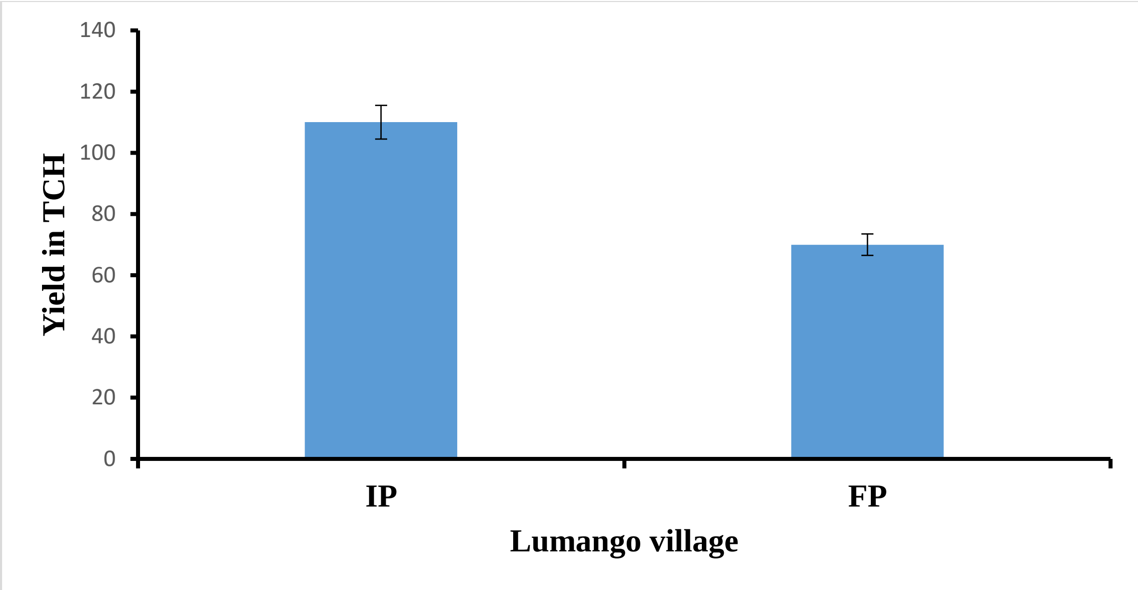

Figure 6.2: Yield of FFS at Kilombero mill area in 2018/2019

6.1.4 Discussion

The sugarcane technologies presented and trained during FFS appeared to be very relevant to farmers as they increased their productivity from 70 TCH of farmers' practices to 110 TCH of improved practices. It was revealed that farmers have a clear understanding of the objectives of FFS and recognizes the importance in making farmers capable of being decision makers, such as when and how to manage sugarcane field activities. Mwangi and Kariuki (2015) said that successful adoption of improved techniques is based upon the efficiency of dissemination methods to join new knowledge and understanding new technological practices to farmers. Also, increase of farmers' accessibility to FFS increase adoption of the improved technologies (Simpson *et al.*2015), thus the FFS is effective and efficient of providing agricultural information in maximizing uptake of new messages disseminated.

6.5 Conclusion and recommendation

The study revealed that FFS participants had higher positive attitude and high perception toward FFS training on sugarcane production. This clearly suggests that FFS is an effective communication tool for delivery of agricultural information. FFS accelerating farmers' willingness to use the improved technologies and to be a role model for other farmers in their locations. By doing so, other farmers in turn will be motivated to test the newly improved farming practices on their fields.

6.2 Awareness creation through use of demonstrations as one of extension method

Project Number: TT 2019/02
Principle Investigators: John Msemo, Diana S. Nyanda, Magreth Kinyau and Ambilikile Mwenisongole
Collaborators: Farmers, VAEO's, DAICO, LAO, KSE and Farmers' Organizations
Reporting period: 2019/2020
Remark: Ongoing

Project summary

Extension methods are essential in dissemination of new knowledge and skills to farmers by drawing their attention toward them, arousing interest and helping them to have successful experiences of the new practices. Demonstration plots are one of the tools for effecting desirable changes in the behavior of farmers and explore the technologies available and developed. In the year 2019/20, nine (9) demonstration plots were established. Seven at Kilombero mill area: Ruhembe, Mbwade, Msufini, Msolwa ujamaa, Mfilisi, Sanje and Ichonde and two at Mtibwa mill area: Kunke and Kisala kwa Mayambi villages. A total of 655 farrmers (358 males and 297 females) were learned sugarcane technologies through visiting the established demonstration plots. Farmers were able to see, learn and apply technologies to their fields. The yield data will be captured and reported in 2020/21 season. In this report the data captured and discussed are of the demonstration plots of 2018/19, of which nine demonstration plots were established at in Kilombero, Kilosa and Mvomero district. The results showed that the yield from research practice was higher as compared to farmers practice. The yield of research practice ranged from 100 ton cane per hectare (TCH) to 155 TCH as compared to farmers practice which ranged from 70 to 93.1 TCH in both sites: Kilombero and Mtibwa mill areas.

6.2.1 Introduction

Demonstration plots are powerful delivery system of improved technologies in the farmer's field under farmers' conditions. It can be used to teach and share ideas about agricultural practices with the aim of demonstrating the best sugarcane technologies available. Hence, provides a learning platform for farmers to apply these technologies on their fields. The efficiency of a dissemination pathway depends on the number of farmers that receive information and how positive that pathway influences farmers' decision to adopt a given technology (Murage et al., 2012). The use of demonstration plots for technology transfer is perceived as means of improving efficiency in knowledge transfer. It designed to compare differences in tillage methods, herbicide treatments, varieties, fertilizer rates, methods of pesticide application, inputs and good agronomic practices such as land preparation, planting, gap filling, weeding, fertilizer and herbicide application, harvesting and post harvesting management.

Figure 6 3: Demonstration plot at Mbwade village

Main Objectives

To create awareness to sugarcane growers through demonstration plots

Specific objectives

1. To disseminate improved technologies of sugarcane production and productivity.

AchievedOutputs

1. Nine (9) demonstration plots established in the year of 2019/20
2. A total of 655 farmers/visitors (358 males and 297 female) accessed demonstration plots in Kilombero and Mtibwa mill areas
3. Increased yield in demonstration plots under mproved practice (100 - 155 TCH) compared to farmers practice (70 - 91.3 TCH)

6.2.2 Methodology

Fields for demonstration plot establishment were selected from sugarcane growers who were purposely selected based on their ability and track record in best cane growing practices. Criteria for selection of demonstration plots included passability of the area throughout the year, visibility (where farmers and other persons can see and learn easily), and the land should reflect typical ecological situations of sugarcane crop. A total of nine (9) demonstration plots were established, each measuring one acre. Seven at Kilombero mill area: Ruhembe, Mbwade, Msufini, Msolwa ujamaa, Mfilisi, Sanje and Ichonde and two at Mtibwa mill area: Kunke and Kisala Kwa Mayambi villages. Farmers were trained on the use of clean seedcane from nursery B, fertilizer recommendation (N_{100}, P_{25}, K_{100}) and herbicides combination of Paraquat and Diuron (Volmuron) in a ratio of 1 to 3 and rates of 4 litres/Ha and agronomic practices including site selection and preparation, planting, fertilizer application, weeding, pest and disease control, harvesting, post harvesting management and safety of using pesticides.

Harvesting of one acre demonstration plots and nearby farmers' fields was done at crop maturity, 11 months after planting. Yields (TCH) under improved practices (demos) and farmer's practices were finally compared.

6.2.3 Results

Performance of six (6) demonstration plots that were established in 2018/19 season at Kilombero and Kilosa mill areas is presented in Table 2. The mean TCH yield was significantly (P= 0.001) higher in demonstration plot with improved practices (118.9 t/Ha) than that of farmers' practice (78.3 t/Ha). Further, the yield among demonstration plots with improved practices ranged from 100 to 155 TCH as compared to farmers' practice which ranged from 70 to 91.3 TCH in both sites of Kilombero and Mtibwa mill area (Figure 6.4).

Table 2: Mean yield (t/Ha) of NCo37 under FP and IP at Kilombero and Kilosa mill areas in 2018/19 season

Practice	Size	TCH	Variance	SD	SE
FP	6	78.3	65.1	8.1	3.3
IP	6	118.9	457.0	21.4	8.7

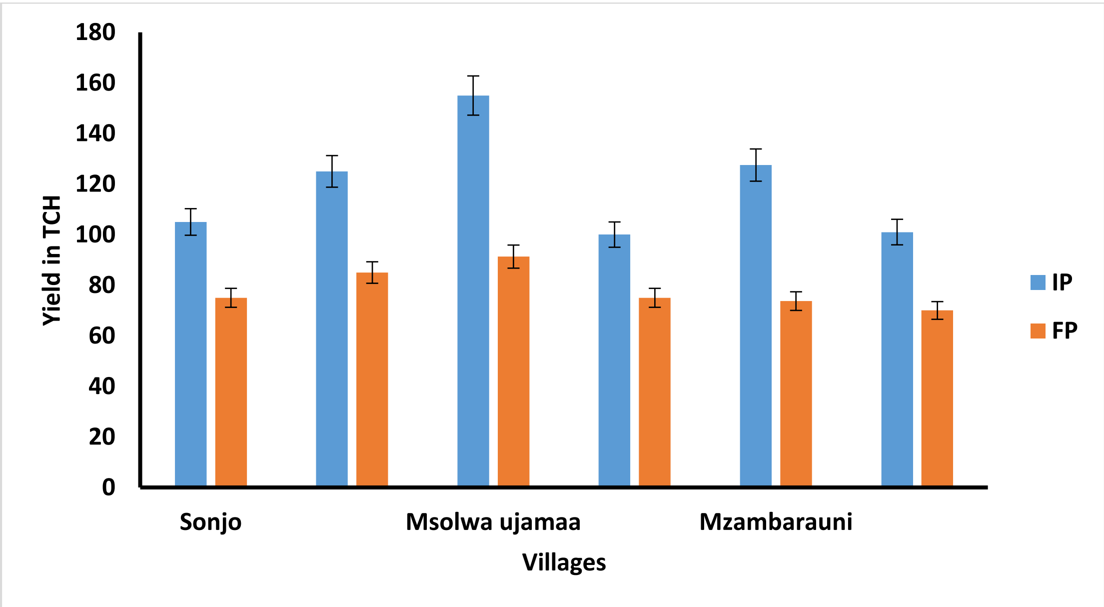

Figure 6.4: The yield of the demonstration plots for 2018/19

6.2.4 Discussion

The current study indicated that farmers who cultivate near demonstration plots adopted new technology and improve their farm yields. Other framers who accessed demonstration plot were able to copy technologies and apply in their fields for more production. Khan et al., 2009 documented that demonstration plot is an effective means of communication to transmit knowledge and skills to farmers so as to improve agricultural production and productivity.

6.2.5 Conclusion and recommendation

Demonstration plots are used to teach farmers various sugarcane techniques for improving production and productivity. Demonstration plots provide sufficient visual confirmation to the farmers, whereas extension worker visits and input suppliers provide interactive learning environment to the farmers. It is designed to compare differences in tillage methods, herbicide application and rates, varieties, fertilizer rates and production inputs. Farmers, extension officers and researchers have a common interest in demonstration plots for studying various sugarcane crop management practices.

6.3 The multiplication of clean seedcane through nursery B

Project Number: TT 2019/03
Principle Investigators: Diana S. Nyanda, John Msemo, Magreth Kinyau and Ambilikile Mwenisongole
Collaborators: Farmers, VAEO's, DAICO, LAO, KSE and Farmers' Organizations
Reporting period: 2019/2020
Remark: Ongoing

Project summary

The accessibility of clean seedcane is the biggest challenge that most of farmers face in Kilombero, Kagera and Mtibwa sugarcane mill areas which contributes to low productivity. To solve the problem, the multiplication of nursery B was established near farmers' fields at the mill areas using varieties NCo376, Co617 and R 570 from nursery 'A'. In the year 2019/20, a total area of 12 acres was planted to growers at Kilombero, Kilosa and Mvomero districts: 5 acres in Kilombero district (2 at Miwangani, 1 at Ichonde, 2 at Msolwa ujamaa), 5 acres in Kilosa district (3 at Mbwade, 2 at Gombati) and 2 acres in Mvomero district (2 at Kunke). The seedcane multiplication fields were owned and managed by farmers. TARI Kibaha supported farmers with 4 tones clean seedcane/acre from A nursery. The observation and monitoring was done by researchers and agricultural extension officers of the particular area.

Furthermore, a total of 38.5 acres was established in 2017/18, out of which only eight (8) acres were harvested and planted as commercial fields to a total area of 85 acres in Kilombero, Mtibwa and Kagera mill areas in this 2019/20 season. Other fields were not harvested due to heavy rainfall.

6.3.1 Introduction

The cane growers in Tanzania face many problems in attaining the potential yields (Tarimo and Takamura, 1998). The main problems leading to low yields include the use of the poor quality seedcane, transportation cost and high price of seedcane, unavailability of seedcane near their premises. These make most of the farmers to depend on seedcane from neighbors imposing the risks of continuing spreading the pests and diseases such as ratoon stunting disease (RSD), smut and eldana ,hence, low sugarcane productivity. Planting good quality seedcane reduces the risk of pest or disease outbreaks in commercial fields which lead to increased sugarcane productivity.

General Objective

To ensure farmers accessibility of clean seed cane from Nursery "B"

Specific Objectives

To establish multiplication of clean seedcane through nursery B to sugarcane growers

Output

1. Multiplication of 12 acres of nursery B farms established
2. 18 sugarcane growers trained on how to establish seedcane nursery B
3. New 85 acres of commercial fields were planted through seedcane from nursery B established in 2017/18
4. 109 farmers obtained seedcane from nursery B and planted in their fields

6.3.2 Methodology

Purposive sampling was done to identify reliable farmers with the ability and track record in best cane growing and an attitude of cooperation with partners who follow the recommendations described in developed protocol for seedcane multiplication. The selected multiplication sites were in Kilosa, Mvomero and Kilombero districts. In Kilombero district the sites were at Miwangani, Ichonde and Msolwa ujamaa, in Kilosa district the sites were Mbwade and Gombati, while in Mvomero district the site was at Kunke village. The main source of seedcane, NCo376 and R 570 varieties, was from nursery "A" in Kilombero and Mtibwa estates. TARI Kibaha supported the growers with 4 tons of clean seed cane and inputs (basal fertilizer and herbicides) enough to cover one acre. The farmers were supposed to repay loan to TARI Kibaha in monetary form equivalent to the market price of 4 tons of seedcane. Then extension officers of the particular area were helping in managing the multiplication plot.

6.3.3 Results

A total of 12 acres of seedcane nursery B were established in Kilombero, Kilosa and Mvomero district as shown in Table 6.2. Prior to planting, a total of 18 sugarcane growers were trained on how to establish seedcane nursery B in these districts. Moreover, new 85 acres were planted to a total of 109 farmers using seedcanes from B nurseries established 2017/18.

Table 6.2: Areas planted with B nursery seed canes in 2019/20

S/n	District	Location	Area planted (acres)
1	Kilombero	Miwangani	2
		Ichonde	1
		Msolwa Ujamaa	2
2	Kilosa	Mbwade	3
		Gombati	3
3	Mvomero	Kunke	2
		Total	**12**

6.3.4 Discussion

The approaches of seedcane multiplication was able to produce and distribute high quality seedcane to the farming community compared to currently tradition of obtaining low quality seed cane from neighbours. The long term future of seed cane multiplication is identifying farmers for commercial seed multiplication near farming community to reduce transportation cost.

6.3.5 Conclusion

Planting of good quality seedcane is a key component for improving sugarcane productivity. It reduces the risk of pest and disease outbreaks in commercial fields which lead to improved sugarcane productivity. Commercial seed cane production will ensure availability of high quality seed cane to farmers and continuous increase productivity.

6.4 Scaling up sugarcane production technologies through training and development of extension materials

Project Number: TT 2019/04
Principal Investigators: Msemo, J., Nyanda, D., Kinyau, M. and Mwenisongole, A.
Collaborators: Farmers, VAEO's, DAICO, Local Area Officer and Farmers' Organizations
Reporting Period: 2019/2020
Remarks: Ongoing

Summary
The sugarcane growers face many problems in production of sugarcane; one of them is inadequate knowledge and access to information on the available technologies for improvement of sugarcane production. TARI Kibaha was invited to display, train and demonstrate different technologies that is important to farmers to increase sugarcane production and productivity at Sokoine University of Agriculture (SUA). A total of 1938 people (1201 males and 737 females) attended TARI booths/pavilion. A total of 2100 fliers, 8 banners displayed and 150 brochures from TARI Kibaha distributed during exhibition. 40 students from university of Dar es salaam (29 males and 11 females) acquired basic knowledge and function of the research activities conducted at TARI Kibaha. A total of 24 (17 males and 7 females) new recruited extension workers of Kilombero Sugar Company were trained on activities of demonstration plot and farmers field school located at Kilosa and Kilombero district.
Apart from that a total of 5000 flyers, 5000 Brochure and 500 books in Swahili version have been developed and printed. 2820 flyers, 2300 brochures and 150 training manuals in Swahili version have been distributed to cane growers and other stakeholders during farmers' day, conferences, exhibitions and inauguration of crop season in Kilombero, Kilosa, Missenyi and Mvomero districts.TARI Kibaha attended the National agricultural show (Nanenane) held at Nyakabindi, Simiyu (National) and Mwalimu Nyerere ground in Morogoro region (Zonal). A total of 2567 visitors (1733 males and 834 females) visited TARI pavilion and a total of 2656 visited SBT Pavvilion Morogoro,

6.4.1 Introduction

Sugarcane is an important crop widely cultivated for multiple purposes by smallholder farmers in sub-Saharan Africa (SSA), including Tanzania. Scaling up of improved technologies had being promoting adoption of the improved sugarcane technologies among the farmers. The use of improved technologies has remained the major strategy used by governments to increase agricultural productivity and promote food and livelihood security. Print media still regarded as primary means of disseminating agriculture information in developing countries (Ariyo *et al*, 2013). For farmers to benefit from such technologies, they must have access to them and learn how effectively utilize them in their farming system practices

Therefore, the intended project tried to use methods of developing research training materials like banners, posters, flyers, brochure and training manuals, also conducting training to farmers and other stakeholders involved aiming at improving productivity and awareness creation on available technologies at research.

The training included field demonstrations, capacity building of stakeholders through field visits on concept of integrated sugarcane farming, climate change adaptation, Good Agriculture Practices such as site selection, land preparation, proper spacing, proper weeding and proper harvesting.

Training of trainers (TOT) is the necessity for an effective implementation of technical solutions in the field and an important step for their dissemination. It follows a specific curriculum of basic crop management skills and field practical such as planting and weeding. It is a core activity in extension process and is the effective way to help bring extension workers up to date on newly developed technologies. The knowledge gained will enable them to organize Farmers in the production of sugarcane in the particular area (Braga et al, 2011).

Main Objective

The development of the research materials for improved sugarcane production, diffusion and capacity building

Specific Objectives

1. Backstopping of sugarcane stakeholders on agronomical packages of sugarcane
2. Dissemination and awareness' creation of sugarcane improved technologies to different events

Achieved Outputs

A total of 5000 flyers, 5000 brochures, 14 banners and 500 books have been developed and printed for sugarcane growers and other stakeholders.

1. A total of 3429 farmers attended sugarcane pavilion (1992 males and 1437 females) during farmer's day, conferences, exhibitions and inauguration of crop season.
2. 9 newspapers and 21 TV stations aired activities of Sugarcane
3. A total number of 2567 visitors (1733 Male and 834 Female) participated in the National agricultural (Nanenane) show held at Nyakabindi and Mwalimu Nyerere ground in Simiyu and Morogoro region respectively.
4. A total of 3700 brochures, 2428 flyers and 130 training manuals were distributed to participants covering sugar production, entomology, pathology, nematology and sugarcane business.

5. 14 different artwork banners showing sugarcane agronomic practices displayed during farmer's day, conferences, exhibitions and inauguration of crop season.
6. A total of 2656 people visited agricultural exhibition the SBT's pavilion at Nane nane grounds in Morogoro

6.4.2 Methodology

The development of training materials was done to all units which are breeding, pathology, entomology, nematodes, agronomy and technology transfer. The aim was each section to develop the user friendly materials for the available technologies which are directly to farmers needs showing the problems and solutions. The process of production was based on the available technologies which developed in each unit. The developed training materials were reviewed by experts. The developed extension materials were leaflet, brochures, banners and training manuals.
Training of trainers and farmers were prepared by using manuals prepared by researchers at TARI Kibaha by dividing the contents of training into nine different modules.

6.4.3 Results

At total of five (5) brochures from breeding, pathology, agronomy, nematology and technology transfer were developed and 1000 copies from each sections printed. Also five leaflets from same sections were prepared and 1000 copies printed to make up 5000 copies. Fourteen (14) art work banners showing sugarcane improved technologies were developed and printed, for awareness creation to different stakeholders of sugarcane. A total of 500 training manual for farmers and extension staff was reviewed and printed.(Table 6.3)

Table 6:3: Summary of materials printed and distributed

S/N	Type of Materials	Printed	Distributed	Percentage
1	Flyers	5000	2428	48
2	Brochures	5000	3250	74
3	Training Manual	500	130	26
4	Banners	7		

Nanenane Agricultural Show

The (Nanenane) National Agricultural Show is a one week event, usually from 1st to 8th August annually with the aim of show casing new technologies, ideas, discoveries and alternative solutions that will help to improve agriculture sub-sectors. In year 2019 TARI Kibaha was well represented at national level at Nyakabindi, Simiyu and zonal level at Mwalimu Nyerere ground at Morogoro, displaying various technologies that help to improve sugarcane productivity. A total of 3429 participants visited sugarcane pavilion (1992 male and 1437 females) during farmer's day, conferences, exhibitions (Table 6.4)

Table 6.4: Distribution of participants in Nanenane Agricultural Show

S/N	Location	Total	Male	Female

1	Nyakabindi	357	206	151
2	Morogoro	2210	1527	687

Awareness creation through different media channels

Newspapers as one of important mass communication were used also to create awareness on the developed sugarcane technologies (Table 6.5).

Table 6:5 Different types of newspaper explaining sugarcane production

S/N	Newspaper name	Date	Heading
1	Nipashe	11/08/2019	TARI Yaanzisha Mikakati Ya Uzalishaji Miwa
2	Mwanachi	19/11/2019	WakulimaWa Miwa Kunufaika Na Miwa
3	Citizen	19/11/2019	Sugarcane Small Scale Farmers Trained On Modern Agriculture
4	Mtanzania	21/01/2010	WakulimaWa Miwa Kibaha Washauriwa
5	Mtanzania	17/03/2020	TARI Yasaka Mbegu Zinazostahimili Ukame
6	Habarileo	06/03/2020	TARI Yaanzisha Mkakati Wa Uzalishaji Wa Mbegu
7	Nipashe	07/03/2020	TARI Kuongeza Tija Ya Miwa
8	Tanzania daima	10/03/2020	TARI-Kibaha Kusadia Wakulima Wa Miwa Kuongeza Tija
9	Nipashe	03/04/2020	TARI-Yaanzisha Uzalishaji Wa Mbegu Za Miwa

The use of Television in Technology Dissemination and awareness creation: The television was amongst the sources of information for the technology dissemination and awareness creation, on other hand, although farmers in the villages not all have television, access to the information was established high.

Table 6:6 Different types of Television programs explaining sugarcane production

SN	Type of TV	Program
1	ITV	TARI-Kibaha kutoa mbegu mpya
2	TBC	TARI-Kibaha kuendeleza zao la miwa
3	UTV	TARI - Kibaha kuzalisha miwa kwa kutumia viinitete
4	Chanel 10	Matokeo ya utafiti wa miwa kuwafikia wakulima
5	Abood TV	Mafanikio ya TARI-Kibaha kuwaondolea kero wakulima
6	ITV	TARI-Kibaha yajipanga kuwafikia wakulima wa miwa
7	TBC	TARI-Kibaha ilivyojikita kuzalisha mbegu za miwa
8	TBC	TARI-Kibaha yawafikia wakulima wa miwa Manyara
9	Chanel 10	TARI-Kibaha Yajipanga kuwasaidia wawekezaji sekta ya miwa
10	TBC	Shamba mtaji vipindi 12

6.4.4 Discussion

Printing of training materials: The printed materials were distributed to different stakeholders. A total of 3700 brochures, 2428 flyers and 130 training manuals were distributed to participants in different sugarcane stakeholder’s forum. (Table 6.4)

The printed materials contained the different technologies which developed by sugarcane research and the aims was to create awareness of available technologies of research to different stakeholders especially for those who wishes to invest in sugarcane industry.

Nanenane Exhibitions: A total of 357 visitors (206 males and 151 females) visited at Nyakabindi (TARI pavilion) of sugarcane and 2210 visitors (1527 males and 683 females) visited at Mwalimu Nyerere Nanenane agriculture show is a forum where farmers, researchers, and other stakeholders meet and exchange ideas on the available developed, therefore it was a good forum for showing our technologies for awareness creation among the technologies users.
Awareness creation through different media: About nine newspapers' in Tanzania, reported the news concerned with technology available at sugarcane and strategy to improve productivity to farmers. Furthermore, nine events concerning with the Television program was aired for awareness creation, this also was among on strategies to create awareness to stakeholders on technology available
Farmers day and launching of agriculture seasons: Kilosa, Kilombero and Mvomero districts launched agriculture seasons of 2019/20. TARI Kibaha was invited to display, and demonstrate different technologies that are important to farmers to increase sugarcane production and productivity. The technologies displayed by TARI Kibaha were released varieties of Sugarcane R570, N47, R579 and clean variety of NCO376. Different training materials such as leaflet, banners, flyers and posters were displayed and distributed to farmers and other stakeholders.

Figure 6.5: Farmers and other stakeholders listen the explanation of sugarcane crop

6.4.5 Conclusion and recommendation

Building capacity of farmers through enhancing agricultural knowledge and skills is the basic aim of agricultural extension services which ultimately improves farm productivity, income and living standard. Backstopping training and development of training materials are the user friendly knowledge sharing materials. It is very important in the dissemination of technology to farmers.

6.5 Promoting Sugarcane Production Technologies to cane Growers by using Mass Media Technique.

Project number: TT 2019/05
Investigators: John Msemo, Diana S. Nyanda Kinyau, M.and Ambilikile Mwenisongole
Collaborators: Farmers, VAEO's, DAICO, Local Area Officer, KSC, MSE and Farmers' Organizations
Reporting Period: 2019/2020
Remarks: Ongoing

Summary
Radio is one of the important mass media for transferring information to communities. It helps to narrow the gap between the extension officer and family households in obtaining information of agricultural technologies. In view of this, the implemented plan aimed at transferring knowledge of sugarcane technologies to growers at Kilombero, Kagera and Mtibwa mill areas. Radio recording for the year 2019/20 involves three radio station; Abood FM radio for Morogoro sugarcane growing areas, Karagwe radio for Kagera and Tanzania Broadcasting Cooperation (TBC) radio which cover larger part of countries. Also newspapers and you tube were used to disseminate technology to sugarcane farmers and other stakeholders. A total of 9 different news papers used to disseminate to farmers. Participatory Rapid Appraisal (PRA) were conducted at Misenyi for collecting information about radio and farmers' knowledge on sugarcane production at Bubale, Kyaka, Mtukula and Nsunga villages. One workshop was conducted at Missenyi district thereafter radio programme was prepared. The continuation of radio programs for Kilombero Kilosa and Mvomero districts were successful accomplished through Abood radio FM and TBC radio. Total of 26 radio episodes recorded and aired by TBC. Not only this but also 33 episodes recorded and aired by Abood radio, furthermore, 26 episodes recorded and aired by Radio Karagwe in Kagera region. Three documentaries conducted at Kilombero, Kilosa and Mvomero districts. A total of 335 calls received so far from listeners of Radio Karagwe, 462 Abood Radio and 76 TBC. More than 6000 messages received from all 3 radio stations, this indicate that these radio have potential influence in transferring technologies and narrow the gap between of extension officers and household's communities on knowledge and information.

6.5.1. Introduction

The use of mass media in agriculture is one of extension methods that bring attention and stimulate interest of farmers to receive information. The method used to reach quickly many people at the same time in different locations. The efficiency of this method is measured by their ability to change a static situation into a dynamic one. It comprises both electronic and print media such as bulletins, leaflets, posters, telephone, radio and newspapers, which play an important role in creating awareness about new agricultural technologies among farming communities across the world (Ali, 2011)
Radio is an important vehicle for increasing agricultural productivity through provision of relevant and current agricultural information on time and in the right format to stakeholders.

(Ariyo *et al*., 2013). According to Levi, (2015) radio was considered a cost-effective due to the large geographical coverage and timeliness in the provision of information to farmers on improved agricultural technologies. Radio is a one-way communication of technologies to farmers that creates the best combination of extension methods in disseminating agricultural technologies to farmers (Sam and Dzendu, 2015). This method is particularly useful in making a large number of people aware of new ideas and practices stimulate farmers' interest and alerting them to sudden emergencies.

Radio plays the most significant role of any communication technology in the transfer of information in African countries because spoken word on broadcast radio is the principal means of information transfer (Yahaya *et al*., 2012).

In Tanzania, various communication media are being used to transmit agriculture information. The communication media include, farm magazine, leaflets, newspapers, newsletter, pamphlets, radio and television. Among that radio programmes are the most accessible tools to many people therefore, the intended projects aimed to use radio to create awareness and dissemination of improved technologies to sugarcane farmers in Tanzania

Main objective

Promotion and awareness' creation of sugarcane production technologies through radio program

Specific objective

Dissemination of sugarcane production technologies in Kilombero, Kilosa, Mvomero and Misenyi mill areas

Outputs

1. A total of 33 episodes recorded and aired by Abood radio.
2. A total of 26 radio episodes recorded and aired by TBC radio.
3. A total of 26 episodes recorded and aired by Radio Karagwe.
4. A total of 3718 messages were received through radio karagwe.
5. A total of 335 telephone calls were received from radio Karagwe.
6. A total of 3250 message was received through Abood radio.
7. A total of 442 messages received through TBC Radio.

6.5.2 Methodology

The Execution of the Project Involved Three Stages

Stage 1: Information gap: In identifying information, Participatory Rapid Appraisal (PRA) and Focus groups discussion (FGD) were conducted at Misenyi. Tools used were crop calendar, matrix ranking and pair wise ranking and score. The selection of farmers was done purposively with assistance of extension officers of the particular area and criteria used were good record on production of sugarcane and participation on farmer field school. Villages used for PRA and FGD were Bubale, Kyaka, Mtukula and Nsunga at Misenyi district Kagera region.

Stage 2: Workshop for making radio contest: The second stage involved a workshop which aimed at deciding the basic component based on PRA and FGD results including picks out song for music show. Preparation of interviews and documents show and designed scripts.

Stage 3: Broadcasting radio program: The third stage was to broadcasting radio programs by identifying an expert in each program. The expert uses the contest prepared which was prepared at stage .The expert for airing radio was from TARI Kibaha and extension workers from respective districts and agriculture specialist from mill area.

6.5.3 Results

Radio preferences: Respondents were asked to name radio stations they tune and rank them according to preference. Overall 6 radio stations were among the preferred ones. Radio Karagwe seems to have wide area coverage and selected as one of the best radio stations followed by KCR and radio Mbiu (Table 6.7)

Table 6:7 Pairwise and ranking of most farmers preferred radio

	Karagwe	TBC	KCR	Radio mbiu	Kwizera	Kasibantu	Rumuli	Total	Rank
Karagwe		Karagwe	Karagwe	Karagwe	Karagwe	Karagwe	Karagwe	6	1
TBC			TBC	Radio mbiu	TBC	Kasibantu	TBC	2	4.5
KCR				Radio mbiu	KCR	KCR	KCR	3	3
Radio mbiu					Radio mbiu	Radio mbiu	Radio mbiu	4	2
Kwizera						Kasibantu	Rumuli	0	7
Kasibantu							Kasibantu	2	4.5
Rumuli								1	6

Preferred time for farmers to listen radio at Kagera region: The preferred time to listen radio according to farmer's preference was in late evening at 8:30pm to 9:30pm or 2:00 pm after evening news or at 7: 30 pm when most people are resting after farming activities. The most preferable format was farmers' interview in the fields and asking questions after presenter announced some topics in the radio.

Based on the finding from focus groups one workshop combined the extension officers and representative from farmers suggested that 26 episodes should be aired by Karagwe radio FM. In these findings all recorded episodes were aired in 2019/20 that covered land preparation and agronomic practices. According to radio Karagwe data total of 1510 calls were received from the respondents over directed calling, almost questions and comments were covered in all aspects.

Not only this but also total of 3718 messages were delivered and received to radio Karagwe from listeners on the questions and issues related to sugarcane.

Table 6:8 Summary of message and calls received from listeners of radio

Radio station	Number of Episode	Number of message	Number of calls	Farmers Interviewed
TBC FM	26	442	46	19
Abood FM	33	3250	198	33
Karagwe FM	26	3718	335	38

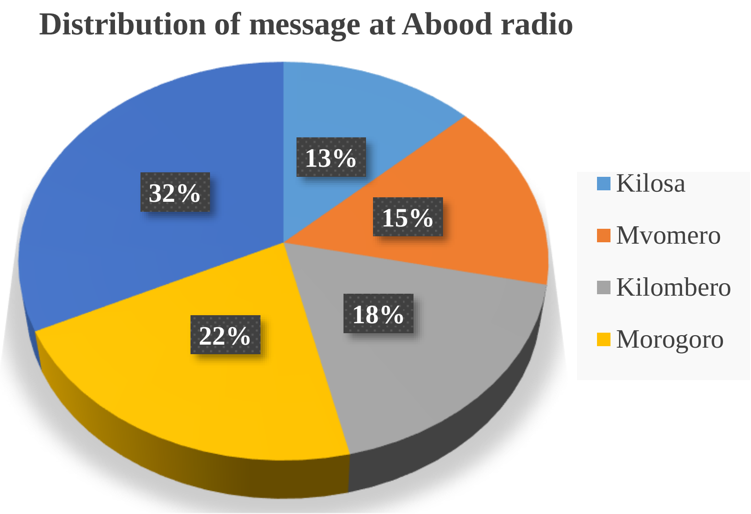

Figure 6:6 Distribution of messages asked by listeners on radio Abood program and aired.

The distribution of messages from viewers of radio Abood, from Morogoro sugarcane growing areas figure 6.6. It was worth to note that many messages were received from the sugarcane growing areas. The episodes were covered sugarcane issues which particularly sugarcanes varieties, preparation of multiplication plots, planting, management of sugarcane fields, fertilizer application rates and combination, weeds, insect diseases management and control.

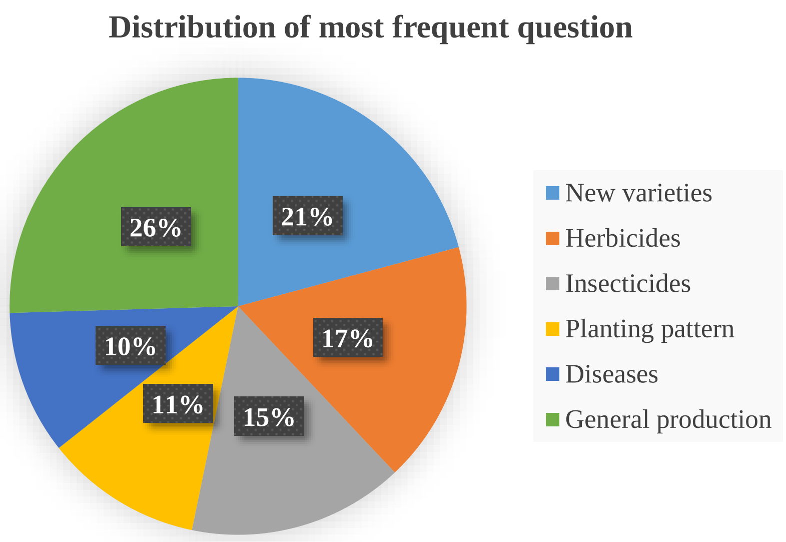

Figure 6:7 Distribution of Most frequent question asked by listeners

The listeners were interested to understand general production of sugarcane from zero stage to maturity (26%). Apart from that the demands for new varieties were also preferable (21%) as compared to other technologies, and these were according to summary of the questions asked by farmers (Figure 6.7). This is not surprising because currently the cane growers depend on two varieties NCO 376 grown in Morogoro areas and CO 617 planted at Kagera. Not only this but also listeners were interested on insecticides, herbicides, planting pattern and diseases.

6.5.4 Discussion

The radio program as methods for awareness creation show that demand for technologies from Sugarcane was not different among the farmers from different mill areas that is Morogoro regions and Kagera. The numbers of listeners were increased as radio program was aired and this are in line with number of studies which have shown radio has been in transfer and dissemination of information. FAO (2001) shows that radio is cheapest and most ubiquitous communication media. Preferred time to listen radio was difference between Lake Zone and eastern zone this was due to different in agro-ecological between these two regions, however it was worth to note that the message contents were the same.

In the scarcity of agricultural extension agents providing service to farmer's radio comes handy due to its wide geographical covering and this is also supported by study by (Girma Hailu *et al*,. 2017) which shows that radio is one of efficient tools in delivering agricultural information

6.5.5 Conclusion and Recommendation

The studies show that radio can be used to improve the sharing of agricultural information to farmers through participatory communication techniques. It can be concluded that radio programme were well received by target audience who were among major sources of information to small scale sugarcane growers of Morogoro and Kagera regions. The format presented were easily understood, the experience found from farmers after obtained skills through radio indicated that sustainability and continuity of these programed must be taken into consideration. Furthermore, practical training is required to extension officers in order to supplement more knowledge to sugarcane growers who acquired knowledge through radio program.

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