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Verification of Comet Plus 475 G/L EC Fungicide Against Wheat Stripe Rust (*Puccinia striiformis* f.sp. *tritici*) Disease on Bread Wheat in Bale, Southeastern Ethiopia

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Abstract: Wheat (*Triticum aestivum* L.) is the most widely cultivated crops in Ethiopia. However, wheat production is very low due to many factors. Of these, disease like stripe rust of wheat is the main constrained biotic factor and cause great yield losses. The field experiment was conducted at three hot-spot locations of wheat rust diseases in the zone namely; Sinana, Selka, and Agarfa during the 2019 cropping season to evaluate the effectiveness of newly introduced fungicide for the management of yellow rust disease of wheat. Variety Kubsa, which is susceptible to the three wheat rusts were used. The trial was laid out at three locations with non-replicated plots. Two systemic fungicides (Comet plus and Rex®Duo) and untreated plot (control) were used as a treatment. A significant difference ($P<0.05$) was observed between fungicide treatments and unsprayed plots on yellow rust severity, grain yield, thousand kernel weight, and hectoliter. Based on field observation and analyzed data results revealed that the newly introduced fungicide found to be effective in controlling stripe rust of wheat. Thus, Comet plus 475 G/L EC is recommended as an alternative fungicide for the management of stripe rust of wheat in wheat-growing areas of the country.

Keywords: Bread Wheat, Fungicide, Variety, Stripe Rust

1. Introduction

Wheat (*Triticum aestivum* L.) is the most widely grown cereal crops in the world. It ranks fourth next to rice, maize, and sorghum in the world. Annually, wheat is produced on 224.53 million hectares of land, and 672.2 million metric tons of wheat is produced in the world [16]. Wheat is one of the most important widely cultivated cereal crops in Ethiopia. It is the main staple food for about 36% of the Ethiopian population [6, 5]. Wheat ranks third in area coverage and total production after tef and maize. The country is the largest wheat producer in Sub-Saharan Africa [10]. The area under wheat production is estimated to be about 1.7 million hectares with national average wheat productivity of 2.7 tons/ha, which far below than the world's average yield [11]. Wheat production is constrained by several biotic and abiotic factors in the country. Among biotic factors, fungal rusts are the most damaging diseases of wheat [14]. In Ethiopia, wheat rusts are one of the key biotic constraints to wheat production [9]. Recurrent wheat rust (stem and stripe) epidemics had great yield loss in Ethiopia. Particularly, stripe rust epidemics occurred in 2010 approximately 600,000 ha affected and reduced high grain yield in the country [15]. The highlands of the country have been known wheat producing areas as well as hot-spot for wheat rusts [14]. Bale and Arsi regions are wheat belt growing areas of the country, getting bimodal rainfall pattern which is permitted two growing seasons per year. Growing same crop year after year which is lead to green bridge allowing the wheat rusts to bulk-up transferring inoculums source from one cropping season to the next growing season and suitable for the occurrence of rust epidemics [18, 3]. Especially, in Bale highlands wheat yields loss up to 71% due to stripe rust [3, 7]. However, in severe cases, stripe rust can cause 100% yield losses if infection occurs very early and the disease continues developing during the growing season, particularly on a highly

susceptible wheat line [4]. The two main methods of wheat rust control are resistance breeding and chemical controls are implemented in most wheat producing areas of the world. The development of host genetic resistance is considered the most effective and low cost management strategy for rust diseases, particularly in developing countries [8]. However, in the lack of genetic resistance, fungicide applications are used to control the wide spread of rust diseases. In Ethiopia, the use of fungicide is very low compared to other developed countries. Hence, to increase the availability of more fungicides on the market frequent verification and evaluation of newly introduced fungicides to be routine work in the country to manage the yield loss due to wheat rust diseases. Therefore, the current study was to verify newly introduced fungicide for the management of wheat rust diseases.

2. Materials and Methods

The experiment was conducted at three locations (Sinana on-station, Selka, and Agarfa) during the 2017/18 main cropping season. Bread wheat cultivar (Kubsa) highly susceptible to yellow rust disease was planted in non-replicated plots of 5m x 5m size, where locations were considered a replica. The plots were spaced 2 m apart and 1.5 m between plots. The seed and fertilizer rates of 150 kg ha^{-1} and 41/46 $N/P_2O_5kgha^{-1}$ were used, respectively. Test fungicide, COMET PLUS 475 G/L EC (Pyraclostrobin 100 G/L + Fenpropimorph 375 G/L) provided by BASF Company PLC. Currently, widely used fungicide Rex Duo was included as a standard check along with an untreated check (control). Land preparation and weeding were done manually as recommended for wheat. The test fungicide was applied manually using a knapsack sprayer with a rate of 1 lit/ha and was diluted in 250 lit/ha water, and sprayed at a 5% severity level of yellow rust at the booting crop growth stage. Stripe rust severity was assessed in percentage by estimating the approximate percentage of the whole plant affected by using a modified Cobb scale [13] on a plot basis. Data on yield and yield components were recorded on basis of crops harvested from net harvestable plot area 25 m^2 and converted to hectare base.

Analysis of variance (ANOVA) was done by using R-software and means comparisons for the significantly different variables were made among treatments using the Least Significant Difference (LSD) test at 0.05 levels of significance.

3. Results and Discussion

3.1. Disease Onset and Severity Level

Wheat yellow rust (*Puccinia striiformis* f.sp. *tritici*) disease was early-onset on susceptible variety Kubsa across the three locations during the cropping season resulting in severe infection to create a significant difference among the treatments at tested locations. The fungicide treatments significantly ($P<0.05$) reduced stripe rust disease severity over the unsprayed check. This work is in line with the findings of [17] indicated that fungicide treatments significantly reduced stripe rust severity over the nil application. Foster [10] reported that the rate of disease epidemics was significantly reduced when the management of rusts was supplemented with fungicide applications. Statistically, no significant difference was observed between the fungicide treatments in controlling stripe rust disease severity (Table 1). Based on the visual field observation and analyzed data showed that the test fungicide (COMET PLUS 475 G/L EC) had comparable effect in reducing stripe rust disease compared to fungicide Rex Duo. Test fungicide and the check fungicide reduced stripe rust disease severity by 20% and 18.3% as compared to the unsprayed plots, respectively. This work is supported by [2] reported that Zantara EC 216 fungicide reduced stripe rust severity by 94.2% compared to the control treatment. Results revealed that the test fungicide showed a comparable level of efficacy on stripe rust disease reduction compared to the Rex Duo fungicide.

Table 1. *Mean of stripe rust severity, yield, and yield components of bread wheat in Bale highlands during 2017/18 main cropping season.*

Treatments	Fungicide rate (l/ha)	SRS (%)	PH (cm)	BM (ton/ha)	GY (kg/ha)	TKW (gm)	HLW (kg/hl)
COMET PLUS	1	10.0^{a}	87^{a}	11.07^{c}	3213^{b}	35.12^{b}	74.40^{b}
Rex Duo	0.5	11.7^{a}	88^{a}	9.73^{bc}	3227^{b}	35.81^{b}	73.63^{b}
Nil	-	30^{b}	86^{a}	6.87^{a}	1693^{a}	23.56^{a}	63.67^{a}
Mean		16.4	87.72	9.14	2833	32.87	71.91
CV (%)		29.8	4.4	10.7	13.2	5.1	2.8
LSD (0.05)		8.89	6.97	1.77	679.4	3.04	3.72

PH=Plant Height, TKW=Thousand Kernel Weight, HLW=Hectoliter Weight, SRS=Stripe rust severity, LSD=Least significant difference among treatment means ($p\leq5\%$), CV=Coefficient of variation, Means with the same letter within a column are not significantly different.

3.2. Grain Yield and Yield Components

The ANOVA table revealed that no significant difference observed between test fungicide and check fungicide in plant height (Table 1). Significant differences were observed between fungicide treatments and untreated plots for all yield related parameters (Table 1). The test fungicide and check fungicide revealed 1520 kg ha^{-1} (15.20 q/ha) and 1534 kg ha^{-1} (15.34 q/ha) yield advantage over unsprayed plots, respectively (Table 1). This is in line with [1] reported that the treatments resulted in an increase of 6.72-14.58 qt/ha in mean grain yields over the unsprayed check. Similar work was conducted by [12] reported that significant variation in yield parameters was observed among the fungicide applications under different environments. The highest mean

thousand kernel weight and hectoliter weight were recorded from plots sprayed by test and check fungicides compared to unsprayed plot. This work is in agreement with [2] reported that Zantara EC 216 fungicide revealed the highest mean (44.03gm) thousand-grain weights compared whereas the smallest (38.0gm) was recorded from the control treatment.

4. Conclusions and Recommendation

The newly introduced Comet plus 475 G/L EC fungicide significantly reduced stripe rust disease severity of wheat than untreated plot. The newly introduced fungicide had comparable efficacy in controlling stripe rust severity compared to the check fungicide (Rex®Duo). The highest mean grain yield and yield-related traits were recorded from plots sprayed by Comet plus 475 G/L EC and Rex®Duo as compared to the unsprayed plots. Moreover, Comet plus 475 G/L EC significantly reduced stripe rust severity. The Comet plus 475 fungicides also gave better grain yield and yield related parameters compared to unsprayed check, but comparable with check fungicide. Hence, based on the strong positive merits of test fungicide indicated in reducing stripe rust disease severity to the lowest level, thus, Comet plus 475 G/L EC fungicide could be registered as an alternative fungicide for the management of stripe rust severity of wheat.

Competing Interests

The authors declare that they have no competing interests.

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