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Research Article

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Impact of Scald and Net Blotch on Malt barley (*Hordeum vulgare* L.) Yield in Southeast Ethiopia

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Keywords

Malt barley,
Net Blotch,
Scald, Resistant,
Yield.

Abstract

Evaluation of Net Blotch and Scald disease was conducted better malt barley cultivars with relatively resistant to leaf disease. Twelve released genotypes were evaluated at Bekoji and Koffele Sub centers of Kulumsa Agricultural Research Center through RCBD in three replications in 2012 cropping season. Based on the analysis result, relatively Net Blotch resistant variety was recorded for IBON 174/03 while susceptible variety was recorded for Bekoji I and Holker at Koffele and Bekoji sub center respectively. Relatively Scald disease resistant variety was recorded for HB 120 followed by EH1847 and Bahati while susceptible variety was recorded for Sabini followed by HB1533 and Holker at Bekoji sub center. Leaf disease severity on different genotypes varies from location to location.

Introduction

Barley (*Hordeum vulgare* L.) is one of the most important cereal crops ranking fifth in Ethiopia next to maize, teff, sorghum and wheat in area coverage and production (CSA, 2016). In 2015/16 cropping season 944,401 ha of land was covered by barley and more than 1.8 million t was produced (CSA, 2016). Plant characteristics are determined by genes that are transferred from one generation to the next. The breeder is seeking to combine a range of traits in one plant, such as high yield, quality and resistance to disease, developing a successful variety is an extremely lengthy process. Pathogens, particularly fungi, viruses and nematodes, can reduce grain yield and quality in barley. Disease management strategies include using resistant varieties and rotation with non-host crops (Adelaida University, 2008). In the case of barley under Ethiopian condition scald and net blotch are the most common diseases that cause yield reduction. To identify resistant varieties of malt barley was done in different locations.

Objectives

To evaluate and recommend scald and net blotch disease resistant cultivars for specific environment

Materials and Methods

Description of the study area

The study was conducted at Bekoji and Koffele in 2013 cropping season. The experimental sites are sub-stations of Kulumsa Agricultural Research Center located in Arsi and West Arsi Zone, in south east Ethiopia. The site receives an annual average rainfall of 1020 and 1211 mm at Bekoji and Kofele respectively in the main crop growing season. The station is situated at an altitude of 2,780 and 2660 m.a.s.l. with an annual average temperature ranges from 8^0C to 18.6 and 7.1 to 18 ^{0}C at Bekoji and Kofele respectively.

Materials Used and Experimental Design

Table 1. List of Genotypes used for evaluation

HB 120	EH1847
HB52	IBON 174/03
HB1533	Bekoji I
Holkr	Sabini
Beka	Bahati
Miscal-21	Frie Gebs

The field experiment was carried out with twelve advanced (released) malting barley genotypes in RCBD, with three replications in the 2012 main cropping season.

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Data to be collected

Grain yield data was measured from the central four rows at maturity. Scald and net blotch severity data were recorded (1-9 scale).

Data analysis

To reveal the total variability present within the tested genotypes in randomized complete block design, the data were computed for all the characters evaluated as per Gomez and Gomez, 1984. The data was subjected to analysis of variance by using SAS soft ware version 8 (SAS, 1999). Variance components and genetic parameters were computed. ANOVA of randomized complete block design was computed using the following mathematical model: Let Y_{ij} was the observation for the i^{th} treatment, which was supposed within the j^{th} replication.

The linear model is:

$$* Yij = « + rj + gi + £ig$$

Where: Yij= the observed value of the trait Y for the i^{th} genotype in j^{th} replication

μ= the general mean of trait Y

rj= the effect of j^{th} replication

gi= the effect of i^{th} genotypes and

εij= the experimental error associated with the trait y for the i^{th} genotype in j^{th} replication.

Table 2. Analysis of Variance (ANOVA**)**

Source of variation	Df	Mean squares	Expected Mean Squares	F ratio
Replication	(r-1)	MS_r	$\sigma^2_e + g\sigma^2_r$	
Genotype	(g-1)	MS_g	$\sigma^2_e + r\sigma^2_g$	MS_g/MS_e
Error	(r-1) (g-1)	MS_e	σ^2_e	
Total	rg-1			

Where: r=number of replications, g = number of genotypes, DF = degree of freedom, MS_r = mean Square due to replications, MS_g = mean square due to genotypes, and MS_e = mean square due to environment, σ^2_e=Environmental variance and σ^2_g=Genotypic variance.

Results and Discussion

Location I. Bekoji

The overall mean yield of the experimental site indicated that there is a significant difference between genotypes at 5% (Table 1 and Fig. 1a and b). The mean yield ranged from 1.88 to 3.65 ton per hectare at Bekoji. The highest yielder genotype was recorded for EH1847 (3.65 ton/ha) followed by Bekoji I (3.12 ton/ha), Firie Gebs, HB 52 (3.06) and IBON 174/03 (3.05 ton/ha). Poor yield was recorded for Sabini (1.88 ton/ha) and it was susceptible to scald and net blotch in the experimental site.

The mean value of Net Blotch revealed that, there is a significant difference between genotypes between varieties. The mean Net Blotch score values ranged from 0.33 to 2. Relatively resistant was recorded for IBON 174/03 (0.33) while susceptible variety was recorded for Bekoji I followed by Holker. Highly significance difference between varieties was recorded in scald susceptibility at Bekoji. The mean Scald score values ranged from 2 to 7. Relatively resistant variety was recorded for HB 120 followed by EH 1847 and Bahati while susceptible variety was recorded for Sabini followed by HB1533 and Holkr. Determining the cause of any severe symptoms is important because a disease may lead to economic losses, but could be prevented or treated (Neate and McMullen, 2005). Cool temperature favors the net blotch disease development.

a. Scald

b. Net Blotch

c. Disease free malt barley field

Table 2. Mean comparison of genotypes, at Bekoji sub center.

Trt	SC	NB	GY
HB 120	2.0H	1.0B	2812.2BAC
HB52	3.0GFEH	1.0B	3067.8BAC
HB1533	5.6BA	0.66CB	2254.2BC
Holker	5.0BC	1.6A	2601.3BAC
Beka	3.3GFEHD	1.0B	2458.7BAC
M-21	4.6BCD	0.66CB	2975.1BAC
EH1847	2.3GH	1.0B	3655.3A
IBON 174/03	3.6GFECD	0.33C	3052.7BAC
Bekoji I	4.3BECD	2.0A	3127.7BA
Sabini	7.0A	0.66CB	1881.5C
Bahati	2.6GFH	1.0B	2201.9BC
Frie Gebs	4.0FECD	1.0B	3098.5BAC
Mean	3.97	1.0	2765.5
CV	22.1	34.8	26.5
LSD	1.5	0.58	1241.8

NB: Trt=treatment, Gy= grain yield, NB= net blotch, SC=scald

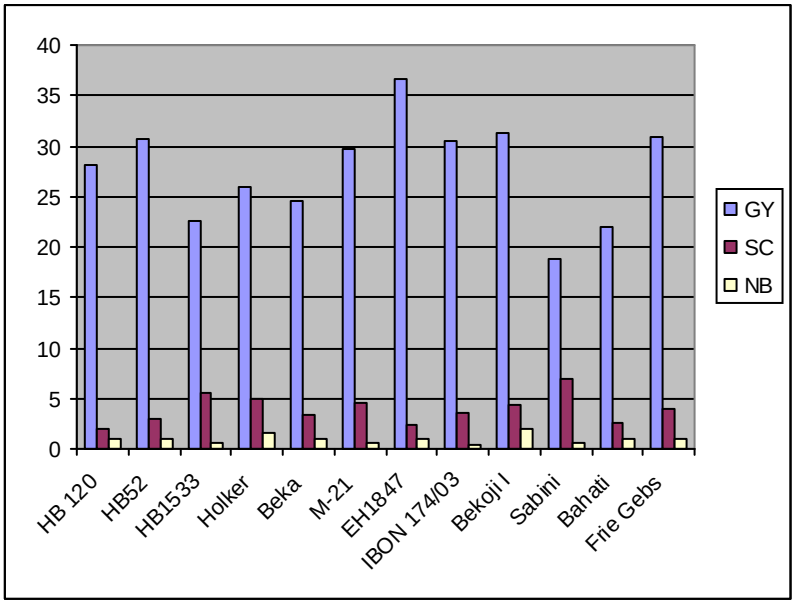

Fig.1a Scald and Net blotch leaf disease on barley grain yield at Bekoji

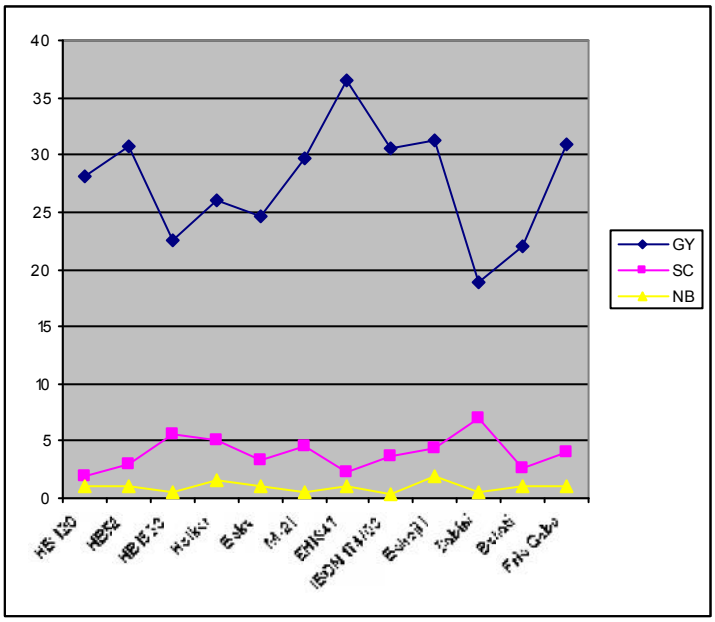

Fig.1b Scald and Net blotch leaf disease on barley grain yield at Bekoji

Location II Koffele

The overall mean yield of the experimental site indicated that there is a significant difference between genotypes at 1% (Table 2 and Fig. 2 a and b). The mean yield ranged from 3.44 to 5.2 ton per hectare at Koffele. The highest yielder genotype was recorded for IBON 174/03 (5.2 ton/ha) followed by Bahati (5.1 ton/ha) and EH1847 (5.09 ton/ha) and Poor yield was recorded for Beka (3.44 ton/ha) and it was susceptible to scald and net blotch in the experimental site.

The mean value of Net Blotch revealed that, there is a highly significant difference between genotypes between varieties. The mean Net Blotch score values ranged from 1 to 5. Relatively resistant was recorded for IBON 174/03 (1) while susceptible variety was recorded for Bekoji I followed by Holker. No significance difference between varieties was recorded in scald susceptibility at Koffele.

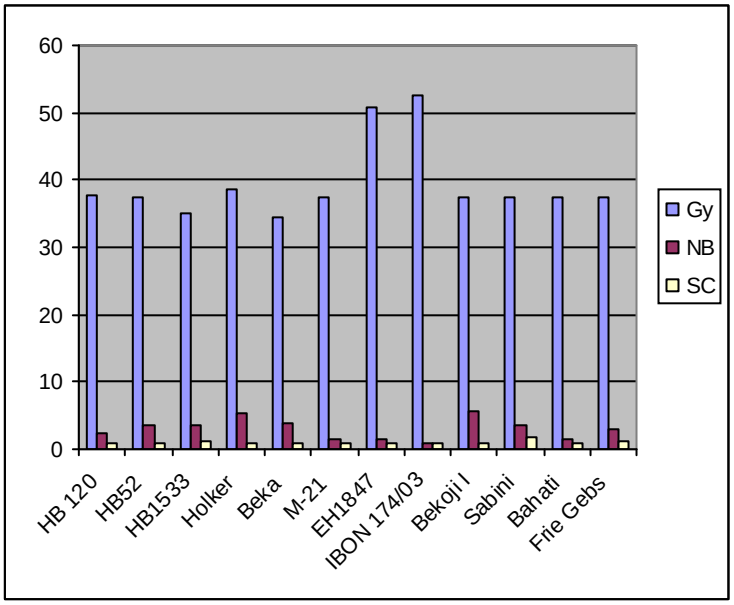

Fig 2a Scald and Net blotch leaf disease on barley grain yield at Koffele

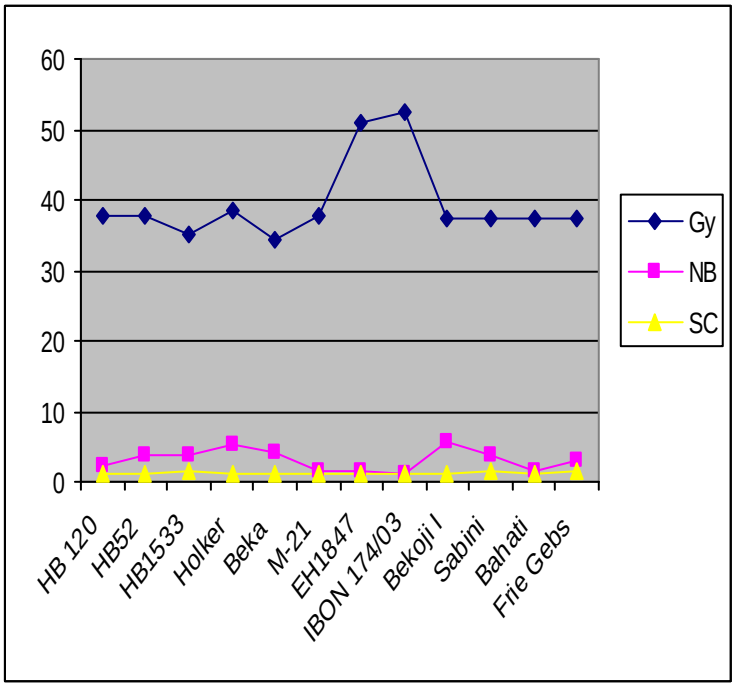

Fig.2b Scald and Net blotch leaf disease on barley grain yield at Koffele

Table 3. Mean value comparison of genotypes at Koffele sub center

Trt	Gy	NB	SC
HB 120	3759.3CB	2.3DFE	1
HB52	3757.6CB	3.6DC	1
HB1533	3514.2CB	3.6DC	1.3
Holker	3860.2CB	5.3BA	1
Beka	3445.3C	4.0BC	1
M-21	3756.3CB	1.6FE	1
EH1847	5092.5A	1.6FE	1
IBON 174/03	5250.1A	1.0F	1
Bekoji I	3728.8CB	5.6A	1
Sabini	4103.7B	3.6DC	1.6
Bahati	5139.9A	1.6FE	1
Frie Gebs	4053.2CB	3.0DCE	1.3
Mean	4121.7	3.1	1.1
CV	9.3	28.4	18.1
LSD	648.3	1.5	-

NB: Trt=treatment, Gy= grain yield, NB= net blotch, SC=scald

Conclusion

Lastly, it can be stated that scoring of barley leaf diseases help in understanding the role of various plant traits in establishing the growth behavior of cultivars under a given set of environmental conditions. Evaluation of genotypes for Barley leaf diseases leads us to a clear understanding of different genetic characters and also the type and extent of their contribution to grain yield. Mostly the studied characters showed from susceptible to relatively resistant varieties due to genetic influence indicating that, these plant traits can be further improved through individual plant selection.

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