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Evaluation of Maize Variety for Ear Rot *(Fusarium graminearum*) in South Omo Zone of Ethiopia

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Abstract: Maize is a staple food crop which plays a great role in food security in Ethiopia. It is affected by many diseases which reduces yield. Mycotoxin contamination of maize grain (*Zea Mays L.*) is a global threat to safety both for human food and animal feed. Mycotoxins are secondary metabolites produced by fungi, which may be toxic or have other debilitating effects on living organisms. The major control methods are use of relative resistant or tolerant varieties mean that varieties with tight husk coverage, harvest on the time, proper storage and good crop management. An experiment conducted on experimental field of Jinka Agricultural Research Center to evaluate 12 improved maize varieties and one local check using Randomized Complete Block Design with three replications. The objective of the study was to select maize variety /varieties resistant/tolerant to ear rot. The variety BH660 and BH540 was highly resistant compare to the other tested varieties with the incidence of 19.00% and 14.66% and a grain yield of 3.70kg/plot and 3.79kg/plot respectively. The varieties BH543, Melkassa7 and BH661 were susceptible with the incidence of 64.00%, 50.13%, and 64.33% and their grain yields were of 3.37kg/plot,2.62kg/plot and 3.62kg/plot respectively. On the other hand BHQPY545 and local check were susceptible to ear rot but their yields were 4.05kg/plot and 3.84kg/plot respectively. This indicates that the local check and BHQPY545 were able to tolerate high disease pressure. Therefore, the variety BHQPY545 is recommended for mid land maize production areas of South Omo zone.

Keywords: Resistance, Mycotoxin, Disease Incidence Severity, Yield

1. Introduction

Maize (*Zea mays* L.) is world's third most important cereal food crop next to wheat and rice. In sub-Saharan Africa it is considered as the major food and income provider crop for more than 300 million households (Tefera *et al*., 2011). Specific to Ethiopian maize is one of the principal food crop .The crop ranks first in terms of productivity and second in area coverage after tef. Maize is cultivated in all of the major agro-ecological zones in Ethiopia up to 2400 m.a.s.l (Assefa *et al.,* 1993). It is widely produced in western, southern, southwestern, and eastern and in some north, northwestern and eastern parts of the country. However, in most cases the maize yield is strongly affected by a number of diseases, insect pests and other disorders which reduce both quality and quantity of production (Fajamision, 1985). Maize suffers from the attack of the diseases from seedlings to maturity in the field.

Also losses in storage are high due to maize weevil, Sitophilus zeamais (Motsch.), especially among smallholder farmers (Simbarashe. *et. al., 2013).*

Factors that may contribute to maize diseases development are climatic variability's (temperature, humidity and rain fall), cultural practices and susceptibility of varieties used (Fajamision, 1985). As reported in the 2nd National maize workshop about 47 maize diseases are recorded in Ethiopia, from these diseases ear rot is the one which causes yield loss both in quality and quantity.

Myc otoxin contamination of maize grain (*Zea Mays* L.) is a global threat to safety both for human food and animal feed (Balazs and Schepers, 2007). Mycotoxins are secondary metabolites produced by fungi, which may be toxic or have other debilitating effects on living organisms (Castegnaro and McGregor, 1998; CAST, 2003). New regulations for the allowable mycotoxin limits in food and feed have been put in place in many countries. The binding European Union regulations on toxin contamination for human consumption and recommendations for animal feeding (Commission

Recommendation 2006; Commission Regulation 2007), have forced renewed interest in breeding efforts for resistance to toxigenic fungi as the preferred method for control of mycotoxin contamination. The primary causal organism of Fusarium ear rot in most maize-growing areas of Ethiopia is the pink ear rot caused by toxigenic fungus *F. moniliforme = G.fujikuroi and* red ear rot caused by *F.graminearum =G.zeae* (Assefa and Tewabech, 1993).This pathogen causes losses in grain yield and quality, due to the contamination of grain by mycotoxins, primarily fumonisinB1 (FB (Munkvold and Desjardins, 1997; De Curtis *et al.,* 2011; Parsons and Munkvold, 2012).

Maize is the major cereal crop for the people of Ethiopia it grows in diverse ecology in the country but it is faced with major challenges including diseases. Among diseases, as identified by diagnostic survey of farmers' fields at South Omo zone, it is mainly affected by foliar diseases and corn diseases (yesuf *et al.,* 2014). The most common potential economic corn disease on maize is ear and kernel rot (Assefa and Tewabech, 1993). Development of plants able to withstand damage caused by fungal pathogens has been a significant challenge for maize breeders. Although selection

Eliminates genotypes particularly susceptible to diseases, cultivated hybrids frequently show serious fungal infections (Munkvold, 2003a; Balconi *eal.*, 2010). The genetic modification of maize, either through plant breeding or transgene mediated, represents one potential way to reduce Exposure to mycotoxins in food and feed, through increased resistance to fungal infection and/or reduced toxin production in maize tissues (Munkvold, 2003b).

Currently the recommended control measures of kernel and ear rot of maize are the use of relative resistant / tolerant varieties mean that varieties with tight husk coverage, harvest on the time, proper storage and good crop management, (Assefa and Tewabech, 1993) also tillage to bury infected residue may also be helpful where erosion is not a problem while, crop rotation is also helpful because the disease tends to increase in continuous cropping and the use of fungicides. But significant yield losses still occur when the environmental conditions are favorable for the disease. In addition to those control measures leaf extract of some medicinal plants like Boscia coriacea and bark extract of croton megalocarpus has high antifungal activity for controlling of aflatoxin causing pathogen (Theddeus M.*et al.,* 2014)

The use of resistant varieties adds little or nothing to cost of production (Gareth and Cliffored, 1983). Efficient control of ear and kernel rot disease is achieved through use of good crop management, varieties with tight husk coverage and harvest on the time and proper storage (Assefa and Tewabech, 1993).In South Omo zone the predominant maize cultivation system is mono cropping system. Hence, the lack of appropriate farming system and the absence of crop rotation/management practice in the zone increase the potential of the disease incident for ear rot.

As a result it becomes a major yield limiting factor in the zone. Therefore, introducing available control measures to the farmer is vital to increase production and productivity of maize in the areas. Among the available control measures, the use of resistant and high yielding varieties has been very cheap and effective method (Daniel *et al,* 2008) The study was conducted to evaluate maize varieties against maize ear rot diseases.

2. Materials and Methods

The experiment was conducted on experimental field of Jinka Agricultural Research center of South Agricultural Research Institute, Ethiopia. It is located at 5°52'N, 36°38'E, and 1450 m above sea level with annual average rainfall and temperature of 900 mm and 22.3°C, respectively. The soil of the experimental field is sandy loam. Twelve maize varieties and one local check were planted on March 2, 2013. A randomized complete block design with three replications was used. Each plot consisted of four rows, 3.6 m long and 3m width with spacing of 75 cm between rows and 30 cm between plants were used. All experimental plots were managed according to farmers' practices and the recommended management approaches for weed and insect pest problems. Disease assessments were conducted in the field after onset of the disease. Six randomly selected plants from the center row were tagged and used for successive disease assessments. Plants were rated at silking, grain feeling and harvesting stage for percent incidence, agronomic, yield and other disease related traits.

Ear Evaluation

At maturity, when kernel moisture was 12-15%, ears were manually harvested and after hand de-husking, the severity of *F. graminearum* infection was measured as follows: i) for *Fusarium* ears, the number of kernels showing visible symptoms of infection, such as rot and mycelium growth was used.Disease severity was rated using 1-9 scoring scale's, ranging from 1 = 0%, 2 = 1–3%, 3 = 4–10%, 4 = 11–25%, 5-6 = 26–50%, 7-8 = 51–75%, 9 = 76–100% of visibly infected kernels/ear (Reid *et al.*,1996a). After visual inspection, the ears from each plot were dried, shelled, and the kernels bulked to take the yield. The data were analyzed using ANOVA procedure of SAS software. The means were separated using LSD at 0.001 probability level.

3. Results

Table 1. *Significance of mean square value for yield, incidence and severity of ear rot for 12 improved maize varieties and 1 local check.*

Source of variation	DF	IN (%)	SV	GY(kg/plot)
Replication	2	92.87643ns	0.48717949ns	0.45718718^{ns}
Treatment	12	917.35400***	6.20085470***	0.53539658^{ns}
Error	24	114.32910	1.01495726	1.26852607
Cv (%)		22.98406	24.10465	32.28137

***, ns, DF, IN, SV, GY =significant at p<0.001, not significant, degree of Freedom, Incidence, Severity and grain Yield.

Table 2. *Mean values of grain yield, Incidence and severity of ear rot for the tested varieties.*

Varieties	Grain Yield(kg/plot)	Incidence (%)	Severity(1-9)
BH661	3.6267	64.333ab	5.6667ab
Melkassa 7	2.6267	50.150bc	4.3333bc
BH543	3.3700	64.000ab	5.6667ab
Gibe1	3.7767	50.000bc	4.3333bc
Melkassa4	2.6900	41.667c	4.0000bc
Melkassa1	3.5067	38.000c	3.3333cde
Gibe2	3.4367	42.333c	3.6667cd
BH540	3.7967	14.667d	1.6667e
BH660	3.7033	19.000d	2.0000de
BHQP542	3.6467	46.627bc	4.0000bc
BHQPY545	4.0500	49.667bc	4.6667bc
Melkassa6	3.2900	44.333bc	4.0000bc
Local	3.8367	80.000a	7.0000a
LSD	1.898	18.019	1.6977

LSD= least significance Difference at 0.01 probability level. The analysis of variance showed that the tested maize varieties were significantly different ($P<0.01$) in incidence and severity of ear rot but, they were not significantly different in their grain yield (Table1). Grain yield, incidence and severity ranged from 2.63 to 4.05, 14.67 to 80.00, and 1.67 to 7.00, respectively.

The most tolerant varieties to ear rot were BH540 and BH660, with scores of 14.67% and 19.00% respectively. The variety Melkassa 7, Local, BH661, BH543, Gibe1, BHQP542, BHQPY545 and Melkassa6 were most susceptible with the score of 50.15%, 80.00%, and 64.33%, 64.00%, 50.00%, 46.62%, 49.66% and 44.33% respectively. The variety Melkassa 1, Melkassa4 and Gibe 2 had intermediate score (Table 2).

4. Discussion

The variety BHQPY545 and local check was highly susceptible to ear rot, but relatively they are high yielding. This indicates that the local check and BHQPY545 were able tolerate high disease pressure. This result is in line with (Karavina1, Mandumbu1 and Mukaro, 2014). On the other hand the variety melkassa 4 was moderately susceptible to ear rot and gave lower yield, which showed that a dominant gene or particularly dominant genes that control grain yield could not express themselves due to susceptibility to northern leaf blight (Hooker, 1963, 1977; & 1981 and Ogliari *et al*., 2005).

5. Conclusion and Recommendation

The variety BHQPY545 was susceptible to ear rot, and is a high yielder variety with score of 4.05kg/plot compared to the other tested varieties. Therefore, dissemination of this variety to the farmers in mid land areas of South Omo zone will be vital to increase production and productivity of the farmers utilize it as an alternative of the local cultivar.

References

[1] Assefa, T. and T.Tilahun. 1992. Review of maize disease in Ethiopia, pp 45-51. In the proc. Of the first maize workshop of Ethiopian. 5-7 May, 1992. Addis ababa, Ethiopia.

[2] Assefa, T. and T.Tilahun. 1993. Review of maize disease in Ethiopia, pp43-51.Benti Tollesa and Joel.k.Ransom (eds.).1993. Proceedings of the first National maize workshop of Ethiopian. 5-7 May, 1992.IAR/CIMMYT, Addis ababa, Ethiopia.

[3] Balazs E. and J.S. Schepers, 2007. The mycotoxin threat to world safety. *International Journal of Food Microbiology* 119, 1–2.

[4] Balconi C., M. Motto, G. Mazzinelli and N. Berardo, 2010. Ear Secondary traits related to aflatoxin accumulation in commercial maize hybrids under artificial field inoculation. *World Mycotoxin Journal* 3, 239–250.

[5] Burnette, D.C. and D.G.Whit. 1985. Control of northern corn leaf blight and south corn leaf blight with various Fungicide.Fung. Nem. Test. 40: 148-149.

[6] Castegnaro M. and D. McGregor, 1998. Carcinogenic risk assessment of mycotoxins. *Revue de Medecine Veterinaire* 149, 671–678.

[7] Commission Recommendation, 2006. European Commission Recommendation N 2006/576 on the presence of deoxynivalenol, zearalenone, ochratoxin A,T-2 and HT-2 and fu-monisins in products intended for animal feeding. *Official Journal of European Union* 229, 7–9.

[8] Commission Regulation, 2007. European Commission Regulation (EC) N 1126/2007 of 28 September 2007 amending regulation (EC) N1881/2006. Setting maximum levels for certain contaminants in food stuffs as regards *Fusarium* toxins in maize and maize products. *Official Journal of European Union* 255, 14–17.

[9] Daniel, A.Narong, S.Sangchote and E.sarobol. 2008. Evaluation of Maize Varieties for Resistance to Northern Leaf Blight under Field condition in Ethiopia. Kaset sart J. Nast. sci. 42: 4-9.

[10] De Curtis F., V. De Cicco, M. Haidukowski, M. Pascale, S. Somma and A. Moretti, 2011. Occurrence of *Fusarium* ear rot and fumonisin contamination of maize in central Italy and effects of agrochemical treatments. *Field Crop Research* 123, 161–169.

[11] EARO. 1999. Awassa National maize Research program /pathology section progress report for 1999, Awassa, Ethiopi 1983a.

[12] Fajamision, J.M.1985.Maize disease in Africa and their role in the varietal improvement process. IN proceeding of the first Eastern, enteral and Southern Africa Regional Maize Work shop. Zambia 10-17 March 1985.CIMMYT, Mexico.D.F.

[13] Gareth, D.S and B.C.Clifford. 1983. Cereal Disease: Their pathology and control.2 nd ed. A Wiley inters science publication. Chic ester

[14] Munkvold G.P., R.L. Hellmich and W.B. Showers, 1997. Reduced *Fusarium* ear rot and symptomless infection in kernels of maize genetically engineered for European corn borer resistance. *Phytopathology* 87, 1071–1077.

[15] Munkvold G.P., 2003a. Epidemiology of *Fusarium* diseases and their mycotoxins in maize ears. *European Journal of Plant Pathology* 109, 705–713.

[16] Munkvold G.P., 2003b. Cultural and genetic approaches tomanaging mycotoxins in maize. *Annual Review Phytopathology* 41,99–116.

[17] Parsons M.W. and G.P. Munkvold, 2012. Effects of planting date and environmental factors on *Fusarium* ear rot symptoms and fumonisin B1 accumulation in maize grown in six North American locations. *Plant Pathology* doi: 10.1111/j.1365-3059.2011.02590.x

[18] Reid L.M., R.I. Hamilton and D.E. Mather, 1996a. *Screening Maize for resistance to* Gibberella *ear rot*. Technical Bull 19965E, ResearchBranch, Agriculture and Agri-Food Canada

[19] Simbarashe Muzemu, James Chitamba, Benny Mutetwa. Evaluation of Eucalyptus tereticornis,Tagetes minuta and Carica papaya as Stored Maize Grain Protectants against Sitophilus zeamais(Motsch.) (Coleoptera: Curculionidae).Agriculture, Forestry and Fisheries. Vol. 2, No. 5, 2013, pp. 196-201. doi: 10.11648/j.aff.20130205.13.

[20] Theddeus M. Kiswii, Ethel O. Monda, Paul O. Okemo, Christine Bii, Amos E. Alakonya, Efficacy of Selected Medicinal Plants from Eastern Kenya against Aspergillus flavus, Journal of Plant Sciences. Vol. 2, No. 5, 2014, pp. 226-231. doi: 10.11648/j.jps.20140205.22

[21] Tilahun, T., G.Ayana, F.abebe and D.Wegary. 2001. Maize pathology Research in Ethiopia: a review, pp. 97-105. In N.Mandefro, D.Tanner and S.Twumass-Afriyie (eds.).Enhancing the contribution of maize to food security in Ethiopia.Proceeding of the second National Maize Work shop of Ethiopia. 12-16 November 2001, EARO and CIMMYT, Addis Ababa, Ethiopia.

[22] Yesuf.E and M.mitiku.Assessment of important plant disease of major Crops (Sorghum Maize, common bean, coffee, Mungbean, Cowpea) in South Omo and Segen Peoples Zone of Ethiopia. PSCI publication, 8(2), 2014:91-94.