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Research Article

Evaluation of Aleka 33% EC Fungicide against Net Blotch (*Pyrenophora teres* and Leaf Scald Diseases (*Rhynchosporium secalis*) on Barley

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ABSTRACT

In Ethiopia, barley is predominantly considered as food crops and ranks fifth after teff, maize, sorghum and wheat. Barley productivity is low (1.97 t/ha) in Ethiopia as compared to world average of 3.1 t/ha and the reduction in productivity of the crop is mainly directed to multidimensional a biotic stresses and biotic stresses. In Ethiopia about 40 plant diseases, have been recorded on barley. Among them widespread occurrences of barley scald and net blotch foliar diseases is limiting barley production worldwide including Ethiopia. Field experiment was conducted to verify the effectiveness of the Aleka 33% EC fungicide (Cyproconazole 8%+Proconazole 25%) against net blotch (*Pyrenophora teres*) and leaf scald diseases (*Rhynchosporium secalis*) on barley. It's carried out at three locations, Kokate, Dalibo Wogane and Bossa Qacha, on farmers' field in a Randomized Complete Block Design (RCBD) with five replications during 2022 cropping season. The experiment result showed that, fungicide treated plots were showed significant difference compared to the control treatments in all variables. Evidence obtained from the verification trial showed that Aleka 33% EC (Cyproconazole 8%+Proconazole 25%) at the rate of 0.5 lit/ha with 200 liter water acted significantly at 5% probability level in managing barley net blotch and leaf scald and consequently increased grain yield of barley as compared to the standard check (Natura 250 Ew) and unsprayed checks in tested locations. Considering the present investigation, it is concluded that Aleka 33% EC at the rate of 0.5 lit per hectare with 200 liter of water was found the best by minimizing barley net blotch and leaf scald in all experimental locations. During the growing periods, no foliar toxic effect was observed from the effect of any tested fungicides. Generally, results showed that Aleka 33% EC at the rate of 0.5 lit/ha per hectare with 200 liter water was highly effective in controlling barley net blotch and leaf scald diseases of the barley. Therefore it is recommended for registration to the management of the barley net blotch and leaf scald diseases of the barley.

Keywords: Barley; Net blotch; Leaf scald; Verification; Fungicides

INTRODUCTION

Barley (*Hordeum vulgare* L.) is one of the most important crops grown worldwide. At global level, barley ranks fourth among cereal crops in both yield and hectare coverage after wheat, rice and maize [1]. In Ethiopia, barley grown from 1500 to 3500 meters above sea levels predominantly as food crops [2] and ranks fifth after teff, maize, sorghum and wheat [3]. Barley is staple food for many people globally, especially for poor households, in addition to its uses in malting and as an animal feed [4]. Barley's grain used for the preparation of different food stuffs in Ethiopia, such as malt production, injera, porridge, roasted grains; and different local drinks and the straw and stem stub are good source of feed for animals and roof thatching, respectively, in Ethiopia [5]. Barley productivity is low (1.97 t/ha) in Ethiopia as compared to world average of 3.1 t/ha and the reduction in productivity of the crop is mainly directed to multidimensional a biotic stresses and biotic stresses [6]. The

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American phytopathological society recorded thirty-six fungal, organisms causing barley diseases. In Ethiopia about 40 plant diseases, have been recorded on barley. Among which net blotch and scald are the most three important barley diseases causing significant yield and quality loss [7]. Among them widespread occurrences of barley scald and net blotch foliar diseases is limiting barley production worldwide including Ethiopia [8]. Furthermore, barley net blotch and scald diseases are widely distributed foliar diseases of barley limiting its production in Ethiopia. High yield loss reaching up to 34% has been reported due to net blotch [9]. The yield loss assessment over locations in central high lands of Ethiopia showed mean grain yield loss due to net blotch and scald combined ranged from 14% to 25% in 1999 and 2000 years, respectively while yield losses of 9.8% to 31.54% resulted from scald in western Ethiopia. Currently, this disease is an ever endemic disease to the most parts of the highlands of the country that causes an extensive grain yield loss in the country, 27% on an average and up to 34% when it is severe [10]. Besides to poor quality and low yielding varieties, regular occurrence of barley diseases mainly scald and net blotch are the major constraints of barley producing zones of Ethiopia [11]. Scald and net blotch caused by are major foliar diseases of barley (*Hordeum vulgare*) and often occur together in the same fields. A mixture of inoculums caused more yield reduction in barley than either pathogen inoculated alone. This suggests that the net blotch and scald pathogens may interact at the onset of infection and subsequent leaf disease development under conductive conditions. The disease is most severe in seasons of above average rainfall. To prevent the yield loss due to these diseases, farmers used different fungicides due to the barley disease's aggressiveness under field conditions. Research reports support the fact that unwise use of fungicides has led to the development of resistance to the pathogen [12,13]. Measures using appropriate management options, like proper fungicides, to reduce sources of infection and prevent the spread of disease are of great importance in controlling barley diseases during the growing periods. Thus, there is a need for alternative and effective fungicides through the introduction of a new fungicide or different formulations of the existing fungicides with the same active ingredient that might be continue to be introduced by the pesticide companies. To increase the availability of effective fungicides for the growers, the efficacy of the newly introduce fungicide on net blotch and leaf Scald of barley should be regularly tested and verified before introducing to the farming community and also the efficacy of fungicide is highly influenced by environmental factors, diseases occurrence, application time, and rates of fungicide application. Therefore, evaluation of the fungicide across the locations is greatly important to get an insight into the effects of the fungicide. Based on the above background, Areka agricultural research center has been designated by the ministry of agriculture through Southern agricultural research institute to test the efficacy of the new fungicide, Aleka 33% EC against net blotch, and leaf scald of barley during the 2022 cropping season. Therefore, the objective of the study was to evaluate the efficacy of the of the new formulation fungicide Aleka 33% EC with active ingredient Cyproconazole 8%+Proconazole 25% relative to another promising standard fungicide, Natura 250 Ew (Tebuconazole) for the management of net blotch and leaf scald diseases of barley for registration purpose.

MATERIALS AND METHODS

Descriptions of the study areas

The verification trial was conducted during 2022 main cropping season in an open environment to convince the objectives of the current verification around Wolaita zone in three locations (Kokate, Dalibo Wogane and Bossa Qacha) of Southern Ethiopia. The three experimental sites are geographically located at 06° 85' 28'' N and 037° 76' 10'' E (at Kokate), 06° 88' 79'' N and 037° 80' 18'' E (at Dalibo Wogane) and 06° 51' 25'' N and 037° 47' 30'' E (at Bossa Qacha). The sites are found at an elevation of 2156 (at Kokate), 2200 (at Dalibo Wogane) and 1944.73 (at Bossa Qacha) meters above sea level. Bimodal rainfall pattern is the major characteristics of the study area, short rainy season (April and May), and the main rainy season (early June to mid-November). Thus, the areas receive average annual rainfall is 1200-1300 mm and mean monthly temperatures varies from 11°C-26°C. The soils are sandy-loam with a pH of 5.2.

Treatments, design of experiment and trial management

The study was conducted in the natural environment to assure the incident and increase natural infections at the beginning of the study. The areas are the hot spots for the intended pest. The total width and length of the layout were designed at 35 m × 33 m with a unit plot size of 10 m × 10 m, respectively. Plots were spaced by 1.5 m and blocks separated by a safeguard path of 2.0 m to prevent drifts or cross-contamination. The experiment was laid out in a randomized complete block design with five replications. The barely variety, Sabini, which is susceptible to barley diseases was used in the study and planted in a row of 20 cm spacing on 7 July 2022 simultaneously in three locations. The recommended fertilizer rate of 100 kg ha^{-1} of NPS was applied in rows during planting, while 200 kg ha^{-1} of urea was side dressed, of which $1/3^{rd}$ of it during planting and $2/3^{rd}$ of it 35 days after planting. A total of three treatments, including control, were comprised during the study. Aleka 33% EC at the rate of 0.5 lit/ha with 200 liter water (Candidate fungicide), Natura 250 Ew at the rate of 0.5 lit/ha with 250 liter water (standard check), and unsprayed check were used. For the candidate fungicide, the use of the rate of fungicide per hectare and amount of water for dilution of fungicide was performed as suggested by the manufacturer. Spraying was performed using a manual knapsack sprayer calibrated to deliver 500-700 liter of water ha^{-1}. The control plots were sprayed with water only. The fungicide was sprayed two times at 7 days intervals on each plot. Unsprayed plots were left for each replication as controls to allow maximum disease development. The first fungicide spray was started 34, 36 and 41 days after planting when the first symptom of leaf scald appeared in the plots at Kokate, Dalibo Wogane and Bossa Qacha respectively. Regular weeding and earthling up were practiced to all plots uniformly manually when necessary in the three locations.

Disease assessment

Disease severity of net blotch and leaf scald were assessed five times from the middle rows, at every 7 days starting from six day of the first fungicide application. The disease severity were assessed from the three top leaves: F, unfolded most top leaves, F-1, second most top leaves and F-2, the third most top leaves [14] of each tagged plants of 15 randomly selected plants per plot. Net blotch and leaf scald severity data was recorded from the randomly selected and tagged most top fully emerged three leaves using disease severity scales of 0-6 [15]. The disease severity percentage calculated from severity scale as:

$$DS(\%) = \frac{\sum(nv)}{NV} \times 100$$

Where;

n=Degree of infection on 6 grade scale.

v=Number of leaves per category.

V=Total number of leaves assessed.

N=Highest degree of infection.

From the severity data, AUDPC for each treatment was calculated as described by Campbell and Madden as follows [16]:

$$AUDPC = \sum_{i=1}^{n-1}[0.5(xi + xi + 1)(ti + 1 - ti)]$$

Where;

x^i =Percentage of disease severity index at i^{th} assessment.

t^i =Time of the i^{th} assessment in days from the first assessment date.

n=Total number of days disease severity was assessed.

Fungicide efficacy

Fungicide Efficacy (EF) was calculated

$$EF(\%) = \frac{X - Y}{X} \times 100$$

Where;

X=Disease severity in control.

Y=Disease severity in treated plots.

Data analysis

Analysis of Variance (ANOVA) was done by using SAS version 9.3, and means comparisons for the significantly different variables were made among treatments using Least Significant Differences (LSD) test at 0.05 levels of significance.

RESULTS AND DISCUSSION

Effect of Aleka 33% EC fungicide on net blotch development

The statistical analysis showed that there was significant (P<0.05) difference among treatments in reducing net blotch disease severity (Table 1). Even from visual field observation it is evident that, plots treated by the test fungicide fully deep green compared to the other treatments. Aleka 33% EC and Natura 250 Ew fungicides significantly reduced disease severity compared to the control. The mean severity of net blotch disease on unsprayed plot reached 85.4%, 89.4% and 87.4% were reduced to 13.6%, 16.6% and 19.8% at Kokate, Dalibo Wogane and Bossa Qacha respectively on the plots sprayed by Aleka 33% EC fungicide. This study was in line with finding of Bekele et al., [17] who revealed 5.75%-83.82% net blotch disease of barley severity reduction over unsprayed treatment using different fungicide. The experiment conducted by Wubishet et al., [18] on evaluation of integrated disease management for malt barley production in bale highlands, South-Eastern Ethiopia, also indicated that Tilt 250 EC fungicide application significantly reduced net blotch disease severity when applied twice 7-10 days intervals as compared to nil application.

There was significant (P<0.05) difference between fungicide treatments and the control in reducing the AUDPC of net blotch disease of barley. The area under disease progress curve of the control plots was 595.5, 605.5 and 603.7 which was reduced to 110.4c, 130.1c and 132.3 at Kokate, Dalibo Wogane and Bossa Qacha respectively on the plots sprayed by Aleka 33% EC fungicide (Table 1). This study was in line with the experiment done by Bekele et al., 2004 on barley net blotch epidemiology and management which indicated that fungicide application reduced AUDPC from 11.38%-84.81% over non-fungicide applied treatment. Significant (P<5%) differences was observed between fungicides sprayed and unsprayed plot in grain weight. Aleka 33% EC fungicide revealed better grain yield which was 38.3, 42 and 36.3 q/ha at Kokate, Dalibo Wogane and Bossa Qacha respectively. Aleka 33% EC fungicide showed 49.1%, 48.8% and 50.1% yield advantage over the nil (control) fungicide applied plot at Kokate, Dalibo Wogane and Bossa Qacha respectively. The result of the analysis also indicated that, Aleka 33% EC showed highest level of efficacy 84.1, 81.43 and 77.5 followed by Natura 250 EC compared to the control.

Table 1: Effect of Aleka 33% EC on mean severity, area under disease progress curve and yield on net blotch at Kokate, Dalibo Wogane and Bossa Qacha during 2022 cropping season.

Treatments	Kokate				Dalibo Wogane				Bossa Qacha			
	Mean sev (%)	AUDPC (%)	YLD (qt/ha)	EF (%)	Mean sev (%)	AUDPC (%)	YLD (qt/ha)	EF (%)	Mean sev (%)	AUDPC (%)	YLD (kg/ha)	EF (%)
Aleka 33% EC	13.6^{c}	110.4^{c}	38.3^{a}	84.1	16.6^{c}	130.1^{c}	42^{a}	81.43	19.8^{c}	132.3^{c}	36.3^{a}	77.5
Natura 250 Ew	30.2^{b}	292.2^{b}	29^{b}	64.6	35.2^{b}	350.7^{b}	32^{b}	60.6	29.2^{b}	348.2^{b}	27.4^{bc}	66.78
Untreated	85.4^{a}	595.5^{a}	19.5^{c}	0.00^{c}	89.4^{a}	605.5^{a}	21.5^{c}	0.00^{c}	87.9^{a}	603.7^{a}	17.8	0.00^{c}
LSD (0.05%)	13.3	102.6	7.2	15.6	11.5	121.5	8.5	13.7	8.6	104.3	6.7	7.6
CV (%)	15.5	14.6	12.1	16	17	19	18	17	21	32.3	15.6	11.2

Note: Means in the same column followed by the same letters are not significantly different at 5% level of significance. AUDPC=Area Under Disease Progress Curve in %; Sev=Severity; YLD (qt/ha)=Yield quintal/ha); CV=Coefficients of Variation (%); EF=Fungicide Efficacy and LSD=Least Significant Difference at p<0.05 probability level.

Effect of Aleka 33% EC fungicide on Leaf scaled development

Analysis of variance revealed significant variation for severity and AUDPC of leaf scaled were detected between the treatments evaluated across locations (Table 2). Minimum mean severity and AUDPC for leaf scaled were recorded on Aleka 33% EC, which was statistically similar to the values obtained from Natura 250 Ew sprayed plots in the three locations. In all locations, maximum mean severity and AUDPC for leaf scaled was recorded on the unsprayed control plots.

Overall, the low magnitude of significant variation in leaf scaled severity and AUDPC might be due to the characteristic nature of the product formulations targeted for this particular disease. Across locations, leaf scaled epidemic development is comparatively higher at Dalibo Wogane, followed by Kokate and Bossa Qacha, which could be explained by the prevailing relatively temperature, rainfall, and relative humidity during the period of infection [19].

Table 2: Effect of Aleka 33% EC on mean severity, area under disease progress curve on leaf scaled at Kokate, Dalibo Wogane and Bossa Qacha during 2022 cropping season.

Treatments	Kokate			Dalibo Wogan			Bossa Qacha		
	Mean sev (%)	AUDPC (%)	EF (%)	Mean sev (%)	AUDPC (%)	EF (%)	Mean sev (%)	AUDPC (%)	EF (%)
Aleka 33% EC	26.7^{b}	152.3^{b}	67.9	23.7^{b}	109.1^{b}	70.3	20.3^{b}	125.7^{b}	79.4
Natura 250 Ew	38.5^{b}	218.2^{b}	61	30.6^{b}	193.7^{b}	61.7	37.5^{b}	192.2^{b}	61.9
Untreated	83.4^{a}	418.8^{a}	0.00^{c}	79.8^{a}	492.3^{a}	0.00^{c}	98.6^{a}	412.9^{a}	0.00^{c}
LSD (0.05%)	11.3	109.6	10.3	14.4	98.7	13.2	21.3	88.4	21.6
CV (%)	17.5	24.7	14.9	23	24.3	11	32	21.7	30.3

Note: AUDPCs=Area Under Disease Progress Curve in %; Sev=Severity; EF=Fungicide Efficacy; CV=Coefficients of Variation (%); and LSD=Least Significant Difference at p<0.05 probability level.

CONCLUSION

Barley net blotch and leaf scald cause serious problems in the study areas during the production season. The experiment result showed that, fungicide treated plots were showed significant difference compared to the control treatments in all variables. Evidence obtained from the verification trial showed that Aleka 33% EC with active ingredient Cyproconazole 8%+ Proconazole 25% at the rate of 0.5 lit/ha with 200 liter water acted significantly at 5% probability level in managing barley net blotch and consequently increased grain yield of barley as compared to the standard check (Natura 250 Ew) and unsprayed checks in tested locations.

Considering the present investigation, it is concluded that Aleka 33% EC at the rate of 0.5 lit perhectare with 200 liter of water was found the best by minimizing barley net blotch and leaf scald in all experimental locations. During the growing periods, no foliar toxic effect was observed from the effect of any tested fungicides. Generally, results showed that Aleka 33% EC at the rate of 0.5 lit/ha per hectare with 200 liter water was highly effective in controlling barley net blotch and leaf scald diseases of the barley. Hence, Aleka 33%EC was found highly effective for the barley net blotch and leaf scald diseases on barley and therefore it is recommended for registration to the management of the barley net blotch and leaf scald diseases of the barley.

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COMPETING INTERESTS

The authors declare that they have no competing interest.

REFERENCES

1. Munck L. Barley for food, feed and industry: Theory and practice. American Association of Cereal Chemists, St. Paul, MN, USA. 1981.
2. Berhane L, Hailu B, Fekadu A. Barley production and research. In: Hailu-Gebre, Van Leur JAG, Editors. Barley Research in Ethiopia: Past work and future prospects. Proceedings of the 1st Barley Research Review Workshop. Addis Ababa, Ethiopia. 1993, 1-8.
3. Abdi A. Barley genetic resources collection and conservation in Ethiopia: Barley. Research and Development in Ethiopia. 2011.
4. Newton AC, Johnson SN, Gregory PJ. Implications of climate change on diseases, crop yields and food security. Euphytica. 2011;179:3-18.
5. Fenta A. Effect of fertilizer on growth response of food barley (*Hordeum vulgare* L.). J Agric. 2018;13:40-47.
6. EIAR. Field crops research. Ethiopian Institute of Agricultural Research. 2019.
7. Yitbarek S, Bekele H, Dereje T. Disease survey and loss assessment studies on barley. In: Hailu G, van Leur J, Editors. Barley Research in Ethiopia: Past Work and Future Prospects, IAR/ICARDA, Addis Ababa. 1996;105-115.
8. Xi K, Bos C, Turkington TK, Xue AG, Burnett PA, Juskiw PE. Interaction of net blotch and scald on barley. Can J Plant Pathol. 1996;30(2):329-334.
9. Yitbarek S, Bekele H, Getaneh W, Dereje T. Disease surveys and loss assessment studies on barley: In Gebre H, van Leur J, Editors. 1996;105-115.
10. Yitbarek S, Wudneh E. Preliminary studies on the yield losses due to net blotch in barley, In Proceedings of the 10th EPC annual meetings. Addis Ababa, Ethiopia. 1985;47-52.
11. PPSE. Plant Protection Society of Ethiopia. PPSE. 2008.
12. Roelfs AP. The cereal rusts, Vol. II: Diseases, distribution, epidemiology and control. Am J Epidemiol. 403-434.
13. Green MB, Le Baron HM, Moberg WK. Managing resistance to agrochemicals: From fundamental research to practical strategies. J Am Chem Soc. 1990;496.
14. Jayasena KW, Loughman R, Majewski J. Evaluation of fungicide in control of spot type net blotch on barley. Crop Prot. 2002;21:63-69.
15. Townsend GR, Heuberger JW. Methods for estimating losses caused by diseases in fungicide experiments. Plant Dis Rep. 1943;27:340-343.
16. Peterson RF, Campbell AB, Hannah AE. A diagrammatic scale for estimating rust intensity on leaves and stems of cereals. Can J Res. 1948;26:496-500.
17. Bekele H, Sangchote S, Sarobol E. Barley net blotch epidemiology and management. J Nat Sci. 2004;38:380-392.
18. Wubishet A, Bekele H, Tilahun B. Evaluation of integrated disease management for malt barley production in bale high lands, South Eastern Ethiopia. Glob J Pest Dis. 2015; 3:108-112.
19. Agrios GN. plant pathology. 5th edition. Salt Lake City, Elsevier Academic Press, USA. 2005;922.