COMPARATIVE YIELD PERFORMANCE OF MAIZE VARIETIES FOR CIP IMPLEMENTATION

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Abstract

Maize is the primary staple crop in Rwanda and plays an important role in the livelihood of the population. Its availability and abundance determines the level of welfare and food security in the country. Enhanced maize productivity can be achieved by increase use of modern production techniques such as the adoption of improved maize varieties and other inputs. To achieve on this objective, the Crop Intensification Program (CIP) has been created where different seeds varieties are imported and supplied to the farmers.

This study compared yield performance of five maize varieties supplied to the farmers for CIP implementation. The five varieties including one OPV (local: ZM 607) and four hybrids (H629, PAN 4M21, SDCO719 and PAN691). The experiment was laid out in Randomized complete bloc design (RCBD) with five treatments replicated five times. Following parameters were used to evaluate the yield performance of maize: yield per ha, number of cob per plant, height of plant, 1000 grains weight and length of cob was analyzed. Field data was computed with GENSTAT Version 3.

The results show that three parameters (number of cob per plant, cob length, 1000 grains) were associated with yield on a highly significant difference of 0.001. Results indicated that PAN4M21 was the best performing variety in five parameters and ZM 607 shows low results for almost parameters. From results of this study, imported maize varieties must be tested before being spread to local farmers. Hybrids varieties which have been tested locally are of great importance to increase food security in Rwanda.

Keywords: Maize, Varieties, yields performance, CIP
1. INTRODUCTION

Agriculture is the most important sector in Rwanda’s economy, contributing for about 43% to the Gross Domestic Product (GDP) and employing more than 90% of the active population (MINAGRI, 2012). As set in the country priorities of rural development in Economic Development and Poverty Reduction Strategy 2; the increase in productivity of agriculture is at the second grade (EDPRS 2, 2013)

In Rwanda, maize is one of the major commodities in agricultural sector used as cash and food crop contributing to the household income. Consumption of maize is consistently increasing and maize is becoming an important cash crop for farmers, especially in the maize growing regions. Maize has more uses than any other cereals. It is used mainly as food for human consumption, but it is also the number-one feed grain in the country, being the main source of calories in animal feeding and feed. (Sallah et al 2009).

However, green revolution generally in Africa and in Rwanda particularly was mediated by the facilitation of modern inputs such as improved seeds, fertilizers and pesticides to farmers. With the introduction and adoption of these improved inputs, the farmers were able to substantially increase their crop production levels by several folds. (MINAGRI 2011)

The increased yields provided food security and stability which in turn triggered an array of social and economic transformation. The National Maize Program of Rwanda has devoted much effort to improving normal maize and Open pollinated varieties (OPV) for adaptation to the major maize producing ecologies in the country. Improved maize varieties can be profitable alternatives to commercial single-cross hybrids as well as good elite sources of diverse inbred lines (Nyirigira, et Al 2005). In addition to that a good knowledge of the right seeds for the various climatic regions enables farmers attain good yield and income.

Every year, many farmers plant wrong maize seed varieties, ending up with poor yields for lack of correct information. Persistent advertising and promotion of certain maize seed varieties by seed companies was partly to blame for the problem. In addition to that, farmers usually ask local agrovet shops to sell them the best maize varieties. This approach has not been effective because seed stockists always recommend any variety especially that is not moving.

To overcome those challenges related to maize varieties, CIP imported improved seeds from the neighbouring countries such as Kenya and Tanzania in the region. Despite the so called increase in production it has been noticed in the seasonal reports of
the districts that some of the varieties are challenged due to yield variation (District report 2014).

Despite differences in productions among those varieties, no specific in-depth research have been developed to determine seed varieties that do well in different region of Rwanda in order to meet the needs of farmers in every climatic region for further generating sufficient information from comparison of yield performance of different maize varieties.

The study was undertaken to compare the yield performance of most maize varieties including four hybrids H629, PAN691, CDCO 719, PN4M21 and OPV (local variety: ZM607) supplied to the farmers for CIP implementation in Rwanda. Therefore, this study was conducted in Rubengerera sector, Karongi district western province of Rwanda. It aimed at identifying the high productive maize variety in the research area. Evaluating the vegetative characteristics of the hybrids and OPV supplied to the farmers and to find out the relationship between vegetative characteristics and the yield of the maize.

2. MATERIALS AND METHODS

Description of the study area

The study was conducted in Rubengerera sector, Karongi district in western province of Rwanda. Rubengerera sector is located in the western agro-climatic zone with 79.9 km² and 33.005 population distributed in 7032 households. The population density is 697 population / km² (NISR 2012). The agricultural land is 2977 ha on kivu zone and 1171 ha on Congo – Nile crest. Altitude varying between 1470 – 2200 meters, 2.0519° S, 29.4144° E and the annually rainfall ranging from 1100 -1500mm (karongi district, 2013).

Data collection and analysis

Four maize hybrids (PN4M21, PN691, H 629 and SDCO 719) and one OPV (local variety) were analyzed for yield performance in an agricultural field located in Rubengerera Sector in 2015A growing season using a randomized complete block design.

Table 1. Experimental field design

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T1= ZM 607 (OPV), T2= PN4M21, T3= PN691, T4= H 629, T5= SDCO 719

This experimental design was composed by five blocs with five treatments replicated five times in order to spread each variety throughout the field for all benefiting the field nutrients at the same level and all other agronomic practices were kept uniform for all treatments.
In the 25 plots of the experimental field each was 12 m² (4x3m). A ridged plot consisted of four rows of 70 cm interline, respectively. Two seeds were planted in each of the 40 holes of 8 to 10 cm depth and spaced of 40cm to give a 2000 population plants per field.

To ensure the accuracy of the results, all plant of the plot was similarly treated. Chemical fertilizers DAP, UREA and organic fertilizer was applied by deep banding technique to each plant. DAP and organic manure was applied at the day of sowing; urea after 45days. Fertilizers were calculated as follow according to Vanlauwe et al 2001.

\[
\text{Farm yard manure} = \frac{10000 \text{kg} \times 12 \text{m}^2}{10000 \text{m}^2} = 12 \text{kg}
\]
\[
\text{DAP} = \frac{1 \text{ kg} \times 12 \text{m}^2}{100 \text{ m}^2} = 0.12 \text{kg}
\]
\[
\text{Urea} = \frac{0.5 \text{kg} \times 12 \text{ m}^2}{100 \text{ m}^2} = 0.06 \text{kg}
\]

Weeding was done twice along the whole experiment: two weeks after germination, then at a period when young plants was 15 cm high. All of the weeding procedures were performed followed by a ridging around the plant to allow aeration, water infiltration and preventing fertilizer loss during volatilization.

Data collection was focused on two main parameters: parameter of growth (Plant height and Cobs per plant) and parameter related to the yield (1000 grains weight, Grain yield and Cob length)

Plant height was recorded at the time of physiological maturity from bottom to top excluding tassel (Gozubenli et al,. 2004). Number of cobs per plant was noted by counting the total number of cobs and then averaged. Cob length of ten cobs was measured from each plot with the help of scale and then average was taken. It was expressed in cm. thousand grain weights were taken on randomly selected shelled ears of each subplot and then their average weight was recorded. Grain yield data was recorded in each subplot and converted in tons per hectare.

Data was coded after entry in accordingly to treatments in relation to the test plants. Data entry has been done using MS Excel they were coded accordingly to the variables of the research using Genstat (Version 3). Then data was analyzed accordingly to research objectives and tested for significance using Genstat.

3. RESULTS AND DISCUSSION

3.1. RESULTS

3.1.1. Statistical analysis of agronomic data

Number of cob per plant
Figure 1: Number of cob per plant

The above figure number 1 shows the average of each treatment, and revealed that average were between 1.136 and 1.368, where T2 has shown a highest number of cobs per plant.

Plant height

Figure 2: Means height of plants

It has been observed that the means of plant height vary from 136.42 to 200.06 cm, where T4 shows a high plant height than others.

1000 Grains weight (gr)

Figure 3: Means of 1000 grains weight

The figure 3 shows the difference between treatments which arranged from 397.4 to 496.2 gr, so the treatment which indicated more grain weight was T2 and T1 shows a low grain weight.

Yield in ton per ha

Figure 4: Means yield of treatments

As far as the yield is concerned, the figure number 4 indicates that T2 presented the higher yield (4.98 t/ha). It was followed by T3 (4.36 t/ha), T4 came at the 3rd position with (4.02 t/ha) followed by T5 (3.2 t/ha), and the last one was T1 that yielded 2.44 tons/ha.

The cob length
Figure 5: Means of Cob length (cm)

The figure number 5 which contains the data on the cob length reveals that T2 was the treatment with highest cob length and T1 with the shortest cob length.

3.1.2. Relationship between growth parameters with the yield.

Relationship between plant height and yield

Figure 6: Relationship between plant height and yield of maize

As shown by figure no 6, there is no positive linear relationship with R2=0.644 between plant height and yield of maize. This means that, there is no correlation between yield and plant height of the maize at 64.4%.

Relationship between number of cob per plant and yield

Figure 7: Correlation between number of cob per plant and yield

The figure number 7 shows strong correlation between number of pods per plant and the yield (R2=0.894). This means that the yield has been positively affected by the number of cob at about 89.4%, therefore the higher number of cob per plant, the higher yield.

Relationship between 1000 grains weight and the yield

Figure 8: relationship between 1000 grains weight and yield
The figure 8 shows a strong positive correlation between yield and grains weight. So, the yield of maize is highly influenced by weight of grains ($R^2 = 0.919$).

**Relationship between cob length and yield**

![Cob length and yield graph](image)

**Figure 9: Relationship between cob length and yield of maize**

As shown by figure 9, there is a positive linear relationship with $R^2=0.911$ between cob length and yield of maize. This means that, there is a strong correlation between yield and cob length at 91.1%.

**3.2. Discussion**

The present study was carried on four maize hybrids varieties and one OPV (local variety) to compare their yield performance.

Plant height determines the growth attained by the plant during its life development. Plant is generally as well as environmentally controlled factor and different cultivars and hybrids have different plant height. In figure 7 significant differences were observed between the five varieties in treatments where T4 (H629) was seen as the highest among others with 200.06 cm followed by T3 (PAN691) with 193.16cm; 187.04cm for T2 (PAN4-M21); T5 (CDCO 719) with 178.48 cm and the last with the minimum height was T1 (ZM607). This difference was proven to be highly significant at 0.001. This was due to the fact that plant height is a genetically controlled factor so the height of different varieties does not remain equal. These results are in accordance with the results of Beyene et al., 2011 who also reported in the alike study on two maize varieties a difference in plant height in different hybrids. Sangakkara et al 2004 also found the same findings of difference in plant height. The figure 6 has shown that the plant height did not affect the yield.

The number of cobs varied from 1.136 to 1.368, the latter was attributed to T2 (PAN-M21) and the OPV (ZM 607) gave the lowest number of cobs. This difference was found to be highly significant at 0.001. The number of cobs per plant is a genetically controlled factor but environmental and nutritional level may also influence the number of cobs per plant. The more the number of cobs per plant, the higher the grain yield. Khan (2002).

1000- grain weight is an important yield contributing factor, which plays an important role in showing the potential of a variety. Data indicates high significance effect of 1000 – grain weight on yield. The variation in grains was ranged between 397.4(T1), 408.8(T5), 434.8(T4), 473.8(T3) and T2(496.2). T2 (PAN4-M21) performed...
well than others, whereas T1(ZM607) was the least. Grain weight was highly significant; similar to what has been by Zamir et al, 2012 in his study about two varieties.

Both cob per plant, grain weight, and cob length had significant effects on plant yield as shown in fig 7, 8, 9. Cob length significantly affected the yield with 20.2 cm produced by T2 and the lowest of 16.1 cm produced by T1. Significant differences were observed in all five varieties. These results are highly different to those found by Tahir, (2008) who reported the difference of 19.95 cm of the first performer to 15.12 cm.

CONCLUSION

Referring to the program of supplying the agricultural input like improved seed of different maize varieties without doing any experimental trial for testing regional or local adaptability of supplied seeds whereas the soil and climatic condition are different, sometimes reults show changes in harvest and other challenges.

The results of this study show that three parameters (number of cob per plant, cob length, 1000 grains) were associated with yield on a highly significant difference of 0.001. results indicated that PAN4M21 was the best performing variety in five parameters and ZM607 shows low results for almost parameters. From the above findings, we suggest (1) PAN 4M21 Should be supplied to famers based on how it peformed well in many parameter. (2) Ministry of agriculture and animal resources (MINAGRI) should supply imported seeds to farmers after testing its productivity in different agroecological zones. (3) to meet the needs of farmers in every climatic region, researchers must develop seed varieties that do well in different regions. It is therefore important for farmers to buy seeds that can do well in their geographical regions.

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