SPGRC Network News

A Publication of the SADC Plant Genetic Resources Network

January - June 2018

SPGRC Board Meeting Held in South Africa

The 34th SPGRC Ordinary Board meeting was held in Johanesburg, South Africa from 30th November to 1st December 2017.

2017 SPGRC Board group photo

The Board Chairperson, Mr Godfrey Mwila welcomed Board members to the meeting. He extended a warm welcome to Mr. Justify Shava, the new SPGRC Head, thanked Mr Barnabas Kapange for acting for one year up until the Head took position after the departure of Dr Paul Munyenyembe, the former SPGRC Head. The Board Chair said the network deserve to be seen as active players regionally and internationally and that this needs to be reflected into the revised MoU framework, as deliberated during the previous Ministers of Agriculture meeting. Mr Makabanyane commended SPGRC efforts of enhancing its cooperation with potential funding institutions in the area of plant genetic resources conservation and utilization such as the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), Global Crop Diversity Trust, Southern African Network for Biosciences (SANBio) Network, Bioversity International as well as the Nordic Gene Bank.

The meeting was opened by Mr Winston Makabanyane, (Acting Director General for the South African Department of Agriculture, Forestry & Fisheries) who on behalf of the Acting Director General of the South African Department of Agriculture, Forestry and Fisheries welcomed members to South Africa. He then highlighted that the SADC region has witnessed profound changes in environmental conditions due to the effects of climate change. The average annual ambient temperatures were reportedly increasing; droughts and floods were now negatively affecting the region more often than before. He said all these scenarios require a wide crop genetic base from which newly adapted varieties must be developed. Plant Genetic Resources form a broad pool

Strengthening National Capacities on Plant Genetic Resources in the context of the Information System of Article 17 of the International Treaty

The workshop on strengthening national capacities on plant genetic resources in the context of the information system of Article 17 of the International Treaty was held in Cape Town, South Africa between 11th and 15th December 2017. It was organised by the Secretariat of the International Treaty on PGRFA in collaboration with the SADC Plant Genetic Resources Centre (SPGRC) and the FAO Office in South Africa.

Participants' group photo

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Strengthening National Capacities on Plant Genetic Resources in the context of the Information System of Article 17 of the International Treaty

The event was made possible by the financial support of the Government of Germany through the project GCP/GLO/685/GER and the Genetic Resources Policy Initiative executed by Bioversity International and supported by the Government of The Netherlands.

Participation included all SADC Member States except Seychelles and Tanzania. Four other African countries (Congo Brazzaville, Ethiopia, Eritrea and Uganda) were present. All countries presented their reports on progress achieved during the previous season and work plans for the coming season. On the second and third day of the meeting, the Treaty Focal Point representatives had a separate meeting and discussed matters on the outcomes of the 7th Governing Body meeting.

The objective of the workshop was to enhance both individual and institutional capacities to document and exchange plant genetic resources in the context of the Global Information System (GLIS) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). It also offered the opportunity for Treaty national focal points to discuss and follow up on the main decisions adopted by the Seventh Session of the Governing Body.

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SPGRC Board Meeting Held in South Africa

SPGRC Board in Session, December 2017

of diverse genes with a potential for resilience against all forms of challenges in agriculture.

Giving a vote of thanks on behalf of the other Board Members, the Angolan Board Member, Dr Pedro Moćambique thanked the Director, Africa Relations in the Ministry of Agriculture, Mr Winston Makabanyane for representing the Acting Director General who could not officiate at the 34th SPGRC Board Meeting due to other official commitments. Dr Moćambique thanked South Africa for hosting the SPGRC Board Meeting. He thanked the Acting Director of FANR at SADC Secretariat for attending the meeting. He also thanked the SPGRC Management for organising the meeting. He then wished the Board fruitful deliberations during the meeting.

Term of office tenure for the Board Chair and Vice-Chair were expiring and therefore the Board, through a secret ballot, elected Lesotho to be the Chairperson of the SPGRC Board taking over from Zambia and Zambia was elected the Vice Chairperson.

Web-based SDIS Training Workshop

The SPGRC Documentation and Information Unit is developing and rolling out a revised web-based database system, the SPGRC Document & Information System (SDIS) through engaging the users of the system. The system has been installed in most countries and the users have been contributing comments to fine-tune the system at country level.

In order to make an information system meaningful and more applicable, the data generated and captured needs to be standardized in terms of terminology used and format. Plant genetic resources managers have recognized the need for internationally accepted systems to record, classify, communicate, correct or update information about the germplasm they maintain. It is for the above reasons, SPGRC organised the training workshop for Documentation Officers on the use of the web based SDIS so that the region can add more comments, adopt it and benefit more from its use in Pretoria, South Africa, from 16th to 20th April 2018. The training was meant empower them to use the system thus making the web based SDIS the standard Plant Genetic Resources documentation system of the SADC region.

Participants of web-SDIS training, Pretoria

The workshop also touched on a very important subject of effective project proposal writing so that the region can collectively develop fundable project proposals.

Participants came from all the 10 SADC Member States namely Angola, Lesotho, Malawi, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Zambia and Zimbabwe. Countries that were not represented included Botswana, Comoros, DRC, Mauritius, Madagascar, Tanzania.

At the end of the workshop, participants were able to improve and provide documentation standards acceptable to all Member States; and to develop effective

Eco-Geographic Distribution of Terrestrial Edible Orchids in Tanzania: Implications for the Conservation of Plant Genetic Resources

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Abstract

The orchid (Orchidaceae) is one of the big plant families in the world, very popular due to its potential in flower industry. In Africa and South East Asia, the tubers have for a long time been used for food and medicine. Due to high pressure on their harvesting and high rate of habitat degradation, all species in the family are classified in the Convention on CITES class I and II. In Tanzania, over recent years there has been high rate of exploitation of orchid tubers for food and trade accompanied by high pressure on land resources and placing a number of orchid species in danger of disappearance. The wild edible orchid genera are found throughout the country, but high diversity was recorded in the southern highlands area where high rates of exploitation have been reported to extent of threatening the future availability of the species. Efforts to plant the orchids on farmers' fields which is an alternative to wild harvesting has been slowed down by lack of appropriate technologies for orchid propagation. For the long term sustainability of the orchid species in the area, it has been recommended that a multi strategy approach be considered as long lasting solution to the future existence of the orchids in the area.

Keywords: Orchids, Threat, Conservation

1 Introduction

The orchid (Orchidaceae family) is among the most popular plant families in the world. The plants are recognized for their attractive flower colour and shape which make them the highly admired garden plants, contributing billions of dollars in the horticultural industry in Europe and America. In the southern African and South East Asian countries, the orchids for decades have been used for food and medicine to the communities. The tubers are harvested from the wild and processed into meatless sausage (chikanda) which is consumed locally and sold in local and urban markets (Temu and Chihongo 1998; Ruffo 2000; Hamisy and Millinga 2002; Davenort and Ndangalasi 2003; Hamisy 2005; Challe and Struik 2008). It is reported that between 2.2 and 4.1 million orchid tubers are harvested annually in the Southern Highlands of Tanzania and sold in the neighbouring countries of Zambia and Malawi (Bingham 2000; Davenport and Ndangalasi 2003).

Following their high potential as food plants, high exploitation pressure has been exerted on the species in the Southern Highlands of Tanzania to the extent of threatening their future existence (Davenport and Ndangalasi 2003; Hamisy 2005; Challe and Struik 2008). Apart from high exploitation rate, the Southern Highlands areas is known as among the highly populated areas in Tanzania, as a result, there is high demand for land resources for agriculture, settlement and plantation forestry. The named population pressure has caused the clearance of a large part of the natural forest including the orchid habitats (WCS 2003).

Orchid of S. Highlands

Orchid of S. Highlands

Therefore, this study evaluated the eco-geographic distribution of the edible wild orchid genera in Tanzania with the aim of generating the information that will assist in the effective conservation planning.

2 Material and Methods

2.1 Study Area

The study was carried out in Tanzania mainland whose total coverage is about 945,000 Km^2, and which has great diversity of plant species being next to DRC and South Africa in ranking (Rufo 2000). The vegetation has been classified into five phyto-geographic regions named: Afo-motane, Lake Victoria, Somali – Masai, Zambezi and Zambia inhambane (Ruffo 2000).

For the purpose of this study, the country was divided into six zones:

- Southern highlands: covering the southern part of Tanzania including Ruvuma, Mbeya, Iringa, Rukwa and Katavi regions;
- Coast zone: covering the coast area from Tanga to Mtwara (Tanga, Dar es Salaam, Coast, Lindi and Mtwara);
- Central zone: covering central Tanzania with Dodoma and Singida regions;
- Northern zone: covering northern part of Tanzania including Arusha, Kilimanjaro and Manyara regions;
- Western zone: covering part of Rukwa, Kigoma and Tabora regions; and

- Lake Victoria region: covering regions surrounding the Lake Victoria (Mwanza, Mara and Kagera.

2.2 Methods

2.2.1 Herbaria Study

The herbaria studies were carried out at the National Herbarium of Tanzania in Arusha, East African Herbarium in Nairobi, Kenya and the Herbarium of the Botany Department at the University of Dar es Salaam. It involved review of the collected voucher specimens for the orchids and databases such as BRAHMS software, and the Flora of Tropical East Africa.

2.2.2 Field Survey

The field surveys were conducted in the Southern Highlands of Tanzania (Mbinga and Makete districts), the area identified to harbour high orchid species diversity in Tanzania. The study involved semi structured interviews with the District Natural Resources Officers, followed by selection of the study village representatives of the available agro-ecological zones in the area. Six villages were selected in Makete and three villages in Mbinga districts. The key informants (30 households per village) were randomly selected using village register. Participatory interviews were carried out using questionnaires to generate information on the available orchid species in the area, identify the edible species and their habitats, conservation status, indigenous knowledge on its uses. Transect works were carried out in the nearby forests and the orchid species samples were collected by carefully uprooting the plants, preparation of voucher specimens, drying and exporting to the National Herbarium of Tanzania for identification and confirmation.

3. Results and Discussion

3.1 Diversity and Distribution of Wild Edible Orchid Genera in Tanzania

The study recorded 762 sample specimens for 131 orchid species of the three wild edible orchid genera: Disa (21), Habenaria (77) and Satyrium (33) (Figure 1).

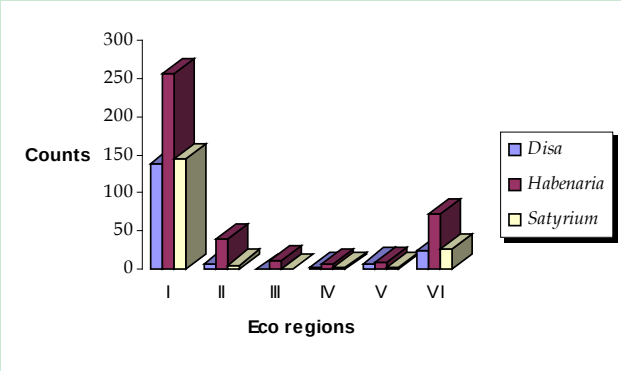

Figure 1: Disa, Habenaria and Satyrium species richness in Tanzania mainland

The Disa, Harbenaria and Satyrium species are widely distributed in Africa found throughout the tropics and sub-tropical regions. In Tanzania, the species occurs throughout the country, with the highest species diversity in the Southern Highlands area (73%) followed by the Northern Zone (13 %), Coastal (7 %) while the rest accounted for 2 – 3 % of the total records.

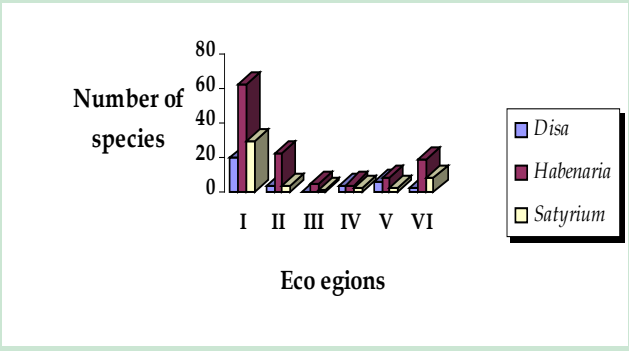

Figure 2: Disa, Habenaria and Satyrium species richness in Tanzania mainland

Table 1: The study villages in Makete and Mbinga districts

District	Ward	Village	Latitude	Longitude	Altitude (m.a.s.l)
Makete	Kituro	Nkenja	09⁰ 08′ 38″	34⁰ 00′ 55″	2500
	Iwawa	Ndulamo	09⁰ 14′ 26″	34⁰ 08′ 14″	2200
		Makangalawe	09⁰ 20′ 810″	34⁰ 20′ 528″	2400
		Ilundiwe	09⁰ 21′ 900″	34⁰ 14′ 613″	2360
		Numbe valley	09⁰ 04′ 1470″	33⁰ 58′ 800″	2487
		Ibaga	09⁰ 14′ 2890″	34⁰ 14′ 400″	2472
Mbinga	Mpapa	Mitawa	09⁰ 08′ 04″	34⁰ 54′ 36″	1500
	Tingi	Mpeopo	11⁰ 27′ 09″	35⁰ 04′ 31″	1480
	Liwili kitesa	Liwili kitesa	09⁰ 15′ 042″	34⁰ 20′ 360″	1590

Species wise, the Southern Highlands was the leading by having the highest number of species (56 %) followed by the Coastal and Northern Zones (14 %). Habenaria was the most diverse genus accounting for 56 % of the total species followed by Satyrium (25 %) while Disa had the least (16 %).

Disa species were found throughout the country with varying diversity, The largest number of Disa (58%) were recorded in the Southern Highlands (Iringa, Mbeya, Ruvuma and Rukwa), followed by the Western zone (16%) while very low number of were found in the Central zone. Among the recorded species some had very little number of observations (D. aequiloba, D. aperta, D. cryptantha, D. engleriana, D. equestris, D. longilabris, D. ornithantha, D. rungweensis, D. satyriopsis, D. saxicola, D. ukingensis, D. zombica).

The Habenaria species also had the largest number of species in the Southern Highlands of Tanzania (52 %), followed by the Coast (18%) and the Northern Zone (16 %) with very few species recorded in the remaining zones. The genus was the richest in species most of which were common with very few rare species such as Habenaria anaphysema, H. armatissima, H. burtii, H. helicoplectrum, H. holothrix, H. inaequiloba, H. insolita, H. leucotricha, H. lithophila, H. mirabilis, H. indiana, H. odorata, H. pauper, H. perpulchra, H. rauta, H. rhopalostigma, H. richarsiae, H. triraceras, H. tweedieae, H. chirensis, H. cirrhety, H. fricornis, H. galactantha, H. genuflexa, H. haareri, H. ichneumonia, H. ineequiloba, H. insolita, H. kassnerana, H. magnitostlis, H. macrandra, H. tenuispica, H. trilobulata, H. xanthochlora and H. zambesica.

The genus Satyrium was frequently recorded in the Southern Highlands (64%), followed by the Northern Zone (18%). Most of the species in this genus had a very narrow range of distribution except S. anthersteis, S. crassicaule, S. sacculatum, S. volkensii.

Although the edible orchid genera were found throughout the country, the Southern Highlands bears the largest diversity (78%) compared to other areas, meaning, conserving the orchids in the Southern Highlands will capture more than one-third of the available edible orchids genera in Tanzania. Although some species are too specific in their habitat preference, the issue needs not to be underestimated.

3.2 Diversity and Local Knowledge on Orchid Utilization in Makete and Mbinga Districts

3.2.1 Diversity of the Wild Orchids

Apart from a report that more than 80 orchid species are in danger due to root harvesting (Davenport and Ndangalasi 2003), this study recorded about thirty orchid species in Makete and Mbinga districts out of which 14 (47 %) were reported to be used for chikanda while 13 (43 %) were not and 3 (10 %) were used in some communities and not used in others (Figure 1a). The named difference shows that there are still a number of species that could not be captured by this study due to various reasons, one being that they have already gone extinct in the area (Nyamora 2005).

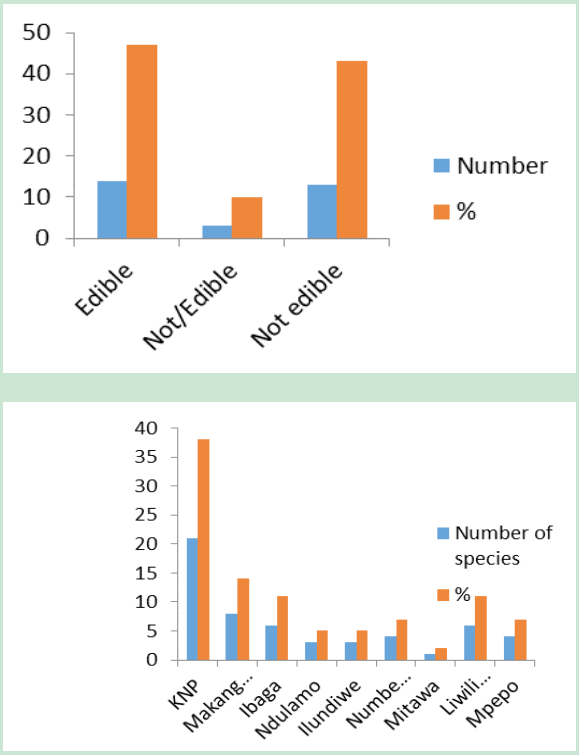

Figure 3: Distribution of edible and non-edible orchids in Makete and Mbinga districts

Generally, Makete District had the highest total number of orchids as well as the used orchids compared to Mbinga District. The largest number were found in the Kitulo National Park (38%) followed by Makangalawe (14%).

The Kitulo National Park with 38% of the total orchid species is the only conserved area. This area protects about one-third of the species in the area with the remaining 68% falling out of the protected area. However, apart from the area being conserved, some illegal harvesting still exists which continues to threaten the survival of the species in the area.

3.2.2 Naming of Wild Edible Orchids

In Makete districts, the local communities name the orchids based on market potentials of the species. The names such as Dume, Jike, Dume Feki, are used for the species that have market potentials while Masekelele, Masekeni are used for non-marketable species. On the other hand, in Mbinga District, local communities name the orchids based on morphological features and behaviour of the tubers during chikanda preparations. The naming is useful for the communities in identifying which species to collect but it does not correspond to the scientific classification as also noted by Cunningham (2001).

Apart from the named preferred species, in case the preferred species absence, farmers switch to the non-preferred available species, which explains the presence of species used by some communities and not used by the others. In this situation, a precise account of the edible orchids can only be comprehended through both morphological and molecular markers. In most cases, the most preferred orchids are those that do not have the core, as well as those with

crystal-like and sweet flesh. However, other factors were also pointed such as tuber size and flesh colour though less important in the selection process.

3.2.3 Wild Edible Orchid's Habitat Preferences

Most of the species in Makete District were found on the open grassland areas with some sparsely distributed in the shrub areas and few species were found on depression along the river in wet soils either as single plants or in a group. In Mbinga District, the orchids grow in wet to very wet sand soils in deep shade, open montane forests, perennial wet lands, and some species of Habenaria were found in dry woodland area.

In Makete District, the edible orchids were found in a number of locations with the Kitulo plateau being the most potential area followed by the Kipengere mountain ranges. In Mbinga, the orchids grow in a number of locations; however, most of the areas have been cleared for agriculture hence only few habitats remain such as the grasslands in Mpepo, Lipalamba game reserves and in Liwili Kitesa forest.

3.2.4 Conservation Status and Threats

Generally, land degradation for settlements and agriculture were the serious problem both in Makete and Mbinga districts. The area is known to be among the highly populated in the country hence competition for land area for agriculture, settlement and conservation is so high. Most of the forests in the area are almost gone. Orchid harvesting is another source of threats to the existence of orchids. The harvesting involves removal of whole plant hence diminishing the hope for plant regeneration. It is estimated that a total of 2,220,000 tubers are harvested annually for sale to Zambia (Davenport and Ndangalasi 2003). While in Makete the orchids are collected mainly for sale to Zambia and other area like Mbinga; in Mbinga itself, the orchids are collected for local consumption. Due to depleted resources in the area, communities import orchids from other areas such as Tunduru Njombe and Makete districts; sometime crossing the national borders into Mozambique.

Orchid propagation trial at the NPGRC in Arusha, Tanzania

3.2.5 Socio-economic Importance of Orchids

The orchid form one of the most profitable commodities to the rural communities in Makete and Mbinga districts hence contributing to the livelihood improvement. In Mbinga District, one sack (approx. 100 Kg) is sold at Tanzanian Shillings 120,000.00 (equivalent to about US$ 55.00), which is generally the most profitable business compared to that of formal crops. This therefore contributes to high rate of exploitation both in Makete and Mbinga districts thus contributing to orchid resources diminishing in the area. Local communities have reported trying to grow the orchids on their farm, but less productive (one tuber produces only one tuber) which is a major hindrance. Nyamora (2005) also noted that one orchid tuber give rise to only one plant by vegetative means of reproduction. Production of orchids using seeds is limited due to poor knowledge on seed viability and survival.

Stalk of orchid tubers abandoned by illegal collectors in Makete, Tanzania

4. Conclusion and Recommendations

Tanzania and in particular, the Southern Highlands region harbour high diversity of the wild edible orchid species. However, the orchids in this area are facing high threat of disappearance due to high rate of collection for use as well as high pressure on land resources. Effort to cultivate the species has been challenged by lack of appropriate propagation techniques. Though important, most of the wild edible orchids are yet to be identified. Currently, the identification work has been based on local and morphological characteristics which sometimes fail to give accurate results. Hence it is recommended that more efforts be devoted into species identification using more sophisticated molecular markers, studies on propagation techniques be conducted to develop the more efficient protocols for use by the rural communities. There should be more effort to promote on farm cultivation, ex-situ and in-situ conservation.

5. Acknowledgement

The author wishes to thank the Rufford Foundation for funding this study, the Tropical Pesticides Research Institute (TPRI) administration for allowing its staff to participate in the study as well as District authorities (District Natural Resources Officers, Extension Officers) and farmers who gave maximum cooperation to the research team without which this work would have not been successful.

Tillage No Better Than Minimum Tillage

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1. Background

Over the years, land preparation through a series of operations using tractor-drawn equipment was observed not only to be expensive but also environmentally unsustainable. The adverse effects of repeated tillage of soil using conventional land preparation equipment have been alarming. Continuous use of tractors and other heavy plant machinery is considered to be one of the main contributing factors to the increase in greenhouse gas emissions and has resulted in massive loss of topmost layer of cultivated soils.

In order to raise awareness aimed at addressing the permanent loss or displacement of top soils in cultivated lands and the heavy usage of agricultural machinery, the world realised the need to revert back to minimum tillage practices in order to reduce run-off and soil erosion, increase water infiltration, conserve soil moisture and maintain a permanent soil cover. Consequently, a variety of modern minimum tillage equipment were developed and promoted the world over, including Eswatini. The new land management trend raised questions on the most appropriate and cost effective tools and tillage methods including their economic benefits. Consequently, urgent need to conduct research especially in maize, Eswatini's staple food crop intensified in order to guide farmers in making informed evidence-based decisions.

2. Study Objective

The objective of the current study was to compare the agronomic performance of maize under different tillage practices (methods) in order to identify and promote agronomic tillage practice(s) that are environmentally sustainable and most beneficial to the farming community.

3. Methodology

3.1 Field Layout and Treatments

A field experiment which was in its fourth season was conducted at the Malkerns Research Station in Eswatini, during the 2016/2017 cropping season. The trial was laid out in a Randomized Complete Block Design (RCBD) with three replicates. There were five trial treatments consisting of conventional plough (control) treatment), hoe basins, jab planter, a combination of tractor drawn ripper with a tractor drawn plus direct seeder (T.R.D.C), and a tractor drawn direct seeder (T.D.S) treatments.

Planting was done on the 3rd of November, 2016 using commercial maize variety, SC 719. Compound basal fertilizer NPK 2:3:2 (22) was applied at a rate of 400 Kg/ha at planting, thus applying 25 kg/ha, 38 kg/ha and 25 kg/ha for N, P, and K respectively. Side dressing with Nitrogen in the form of LAN (28%) (28 kg/ha) was applied 35 days after planting.

Clear-out herbicide was applied at 400 ml per 20 litre of water (4 litres /ha) on untilled plots while Dual gold at 100 ml / 20 litres was applied for pre-emergence herbicide on all plots at planting. A mixture of Bladex at 400 ml and Decis at 15 ml per 20 litre of water each was applied at 5 weeks after planting for weeds, and stem borer (Busseola fusca) control respectively.

3.2 Data Collection

Data was collected on various parameters including emergence count, soil moisture, bulk density, infiltration rate, plant height, dry matter yield and grain yield.

3.3 Infiltration Rate

At 9 weeks after planting, the soil infiltration test was carried out in all the treatments using a double-ring infiltrometer. The rings were driven into the soil using a 2 kg hummer only in one replicate representing all the 5 treatments. Water was poured into the rings and the time taken for every 10 mm percolating into the soil was recorded.

3.4 Data Analysis and Presentation

Data was analyzed using Gen-Stat Statistical Package. The Analysis of Variance (ANOVA) was used to determine variation between the treatments and the mean separation test was done using least significant difference (LSD).

5. Results and Discussion

5.1 Plant Height

Plant height results (Table .1) show a significant difference in the maize plant height between the treatments at the early stages of development ($p < 0.05$). At 7 weeks after planting, the conventional and T.R.D.S tillage methods recorded a significantly higher plant height (122.01 cm and 120.5 cm respectively) than the other three tillage methods. At 9 weeks after planting, T.R.D.S recorded a significantly higher ($p<0.05$) plant height (208.2 cm) than the conventional plough (194.4 cm) and T.D.S (193.8 cm) which in turn, scored higher ($p<0.05$) than the under basins and the jab planter

tillage methods treatments, (183.8 cm and 179.4 cm respectively). Growth in height, however, had stabilized during the 21st week after planting as the different treatments – conventional and the T.R.D.S treatments were surpassed by the T.D.S which scored significantly higher ($p<0.05$) at 268.5 cm than the rest of the tillage methods treatments.

Table 1: Maize plant height (cm) at 7, 9, and 21 weeks after planting (WAP) as per the treatments

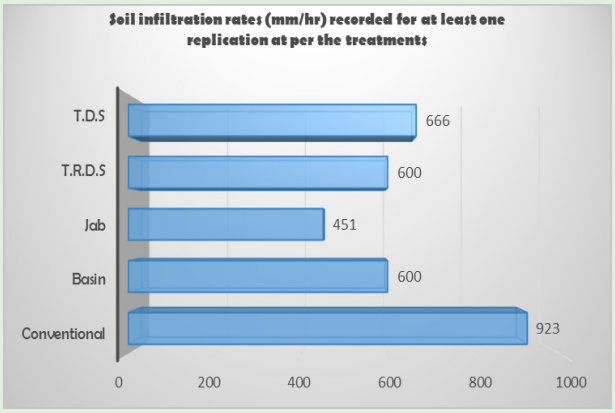
Treatments	Plant Height		
	7 WAP	9WAP	21WAP
Conventional	122.01b	194.4b	260.3a
Basin	111.7a	183.8a	265.4a
Jab	109.7a	179.4a	248.0a
TRDS	120.5b	208.2c	266.0a
TDS	112.1a	193.8b	268.5b
Sig. <0.05	*	**	*
C.V%	3.4	3.2	3.7
LSD – 0.05	7.39	11.43	18.36

Table 2: Grain yield (tons/ha) for the 2016/2017 cropping season

Treatment	Grain Yield (tons/ha)
Conventional	9.57a
Basin	8.95a
Jab	9.09a
T.R.D.S	9.90a
T.D.S	9.58a
Sig. <0.05	N.S
C.V%	6.5
LSD - 0.05	1.16

5.2 Infiltration Rate

The outcome from the soil infiltration rate test showed that infiltration rate is higher under conventional tillage (923 mm/hr), followed by the T.D.S (666 mm/hr), basin and T.R.D.S both at 600 mm/hr. Infiltration rate was lowest under Jab planter. The generally low infiltration rate trend under minimum tillage practices may imply high compaction and hence low infiltration rate under minimum tillage methods plots compared to conventional tillage.



5.3 Grain Yield

The grain yield results (Table 2) show that there is no significant difference ($p>0.05$) grain yield between conventional ploughing and the four minimum tillage (conservation tillage) methods although T.R.D.S treatment recorded a much better yield of 9.90 tons/ha than all other treatments. This was followed by T.D.S (9.58 ton/ha), conventional (9.57 ton/ha), jab planter (9.09 ton/ha) while the hoe-dug basin tillage treatment scored the least yield (8.95 ton/ha). This implies that conventional tillage produce the same maize yields obtainable when planting is done using minimum tillage. However, the general trend for the across season results from 2013/2014 to 2016/2017 for each cropping season (Figure 1) and for each tillage method (Figure 2) show a decrease in maize yield under the direct seeder or jab planter tillage practices. On the other hand, the results show that the use of a combination of ripper and direct seeder leads to increase in yield over seasons.

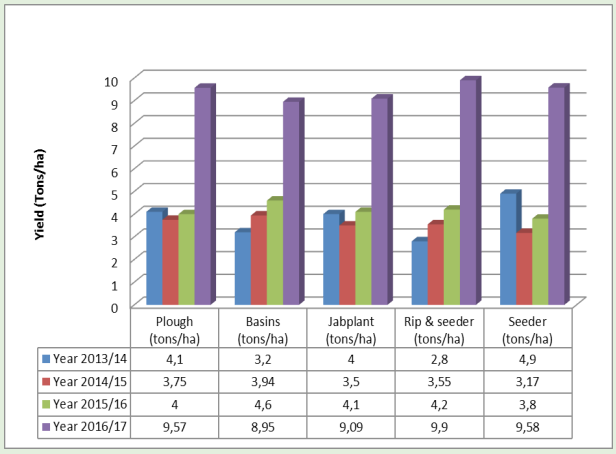
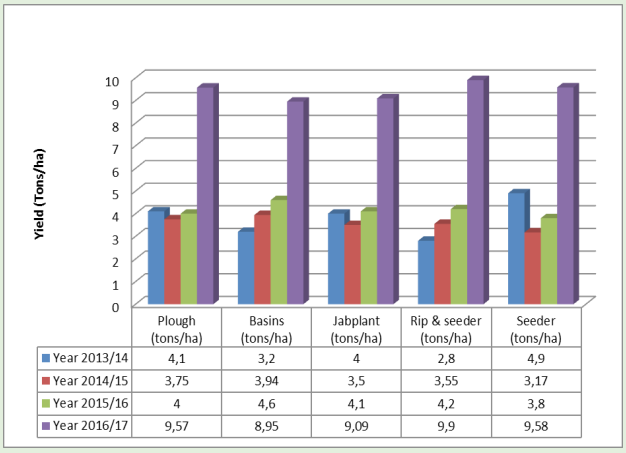


Figure 1: Maize grain yield (tons/ha) of 4 cropping seasons for each tillage methods practice



	Plough (tons/ha)	Basins (tons/ha)	Jabplant (tons/ha)	Rip & seeder (tons/ha)	Seeder (tons/ha)
Year 2013/14	4,1	3,2	4	2,8	4,9
Year 2014/15	3,75	3,94	3,5	3,55	3,17
Year 2015/16	4	4,6	4,1	4,2	3,8
Year 2016/17	9,57	8,95	9,09	9,9	9,58

Figure 2: Maize grain yield (tons/ha) for different tillage methods practices for each cropping season

Conclusion

The soil moisture trends by tillage and cropping systems were inconsistent for the season ($p<0.05$). However, on average, the hoe basins, jab planting, ripper + direct seeder and direct seeder conserved the highest moisture compared to the conventional (control) treatments.

In short term (1st to 2nd year): During the initial stages of switching from conventional to conservation agriculture (CA), adoption Jab planter and direct seeder tillage practices, produce yield were comparable or even slightly higher than conventional tillage but significantly higher than other minimum tillage practices probably due to low compaction of the soil.

In medium term (3rd to 4th year): From third year, maize planted using Jab planter and direct seeder tillage methods practices became highly compacted. This results in decline in yields due to low infiltration and hence low soil moisture retention and poor plant growth and development.

The non-incorporation (burial) of crop residues in CA plots results in accumulation of residues on the surface, which blocks proper seed placement in soil during direct seeding. This results in poor germination and plant stands in direct seeded plots. Hence light disking may be necessary in order to chop and incorporate residues into the soil for soil structure improvement.

It is worth noting that the control of notorious weeds especially grass species such as Cynodon species is the major challenge in CA, an indication that no till methods alone are not a solution. Mechanical weed control using hand hoes is also dependent on soil type. This is a major challenge in soils that compact easily under pressure such as red loamy soils that forms a hard pan. Under such circumstances, the incorporation of other CA principles such as the use of legume cover crops in rotation or as an intercrop which have other potential benefits is very important. Otherwise, the use of herbicides with caution is unavoidable in the short term especially at planting and under continuous rainy conditions.

Recommendations

Based on an across season' results for 4 cropping seasons, 2013/14 to 2016/2017, it has been observed that no single tillage equipment including conventional plough is effective enough for optimal maintenance the principles of CA when use alone. The use of a combination of tractor drawn ripper and direct seeder where clear-out herbicide is used at planting (at-least in the short term), is therefore recommended. Also, where no till is practiced using hoe basins, jap plant or tractor drawn direct seeder, the need for deep ploughing with chisel plough or ripper every 4 to 5 cropping seasons in order to break the hard pan, and promote infiltration at some point arise.

Lessons Learnt About Minimum Tillage over Past Four Years of Trial

- In some or all minimum (no)–till treatments, incorporation of crop residues or stalks which conventional ploughing accomplishes is excluded, leading to accumulation of stover without or with minimal breakdown for seasons which in turn results in difficulties in planting especially with T.D.S in subsequent seasons.
- It also precludes livestock feeding on stover that reduces maize stover breakdown in on-station trial environment because of the absence of livestock. However, there is still a need to continue with this study to a medium to long term period in order to understand the effect of residue build up on soil physical properties over time and hence agronomic performance of maize crop.
- There is need for agricultural engineers who would design new or modify existing equipment to address challenges. Likewise, there is need to invest towards the development of appropriate and user-friendly cost effective equipment.
- Currently available equipment (T.D.S) is also inappropriate for a majority of maize farmers due to small size of their farms and is thus expensive and unaffordable to the resource poor. The jab planter on the other hand is laborious and requires energy, and thus not user friendly to the current crop of farmers who are either old aged or weak. The technology has so far been evaluated through on-station trials at Malkerns where there is minimal microbial activity partly due to resource constraints, and thus still need to be replicated in different agro-ecological zones of the country.

Svalbard Seed Vault 2008–2018 Anniversary

Entrance to the Svalbard Global Seed Vault

In February 2008, the eyes of the world focused on a frozen mountainside on an archipelago in northern Norway – the site of the Government of Norway's Svalbard Global Seed Vault. The Vault was built to provide a backup system for storing and safeguarding samples of the world's agricultural seeds deep inside a permafrost mountain.

The opening of the Seed Vault captured the imagination of the world, with journalists comparing it to a Noah's ark for seeds. Today, as the world is observing the tenth anniversary of the Seed Vault, there can be no doubt as to the enormity and importance of this Norwegian contribution to the future of global food security.

During the ten years since Norwegian Prime Minister Jens Stoltenberg opened the Seed Vault on behalf of the Norwegian Government, the number of deposited seed samples and depositing institutes has steadily increased. With more than a million seed samples now safely deposited in the vault, the Food and Agriculture Organization of the United Nations (FAO) estimates that the vault now houses samples of 40 percent of the world's total agricultural seed diversity.

Svalbard Global Seed Vault Coordinator Åsmund Asdal in front of the Seed Vault

Ceremonial seed deposit by Head of SPGRC

Operated Through Three-Party Agreement

Svalbard Global Seed Vault is established, owned and mainly financed by the Norwegian Government. The organisation Crop Trust contributes with some of the funds while NordGen is operating and managing the Seed Vault. This is all regulated in a three-party agreement. It is also NordGen, on behalf of the three parties, that arranges the 10 Year Anniversary

Gene Banks From All Over the World

As part of the 10-year anniversary celebration, more than 60 thousand new seed samples from about 20 gene banks were added to the ever-growing Seed Vault. Their deposit were accompanied by a modern dance choreographed and performed by the Arctic Theatre in Tromsø to interpret the glacial drama the vault inspires.

At the "10 year anniversary seed deposit" hosted by the Norwegian Minister for Agriculture and Food Jon Georg Dale, seed samples from all part of the world were brought into the Vault. Gene banks from North- and South-America, Africa, Asia, Europe and Australia have packed and shipped seeds for the anniversary. Many of the gene banks were also represented by gene bank managers and/or scientists.

Source: http://www.seedvault.no/news/svalbard-seed-vault-2008-2018-anniversary/
and https://www.nordgen.org/en/one-million-seed-samples-safeguarded-svalbard-global-seed-vault-celebrates-10-years/

Notice to Readers

Our New Telephone Numbers:

Following upgrading of ICT infrastructure and communication systems, our telephone numbers have changed to:

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(Please inform others)

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