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Research Article

Evaluation of Selected Management Options against Ear Rot (*Fusarium graminearum*) Disease of Maize (*Zea mays* L.) in Ari Zone, South Ethiopia Regional State

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ABSTRACT

Maize (*Zea mays* L.) is world's third most important cereal food crop next to wheat and rice. The crop is affected by a number of diseases that reduce both the quality and quantity of production. Mycotoxin contamination of maize grain (*Zea mays* L.) is a global threat to safety both for human food and animal feed. So the study was conducted to investigate the effect of crop rotation and maize stock removal from fields on the incidence and severity of maize ear rot disease. The experiment was conducted done at Jinka Agriculture Research Center experimental field. During experiment maize variety BH 140 (susceptible variety) and Haricot bean (Hawassa dume) varieties were rotated in three ways as following in three years: Maize+haricot bean+maize, Haricotbean+haricot bean+maize and Maize+maize +maize. Spacing between plant and rows was 30 × 75 cm respectively for maize whereas for common bean 10 × 40 cm was used between plant and rows respectively. The results of independent T-test indicated that there is no significant effect of the management practices such as crop residue management and crop rotation on yield, severity and incidence of ear rot on maize in the second and third year of experimental period. But, there was significant effect of management practices and crop rotation on the disease severity in the first year of the experimental period at ($p<.05$). So to reduce the effect ear rot disease on maize production we have to remove the previous maize stalk from the field because it reduces the inoculum source for the disease development. But, additional research has to be work to confirm this research output in the studied area and foe developing sound base management strategies for ear rot disease of maize in the studied area.

Keywords: Maize; Mycotoxin; Crop residue management; Crop rotation; Haricot bean

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. The crop is affected by a number of diseases that reduce both the quality and quantity of production. Mycotoxin contamination of maize grain (*Zea mays* L.) is a global threat to safety both for human food and animal feed [1]. Mycotoxins are secondary metabolites produced by fungi, which may be toxic or have other debilitating effects on living organisms [2]. New regulations for the allowable mycotoxin limits in food and feed have been put in place in many countries. 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* [3]. This pathogen causes losses in grain yield and quality due to the contamination of grain by mycotoxins, primarily fumonisin B_1 [4]. Maize is the

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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 Ari zone, it is mainly affected by foliar diseases and corn diseases. The most common potential economic corn disease on maize is ear and kernel rot. Since there is no efficient chemical control in the field for managing of maize ear rot heavily depend on cultural practices like crop rotation and crop residue management. The main inoculums sources for red and pink ear rots infection in the field are crop residues of previous diseased crops; so that removal of maize stalk from field helps to reduce inoculums source for next season infection and subsequently decrease disease severity and also, rotation of maize with non-host crops like common bean can reduce inoculums build up in the field by through decomposition of residue as well as killing of the pathogen. Currently, the recommended measures for the control of kernel and ear rot of maize are the use of relative resistant or tolerant varieties, that is, the use of varieties with tight husk coverage, harvesting on time and proper storage, and good crop management.

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 continuous use of fungicides. But significant yield losses still occur when the environmental conditions favors the growth of the disease. Efficient control of ear and kernel rot disease is achieved through the use of good crop management, varieties with tight husk coverage, harvesting on time and proper storage [5]. In Ari 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 the available control measures to the farmer is vital to increase production and productivity of maize in the areas. So the study was conducted to investigate the effect of crop rotation and maize stock removal from fields on the incidence and severity of maize ear rot disease.

MATERIALS AND METHODS

Description of the study site

The study was conducted at Jinka Agricultural Researcher Center (JARC) located 729 kms South West of Addis Ababa at E 36° 33' 02.7" longitude and N 05° 46' 52.0" latitude and at an altitude of 1383 m.a.s.l. Long term weather data revealed that the maximum and minimum monthly average temperature is 27.55 and 16.55°C, respectively while the mean annual rainfall of the area is 1274.67 mm. It is characterized by gentle to flat land features. The slope of the research field ranges from 0 to 5%. Kebede et al. classified the soil types of study site as Cambisols according to soil taxonomy and FAO/UNESCO. The majority of the fields have a very deep (>150 cm) soil depth. The soil reaction varies from strongly acidic to slightly acidic. The soil OM, total nitrogen and available P generally low. Exchangeable bases ranges from low to medium and the micronutrients found to fall in medium. The dominant soils of site are classified low base saturation. Cambisols generally make good agricultural land and are used intensively.

The experiment was conducted done in Jinka Agriculture Research Center experimental field. During experiment maize variety BH 140 (susceptible Variety) and Haricot bean (Hawassa dume) varieties were rotated in three ways as following.

- Maize+haricot bean+maize
- Haricot bean+haricot bean+maize
- Maize+maize+maize

For the experiment, plot having 3 m × 4 msize were used and replicated three times. Spacing between plant and rows was 30 × 75 cm respectively for maize whereas for common bean 10 × 40 cm was used between plant and rows respectively. For the first treatment plots maize stalk residue from the previous season were completely removed before planting for the next season while for the other treatment plots; maize residue was remaining on the plot during planting. While all recommended agronomic practices and plant population were maintained in each experimental plot [6]. From maize planted plots; entire two middle rows were used for ear rot disease assessment. Incidence and severity of ear rot were recorded at ear maturity. Severity and incidence of ear rot were calculated in scale and percentage of plant ear showing disease symptom respectively (Figure 1). Data on disease incidence, severity and yield were subjected to analysis by using SAS software.

Figure 1: Monitoring of trial at different stage.

RESULT AND DISCUSSION

Analysis of independent T-test was conducted to examine whether the management practices such as crop residue management and crop rotation are significantly different for incidence and severity of maize ear rot. The results of analysis independent T-test for their grain yield, incidence and severity in the second and third year revealed that, there is no significant effect of the management practices such as crop residue management and crop rotation on yield, severity and incidence of ear rot on maize (Tables 1 and 2). But, there was significant effect of management practices and crop rotation on the disease severity in the first year of the experimental period at (p<.05) (Table 1). Therefore, we can conclude from the first year result that, the management practices namely crop residue management and crop rotation solely and in combinations, had effect on severity of maize ear rot disease [7,8].

So to reduce the effect ear rot disease on maize production we have to remove the previous maize stalk from the field because it reduces the inoculum source for the disease development (Table 1). Whereas the result of the second and third year activity revealed that there was no significant effect of the management practices on the yield, severity and incidence of maize ear rot (Tables 2 and 3), this finding is contradictory with the principle that crop residue removal and crop rotation had significant role in the management of many crop diseases [9,10].

Table 1: Analysis of the independent T-test of means of crop residue management.

Variable	MA option	N	Mean	Std dev	Std err	Min	Max	Method	Variances	DF	t Value	Pr>|t|
DI	RNremoved	6	29.27	8.9395	3.6495	20	42.86	Pooled	Equal	10	-0.66	0.526
DI	Rremoved	6	33.252	11.85	4.8378	16.66	50					
DI	Diff (1-2)		-3.982	10.496	6.06							
DS	RNremoved	6	3.1667	0.4082	0.1667	3	4	Pooled	Equal not assumed	10	1	0.3409
DS	Rremoved	6	3	0	0	3	3					
DS	Diff (1-2)		0.1667	0.2887	0.1667							
Yldkgpt	RNremoved	6	2.945	0.7225	0.295	2.1	4.14	Pooled	Equal	10	-0.26	0.7966
Yldkgpt	Rremoved	6	3.0933	1.1671	0.4765	1.77	4.68					
Yldkgpt	Diff (1-2)		-0.148	0.9706	0.5604							

Equality of variances

Variable	Method	Num DF	Den DF	F value	Pr>F
DI	Folded F	5	5	1.76	0.5511
DS	Folded F	5	5	Infty	<.0001
Yldkgpt	Folded F	5	5	2.61	0.316

Table 2: Analysis of the independent T-test of means of crop residue management.

Variable	MA option	N	Mean	Std dev	Std err	Min	Max	Method	Variances	DF	t Value	Pr>|t|
DI	RNremove	3	68.333	12.583	7.2648	55	80	Pooled	Equal	4	0.67	0.5371
DI	Rremoved	3	60	17.321	10	40	70					
DI	Diff (1-2)		8.3333	15.138	12.36							
DS	RNremove	3	4.9967	0.8844	0.5106	4.33	6	Pooled	Equal	4	0.38	0.724

DS	Rremoved	3	4.7733	0.5095	0.2942	4.33	5.33					
DS	Diff (1-2)		0.2233	0.7218	0.5893							
Yldkgpt	RNremove	3	1.2033	0.405	0.2338	0.86	1.65	Pooled	Equal	4	0.04	0.9687
Yldkgpt	Rremoved	3	1.1833	0.7251	0.4187	0.45	1.9					
Yldkgpt	Diff (1-2)		0.02	0.5873	0.4795							
Equality of variances												
Variable	**Method**	**Num DF**	**Den DF**	**F Value**	**Pr>F**							
DI	Folded F	2	2	1.89	0.6909							
DS	Folded F	2	2	3.01	0.4984							
Yldkgpt	Folded F	2	2	3.21	0.4756							

Table 3: Analysis of theindependent T-test of means of crop residue management.

Variable	MA option	N	Mean	Std dev	Std err	Min	Max	Method	Variances	DF	t Value	Pr>|t|
DI	RNremove	9	31.556	9.4184	3.1395	12.5	48.25	Pooled	Equal	16	0.89	0.3856
DI	Rremoved	9	28.087	6.8847	2.2949	18.5	36.08					
DI	Diff (1-2)		3.4689	8.2494	3.8888							
DS	RNremove	9	3.2222	1.2019	0.4006	2	5	Pooled	Equal	16	0.86	0.4011
DS	Rremoved	9	2.7778	0.9718	0.3239	2	4					
DS	Diff (1-2)		0.4444	1.0929	0.5152							
Yldkgpt	RNremove	9	4.3333	0.7071	0.2357	3	5	Pooled	Equal	16	-1.37	0.189
Yldkgpt	Rremoved	9	4.7778	0.6667	0.2222	3	5					
Yldkgpt	Diff (1-2)		-0.444	0.6872	0.3239							
Equality of variances												
Variable	**Method**	**Num DF**	**Den DF**	**F Value**	**Pr>F**							
DI	Folded F	8	8	1.87	0.394							
DS	Folded F	8	8	1.53	0.5617							
Yldkgpt	Folded F	8	8	1.13	0.8718							

Note: RNremoved: Stalk not removed, Rremoved: Stalk removed, Moption: Management option, Min: Minimum, Max: Maximum, DI: Disease Incidence, DS: Disease Severity, Yld: grain yield

CONCLUSION

The results of independent T-test indicated that there is no significant effect of the management practices such as crop residue management and crop rotation on yield, severity and incidence of ear rot on maize in the second and third year of experimental period, But, there was significant effect of management practices and crop rotation on the disease severity in the first year of the experimental period at (p<.05). Therefore, we can conclude from the first year result that, the management practices namely crop residue management and crop rotation solely and in combinations, had effect on severity of maize ear rot disease. So to reduce the effect ear rot disease on maize production we have to remove the previous maize stalk from the field because it reduces the inoculum source for the disease development. But, additional research has to be work to confirm this research output in the studied area and foe developing sound base management strategies for ear rot disease of maize in the studied area.

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