International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 8 Issue 5, Sep-Oct 2024 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Pre-Extension Demonstration and Evaluation of Hybrid Maize Technologies at Highland District of East Hararghe Zone

Bedasso Urgessa, Abdulaziz Teha, Oromia Megersa

Oromia Agricultural Research Institute, Fedis Agricultural Research Centre, Harar, Ethiopia

ABSTRACT

In spite of the wider area coverage, the national average yield of maize per hectare is low. The yield gap is attributed to a number of factors. Lack of sufficient knowledge and awareness of farmers on the production and benefits of the improved maize varieties with good agronomic practice and potential yield is a leading constraint. Demonstration of hybrid maize varieties is essential to alleviate these problems. Therefore, this study was undertaken to enhance the productivity of maize through demonstration of high yielding maize varieties with improved management practices at Meta district. It was conducted at Dursitu bilisuma kebele through farmers' research group approach. A total of 9 trial Farmers were selected based on their interest and land ownership. Damote and BH661 maize varieties were provided to farmers with full packages. Each variety was planted on a plot size of 10mx10m/farmer, with seed rate of 25kg/ha and 75cm*25cm space between row and plant respectively. Likewise, fertilizer (NPS) was applied with rate of 100kg/ha. Training and field visit were organized to create fertile ground for dissemination of technologies through farmers and to evaluate performance of the varieties and share the lessons with different stakeholders. The average yield for Damote and BH661 is 54.69qt/ha and 41.83qt/ha respectively. The mean score for knowledge test before and after implementation is 3.65 and 5.95 respectively. These results indicate an improvement in the awareness and production of beneficiary farmers. Based on their criteria, farmers have preferred and ranked Damote variety as first. Therefore, it is better if effort is exerted for pre scaling up of these technologies.

How to cite this paper: Bedasso Urgessa | Abdulaziz Teha | Oromia Megersa "Pre-Extension Demonstration and Evaluation of Hybrid Maize Technologies at Highland District of East Hararghe Zone" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-8 | Issue-5, October 2024, pp.88-93, URL: www.ijtsrd.com/papers/ijtsrd68330.pdf

IJTSRD68330

KEYWORDS: *Demonstration, Evaluation, Hybrid Maize, Knowledge test*

1. INTRODUCTION

Maize (Zea mays L.) is one of the most important cereal crops broadly adapted in larger parts of the world including Ethiopia (Abate et al., 2015). It is widely grown in most parts of the world over a wide range of environmental conditions ranging between 480 latitude North to about 400South latitude (Geremew et al., 2009). The estimated total world production of maize during 2018 was 1,147,621,938 tons (FAOSTAT, 2020), where, United States, China, and Brazil share 34%, 22%, and 7.2% of this production, respectively. In Sub-Saharan Africa, maize is the main staple crop covering over 38 million hectares and it accounts for 30% of the total area under cereal production (FAOSTAT, 2020). Ethiopia is the second largest maize producer in Africa next to South Africa with high average productivity as compared to African countries, even if low productivity compared to the world average (Dagne, 2016). Maize is cultivated on about 2.526 million hectares of land in the country (CSA, 2021). It ranks first in total production with over 10.557 million tons of produce whereas it ranks second in area coverage next to Teff. The national average yield of maize under subsistence production is about 4.18 ton/ha (CSA, 2021). In Oromia region, maize covers about 1.372 million hectares of land with total production of 5.889 million tons and average yield of 4.29 tons/ha. It also covers about 76,655 hectares of land with 0.22 million tons of production and average yield of 2.9 tons/ha in east hararghe zone (CSA, 2021).

Maize is the most important and widely grown staple food crop and the main sources of calories in Ethiopia. It is popular for its high value as a food crop as well as the growing demand for animal fodder and

source of fuel for rural families (Tsedeke et al., 2015). It contains about 72% starch, 10% protein, and 4% fat, supplying an energy density of 365 Kcal/100g (Ignjatovic-Micic et al., 2015). It also provides many of the B vitamins and essential minerals along with fiber (Ranum et al., 2014). About 88% of maize produced in Ethiopia is consumed as food, both as green and dry grain (Tsedeke et al., 2015). It is consumed as Injera, Porridge, Bread, and Nefro. It is also used to prepare local fermented drinks known as Tela and Areke (MoANR, 2016). The leaf and stalk are used for animal feed and the dried stalk and cob are used for fuel (Tsedeke et al., 2015).

Despite the large area under maize cultivation, the average yield is low as compared to the world's average yield which is about 5.21 ton/ha (FAO, 2011; Tilahun et al., 2017). The average yield in eastern Hararghe zone is still low (2.9 ton/ha) even as compared to the national and regional average of Oromia 4.18 ton/ha and 4.29 ton/ha respectively (CSA, 2021). The yield gap is attributed to a number of factors like frequent occurrence of drought, declining of soil fertility, poor agronomic practice, limited use of input, poor seed quality, disease, and others (CIMMYT, 2004; Girma et al., 2015; Zelalem et al., 2018). In Eastern Ethiopia, especially Eastern Hararghe farmers are producing local variety of maize with traditional farming practice. The performance of improved maize varieties were evaluated for adaptability and stability to recommend the best one for highlands of eastern Hararghe and similar agro-ecologies. As a result, Damote and BH661 varieties were recommended with average yield of 44.09qt/ha & 34.15qt/ha respectively.

Lack of sufficient knowledge and awareness of farmers on the production and benefits of the improved maize varieties with good agronomic practice and potential yield is a leading constraint. (Die et al., 2016a).Thus, this study was conducted to demonstrate and evaluate the productivity and profitability of improved maize under farmers' condition.

Objectives

- To evaluate the productivity and profitability of improved maize under farmers condition.
- To demonstrate and select best performing varieties for pre-scaling up
- To enhance farmers' knowledge and skills on Maize production and management technique
- To strengthen linkage and create awareness among the different development practitioners on improved maize production technologies.

2. MATERIALS AND METHODS

Description of the study area

The study was conducted in Meta district of East Hararghe Zone of Oromia National Regional State. East Hararghe Zone covers an area of about 90,620 square kilometers with an altitude ranging between 700 and 3,400 meters above sea level, and mean annual rainfall ranges between 315 and 1040 mm. The land holding per household ranges roughly between 0.3 and 1.5 hectares. The capital town of East Hararghe, which is Harar, is located on distance of 526 kms from national capital city Finfine to eastern part of the country. The climatic condition of the zone includes highland, midland and lowland (ZANRO, 2020). Meta district is bordered on the southwest by Deder district, on the northwest by Goro Gutu district, on the north by the Somali Region, on the northeast by Kersa district, and on the southeast by Bedeno district. The district is located at 445 km east of the capital city Finfine and 80 km west of Harar town. It is located between 9°0′09″ to 9°0′31″ N latitude and 41°0′29″ to 41°0′44″ E longitude with altitude of 2830 meters above sea level. The annual rainfall ranges between 600-900 mm and the temperature ranges between 15 °C-37 °C. (DANRO, 2020).

Site and farmers selection

Meta district was selected from east Hararghe zone purposively. From the district, Dursitu bilisuma kebele was selected purposively based on maize production potential. Farmers were selected based on their interest, land holding and willingness to learn and share experiences for other farmers in collaboration with experts from wereda agriculture and natural resource office and development agents. The selected farmers were grouped as Farmers Research Group (FRG) with the member of 15 farmers in consideration of gender issues (women, men and youth). A total of 30 farmers were grouped in 2FRGs. Each FRG have selected their own leader who played facilitation role and communication with development agents and researchers in the process. In the FRG, 4 farmers were trial farmers (3 male and 1 female) and 11 farmers were fellow farmers. Hence, 30farmers are addressed within duration of this project.

Implementation design

One improved (Damote) Maize variety was demonstrated using BH661 as standard check. Each variety was replicated across eight trial farmers. Each variety was planted on a plot size: 10mx10m, at seeding rate of 25kg/ha. Space between row and plant was 75cm*25cm respectively. Likewise, fertilizer (NPS) was applied with rate of 100kg/ha. Field

management was undertaken by hosting farmers with close supervision of researchers and development agents.

Capacity building and experience sharing

Training was given to farmers, DAs and experts on agronomic practices and post-harvest handling before plantation and harvesting time. Field visit was also organized on the fields of beneficiary farmers in order to evaluate the performance and final outputs of the varieties and share the lessons with different stakeholders. Famers, development agents (DAs), experts from agriculture and natural resource office, researchers and other relevant stakeholders had attended the event. Extension materials such as leaflets and manuals of training were distributed to farmers, extension agents, and agricultural office experts.

Data collection Method

Number of beneficiary farmers by age and sex, plot size, amount of seed provided and variable cost were collected with checklist. The grain yield data of the varieties were taken from all plot with checklist. Farmers' perception related to attributes of the varieties was collected using semi-structured interview schedule. The perception data on the varieties attributes was grouped into; grain size, grain uniformity, plant height, grain color, maturity period, number of cob per plant and grain yield. The respondents were responded their perception level on the relative advantage of each characteristics of the variety compared to previously introduced variety.

Data analysis Method

Quantitative data were analyzed using SPSS software version 26. Descriptive statistics such as frequency, mean, standard deviation minimum, maximum, were used and presented using tables. Cost-benefit analysis was used for economic evaluation. Qualitative data were analyzed using narrative explanation and argument. The yield advantage of improved sorghum variety over the standard check was calculated by the following formula.

$$Yield\ advantage\ \% - \frac{Yield\ of\ a\ new\ variety\ -\ Yield\ of\ standard\ check}{Yield\ of\ standard\ check}\ X\ 100$$

3. RESULT AND DISCUSIONS

3.1. Demographic characteristics of beneficiary farmers

The mean age of beneficiary farmers is 41.14 years, implying that the targeted group is in production age. Out of the total beneficiary farmers, 57% are males and the remaining 43% are females.

3.2. Descriptive Results for productivity of the varieties

The maximum harvested yield per plot (100m^2) for Damote and BH661 is 0.725qt and 0.643qt respectively. The maximum yield estimated based on harvested yield per plot for Damote is 72.50qt/ha whereas, the maximum yield estimated based on harvested yield per plot for BH661 is 64.30qt/ha. The estimated mean yield for Damote is 54.69qt/ha, while, the estimated mean yield for BH661 is 41.83qt/ha.

Table 1. Descriptive results for yield per plot and per hectare

Locations	Varieties	parameter	Minimum	Maximum	Mean	St. dev
Dursitu Bilisuma	Damote	Yield per plot	0.36	0.73	0.546	0.1258
		Yield per hectare	35.90	72.5	54.686	12.649
	BH661	Yield per plot	0.26	0.64	0.4177	0.14286
		Yield per hectare	26.00	64.30	41.829	14.2588

Source: computed from own data (2021)

The result of t-test for mean difference (table 2.) indicates that there is no significant combined mean difference between the two varieties. However, the percentage of mean yield difference of the varieties (table 3.) shows that Damote variety has 30.7% yield advantage over BH661 variety.

Table 2. The mean yield of hybrid maize and its yield advantage.

Varieties	Yield (Qt/ha) (n=9)				Mean difference over standard check	Yield advantage over standard check
	Min	Max	Mean	St. dev	Qt/ha	%
Damote	35.9	72.5	54.69	12.649	12.86	30.7%
BH661	26	64.3	41.83	14.2588	0	0

Source: computed from own data (2021)

Table 3. The result of t-test for combined mean difference

Parameters	Damote (n=9)		BH661 (n=9)		
	Mean	St.Dev	Mean	St.Dev	T-value
Harvested Yield per plot	0.546	0.1258	41.83	14.26	1.785*
Estimated Yield per hectare	54.686	12.649	4182.86	1425.88	1.785*

Source: computed from own data (2021)

Damote maize variety is preferred by farmers and ranked as first for the parameters such as grain size, grain uniformity, grain color, grain yield and maturity period while BH661 is ranked second for the same parameters.

Table 4. Matrix Ranking of Maize Varieties

Parameters	Damote		BH661	
	Point	Rank	Point	Rank
Grain size	2	1	1	2
Grain uniformity	2	1	1	2
plant height	1	2	2	1
Grain color,	2	1	1	2
maturity period	2	1	1	2
number of cob per plant	1	2	2	1
Grain yield	2	1	1	2
Total score	12		9	
Final Rank	1		2	

Source: computed from own data (2021)

Note: Score 2 is given if the variety is highly preferred and score 1 is given if the variety is less preferred.

3.3. Capacity building and experience sharing

A total of 45 farmers out of which 34 are males and 11 are females have participated on field day. 3 experts (two males and one female) and 3 development agents have also participated on the event. Similarly, a total of 37 farmers (twenty four males and thirteen females), 3 development agents and 3 experts have participated on training.

3.4. Results of Knowledge Test

A simple knowledge test items were developed based on the contents of training and production package practices and knowledge level of participant farmers regarding improved hybrid maize production technologies was measured before and after implementation. Score of 1 is given for correct answers and 0 for incorrect answers. As one can observe from the table 4 below, the percentage of respondents for correct answers is increased after intervention while, the percentage of respondents for incorrect answers is decreased.

Table 5. Percentage of Respondents for each knowledge test Items

No	Test Items	Respondents' percentage			
		After		Before	
		Correct	Incorrect	Correct	Incorrect
1	Name at least one improved hybrid maize variety	80	20	60	40
2	What is the seed rate of maize required for one hectare?	70	30	50	50
3	What is fertilizer rate per hectare recommended for maize?	70	30	70	30
4	What is the recommended space between rows for maize	65	35	40	60
5	What is the recommended space between plants for maize	65	35	45	55
6	What is the Potential productivity (yield/ha) of the variety	55	45	25	75
7	The maximum maize plant density(plant population) per hectare recommended for good harvest is 53,333.33plants/ha	30	70	0	100
8	What types of yields are considered in maize production?	25	75	0	100
9	Actual yield/farmer yield/realized yield losses due to misuse of recommended agricultural practices and environmental stress	55	45	40	60
10	Economic yield losses due to post-harvest losses	50	50	35	65
11	The recommended grain moisture content for maize harvest is 15%	30	70	0	100

Source: computed from own data (2021)

The mean score for knowledge test before intervention and after intervention is 3.65 and 5.95 respectively. The result of paired-sample t-test indicates a significant difference between the mean score for knowledge test before intervention and after intervention at 1% significant level. This implies an improvement of farmers' knowledge concerning the hybrid maize technologies due to technological intervention.

Table 6. Results of paired-sample t-test for knowledge test

	Mean	St. Dev	T-value
Total score after	5.95	1.877	7.254***
Total score before	3.65	1.631	

Source: computed from own data (2021)
Note: ***: refers to significance at 1% level.

Economic Analysis of Hybrid maize production

The changes in net benefit between Damote variety and BH661 variety is 15276 whereas, the change in total cost is 5300. These indicate that shifting from BH661 hybrid maize variety production to Damote hybrid maize variety production has about 9976 EB net benefit advantage.

Table 7. Economic analysis of hybrid maize production

No		Hybrid Maize varieties	
		BH661	Damote
Gross Farm gate benefits			
1	Average yield(Kg/ha)	4183	5469
2	Farm gate price(Birr/Kg)	16	16
3	Gross farm gate benefits	66928	87504
Costs			
4	Land preparation	2800	2800
5	Seed	750	750
6	Sowing	2400	2400
7	Fertilizer(NPS)	1750	1750
8	Fertilizer(UREA)	2100	2100
9	Weeding	3600	3600
10	Harvesting	4800	7200
11	Shelling	2400	4000
12	Threshing	4000	5300
13	Miscellaneous	3500	3500
14	Total cost	28100	33400
15	Net benefit	38828	54104
16	Change in net benefit		15276
17	Change in total cost		5300
18	Benefit-cost ratio	2.38	2.62

Source: computed from own data (2021)

4. Conclusions and Recommendations

The average yield of improved hybrid maize varieties indicates an improvement in the production of beneficiary farmers. Hence, it is better if all farmers of the study areas and those living in the same agro ecologies accept the hybrid maize varieties in sustainable manner in order to increase their production. There is significant mean difference between Damote and BH661 varieties. Therefore, the attention should be given to Damote variety. It is also good if both research center and research institute mobilize resources for pre-scaling up of the technologies. The result of paired-sample t-test indicates an improvement of farmers' knowledge concerning the hybrid maize technologies due to intervention. Therefore, it is better if relevant government and non-government organizations focus on capacity building just to increase awareness and knowledge of farmers towards the promising technologies.

5. REFERENCES

[1] CIMMYT (International Maize and Wheat Improvement Center). 2004. Second Semi-Annual Progress Report for the QPM Development Project for the Horn and East Africa. July 1- December 31, 2003.

[2] CSA (Central Statistical Agency). 2014. Agricultural Sample Survey: report on area and production of major crops (private peasant

holdings, Meher season 2013/2014). Statistical Bulletin, volume1:.Addis Ababa, Ethiopia.

[3] CSA (Central Statistical Agency). 2015. Agricultural sample survey 2010/2011: report on area and production of crops (private peasant holdings, main season), vol. 1. Addis Ababa, Ethiopia.

[4] FAO (Food and Agriculture organization of the United Nations). 2011. FAOSTAT online database, available at link http://faostat.fao.org/.

[5] Geremewu Taye, 2009. Effect of Nitrogen and Phosphorus Fertilizers on the Growth, Yield and Yield Components of Maize (Zea mays L) at Nejo Western Wollega, Ethiopia. MSc Thesis. School of Graduate Studies Haramaya University. p16 - 24.

[6] Tsedeke A., Bekele S., Abebe M., Dagne W., Yilma K., Kindie T., Menale K., Gezahegn B., Birhanu T. and Tolera K, 2015. Factors that transformed maize productivity in ethiopia. Food sec. DOI 10.1007/s12571-015-0488-z

[7] Abate, T., Shiferaw, B., Menkir, A., Wegary, D., Kebede, Y., Tesfaye, K., Kassie, M., Bogale, G., Tadesse, B. and Keno, T. 2015. Factors that transformed maize productivity in Ethiopia. Food Security 17:965-81.

[8] Girma, C, Sentayehu A, Berhanu T, Temesgen M. 2015. Test cross performance and combining ability of maize (Zea mays L.) inbred lines at Bako, Western Ethiopia. Global Journal of Science. 15(4):2249-4626.

[9] Tilahun, B, Dida M, Deresa T Belay G, Girma D, Dejene K, Dagne W and Adefiris T. 2017.Combining ability analysis of quality protein maize (QPM) inbred lines for grain yield, agronomic traits and reaction to grey leaf spot in mid-altitude areas of Ethiopia. Afr. J. Agric. Res. Vol.12 (20), pp1727-737.

[10] Zelalem, B., Chemeda F., Dagne W., Temam H., Shimelis H.and Belachew A., 2018. Combining ability and nature of gene action in maize (Zea mays L) inbred lines for resistance to gray leaf spot disease (Cercospora zeae maydis) in Ethiopia. Crop Protection 112 (2018) 39–48.

[11] Dagne W (2016). Maize varieties and seed value chain challenges in Ethiopia. CIMMYT-Ethiopia.

[12] Food and Agriculture Organization Corporate Statistical Database (FAOSTAT). 2020. Available at: http://www.fao.org/faostat/en/#data/QC