

Book of Abstracts

Scientific Conference for the Agricultural Productivity Programme for Southern Africa (APPSA)



BINGU INTERNATIONAL CONFERENCE CENTRE IN LILONGWE, MALAWI
30th October – 1st November 2018



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PREFACE

The policy conditions needed to facilitate the movement of agricultural technologies within the SADC region are in place, but national systems face challenges in improving their technology and service delivery systems. The challenges include a lack of capacity to implement technology transfer, ineffective extension services, and bottlenecks in information systems for innovation. In order to provide a forum for research and development practitioners to present and discuss outputs from the technology generation and dissemination activities implemented under the Agricultural Productivity Programme for Southern Africa (APPSA), the Center for Coordination of Agricultural Research in Southern Africa (CCARDESA) organized a scientific conference in Lilongwe, Malawi. Specifically, the conference was aimed at providing a platform for researchers under APPSA and other stakeholders to (i) share research results and experiences and (ii) deliberate on emerging issues in agricultural research and propose possible interventions.

The book of abstracts is one of the main outcomes of the scientific conference and serves as one of the channels for dissemination of the research outcomes for APPSA. It is documented to benefit the researchers, development practitioners, donors and scholars in updating the knowledge on current developments in research for development (R₄D) in SADC region. The abstracts cover the broad areas of plant breeding, agronomy, nutrition, integrated pests and disease management, technology dissemination, water use management, conservation agriculture, storage and post-harvest management.

We acknowledge all those who contributed to the production of these abstracts, including the scientists who made the presentations and contributed to the deliberations.

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INTRODUCTION

This Book of Abstracts is based on oral and poster papers that were presented at the first Agricultural Productivity Program for Southern Africa (APPSA) conference held at the Bingu International Conference Centre (BICC) in Lilongwe, Malawi, from 30th October to 1st November 2018. The APPSA project was coordinated by the Centre for Agricultural Research and Development for Southern Africa (CCARDESA) and implemented in Malawi, Mozambique and Zambia from 2013 to 2019 with funding from the World Bank Group. The objective of the project was to increase the availability of improved agricultural research in participating countries through (i) establishing Regional Centres of Leadership (RCoLs) on commodities of regional importance; (ii) supporting regional collaboration in agricultural research, technology dissemination, and training; and (iii) facilitating increased sharing of agricultural information, knowledge, and technology among participating countries. The project focussed on maize, bean and rice-based cropping systems.

A total of thirty-five (35) papers were presented at the conference, thirteen (13) from Malawi, twelve (12) from Mozambique and ten (10) from Zambia. Of the thirty-five papers, twenty-six (26) percent were on crop improvement/breeding, twenty three (23) percent on agronomy, twenty (20) percent on plant protection and the remainder were on crop-postharvest technologies, food processing, mechanisation and agricultural extension.



MALAWI



EFFECTIVE MECHANICAL MEASURES FOR REDUCING HEAVY METAL-CONTAMINANTS IN HAMMER-MILLED MAIZE/GRAIN FLOUR IN MALAWI, ZAMBIA AND MOZAMBIQUE.

¹Hendrex W. Kazembe-Phiri, ²Limbikani Matumba, ³Fred Sikwese, ⁴N'sira Sylla Mussa, ⁵Aldo Mabureza

¹Department of Agricultural Research Services (DARS), Chitedze Research Station, Farm Power & Machinery Engineering Unit, P.O. Box 158, Lilongwe, Malawi, ²Lilongwe University of Agriculture and Natural Resources, Natural Resources College (NRC) Campus, Lilongwe, Malawi, ³Malawi Bureau of Standards, Chichiri, Blantyre 3, Malawi, ^{4,5}IIAM, Nampula City, Mozambique.

Abstract

In an effort to reduce toxic heavy metal-contaminants in hammer-milled maize /grain flour, mechanical interventions were undertaken to establish strategic measures for reducing the contaminants in the flour for applications in Malawi, Mozambique and Zambia. In pursuit for this objective a series of experiments were conducted that assessed and quantified the toxic metal contents in the flour in comparison with hand pound flour. In this research flour samples were produced by hand pounding using a pestle and mortar in control treatment against two main treatments whose samples were prepared by hammer milling where foundry hammer mill was also compared to artisanal one. In Malawi, two experimental hammer mills (foundry and artisanal) were studied in each of the two districts (Lilongwe and Salima). In Mozambique, only foundry hammer-milling trial, at IIAM in Nampula, was implemented. Furthermore, LB7 hammer mill size was experimented in each country. For the control treatment, Open pollinated variety maize variety (OPV 523), for flour production, was used. The collected flour samples were analyzed by Atomic Absorption Spectrophotometry (AAS) for the metal content in parts per million (ppm) which in turn were compared to the recommended maximum limits. The eight heavy metal elements were targeted and analyzed: Aluminum (Al), Zinc (Zn), Arsenic (As), Cadmium (Cd), Copper (Cu), Lead (Pb), Manganese (Mn) and Iron (Fe). In addition, weight loss of the beaters due to wear and tear as milling progresses, was investigated and recorded. Thereafter, all the flour sample treatments were magnetically metal-scanned. The trend results from both countries confirmed that there is higher heavy metal contents in hammer-milled flour than hand pound samples that could be toxic and cause, significant ill-health to humans, if not checked. Such higher metal contents (whole maize grain “mgaiwa” flour sample) of 28.60 ± 0.80 to 85.24 ± 1.21 , 35.60 ± 0.60 to 562.05 ± 4.11 than 0.07 ± 0.1 to 19.18 ± 4.0 ppm for foundry hammer mill, artisanal hammer mill and hand pounding, were achieved, respectively. In terms of weight loss of the beaters, an average wearing rate of 60.48 and 75.02 ppm for foundry and artisanal hammer milling was achieved, after sixty-six days of milling, respectively. In terms of metal scanning, hand pound flour samples achieved no metal traces as opposed to the hammer milling. Comparison of the foundry and artisanal hammer mill, further, showed that artisanal hammer mill contaminates flour much more than foundry milling. In addition, the results also showed that the findings for hammer mills were much higher than the recommended maximum set limits and thus exhibiting high levels of metal contamination and toxicity with

great potential to cause human ill-health. The maximum limits such as Arsenic (As): 0.2 ppm; Cadmium (Cd): 0.1 ppm; Lead (Pb): 0.2 ppm and Zinc (Zn): 5 ppm, were used for the comparison. On the other hand, the average metal contents (2.4 ppm) for hand pound flour samples were comparable to the recommended limits. In conclusion, there is significant heavy metal content in hammer-milled maize /grain flour being produced in these countries. These heavy metal contaminants would be toxic and health-hazard to humans if not urgently addressed. In this case, employment of safer mechanical design and modification of the hammer mills by incorporating metal detection and separator machine devices that are equipped with adequate magnetic force, would be an effective engineering measure to address the problem and thus reducing the metal contaminants and making the flour safe for humans.

Key words: Hammer milling, heavy metal contaminants, maize/grain flour, hand pounding, health hazard

DEVELOPMENT OF MAIZE HYBRIDS RESISTANT TO MAIZE LETHAL NECROSIS

Johnny I.G. Masangwa¹; K.K.E. Kaonga² and L.M. Suresh³

¹Bvumbwe Agricultural Research Station, P.O Box 5748, Limbe, Malawi, ²Chitedze Agricultural Research Station, P.O Box 157, Lilongwe, Malawi, ³CIMMYT, P.O Box 104100621, Nairobi, Kenya.

Abstract

Detection of the devastating maize lethal necrosis (MLN) disease in Tanzania and DRC in 2012 and 2014 respectively created panic in APPSA countries. In a bid to prevent famine due to the effects of MLN, a project was initiated to develop and screen hybrids for resistance. The hybrids were developed by crossing the local inbred lines with inbred lines known to be resistant. Screening of the hybrids for resistance was done under artificial inoculation at CIMMYT screening facility in Naivasha, Kenya. The disease scale of 1-9 was used in rating resistance of the hybrids to MLN. Alpha lattice design trial replicated three times was implemented in 2015-16 and 2016-17 at Bembeke, Bvumbwe, Chitala and Chitedze Research Stations with the aim of screening maize hybrids for their resistance to prevailing local major diseases and yield performance. The MLN screening results revealed that 16ML5, 16ML13, 16ML14, 16ML20 and 16ML26 are resistant to MLN as they recorded 4 as their mean score on the last scoring date. All the five MLN resistant test hybrids registered a mean GLS scores of less than 2.0 and turicum mean score of 3.0 indicating that they are highly resistant to GLS and moderately susceptible to turicum. Hybrids reacted differently to turicum at different sites which could be attributed to difference of turicum strains present at in those sites. The hybrids 16ML13, 16ML14, 16ML20 and 16ML26 yield above 7 tons per hectare and compared well with those

from MH26 whilst 16ML5 gave a mean yield of around 6.5 ton per hectare. Based on trial and PVS results hybrids 16ML5, 16ML13, 16ML14, 16ML20 and 16ML26 are resistant to MLN and GLS. The MLN resistant hybrids yield between 6 and 7 tons per hectare; their grains are semi-flint and can be liked by farmers. The identified MLN and GLS resistant hybrids will be considered for release in the country and be of great use in famine prevention when MLN will be detected in the APPSA countries. The hybrids also have the potential of being availed to non-APPSA countries.

Key words: Maize lethal necrosis, resistance, screening, disease and yield

EFFECTS OF SILICON ON ENHANCING DROUGHT RESILIENCE IN RAINFED MAIZE

Moses W. Munthali¹, Kelvin Musanje² and Alinafe Kachiguma³

^{1,3}Chitedze Agricultural Research Station, P.O. Box 158, Lilongwe, Malawi; ²Mulungushi University, Zambia, munthalimw@yahoo.co.uk

Abstract

Most sub-Saharan countries including Malawi and Zambia are experiencing intermittent, prolonged dry spells and droughts due to climate change effects which are affecting the crop production such as maize. This research was conducted in a Greenhouse at Chitedze Research Station to study the effects of Si on enhancing drought resilience in rainfed maize using different Si rates and watering regimes for improved crop production. Different Si containing materials were collected from Mchinji, Karonga, Salima, Nkhota-kota and Zomba for extraction of Si as a fertilizer source. The collected materials were characterized chemically for elemental composition, and physically by X-Ray Diffractometer and Scanning Electron Microscope machines to check their physical and morphological characteristics. There were two sets of experiments with and without Si fertilizer application and 10 treatments of watering regimes were laid in RCBD replicated 3 times. The results revealed that the extracted Si from the sample was confirmed to be silica with purity of 93% on average. Extracted silica from rice husks with pretreatment did not contain crystobalite a carcinogenic material suspected of causing lung cancer once inhaled. Greenhouse pot experiment results revealed that there were significant differences ($P \leq 0.05$) in biomass production, soil pH and moisture due to Si application in maize biomass production. There was between 20 to 168% increase in biomass of Si applied maize compared with no Si applied maize. The maize plants applied with Si grew without water up to day 10 where they died while the maize without silicon application died on day 6. The results also revealed that Si application of 10g Si/pot and uptake by maize increased water use efficiency and enhanced

drought resilience. There were also changes in soil parameters due to Si fertilizer application. The Si application enhanced drought resilience in Maize production. It is recommended that field experiments should be conducted to determine optimum Si rates for optimum enhanced water stress resilience in maize production.

Key words: Silicon, drought, resilience,

ASSESSING INCIDENCES OF BRUCHID (Bruchidae) ATTACK IN SEVEN (7) BRUCHID RESISTANT BEAN VARIETIES IN THE LABORATORY - MALAWI.

Arsenio Chimpamba, Jane Bonjesi and L Pungulani

Chitedze Agricultural Research Station, P.O. Box 158, Lilongwe, Malawi

Abstract

Bruchids (*A. Obtectus* Say and *Z. subfasciatus* Boheman) infestation is one of the limiting factors affecting yield and quality of beans in smallholder farming settings. This study was implemented to assess level of infestation by the bruchid species on 7 bruchid resistant bean varieties released in 2011 in order to create awareness to smallholder farmers of the newly released varieties. These varieties include: Mnyambitira, Namtupa, Chitedze Bean 1, Chitedze Bean 2, Chitedze Bean 3, Chitedze Bean 4 and Chitedze Bean 5. The Laboratory experiment was conducted at Chitedze Research station. It was laid out in a split plot design and had three replications. Bruchids were artificially introduced. Results showed that *A. obtectus* is more vicious than *Z. subfasciatus*. Among the varieties, Nyambitira and Chitedze Bean 1 were more susceptible than Chitedze Bean 4 and 5. These results when drawn to attention of the farmers, will enable them to keep beans longer than before when they sold their beans earlier when prices are still low. Farmers will also reduce use of insecticides in storage which pose a health hazard to the household. Farmers should be encouraged to grow the bruchid resistant bean varieties and use hermetic storage techniques to reduce use of chemicals on stored beans.

Key words: Bruchids, smallholder farmers, awareness, vicious, susceptibility index

CORRELATION AND BROAD SENSE HERITABILITY IN PRO VITAMIN A MAIZE GENOTYPES EVALUATED IN MALAWI, MOZAMBIQUE AND ZAMBIA.

K.K.E. Kaonga¹, K. Mwansa², P. Fato³ and M. A. Malangano⁴

^{1&4} Department of Agricultural Research Services (DARS), Chitedze Agriculture Research Station, Box 158, Lilongwe ² Zambia Agricultural Research Institute (ZARI), ³ Instituto de Investigação Agrária de Moçambique (IIAM)

Abstract

Maize yield is a polygenic trait. Indirect selection for other yield related traits that show close correlation and exhibit high heritability is paramount in the selection of improved varieties. In this study sixteen pro vitamin A hybrids were evaluated for three years in Malawi and two years in Mozambique and Zambia using a (0,1) alpha lattice design. The objectives were to evaluate the hybrids for agronomic performance, acceptable traits and identify traits that are correlated with yield for the purpose of indirect selection for improved yield. Significant differences ($p \leq 0.05$) were observed for grain yield across sites and across years in the three countries. APPSA-15 recorded a yield range of 4.4-10t/ha, APPSA-12 recorded 4.0-9.3 t/ha, APPSA-7 4.2-8.6 t/ha, and APPSA-2 4.1-8.4 t/ha. Pearson's Correlation analysis indicated that the number of ears per plant was positively and significantly ($p \leq 0.05$) correlated with grain yield ($r = 0.748$). Anthesis silking interval was negatively and significantly ($p \leq 0.05$) correlated with grain yield ($r = -1.0$). Correlation among other traits indicated that plant vigour was positively and strongly correlated with plant height ($r = 0.651$) and number of ear per plant was positively and strongly correlated with ear height ($r = 0.603$). Carotene colour intensity, grain yield and grain texture exhibited high broad sense heritability (H^2b), 0.81, 0.74 and 0.67, respectively. The across sites and across seasons results showed that the hybrids were early to intermediate within the range of 62 - 67 anthesis date ie 124 to 134 days to mature. The genotypes were tolerant to major common diseases, such as leaf blight, GLS, MSV, and rust with mean disease scores of 1.9, 1.4, 1.4 and 1.3 respectively. Carotenoids laboratory results showed that APPSA-6 and APPSA-7 had pro vitamin A level of $6.54 \mu\text{g/g}$ each while APPSA-12 had pro vitamin A level of $6.08 \mu\text{g/g}$, APPSA-4 and APPSA-17 had pro vitamin A level of $6.0 \mu\text{g/g}$ each. In terms of zeaxanthin which is important for improving quality of chicken egg yolks, APPSA-17 had $14.5 \mu\text{g/g}$, APPSA-11 recorded $10.5 \mu\text{g/g}$, APPSA-12 recorded $9.6 \mu\text{g/g}$ while APPSA-13 and APPSA-16 recorded zeaxanthin of $9.3 \mu\text{g/g}$ Dw each. The hybrids are adapted to the three countries and have acceptable traits.

Key words: Vitamin A, Carotenoids, zeaxanthin, carotene, heritability, genotype, correlation

DRAINAGE WATER RE-USE FOR IMPROVED RICE PRODUCTION IN MALAWI

Geoffrey Mwepa¹, Isaac Fandika¹ and Grivin Chipula²

Kasinthula Agriculture Research Station, P/O Box 28, Chikwawa

² Lilongwe University of Agriculture and Natural Resources, P.O. Box 219, Lilongwe

Abstract

The unreliability of rainfall has steadily increased the use of irrigation for crop production. This trend is likely to continue with the challenges posed by climate change as irrigation offers a viable technical option for managing climate change. Demands for more irrigation water have led to a practice where farmers reuse drainage water for crop production. However, this is done without any technical guidance, thereby exposing the farmers to harmful effects as drainage water is considered to be of low quality. Baseline and field experiment studies were therefore conducted at Hara, Domasi and Nkhate irrigation schemes from 2015 to 2017 to generate information and encourage adoption of improved drainage water reuse technologies. The field experiment was arranged in a randomized complete block design with five farmers as replicates. Five irrigation treatments included: (1) Irrigating with 100% water from canals; (2) Irrigating with 100% drainage water; (3) Irrigating with 75% drainage water and 25% water from canals; (4) Irrigating with 50% drainage water and 50% water from canals and (5) Irrigating with 25% drainage water and 75% water from canals. The baseline found that 10% of farmers used drainage water. Others did not use it due to lack of hydraulic structures, limited supply of drainage water and others considered it of poor quality. Water quality analysis results showed that drainage water was of acceptable quality for irrigation. Rice grain yield and yield components were not significantly affected by drainage water or blending of drainage water ($p>0.05$). The 50:50 blending was recommended to farmers on the basis of ease of management as well as good crop yields. It can be concluded that drainage water reuse is a safe strategy for supplementing irrigation where water is scarce. Farmers can enhance their access to best practices for drainage water reuse at 50:50 blending through modernized hydraulic structures.

Key words: Drainage water, drainage water reuse, water scarcity

HERBICIDE WEED CONTROL IN CONSERVATION AGRICULTURE MAIZE-CROPPING SYSTEMS AMONG SMALLHOLDER FARMERS IN MALAWI

L. Botoman^{1*}, P. Simwaka¹, A. Ngwira¹ and V.H Kabambe²

¹ Department of Agricultural Research Services (DARS), Chitedze Agricultural Research Station, P.O Box 158, Lilongwe, Malawi

² Lilongwe University of Agriculture and Natural Resources, P. O Box 219, Lilongwe, Malawi, *Corresponding author: botomanlester@yahoo.com

Abstract

Conservation agriculture (CA) technology is widely promoted as one of the best agricultural technologies in farming systems. However, minimum tillage practices as applied under CA have proven to harbour more weeds than the conventional tillage options especially where no crop residues are retained as surface mulch. Weeds are, therefore, considered a major biological constraint for smallholder farmers practicing CA. Therefore, on station and on farm experiments were conducted to assess the herbicide weed control through a participatory research process with ultimate aim of developing effective recommendation for herbicide weed management option for smallholder farmers practicing CA in Malawi. The study was laid out as a randomized complete block design (RCBD) with eight treatments replicated four times at each experimental site. The treatments consisted of Hand weeding on ridges, Glyphosate + hand weeding, Harness + hand weeding, Hand hoe weeding + Stellar, Glyphosate + Stellar, Harness + Glyphosate, Harness + Stellar, and Harness + Glyphosate + stellar star. The results indicated that contrary to what farmers claim, some herbicides were effective in controlling weeds. Apart from hand hoe weeding, treatment combinations that contained stellar star were superior in weed control and performance over other treatment combinations. It was also observed that there were statistical differences ($p \leq 0.05$) in maize yield across the treatment combinations in some experimental sites. Generally, yield was higher in treatment combinations that contained stellar star suggesting that, holding other factors constant, this herbicide is highly effective in controlling weeds in the field. The obtained results auger well with majority of resource-constrained smallholder farmers in Malawi who cannot afford to apply stellar star alone since it is expensive. By combining properly with other herbicides (2.5 L ha⁻¹ glyphosate + 0.7 L ha⁻¹ stellar, 1 L ha⁻¹ harness + 0.7 L ha⁻¹ stellar, hand hoe weeding + 0.7 L ha⁻¹ stellar star) respectively and following proper application guidelines, costs are minimized and weeds are controlled.

Key words: Herbicide, Conservation Agriculture, Weed control, Maize-cropping system, Smallholder farmer.

OPPORTUNITIES AND CHALLENGES IN THE PRODUCTION AND UTILIZATION OF PIGEON PEAS (*CAJANUS CAJAN*), COWPEA (*VIGNA UNGUICULATA*) AND BAMBARA NUT (*VIGNA SUBTERRANEA*)

Lawrent Pungulani, Beatrice Mwale, Nellie Chipole, Maclean Goodson & Abiud Mndala

Department of Agricultural Research Services (DARS), Chitedze Agricultural Research Station, P.O Box 158, Lilongwe, Malawi

Abstract

Pigeon pea, cowpea, and bambara nut are amongst the common legumes produced in Malawi. These legumes are widely produced by small-holder farmers across the country. However, some challenges underpin the production of the crops whilst at the same time some opportunities exist that may be capitalised on to boost their production. Therefore, this study was undertaken to identify opportunities and challenges associated with the production and utilisation of pigeon pea, cowpea and bambara nut. The study was conducted in 8 districts namely Karonga, Mzimba, Ntchisi, Salima, Lilongwe, Balaka, Zomba and Mwanza. Two EPAs were sampled per district except Ntchisi Lilongwe and Zomba which had one EPA, 4 EPAs and 4 EPAs, respectively giving a total of 19 EPAs. Data were collected using a structured questionnaire from a randomly selected 570 farmers producing the target crops. The results from the study show that unavailability of improved seed was the main reason why most farmers get low yields of the target crops. The study has revealed that most farmers prefer local varieties though low yielding because of different reasons including early maturity, good taste and fast cooking. Field pests, diseases, low grain yields and lack of markets were major challenges affecting pigeon pea, cowpea and bambara nut production. Availability of markets for raw product, access to inputs and extension services are some of the opportunities existing in the value chains of the three crops. The results of the study point to the need to accelerate variety improvement programs which will identify improved varieties that meet market demands and also requires reorientation of policies which will enhance availability of improved seeds on the market and marketing of grain.

DEVELOPMENT AND PROMOTION OF IMPROVED PIGEON PEA VARIETIES FOR INCREASED AND SUSTAINABLE PRODUCTION

F. Ngwira¹, E. Yohane¹, O. Madzonga², D. Siyeni³, E. Mazuma¹, R. Mkandawire³ and K. Dambuleni¹

¹Chitedze Research Station, P.O. Box 158, Lilongwe, Malawi, ²ICRISAT, P.O. Box 1096, Lilongwe, ³Makoka Research Station, P/Bag 3, Thondwe, Zomba

Abstract

Pigeon pea (*Cajanus. Cajan* (L)) is one of the most legume crops in the world. The crop is naturally drought tolerant, cheap source of protein required in diets of millions of people especially in the semi-arid zones. However, the production in Malawi is characterized by yields as low as less than 1000kg/ha to dominance of unimproved varieties and pests and disease challenges. Two experiments were conducted at Chitedze, Chitala, Baka, Makoka and Bvumbwe Research Stations to evaluate the short duration pigeon pea and medium duration Fusarium wilt resistant genotypes for yield potential and adaptability from 2014/15 to 2016/17 growing seasons. Yield data and wilt incidences were collected in all sites for three seasons. Short duration genotypes ICEAP00612, ICEAP01103/1, ICEAP01101/1 and ICEAP87091 gave higher yields of greater than 1000 kg/ha. Medium duration genotypes ICEAP 01155, ICEAP 01146/1 and ICEAP 01172/1 gave higher yields outperforming the local check Mwaiwathualimi and Mthawajuni in 2016/17 season an indication that these genotypes have high genetic yield potential. ICEAP00979/1 gave the highest grain yield across sites. The genotypes ICEAP 01155, ICEAP 01170 and ICEAP 01169 were observed to be resistant to Fusarium wilt. These results suggest that the superior genotypes be released for production in Malawi. The release of these genotypes will significantly increase pigeon pea production because of high yields and resistant to fusarium wilt a major disease which affects pigeon pea.

Key words: Short duration genotypes, medium duration genotypes, Fusarium wilt

INVESTIGATING THE OCCURRENCE OF MAIZE LETHAL NECROSIS DISEASE IN MALAWI

Johnny I.G. Masangwa¹; K.K.E. Kaonga² and L.M. Suresh³

¹Bvumbwe Agricultural Research Station, P.O Box 5748, Limbe, Malawi, ²Chitedze Agricultural Research Station, P.O Box 157, Lilongwe, Malawi, ³CIMMYT, P.O Box 104100621, Nairobi, Kenya.

Abstract

Maize lethal necrosis disease is trans-boundary in nature as such it poses a significant negative impact on food security and nutrition in developing countries. A surveillance programme was initiated to establish if the disease is present in the country. Leaf sampling and testing was carried out using Imuno strip kit. The procedure involved establishing survey points at every 5-10km and at each point six samples were collected, and a composite made. The sap extract was tested for MLND using Lateral Flow Assay which is based on immune chromatography of virus specific antibodies. Results indicated that Malawi is MLND free and that 36 % farmers purchased seeds, 30 % planted what they saved from previous season and 32 % of them received it as donation made by either Malawi government or non-governmental organizations. There is a need to continue with monitoring and awareness.

Key words: Maize lethal necrosis, Lateral Flow Assay, survey.

EFFECTS OF COMPOST MANURE MADE FROM VARIOUS MATERIALS ON SOIL FERTILITY, GRAIN YIELD AND YIELD COMPONENTS OF RICE UNDER SYSTEM OF RICE INTENSIFICATION.

W. A. Kanyika¹, T. K. Banda² and E Jeke²

¹Baka Agricultural Research Station, P. O. Box 97, Karonga, Cell: +265 888 781 275/+265 995 679 091, ²Lifuwu Rice Research Station, P. O. Box 102, Salima

Abstract

Lack of improved compost making methods and rates of application deters rice farmers from adopting the System of Rice Intensification (SRI) technique that encompasses use of compost manure. An experiment was conducted in 2014/15, 2015/16 and 2016/17 at Hara, Bwanje and Domasi to test the effectiveness of compost manure made from crop residues, animal manure and top soil on productivity of Mtupatupa rice variety in SRI and on soil fertility improvement. Compost manure types were compared to 40 kg N ha⁻¹+ 25 kg P₂O₅ ha⁻¹ (SRI control) and 80

kg N ha⁻¹ with 25 kg P₂O₅ ha⁻¹(conventional control). The SRI technology, where either inorganic fertilizer or organic manure was applied by lead farmers, was demonstrated. Compost manure contained 0.42 to 1.14 % N. In four of the 8 field trial sites, grain yields were not significantly different among compost manure types and inorganic fertilizer and grain yields as high as 6591 kg were obtained from compost manure. In one of the remaining four field trial sites where significant differences ($p < 0.05$, 0.01) were obtained, in 2014/15 at Hara, the conventional control (4996 kg) was not significantly different from five compost manure types (469-4948 kg) including the SRI control but was superior to three manure types. The conventional control (2421 kg) was inferior to other treatments (3023-3882 kg) in 2014/15 at Domasi but was superior (7040 kg) to all (3865-5476 kg) in 2015/2016 at this site. In both seasons, the SRI gave similar results to all compost types. In 2015/16 at Bwanje, the conventional control was only significantly ($p < 0.05$) better (4930 kg) than compost manure CM + TS (3780 kg). Compost manure improved N, P, OM and carbon in the soil like inorganic fertilizer between 2014 and 2017. Farmers who adopted SRI with manure and fertilizer got higher productivity than those who adopted SRI with inorganic fertilizer only. Compost manure with N % of 0.75-1.14 made from pulverized rice hulls/bran and cattle manure, top soil and cattle manure, top soil and chicken manure and rice straw and cattle manure in the SRI integrated package was superior in improving yields. An integrated application of compost manure and 40 kg N ha⁻¹ + 25 kg P₂O₅ ha⁻¹ is also suggested for farmers to use to improve soil fertility and improve yields. It is recommended that use of compost manure alone or combination of compost and inorganic fertilizer should be promoted for increased production of rice under SRI.

Key words: Compost manure, integrated, system of rice intensification, agronomic packages

MANAGING AFLATOXIN IN SMALLHOLDER GROUNDNUT PRODUCTION IN SOUTHERN AFRICA: PAIRED COMPARISON OF THE WINDROW AND MANDELA COCK TECHNIQUES

Limbikani Matumba^{1*}, Lazarus Singano², Bruno Tran³, Mweshi Mukanga⁴, Beatrice Makwenda⁵, Wycliffe Kumwenda⁵, Sharif Mgwira⁶, Sam Phiri⁵, Frazer Mataya⁵, Talentus Mthunzi⁷, Sharon Alfred⁷, Tshilidzi Madzivhandila⁷, Jonas Mugabe⁸, Ben Bennett³, Tim Chancellor³

^{1&6} Lilongwe University of Agriculture and Natural Resources Lilongwe, Malawi; ²Department of Agricultural Research Services (DARS), Chitedze Research Station, Lilongwe, Malawi; ³Natural Resources Institute - University of Greenwich, Chatham, Maritime Kent, UK; ⁴Zambia Agriculture Research Institute (ZARI), Lusaka, Zambia; ⁵The National Smallholder Farmers' Association of Malawi (NASFAM), Lilongwe, Malawi; ⁷Food, Agriculture and Natural Resources Policy Analysis Network, Pretoria, RSA; ⁸Forum for Agricultural Research in Africa (FARA), Accra, Ghana.

*Corresponding email: alimbikani@gmail.com

Abstract

Timely drying of groundnuts is important after harvest. In most parts of sub-Saharan Africa, moisture content reduction is practically achieved by solar drying. In particular, the groundnuts are traditionally cured in the field using the inverted windrow drying technique. Recently, the Mandela cock technique, a ventilated stack of groundnut plants with a chimney at the center, has been introduced in the southern Africa region with the aim of reducing moisture content and the risk of aflatoxin contamination. An on-farm study was conducted in Malawi to compare the effectiveness of the Mandela cock and Windrow drying techniques with respect to aflatoxin control. For two consecutive years, farmers (2016, n=29; 2017; n=26) were recruited to test each of the two drying techniques. A mixed-design ANOVA showed that the Mandela cock groundnut drying technique led to significantly ($p < 0.001$) higher aflatoxin levels in groundnut seed compared to the traditional inverted windrow drying (5.7 $\mu\text{g}/\text{kg}$, geometric mean vs 2.5 $\mu\text{g}/\text{kg}$ in 2016 and 37.6 $\mu\text{g}/\text{kg}$ vs 8.4 $\mu\text{g}/\text{kg}$ in 2017). The present findings clearly demonstrate the need for technology validation and regulation if farmers and consumers are to benefit.

Key words: Aflatoxin, groundnuts, drying, food safety, "Mandela cock", 'Inverted windrow'.

PRODUCTIVITY AND PROFITABILITY OF MAIZE-LEGUME CROPPING SYSTEMS UNDER CONSERVATION AGRICULTURE AMONG SMALLHOLDER FARMERS IN MALAWI

Amos Ngwira¹, Pacsu Simwaka¹, Vernon Kabambe², Kondwani Makoko³ Kefasi Kamoyo⁴

¹Chitedze Research Station, P.O. Box 158, Lilongwe, Malawi, ²Lilongwe University of Agriculture and Natural Resources, Bunda Campus, P.O. Box 219, Lilongwe, Malawi, ³Department of Agricultural Research Services (DARS), P.O. Box 30779, Lilongwe 3, Malawi, ⁴Department of Land Resources Conservation, P.O. Box 30291, Lilongwe, Malawi

Abstract

Conservation agriculture (CA) is one of sustainable intensification options that is increasingly promoted by various international research centres, international non-governmental organizations (NGO), faith based organizations and governments of southern Africa to overcome the problem of soil degradation, drought, low and unstable crop yields and high production costs. The aim of the study was to validate the short-term effects of maize-legume intercropping and rotation systems under CA on crop productivity and economics. A study was conducted from 2014 to 2017 in selected communities in Mangochi, Mzimba and Salima districts of Malawi consisting of 216 plots in 36 farmers' fields. The treatments were arranged in split plot fashion in randomised complete block design (RCBD) with tillage systems as main plots and cropping systems as sub-plots and farmers in each community acted as replicates. Main plots comprised CA and conventional tillage while sub-plots consisted of continuous monocropped maize, maize intercropped with adapted legume for each area and maize grown in rotation with groundnut. Across seasonal analysis showed that there were significant ($p \leq 0.05$) differences on maize grain yields between treatments. Intercropping maize with legumes under CA gave 18%, 15%, 24% more maize grain yield than conventional tillage in Mangochi, Mzimba and Salima districts respectively. Intercropping maize with pigeonpea gave a land equivalent ratio value of 1.4, suggesting a yield advantage of 40% compared with monocropping. Farmers spent at most 57 days ha^{-1} producing maize under CA systems compared with 78 days ha^{-1} spent under conventional tillage practices. However, total variable costs are higher in CA systems compared with conventional tillage (at most US\$320 versus US\$260 ha^{-1}). Maize-legume intercropping under CA gave 20% more net benefits compared with conventional tillage. Although it was not feasible to directly estimate effects on resource use efficiencies of these farmer-managed experiments, it can be assumed that there was minimal competition for resources between maize and legume that resulted in higher maize yield and economic benefits. Intercropping maize and pigeon pea present a win-win scenario for smallholder farmers due to higher land equivalent ratio and attractive economic returns.

Key words: Conservation agriculture, maize yield, intercropping, land equivalent ratio, net returns

YIELD STABILITY OF PRO VITAMIN A MAIZE GENOTYPES EVALUATED IN MALAWI, MOZAMBIQUE AND ZAMBIA.

K.K.E. Kaonga¹, K. Mwansa², P. Fato³ and M. A. Malangano⁴

^{1&4} Department of Agricultural Research Services (DARS), Chitedze Agriculture Research Station, Box 158, Lilongwe ² Zambia Agricultural Research Institute (ZARI), ³ Instituto de Investigação Agrária de Moçambique (IIAM)

Abstract

Stable performance of maize varieties in a specific cultivation area is a pre-requisite for realizing better yields. In this study, sixteen pro vitamin A hybrids were evaluated for two seasons in Malawi, Mozambique and Zambia using a (0,1) alpha lattice design. These were evaluated alongside two checks provided by individual countries. The objective was to evaluate for yield stability across locations in three countries. Significant differences ($p \leq 0.05$) were observed for grain yield across sites and across seasons in the three countries. Individual site analysis showed that there were no significant differences in yield at Mount Makulu only. Pro vitamin hybrids G15 recorded a yield range of 4.4-10t/ha, G12 4.0-9.3 t/ha, G7 4.2-8.6 t/ha, and G2 4.1-8.4 t/ha. Stability analysis using Average Environmental coordination (AEC) for the comparison biplot showed that G14, G3 and G1 were the most stable across the locations and seasons. Golden Valley (GART), Umbeluzi and Baka were positioned close to the AEC and were identified to be non-discriminative. Principal components (PC1 and PC2) for Genotype and Genotype by Environment (GGE) explained 62.5% of the total variation that existed. Cluster analysis at cut off point 1.0, classified nine locations into four clusters. Locations with similar agro-ecological conditions were grouped in each cluster; Mid altitude locations: Meru and Bembeke formed one cluster and low altitude locations Baka and Chitala formed one cluster. The other mid altitude locations with some similarities formed two other clusters. In this study stable genotypes and environments were identified. Among the stable genotypes, G3 was among the five released provitamin A hybrids.

Key words: Vitamin A, Environment, stability, genotype, cluster, Principal component



MOZAMBIQUE



ASSESSMENT OF MAIZE VARIETIES PERFORMANCE UNDER VARIED WATER APPLICATION FROM A LINE SOURCE SPRINKLER IRRIGATION, SOUTHERN MOZAMBIQUE

A. B. J. C. Nhantumbo^{1*}, S. I. Famba¹, I.R. Fandika² and A. H. Cambule¹

¹Faculdade de Agronomia e Engenharia Florestal. Universidade Eduardo Mondlane, P.O Box 257, Maputo, Mozambique

²Department of Agricultural Research Services (DARS), Kasinthula Agricultural Research Station, P.O. Box 28, Chikwawa, Malawi.

* - Corresponding author. Email: abnhantumbo@yahoo.com

Abstract

In order to assess Crop Water Productivity (CWP) of maize varieties under different water regimes two on-station trials were established during 2017-2018 cropping wet-season. The trials were established at the experimental station of the University Eduardo Mondlane (UEM) in Sábie and at the Chókwe Agricultural Research Station (EAC) of the National Agricultural Research Institute of Mozambique (IIAM). A split-plot design in a randomized complete block arrangement with 15 maize varieties, three water application (rainfall plus irrigation) levels in four replications (blocks) was followed in a line-source irrigation arrangement. The water application amounts were 182, 663, 838 mm at Sábie and 329 and 404 mm at Chókwe, from different water regimes. The maize varieties PAN 53 and PAN 12 were most outstanding under both higher and intermediate water regimes of 838 mm and 663 mm, at Sábie, respectively. The maximum crop water productivity observed was 0.83 kg m⁻³. Tsangano maize variety had lower performance in both regimes. The aboveground biomass was significantly affected only in the higher water regime. Further assessments for high levels of water applications and other agronomic parameters (harvest index, resistance to pest and diseases) of the promising maize varieties in semi-arid areas of southern Mozambique is recommended.

Key words: Crop water productivity; water regime; semi-arid climate; maize yield

CHARACTERIZATION OF PIGEON PEA ACCESSES (*CAJANUS CAJAN* (L.) MILLSPAUGH) COLLECTED IN MOZAMBIQUE

Marques Donça¹, Manuel Amane¹, Salva Somueque¹, Esnart Nyerenda²

¹Mozambique Agricultural Research Institute, ²Department of Agricultural Research Services (DARS)- Malawi

Abstract

In recent years, the rapid expansion of pigeon pea production provided a boost to the rural economy of Central and Northern Mozambique. In these regions the diversity of pigeon pea is expressive. The study was conducted aiming to characterize the germplasm collected in two pigeon pea production regions in Mozambique with respect to yield components and selected morphological traits, to clustering the germoplasm in groups and identifying the correlations between variables. The experiment was conducted in Nampula Research Station during 2012/2013 and 2013/2014 growing season. The experimental design used was partially balanced lattice with 3 replications and 81 accesses. The data were collected using pigeon pea description manual (IBPGR/ICRISAT, 1993) and pigeon pea germplasm catalogue, which included leaf shape, flower colour, number of nodules, number of racemes, number of primary, secondary and tertiary branches, plant height, seed colour and shape, days to flower and maturity, pods shape and colour, pod and seed weight. Correlation between variables and principal clustering of characters was made using Tocher optimization technique in order to find the similarities and dissimilarities within accesses, evaluate the correlation between variables, as well as determine which component has contribution to increase the grain yield. The results showed that the number of racemes per plant, secondary and tertiary branches were the greatest contributors to the increase of yield. On the other hand, the cluster analysis showed that the pigeon pea accesses evaluated formed 5 distinct categories; allowing inferring that there is divergence between the evaluated pigeon pea lines. These materials that are adapted to the region will serve for future breeding activities and selection of cultivars for farmers' own use.

Key words: Accesses, germplasm, cluster analysis, pigeon pea.

EFFECT OF GROUNDNUT PLANT DENSITY ON YIELD AND YIELD COMPONENTS IN NORTHERN MOZAMBIQUE

Amade Muitia¹, Maria Jacinta de Carvalho Mopecane and Lidia Andarusse

Mozambique Agricultural Research Institute, Nampula Research Station, Av. FPLM km 7, Nampula, Mozambique.

Email: amademuitia@hotmail.com

Abstract

An experiment was conducted under field conditions to study the effect of spacing on groundnut yield in three consecutive cropping seasons (2014/2015, 2015/2016 and 2016/2017) at three locations (Nampula, Namapa and Mapupulo). It was used a randomized complete block design with a split-plot arrangement where spacing between rows (30cm, 40cm, 50cm and 60cm) was considered on the main plot and spacing within row (10cm, 20cm and 30cm) was in the sub-plot. Data was recorded from in each plot on seed yield and yield components (100 seed weight, number of pods per plant and shelling percentage). The results indicated that spacing between rows and within row were significant different ($p < 0.001$) for yield and the lower spacing (30x10cm) gave the highest yield (1541kg ha^{-1}) and the larger spacing (60x30cm) gave the lowest yield (665kg ha^{-1}). Number of pods per plant increased with increase of spacing. That is, spacing of 60x30cm had more pods per plant (27.4) than the spacing of 30x10cm (19.1). Different spacing did not influenced on the 100 seed weight while shelling percentage was reduced with the increase of plant population. Overall, the optimum spacing which gave the highest yield was 30x10cm

Key words: Mozambique, groundnut, plant density, yield, yield components

EFFECT OF PLANT DENSITY ON TUMBETA RICE VARIETY UNDER IRRIGATION SYSTEM

Marcos Langa¹

Instituto de Investigação Agrária de Moçambique, Chókwè Agricultural Research Station, Mozambique, marcoslanga@yahoo.com

Abstract

Rice is an important staple food crop and a major source of energy and employment for more than half of the world's population. In Mozambique, rice is becoming not only the staple food, but also the major economic activity and a key source of employment and income for the rural population. Agronomic practices are most important components for sustainable rice production in all rice schemes throughout the country. A planting densities experiment was carried out in Chókwè Agricultural Research Station, the objective evaluating the response of the seedling number per holly in yield components and in the grain yield of the Rice Tumbeta Variety. The experiment was conducted in the hot season and was based on a completely

randomized block design, where only 1 factor (number of seedlings per cove) was evaluated, with 10 levels (treatments) and 3 replicates. The treatments consisted of number of seedlings per cove, varying from 1 to 10. The used was 30 x 11cm. The results showed that the number of seedlings per holly positively influences the yield components and grain yield. Rice planted at a density of 2 to 10 seedlings per holly does not differ statistically from one another and is the best agronomic treatments, unlike when one seedling per holly is planted, which is the worst of all treatments due to the low yield of the grain. The grain yield showed significant differences ($p < 0.05$) between the treatments and between the blocks. Hence, it can be stated that the blocks were efficient in reducing the experimental error to obtain grain yield. The economically variable treatment was P4 (4 seedlings per holly).

Key words: Planting density, economic viability, rice yield

EFFECT OF USE OF CONSERVATION AGRICULTURE (CA) TECHNOLOGIES IN MAIZE AND COWPEA PRODUCTION SYSTEMS IN NORTH OF MOZAMBIQUE

Henriques V. Colial¹, Belarmino Divage¹, Idalina Napita¹, Francisco Ali² e Augusto Muaqueia³

¹IIAM-Nampula Research Station (PAN), at Nampula city (Nampula Province) , ²IIAM-Mapupulo Research Station (CIAM) at Montepuez District (Cabo Delgado Province) and , ³IIAM-Namapa Research Station, at Erati Distict (Nampula Province)

Abstract

The study was conducted in three growing season (2014/2015, 2015/2016 and 2016/2017) in three sites (CIAM, Via Balama road – Bata village and Muriaze). The trials consisted on tillage and rotation treatments in a split plot arrangement (randomized complete block design) with four replications. Two tillage treatments consisting of no till with adequate soil cover and conventional tillage assigned to the main plots and rotation treatments consisting of 2 plots of maize, one plot of cowpea and one plot of maize with 100kg of N/ha (200kg of Urea/ha) were assigned as subplots. The objective of this study was to evaluate the effect of conservation agriculture technologies (Zero tillage, and crop rotation) on maize and cowpea cropping system. The result of this study showed an increase on maize grain yield by using zero tillage alone from 1.6 to 2.01, 1.31 to 1.55 and 1.46 to 1.78 ton/ha at CIAM, Muriaze and Via Balama, respectively. And, from 1.6 to 2.01, 1.31 to 1.55 and 1.46 to 1.78 ton/ha at CIAM, Muriaze and Via Balama, respectively, by combining zero tillage and crop rotation system, respectively. The economic analysis showed consistently in all sites a reduction of production costs when use a combination of zero tillage (ZT) and crop rotation system from 10.29 to 9.12, 13.12 to 11.84 and 11.09 to 10.67 MT/Kg in CIAM, Muriaze and Via Balama, respectively within the 2nd growing season. And, similar results in all sites, reduction of production costs when use a combination

of zero tillage (ZT) and crop rotation system from 4.38 to 3.44, 12.78 to 7.57 and 6.27 to 4.43 MT/Kg in CIAM, Muriaze and Via Balama, respectively.

Key words: Conservation agriculture (CA), Zero tillage, crop rotation system, maize and cowpea production

EFFECTIVENESS OF HIGH DENSITY POLYETHYLENE CONTAINER AND SUPER GRAIN BAG FOR THE STORAGE SYSTEM OF COWPEA GRAIN FOR SMALLHOLDER FARMERS

L. D. Tivana¹, R. J. Nguenha¹, P. Viola¹, I. Monjane², K. Nswana³

¹UEM/FAEF, Universidade Eduardo Mondlane, Faculdade de Agronomia e Engenharia Florestal, PO box 257, Av. Julius Nyerere 3453, Maputo, Mozambique, ² Instituto de Investigação Agrária de Moçambique, PO Box 3658, Av FPLM 2698, Maputo, Mozambique, ³Zambia Agriculture Research Institute –ZARI, Mochipapa-Choma, Zambia

Abstract

Cowpea is one of the most important legume crops and provides excellent and cheap source of protein in sub-Saharan Africa. However, during the storage, the grain is heavily attacked and damaged by insects such as the cowpea weevil (*Callosobruchus maculatus*), resulting in significant grain losses within three months after harvest, under smallholder farmers' storage conditions. The present study aims to evaluate the effectiveness of high density polyethylene container combined or not with Super Grain Bag (SGB) for the storage of cowpea grain. The experiments were carried out first on station and then on farms. The treatments being tested included high density polyethylene container (PC) (60L), Super Grain Bag (SGB) (60Kg) and woven raffia bag (RB) (50Kg), as control. At on station, each storage system was triplicated. At on farm trials, a total of nine farmers were involved. The farmers were distributed in three different regions of Manjacaze district, Mozambique, namely Chizavane, Tavane and Macuacua with three farmers at each region. Each farmer was given each of storage system. Data collection regarding the level of insect infestation and grain damage was carried out every one month for a period of 6 months at on station and every two months for a period of 8 months at on farm trials. Acceptability test of the stored grain, including cooked grain, was carried out at the end of on station trials with farmers. After six months of storage, using naturally infested grain, RB resulted in an increase of insect infestation from 100 insects/kg to above 1000 insects/kg of grain, an increase of grain damage from 26 to 80%, while in the SGB and PC, starting from the same grain, the number of insect showed an increase up to 600 and 350 insects/kg, the grain damage showed an increase up to 40 and 30% respectively. The combination of PC with SGB (PC-SGB) stopped the proliferation of insects and the damage of the grain. The stored grain at PC and PC-SGB systems were highly accepted by the farmers. The results of on farm trials showed similar trends as those of on-station trial, however SGB could only give some protection up to four months, while the PC and the PC-SGB storage

system could protect the grain with acceptable quality preservation up to 8 months. From the trials, the PC, associate or not with SGB, which can be easily manufactured in Mozambique, showed to be effective for the storage and preservation of cowpea grain making this storage structure suitable to be used by smallholder farmers thereby reducing cowpea grain losses.

Key words: Cowpea, polyethylene container, smallholder farmers, Super grain bag

EFFECTS OF CONSERVATION AGRICULTURE AND FERTILIZER APPLICATION ON MAIZE AND LEGUME YIELDS IN MOZAMBIQUE

Chichongue, O.^{1*}, Sualei, F.¹, Timo, F.² & Cauia, H.³

¹IIAM- Lichinga Research Station, Lichinga-Niassa, ²IIAM-Mutuali Research Station, Malema - Nampula, ³IIAM-Gurue Research Station, Gurue – Zambezia, (*Corresponding Author: ochichongue@gmail.com)

Abstract

Mozambique is witnessing severe degradation of its farmlands. Much of this degradation can be attributed to farming practices – ploughing that destroy the soil structure and degraded organic matter, burning or removing crop residues and mono-cropping. To change this situation, improved cereals and legume cropping systems design under better resource allocation and management conditions, Conservation Agriculture systems were tested across environments of Lichinga - Niassa, Mutuali – Nampula and Gurùè – Zambézia. This was done through establishment of on-station experiments aiming to identify best bet resource allocation strategies that can make cropping systems more attractive to poor resourced farmers involved in Conservation Agriculture. The responses in maize intercropped with beans, soybean, cowpea, pigeon pea and groundnuts treatments were determined. The objective of the study was identifying suitable combination of planting arrangement, fertilizers rates for increased productivity of maize-legume intercropping system in Niassa, Nampula and Zambézia and enhance their livelihoods. Two fertilizer treatments and five legume intercrop options were applied in a split plot design with three replications. Due to different legume adaptations in each study sites different intercropping options were used, being in Lichinga maize intercropped with common beans, soybean and pigeon peas, and in Gurùè maize intercropped with soybean, beans and cowpeas while in Mutuali maize were intercropped with soybean, cowpea and pigeon peas. Results were subjected to ANOVA using GENSTAT Statistical package and the least significant differences (LSD) was used to separate the means. This study demonstrates that the intercropping legumes or combining with inorganic fertilizer has potential to address the low soil fertility problem in farmers' fields and raise yields of maize production.

Key words: Maize, legume, tillage, rotation, intercropping, crop yield.

ENHANCED DISSEMINATION OF FOOD LEGUMES BASED TECHNOLOGIES FOR INCREASED PRODUCTION IN MALAWI, ZAMBIA AND MOZAMBIQUE

Belarmino Divage¹, Alipio Simão, Patricia Kaoma²

¹Mozambique's National Institute of Agricultural Research (IIAM), Northeast Zonal Centre, Av. Das FPLM km 7, Nampula-Mozambique, ²Mozambique's National Institute of Agricultural Research (IIAM), South Zonal Centre, Av. Das FPLM km 7, Umbeluzi-Mozambique, ³Ministry of Agriculture and Livestock: Department of Agriculture & Zambia Agricultural Research Institute

Abstract

Food legumes (beans, groundnuts, cowpeas, soybeans and pigeon peas) are important crops in Mozambique. These crops are grown for both cash and food. Production of these crops among smallholder farmers is hampered by a number of factors, including poor dissemination of improved legume production technologies. This study aimed to contribute to the adoption of improved food legume technologies by identifying the indicators of the adoption of agronomic technologies (crop rotation, tillage practices, use of improved varieties and use of fertilizer). The study was conducted in five districts (Mogovolas, Murrupula, Èrati, Monapo and Rapale) in Nampula province, during the growing season 2016/17. To evaluate the adoption of the technologies promoted in this study, a semi-structured questionnaire was used as an instrument, which was applied to farmers, who were randomly chosen 10 in each district, making up a universe of 50 leading farmers. The integrated participatory research was performed through establishment of on farm demos for technology description. The demo dimensions were 22 meters in breadth and 24 meters in length; sub plots 10 x 5 meters each containing 10 lines, with a foot path separating the cereals from the legumes of 1 meter, the treatments separated by 1 meter apart. The demos for all the five districts had a minimum of 2 varieties in Maize, 2 varieties in groundnuts, 2 varieties in Cowpeas and 2 variety of Pigeon peas. The Legume technologies being disseminated were Agronomic practices (Emphasis on crop rotation, tillage practices), use of improved varieties and use of fertilizer. The data were treated with excel office 2010, using descriptive statistics includes mean, frequency and percentage, tabular and graphical representation, which has been mostly used to examine the socio economic and farming characteristics of households and categorization of the farmers' typology. 80% of the respondents selected the use of improved varieties as the better technology. The major conditioning factors that motivated the adherence of improved Legume varieties are: Risk aversion, Intensive in terms of labour, visibility of results and Cost of technology, were 90% of the respondents said that the intensity in terms of labour was an important adoption factor and 94% pointed a Risk aversion as most important conditioning factors to technology selection. The analyses of farmers' impressions about the technologies showed that the four major factors that motivated the selection of improved Legume varieties as technology presented in this study are: Risk aversion, Intensive in terms of labour, Visibility of results and Cost of technology and from the technologies promoted in this study, the use

of improved Legume varieties had a greater acceptability and the compared with other technologies being disseminated.

Key words: Legume crop, Varieties and Adoption

HERMETIC STORAGES: A SOLUTION TO REDUCE MAIZE POST-HARVEST LOSSES UNDER SMALL SCALE FARMERS IN MOZAMBIQUE

¹Egas Nhamucho, ¹Filipe Manhique & ¹Arlindo Mondlane

¹Mozambique Agricultural Research Institute (IIAM), P.O. Box 3658, FPLM Av. N. 2698, Maputo, Mozambique Corresponding author: Egas Nhamucho, egasnhamuchomz@gmail.com, Tel.:+258-829640710

Abstract

Storage methods are important issue for household food security among resource poor farmers in developing countries. Storage conditions and pests are the most important agents of loss of grain quality and quantity during storage. A two-factor experiment (storage methods and sampling time) was set in three different locations under smallholder farmer management in Mozambique, using a completely randomized design with factorial arrangement and replicated three times. The objective of the study was to determine the efficacy of different maize storage methods against post-harvest pests under cultivars produced by farmers themselves over a period of 9 months, with destructive sampling. Five storage methods were evaluated including metal silo, super grain bag™ inside polypropylene bags; polypropylene bag, polypropylene bag with grain treated with Actellic Super® and polypropylene bag with grain treated with Actellic Gold® and in each sampling time, after 3, 6 and 9 months data was collected on, number alive and dead insects, number and weight of damage and undamaged grain in a sample of 500g. Super grain bag and metal silo had the great efficacy over the nine months of storage, showing lowest seed weight loss (average of 2.73% and 5.21%) and seed damage (average of 8.77% and 4.36%) in all three locations. However, metal silo showed to be negatively affected with pre storage management, especially on grain cleaning and moisture content. The polypropylene bag alone was the worst over the same period having a weight loss over 54% and seed damage over 99% after 9 months of storage. Actellic Super and Actellic gold didn't show significant difference between them. If adopted, the use of hermetic storages (metal silos and super grain bag) for maize storage could reduce the negative impact of post-harvest pests among small-scale farmers.

Key words: Maize, storage methods, postharvest, seed weight loss, seed damage

IDENTIFICATION OF GOOD POSTHARVEST PRACTICES (DRYING METHODS) FOR GROUNDNUT IN MOZAMBIQUE

L. Penicela^{1,2}, E. Zuza³

¹Agricultural Research Institute of Mozambique- IIAM, ²Co-Principal Investigator, ³- Agronomist and MSc Student at University of Eduardo Mondlane

Abstract

Groundnut is an important economical and nutritional crop, but it is prone to aflatoxin contamination when good postharvest practices are not taken into consideration, which constitute a health risk to the consumers. This work aimed to identify the postharvest practices used in three districts of Mozambique and then evaluate the level of aflatoxin for further recommendation of those with low levels of aflatoxins. Six postharvest technologies currently used at the community were identified through visits and informal interview to farmer's houses and groundnut fields. These include 1. Store drier, 2. Plants turned down; 3. Concrete floor; 4. Poly-ethilen sheet; 5. Drying on the ground and 6. Plants spread on the ground. To select the good ones, for each drying method, samples were collected from storage places for aflatoxin analysis. All groundnut drying methods show aflatoxin levels that meet the aflatoxin standards of the United States of America (20 ppb) for the crops that they produce. However, Store drier showed the lowest aflatoxin levels (2,96 ppb) that also meet the aflatoxin standards of the European Union (4 ppb) for the crops they produce and plants on the ground showed the highest aflatoxins levels (18,56 ppb) but it still meet the aflatoxin standards of the United States of America (20 ppb). Store drier groundnut drying method could be selected and promoted for use in other groundnut production zones since it meets aflatoxin standard of both USA and EU.

Key words: Drying, storage, aflatoxins, groundnut

IMPROVED SORGHUM VARIETIES DISSEMINATION AND PROMOTION TO INCREASE PRODUCTIVITY OF SORGHUM AMONG SMALL SCALE FARMERS IN MOZAMBIQUE

Joaquim Americo Mutaliano¹, Marcos Armando Marcos²

Agricultural Research Institute of Mozambique – IIAM, Mapupulo Agricultural Research Center, N'tchinga Road N. 2, Montepuez, Cabo Delgado Province- Mozambique

Abstract

Sorghum (*Sorghum bicolor* L.) is a resilience crop in areas where rainfall is limiting factor and maize and rice fail to produce. The development of sorghum varieties tolerant to drought and accompanied with the use of proper crop management recommendations (e.g. use of fertilizers, labor saving through minimum and zero tillage, as well as crop rotation for soil improvements and pest and disease management) have been seen as a huge opportunity to farmers guarantee for food security and poverty alleviation. The study covered a universe of 6,358 farmers, in which 4,845 were direct beneficiaries and 1,513 indirect beneficiaries in three Provinces (Zambezia, Nampula and Cabo Delgado) that covers Central and North sorghum plateau in 2016/2017 cropping season. The objective of this research study is to increase productivity of sorghum among small scale farmers through more farmers using [adopting] appropriate technologies and promote the use of improved varieties. Random complete block design with replications and five improved sorghum varieties including local check were established and each selected farmer represented a replication. The ANOVA and AMMI analyses were conducted for yield performance, to single and combine analyses respectively. The sorghum varieties, Mapupulo, Mucuvea, Otela and Tocolé were the most appreciated by farmers in Montepuez and Ribaue Districts; while the varieties Matica-1, Matica-2, Mucuvea and Otela were the most appreciated by farmers in Alto-Molocue District. Over all improved technologies under dissemination across different environments have shown good performance response and create farmers' awareness for yield performance, adaptability (tolerance for adverse conditions), as well as grain quality. These results have created motivation to farmers for easy adoption of the new varieties because they are early maturing, short in height, none photoperiodic sensitive and stay green synonymous of drought tolerance, white seeded and good thrashability traits.

Key words: Sorghum improved varieties, high yielding, tolerant to drought

INVESTIGATING THE OCCURRENCE OF MAIZE LETHAL NECROSIS DISEASE IN MOZAMBIQUE

Celso Campanellas Manuel¹, Banú Belmiro Irenio¹

1. Mozambique's National Institute of Agricultural Research (IIAM), Northeast Zonal Centre, Av.Das FPLM km 7, Mapupulo.Montepuez- Cabo Delgado-Mozambique

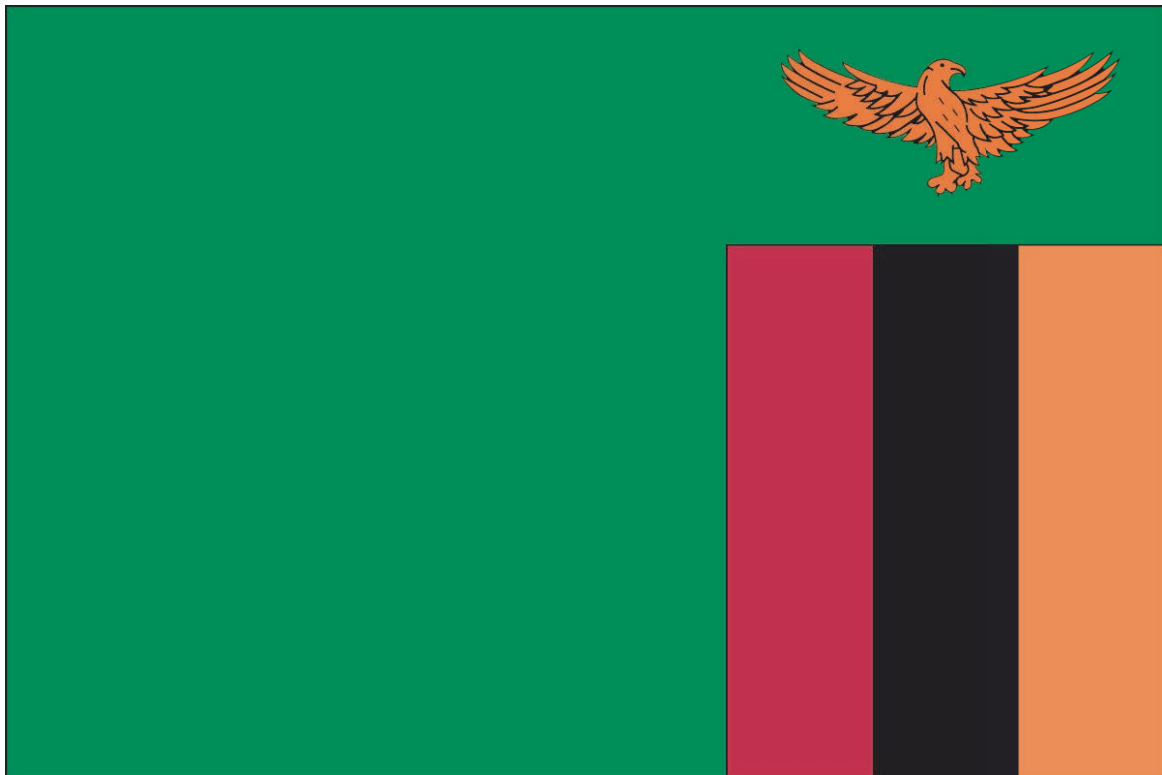
Abstract

Maize Lethal Necrotic Disease (MLND) is a new disease in East Africa, first reported in Kenya in 2011 and then spread to Tanzania, Uganda and Rwanda. The disease is caused by Maize Chlorotic Mottle Virus (MCMV) in combination with viruses of genus Potyvirus, mostly Sugarcane Chlorotic Mottle Virus (SCMV). MLND is a big threat to maize production in East Africa as it can cause intensive to complete yield loss (Wangai et al., 2012b). Maize makes up a large part of the diet in East Africa. Some of the foods in the region are made of maize (githeri, ugali, maize meal porridge), while the plant is the source for many by-products (oil). Losing their harvest has significant impact on both the food and nutrition security of farming. Mozambique, as a neighbouring country to Tanzania, is concerned that the disease may enter into its maize field through the Northern border. A survey was conducted in the northern region of Mozambique in order to establish the occurrence of MLND in Mozambique through disease and vector pest surveillance and understand the relationship between smallholder maize farmers in the border area (Seed system). Two districts in Cabo Delgado Province (Mueda and Palma) and one district in Niassa province (Sanga) were selected for the study. Semi-structured questionnaires in face-to-face interviews were used for farmers and agriculture services to have clear understanding of the seed system in the survey areas with prior focus on seed movement and Integrated Pest and Disease Management (IPDM). For data analyses of Networks of seed and maize transactions between the farmers and other stakeholders were carried out with the igraph and statnet packages in the open source software R programming environment version 3.4.2 (R Core Team 2017). Analysis of variance was carried out with a non-parametric test (Kruskal–Wallis test, significance level $p < 0.05$). The results of the analysis of network Analyzer (Seed system in border areas) for the total of 72 interviewed among the farmers and other stakeholders, the results show that the total number of seed transactions was 175 with greater emphasis on the use of seeds from Tanzania (76), national seed services (53) and the local seed (46). For source of IPDM the result shows that 72 people were interviewed many people said do not have information about the IPDM (63%), 29 % reported having knowledge of agriculture services, and 3% affirmed to obtain knowledge in neighboring Tanzania at the time of purchase of the seed. There is a greater risk and probability of the MLND entering in the districts was they studies, because there is much circulation of the seed coming from neighboring Tanzania.

Key Words: Maize Lethal Necrosis Disease



ZAMBIA



EFFICACY OF A PHEROMONE TRAP WITH TREATED LONG LASTING SCREEN AGAINST FALL ARMYWORM (FAW) SPODOPTERA FRUGIPERDA (J.E. SMITH) LEPIDOPTERA: NOCTUIDAE)

Chipabika Gilson¹, Gonzalez Francisco², Bingham Georgina V* and Mathews Matimelo¹

¹Zambia Agriculture Resaerch Institute,P/Bag 7, Chilanga, Zambia. *gvb@vestergaard.com +1 (202) 304 2323; Vestergaard Frandsen Inc. 1020 19th Street NW, Washington DC 20036. ²francisco_gonzalez@chemtica.com +506 – 2261-2424, Chem Tica International, S.A, Apdo. 640 -3100, Heredia, Costa Rica.

Abstract

Food Security is an issue that impacts everyone and it is projected that by 2050 there will be a global crisis unless action is taken. Currently the fall army worm is a new pest to the SSA continent and the outbreaks over the past two years have been devastating. A key novel technology is a combination of the Phermone Lure from ChemTica and yellow long lasting insecticide treated ZeroFly® Screen. The trial was conducted from 10th August to 28th September, 2017 in wheat and Maize fields to evaluate the efficacy of ChemTica Pheromone with Vestergaard treated net. Treatments were: 2L coke bottles with soapy water at the bottom and either yellow or black net impregnated with deltamethrine and a 2L coke bottles without a net nor lure. There were ten traps per hectare set in two rows. Significant differences $P < 0.001$ in trap catches between lure baited and non baited traps were observed. A total of 1129 fall armyworm adults were trapped of which 51.20% were from Lure ChemTica and yellow treated screen, 41.45% from lure ChemTica and black treated screen and 7.35% from trap WITHOUT lure nor treated screen. It was also noticed that Lure from ChemTica is specific to fall armyworm as no other insects were recorded in all the sites Therefore, the Phermone Lure from ChemTica and yellow long lasting insecticide treated screen can be used in the integrated pest management of fall armyworm in Zambia.

Key words: Food Security fall army worm, outbreak, lures, long lasting insecticide treated screen.

ASSESSING THE MORPHOLOGICAL DIVERSITY OF COWPEA (*VIGNA UNGUICULATA* (L.) WALP.) ACCESSIONS CONSERVED AT THE ZAMBIA NATIONAL PLANT GENETIC RESOURCES CENTRE.

*Munkombwe Graybill¹, Funsani William² and Tembo Masiye¹

¹Zambia Agriculture Research Institute (ZARI), Mount Makulu central research station, Private bag 7, Chilanga.

²Zambia Agriculture Research Institute (ZARI), Mochipapa research station, P.O Box 630090, Choma

*Corresponding author: munkombwegraybill@gmail.com

Abstract

The accessions of Cowpea (*Vigna unguiculata* (L.) Walp.) conserved in the gene bank may possess important traits for breeding, but this information is lacking. An understanding of phenotypic variation within cowpea (*Vigna unguiculata* (L.) Walp.) accessions in the Zambian gene bank will help in enhancing the utilization of this genetic material. The overall objective of this study was to generate information on the genetic diversity of cowpea accessions conserved in the national gene bank by assessing their phenotypic variation. Sixty six cowpea accessions were planted in a randomized complete block design with three replications at Mt. Makulu Research Station in 2016/2017 agricultural season for agro-morphological characterization. The data collected were subjected to multivariate analysis to establish similarity and dissimilarity patterns. The results revealed that the genotypes were predominantly intermediate growth habit, determinate growth pattern, none twining, smooth to rough testa texture and mauve pink flowers. Despite the variability of the genotypes, the results also indicated that there was variation among the 25 traits while one character was found to be monomorphic as all seeds their testa was splitting. Principal component (PC) analysis revealed that first three PC axes explained 30.4% of the total multivariate variation while the first eleven PC axes explaining 73.7%. The most significant traits that delimited the sixty-six cowpea accessions were: growth habit, growth pattern, twining tendency, plant pigmentation, terminal leaf shape, plant hairiness, days to flowering, receme position, immature pod pigmentation, pod colour and pod length. Despite the variability in the accessions, the results also indicate eighteen (18) cluster groups. These results have an important implication for cowpea germplasm improvement, agro-morphological evaluation and conservation.

Key words: Cowpea; agro-morphological; assessing; vigna unguiculata; diversity.

UNDERSTANDING THE KNOWLEDGE, ATTITUDES AND PRACTICES OF SMALL SCALE FARMERS INVOLVED IN COWPEA (*VIGNA UNGUICULATA*) AND PIGEON PEA (*CAJANUS CAJAN*) PRODUCTION IN SELECTED DISTRICTS OF ZAMBIA.

J. Chikopela Mataa¹, R. Kiwanuka-Lubinda² and P. Hamazakaza³,

¹Farming Systems Research Team, Mt. Makulu, Research Station P. B. 7 Chilanga Zambia, ²Dept. of Agricultural Economics and Extension, University of Zambia PO Box 32379, Lusaka, Zambia, ³Farming Systems Research Team, Kabwe Research Station, PO Box Kabwe. Zambia

Abstract

Cowpea and pigeon peas are important crops for smallholder farmers in Malawi, Mozambique and Zambia. They play a role as food and nutrition security crops and source of income for many farmers. Households in the region run out of cowpea and pigeon pea within few months after harvest due to low productivity and production. This is due to several factors, including poor crop management practices. The objective of the study was to understand farmer knowledge, attitudes and practices related to cowpea and pigeon pea production in 6 selected districts (Kalomo, Kaoma, Kazungula, Luangwa, Mumbwa and Rufunsa) of Zambia. Specifically, varieties grown, access to new information, constraints and challenges of cowpea and pigeon pea production were assessed. Primary data was collected through interviews covering 120 small-scale farmers and interviews with field staff, while secondary data was obtained from reports and publications. The findings show that cultivation of cowpea occupies 4.5 % of the cultivated crop fields compared to 18.5 % of maize, while the cultivation of pigeon peas is negligible in the target districts. The farmer awareness levels as well as use of improved cowpea varieties by farmers varied greatly across districts. Of the released ZARI varieties Lutembwe was found to be the most widely grown variety followed by Bubebe. Kalomo district reported the highest number of farmers that sold cowpea with an average of between 150- 200 kg of cowpea grain sold annually. The results were that more farmers should be encouraged to grow cowpeas and pigeon and there is need for more awareness campaigns. The productivity and production of cowpea and pigeon peas is low and therefore there is need for more efforts to promote the use of improved varieties and management practices.

Key words: Knowledge, attitude, practice, cowpea, pigeon pea, survey.

ASSESSING DISEASE INFECTIONS, INSECT PEST INFESTATIONS AND YIELD OF MAIZE VARIETIES UNDER DIFFERENT CONSERVATION AGRICULTURAL PRACTICES IN ZAMBIA

Tembo Mathias^{1*}, Patrick C. Chikoti¹, Suwilanji Sichilima¹, Mtawa Mkulama¹, Mweshi Mukanga¹, Ivy Ligowe², Antonio Chamuene³,

¹Zambia Agriculture Research Institute, Mt. Makulu Research Station, Private Bag 7, Chilanga, Zambia, ²Chitedze Agricultural Research Station, P.O. Box 158, Lilongwe, Malawi, ³Agricultural Research Institute of Mozambique (IIAM), CZnd-Prolongation of Av. FPLM, Corrane Road Km 7, C.P. 622, Nampula, Mozambique.

*Corresponding author's email: mathiastembo2002@yahoo.com

Abstract

An evaluation and assessment study was carried out in three maize growing districts of Mambwe, Choma and Lusaka in 2014 to 2017. The study involved determining the incidence, severity, and damage of maize varieties to the major maize diseases such as maize leaf blight, maize grey leaf spot, maize streak virus, maize cob rots and insect pests such as maize stalk borers and the fall armyworm under conservation and convention agricultural practices. The objectives of the study were i) to assess the maize leaf diseases and pests of economic importance in maize production under conservation practice (CA) as compared to conventional practice (CP); ii) to assess the effect of continued maize crop residue retention on disease and pest build up; iii) to determine the performance of different maize varieties under varying CA practices in the major maize growing agro-ecological regions of Zambia; iv) to investigate maize varietal resistance to diseases and insect pests when subjected to CA in different agro ecological regions of Zambia. Mambwe district had the highest disease prevalences for Curvularia leaf spots (54.6 %) and Maize streak virus (22.9 %) under Conservation rotation farming practice. Lusaka district had the highest disease prevalence for Maize leaf blight (46.4 %) under both Conservation rotation and Convention rotation farming practices, Maize grey leaf spot (11.7 %) under Convention rotation farming practice and Maize leaf rust (4.4 %, 3.8 %) under Conservation continuous and Convention rotation farming practices, respectively. Choma district had the highest disease prevalence for Maize cob rots (46.1 %) under Convention continuous farming practice and highest fall armyworm (FAW) damage (5.8) under Convention continuous farming practice. Maize varieties yielded differently in different locations and farming practices. In Lusaka district, GV 635 and GV 638 had the highest yields under Conservation rotation farming practice (11.25 tha⁻¹ and 11 tha⁻¹, respectively). In Mambwe district, GV 659 had the highest yield (5.75 tha⁻¹) under Convention continuous farming practice. In Choma district, GV 659 and GV 640 had the highest yields under Conservation rotation farming practice (5.09 tha⁻¹ and 5.0 tha⁻¹, respectively). The responses of the maize varieties to diseases (leaf spots, leaf blight, cob rots, Maize streak virus, Maize grey leaf spot, and Maize leaf rust) and insect pests (Fall armyworm) varied across the regions and the farming systems. The variety GV 628 had the lowest minimal damage due to the fall armyworm (2.7) in Lusaka district under

Conservation rotation and Convention rotation farming practices, respectively. In Mambwe district, GV 638 had the lowest FAW damage (1.7) under Conservation rotation farming practice. In Choma district, the range was between medium to high FAW damage among all the varieties across the farming practices. The study provides a basis for decision making with regard to “hot spot” areas for disease and insect pests, suitability of maize varieties to particular farming practices in each location based on yield performance, and response of maize varieties to disease and insect pest in the particular farming practice in each specific location.

Keywords: Diseases, insect pests, incidence, damage, yield, Conservation Agriculture, Convention Agriculture

ESTABLISHING DROUGHT TOLERANCE THRESHOLDS FOR MAIZE

Hampango M. Mudenda*, Chisunka Brian, Malambo Grace

*Principal Investigator, APPSA MZ-P17-2016, Seed Control and Certification Institute, Ministry of Agriculture, P.O. Box 350199, Chilanga, Zambia.

Abstract

Maize (*Zea mays* L.) is a staple food crop in most Sub-Saharan Africa countries. However, maize production has been hampered by adverse weather conditions such as drought. This study was undertaken to establish thresholds for drought tolerance which would help in the identification of drought tolerant maize varieties as such thresholds have not yet been established in Zambia. Field trials involving a total of 30 maize varieties were conducted during the 2017 winter season. The trials involved assessment of maize under controlled irrigation conditions with the plants being subjected to water stress at flowering and grain filling stages respectively and results compared to those from unstressed trials. The maize varieties were planted according to their maturity groups in each water regime and a randomized complete block design with three replications was used. Tolerance Index (TOL) was used to determine the drought tolerance level for each variety as well as a Selection Index (SI) that uses secondary drought traits. Results showed that the varieties in the trials were different and exhibited their respective genetic potential for yield. For the early maturity group P3506W was the highest yielder yield of 9,347.32 Kg/ha. Low TOL with not more than 50% yield as well as positive SI were determined as the minimum acceptable drought tolerance thresholds. Under early maturity, the variety KK 505 had low TOL tolerance to drought with 33% yield reduction under flowering and 27% under grain filling. Under medium maturity, SC 633 was more tolerant under both flowering and grain filling drought with 33% and 15% reduction respectively. PAN 7M-83 was most drought tolerant for both flowering and grain filling with 15% and 19% yield reduction under these drought conditions respectively.

Key words: Drought tolerance, Maturity Group, Yield

DEVELOPMENT OF HIGH IRON AND ZINC BEANS WITH RESISTANT TO ANGULAR LEAF SPOT AND COMMON BACTERIAL BLIGHT IN ZAMBIA, MALAWI AND MOZAMBIQUE

Kennedy K. Muimui¹, Annie Matumba², Virginia Chisale² and Manuel Amane³

¹ Misamfu Regional Research Station, Box 410055, Kasama, Zambia, ²Department of Agricultural Research Services (DARS), Chitedze Agricultural Research Station, Box 158, Lilongwe, Malawi, ³Instituto de Investigacao Agraria de Mocambique (IIAM), Maputo, Mozambique,

Abstract

Beans is an important source of proteins and micronutrients especially for the low-income group in the developing countries of southern Africa. Beans play an important role as a source of proteins and micronutrients especially iron (Fe) and zinc (Zn) for children and pregnant women. Iron and zinc deficiencies apart from causing anaemia, compromising physical work capacity, also leads to growth retardation and alterations in neurological function and immunological response. Beans is affected by a number of field diseases. Among the important diseases in the region are angular leaf spot (*Isariopsis griseola*), common bacterial blight (*Xanthomonas campestris* pv *phaseoli*), anthracnose (*Colletotrichum lindemuthium*), rust (*Uromyces phaseoli*) and bean common mosaic virus. Angular leaf spot and common bacterial blight are far more damaging on varieties that are susceptible resulting in yield losses. To develop lines with high levels of iron and zinc, as well as materials resistant/tolerant to angular leaf spot and common bacterial blight, crosses were initiated in 2013, and a total of 487 plants were raised as F1s. Selection based on plant type, disease score, yield components followed from F2 onwards up to F5. A nursery was constituted for multi-location evaluation. At F7, a replicated trial consisting of elite lines was constituted and evaluated across the three countries. The mean yield across location of 1180kg/ha was obtained, an indication of existence of good lines from the study. The following lines NUA 35, ZMBP/12/61-2, ZMBP/12/59-4, CIM-CBB-FeZn08-30-2 and NUA 45 (control) had yields above 1.4t/ha. In the study, about 36% and 6% of the genotypes had higher iron and zinc concentration compared to average iron and zinc concentration in common bean which is estimated at 70ppm (iron) and 33 ppm zinc. Superior lines were selected by national programmes of the three participating countries and have since being placed for possible releases in the implementing country. The following lines have been earmarked for release CIM ALS-FeZn08-16-6, (Zambia and Malawi) CIM-cbb-FeZn08-30-2 (Zambia and Malawi), ZMBP/12/16-4 (Zambia) CIM ALS-FeZn08-6-2 (Malawi).

Key words: Resistance, tolerance, iron, zinc, micronutrient

KNOWLEDGE AND PRACTICE OF PESTICIDES USE AMONG SMALL HOLDER FARMERS IN ZAMBIA

Malambo M. J¹., Mukanga, M¹., Salati, R. K¹., Sichinga, S¹., Kabamba, B¹ and Nyirenda, J²

¹Zambia Agriculture Research Institute, Mount Makulu Central Research Station, Chilanga, Lusaka, Zambia ²University of Zambia, Great East Road Campus, School of Natural Sciences – Department of Chemistry, Lusaka, Zambia,

Corresponding author: mtintha@hotmail.com

Abstract

Pesticides are essential for the control of infestation of disease, insect pests and weeds on different crops. Due to wide usage of synthetic pesticides which may lead to increased exposure and associated environmental and health risks among small holder farmers in Zambia, it was imperative to undertake a study to understand their knowledge and practices, in order to recommend appropriate pesticide use practices. A total of 418 small scale farmers were randomly sampled from seven Districts (Mkushi, Mpongwe, Luangwa, Mbala, Solwezi, Chipata and Kalomo) and data was solicited from them using a structured questionnaires using structured questionnaires. The data collected was analyzed using SPSS version 21. Findings revealed that pesticide use among small holders is on the increase with over 162 pesticides of varying trade names being used in the target Districts. Glyphosate, followed by Dicamba, Paraquat and Atrazine respectively were widely used by farmers as herbicides in Maize while cypermethrine and Monocrotophos were used as insecticides in both Maize and Soybean. The choice of what pesticide the farmers used was influenced by what was available on the market and the cost. Eighty percent of the farmers had used pesticides for less than three years. Regardless of how long farmers used pesticides, they showed a higher likely hood of not handling pesticides in a safe manner and using rates which were not recommended in agronomic practices. The study showed no correlation between farmers' level of education and adherence to safety precautions on spraying, reuse and storage of empty chemical containers, hence a clear knowledge gap as regards pesticide use among small holder farmers which has an influence on their practices and perceptions. Continuous training of farmers and vigorous enforcement of the national chemical pesticides use safety regulation is indispensable in protecting small holder farmers' lives and ensuring environmental sustainability.

Key Words: Pesticides, Agriculture, Knowledge, Practices, Farmers

IMPROVING GRAIN STORAGE STRUCTURES FOR SMALLHOLDER FARMERS IN MOZAMBIQUE AND ZAMBIA

Nswana Kafwamfwa¹, Lucas Tivana², Raphael Nguenya², Joy Sinyangwe³, Olipa Lungu⁴

¹ Zambia Agriculture Research Institute, Mochipapa Regional Research station, Choma, Zambia², Eduardo Mondlane University, ²Eduardo Mondlane University, ³Department of Agriculture, Ministry of Agriculture, Lusaka, Zambia, ⁴Soil Science Department, University of Zambia, School of Agricultural Sciences, Lusaka, Zambia

Abstract

Food and nutrition security in Sub-Saharan Africa (SSA) remain at risk due to the volatility and rapid increases in food prices, natural disasters, post-harvest losses and climate change effects. At smallholder farm level, PHL is one of the main challenges in much of SSA. For instance, the PHL of cereal and pulses are reported to be over 35%, thereby contributing significantly to food insecurity in rural and urban households in Mozambique and Zambia. PHL in SSA can be attributed to poor storage infrastructure. One of the most sustainable ways to ensure crop productivity, food and nutrition security is to reduce PHL by the use of storage infrastructures such as Polyethylene and metal silo tanks (PST and MS) and Super Grain bags (SGB) apart from the Local grain bag (LGB), which have not been largely promoted in SSA. These materials were tested on-station and on-farm in parts of Mozambique and Zambia, differentiated by climatic conditions. The results indicated that SGB, MS and PST were 88%, 76% and 55% better than LGB, respectively. At 95% confidence level, there were significant differences among the treatments. However, under farmer conditions, there were no significant differences between the PST, SGB and MS in terms of insect pest infestation. There were more insects observed in the LGB compared to the other structures. This means that the PST and SGB, as well as the MS were the most effective structures in maize and cowpea storage due to less infestation of insects which are the major storage problems among smallholder farmers in Mozambique and Zambia.

Key words: Polyethylene, grain, silo, metal, super

DETERMINING THE OCCURRENCE OF CASSAVA BROWN STREAK DISEASE IN ZAMBIA

Rabson M. Mulenga¹; Suwilanji Sichilima¹, Mathias Tembo¹, Dickson Ng'uni¹, Mta-wa Mkulama¹, Judith Malumo¹, Jackson Mwenya¹ and Patrick C. Chikoti¹

¹Zambia Agriculture Research Institute, Mount Makulu Central Research Station, Chilanga, Lusaka, Zambia.

Abstract

Cassava is an important food crop in Zambia upon which 30% of the Zambian populace depends. It is largely grown in the northern half of the country, but its yields are low at 5.8ton/ha compared with an Africa-wide of 12.0 ton/ha. A major constraint to cassava production is cassava mosaic disease (CMD) that has been reported in all the seven cassava producing provinces of Zambia. A viral disease of equal importance, cassava brown streak disease (CBSD), has been reported in four (Malawi, Mozambique, Tanzania and Democratic Republic of Congo) of the eight countries that share borders with Zambia. A targeted cassava pathogens diagnostic survey conducted in July 2017 covering two districts (Chiengwe and Kaputa) in Luapula and Northern provinces respectively, resulted in the detection of CBSD. A follow-up survey targeted at capturing a wider sampling area, was conducted from April to March 2018 to establish the spread of CBSD in seven provinces of Zambia where cassava is grown. A total of 161 cassava fields were surveyed and cassava leaf samples were collected from 483 (57 symptomatic and 426 non-symptomatic) individual cassava plants. CBSD prevalence was approximately 19.9% (32 of 161) across fields. CBSD incidence varied across fields but averaged 7.9% while CBSD severity was 2.2 on a 1-to-5 rating scale. Reverse-transcription polymerase chain reaction (RT-PCR) screening of all 483 samples with two species specific primer pairs that amplify Ugandan cassava brown streak virus (UCBSV) and Cassava brown streak virus (CBSV) only amplified DNA bands of the expected size (440 bp) in 57 of the 483 samples depicting presence of UCBSV only. All the 426 non-symptomatic samples were negative for UCBSV and all samples tested negative with primers targeting CBSV. This report of CBSD and UCBSV in Luapula, Northern and North-western provinces of Zambia shows an expanded geographical distribution of the disease in Zambia and its causal virus and further reinforcing the need to address the problem through a multidisciplinary approach.

Key words: Cassava brown streak virus, Reverse-transcription PCR, Prevalence

DEVELOPMENT OF COWPEA-BASED FOODS TO CONTRIBUTE TO HOUSEHOLD NUTRITION SECURITY: HOUSEHOLD COWPEA UTILIZATION AND CONSUMPTION SURVEY

Twambo Hachibamba*, Mercy Mukuma Mwale, Chiza Kumwenda

University of Zambia, School of Agricultural Sciences, P.O. Box 32379 Lusaka, Zambia, *Corresponding author: thachibamba@unza.zm

Abstract

Globally malnutrition remains one of the major public health problems; the vulnerable groups include children and women. In Zambia, undernutrition is quite common among children, currently 40% of under-five children are stunted. Undernutrition is the underlying cause of 45% of mortality among children under-five years of age. Childhood undernutrition is also one of the main risk factors for morbidity and disability among children. Malnourished children have an increased risk of metabolic disorders as well as lower labour productivity later during adulthood. One of the main causes of malnutrition among children and women is consumption of diets that are low in energy and nutrients. In Zambia, diets for children especially in rural areas are limited in variety and consist mostly of the staple maize consumed with a relish usually of vegetable origins. Cowpeas are one of the nutrient and energy rich legumes that are relatively easy to cultivate and does not require extensive farm inputs. Cowpeas are rich in several micronutrients, carbohydrates and protein. The present study was designed to assess utilization and consumption of cowpeas in communities where an APPSA supported project is to be implemented. A household survey was used to collect data using a structured questionnaire. The study has shown that consumption of cowpeas is quite common in the proposed study sites. The main form of cowpeas consumed in the study sites is boiled dry cowpea, used as relish. Overall, there is less diversity of cowpea-based food products in the study areas. These survey results will contribute towards development of cowpea-based food products which will optimize cowpea utilization and consumption among communities. The survey also demonstrated gender differentials in terms of decisions to purchase, choice and preparation of food at household level.

Key words: Food security, cowpea utilization, undernutrition, gender

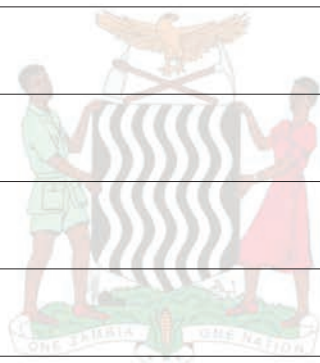
Notes



Government of Malawi



Government of Mozambique



Government of Zambia

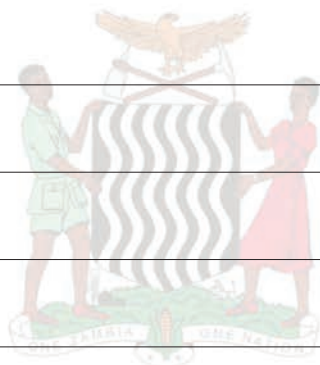
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**Center for Coordination of Agricultural research and Development for
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00357, Gaborone, Botswana
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