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Research Article

Verification of Tamir 250 g/l EC (Pyraclostrobin) Fungicide Against Yellow Rust (*pucciniastriformis.f.s.tritici*) on Bread Wheat (*Triticumaestivum* L) in Bale, Southeast of Ethiopia

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Abstract

Ethiopia's wheat crop faces significant challenges due to fungus, particularly in Bale, which is home to new pathogenic races. These diseases can lead to yield losses of 20-71%, 42-52%, 75, and 82%, respectively. To manage these diseases, Ethiopia breeds resistant cultivars, but resistance screening is crucial due to the evolution of rust disease and new threats. Combining multiple disease resistance sources into a single variety is the most effective way to control wheat diseases. Fungicides have been tested and approved against rusts in wheat, but most susceptible types succumbed to rust. Regular evaluation and verification of new fungicides is essential to maintain wheat production and productivity in Ethiopia. The experiment involved planting Kubsa bread wheat in replica sites in Sinana, Selka, and Agarfa, which is vulnerable to yellow rust disease. A fungicide was manually applied at a 5% severity level during the booting crop growth stage, using a modified Cobb Scale. Grain yield, thousand kernel weight, and hectoliter weight were calculated from seeds collected from a net harvested plot. The R-3.4.3 software was utilized for ANOVA and LSD tests to compare the means of substantially different variables between treatments at 0.05 levels of significance. The Kubsa variety, highly susceptible to yellow rust, showed significant differences in yellow rust disease severity between treatments during the 2019-20 cropping season. Test and check fungicides significantly reduced yellow rust disease severity compared to nil application. However, no significant difference was observed in limiting disease severity. The test fungicide, Tamir 250 g/l, was equally effective in reducing yellow rust disease severity, with a 49% reduction compared to an unsprayed plot. The study found no significant difference in plant height, grain production, thousand kernel weight, and hectoliter weight between test and check fungicides. However, grain yield, thousand kernel weight, and hectoliter weight showed substantial differences. Test and check fungicides showed yield advantages over nil application. Test fungicide Tamir and check fungicide Rex Duo effectively controlled yellow rust. The study found that the test fungicide, Tamir 250 g/l, effectively controlled yellow rust disease in wheat at a rate of 0.5 lit/ha, producing comparable results in plant height, grain yield, thousand kernel weight, and hectoliter weight. It also decreased yellow rust disease severity to the lowest level, suggesting its registration as an alternative to Rex Duo.

Keywords

Wheat Disease, Wheat Production, Pesticide, Efficacy

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1. Introduction

In terms of production and consumption, wheat is one of the main staple crops in the county. After maize, it is the second most significant food in the nation in terms of calories consumed [1]. Ethiopian wheat is mostly utilized as seed and raw material for agro-industries, as well as for domestic food consumption. One of the main biotic issues threatening Ethiopia's wheat crop is fungus [2, 3] Bale is the birthplace of new, highly pathogenic races that proliferate throughout the nation and beyond. Research indicates that, depending on the resistance backgrounds of the types, yield losses from yellow rust, stem rust, leaf rust, and septoria can reach 20–71%, 42–52%, 75, and 82%, respectively [4-6]. The use of resistant cultivars is the main strategy for managing these diseases. The creation of resistant varieties against the main wheat disease has so far proven successful [7]. However, resistance screening has become an integral component of Ethiopia's wheat-improving effort due to the evolution of the rust disease and threats from new races [8]. One of the best strategies Ethiopia has to lower crop losses is to breed for resistance or tolerance to the viruses that cause wheat disease [3]. Pathogens emerge as a result, and this can lead to large losses in wheat production. For instance, stem rusts and wheat yellow rusts are always evolving and adjusting to the Yr and Sr genes found in widely produced varieties that were formerly resistant to the most common races in Ethiopia [9]. The most effective way to control wheat diseases is typically to combine numerous disease resistance sources into a single variety, as opposed to managing each resistance source separately [10]. Although a number of resistant cultivars were made available for production, the majority of the susceptible types succumbed to rust shortly [11]. The final resort for mitigating the impact of rust on wheat production is the application of fungicides. Numerous fungicides have been tested, approved, and used against rusts in wheat, either as a stand-alone treatment or in conjunction with other strategies. Therefore, to maintain wheat production and productivity in the nation, it is essential to regularly evaluate and verify new fungicides on wheat rust infections in order to develop effective fungicides.

2. Materials and Methods

Three locations—Sinana, Selka and Agarfa—were used for the experiment. Each site was a replica, with non-replicated plots measuring 10 m by 10 m. The cultivar Kubsa of bread wheat, which is especially vulnerable to the yellow rust disease, was planted. There were two meters separating each block and 1.5 meters between plots. As a standard check, nil application was combined with recently registered fungicide Rex Duo and test fungicide (Tamir 250 g/l) from EGAA AGRICULTURAL INPUTS SUPPLIER PLC. Fungicide was manually sprayed once at a 5% severity level of yellow rust (during the booting crop growth stage) at a rate of 0.5 L/ha (Test fungicide) and 0.5 L/ha (Check fungicide), diluted in 250 lit/ha of water. The knapsack sprayer was used for this application. A modified Cobb Scale was used to record the severity of rust [10] (Peterson et al., 1948). Based on seeds gathered from a net harvested plot of 100 m^2, grain yield, thousand kernel weight, and hectoliter weight were calculated and converted to hectares. Every required agronomic procedure was carried out following recommendations.

3. Software and Data Analysis

The R-3.4.3 software was used to carry out the analysis of variance (ANOVA), and the least significant difference (LSD) test was used at the 0.05 levels of significance to compare the means of the substantially different variables between treatments.

4. Results and Discussion

4.1. Disease Epidemics

The extremely susceptible variety Kubsa naturally established an excellent yellow rust pressure, which resulted in a considerable difference between the treatments across all testing locations in the main cropping season of 2019–20. When compared to a nil application, the test and check fungicides dramatically decreased the severity of the yellow rust disease. But when it came to limiting the severity of yellow rust disease, there was no statistically significant difference seen between the test and check fungicides (Table 1). The test fungicide was equally effective as the check fungicide in reducing the severity of yellow rust to the lowest level, despite the fact that there was no statistically significant difference between the two fungicides. Furthermore, the test fungicide demonstrated similar efficacy to the check fungicide in managing yellow rust infections, as observed in the visual field. When compared to an unsprayed plot, the test fungicide (Tamir 250 g/l) decreased the severity of the yellow rust disease by approximately 49%, while the check fungicide decreased the severity of the disease by approximately 46%. The test fungicide demonstrated a comparable level of efficacy on yellow rust disease severity reduction compared to the check fungicide, based on visual field observation and data analysis. Thus, yellow rust disease in wheat can be controlled by applying the test fungicide Tamir 250 g/l at 0.5 L/ha.

4.2. Yield and Yield Components

Plant height, grain production, thousand kernel weight, and hectoliter weight were not significantly different between the test and check fungicides, according to the statistical analysis

(Table 1). Despite this, no statistically significant difference was seen between the check fungicide and the test fungicide. Grain yield, thousand kernel weight, and hectoliter weight show a substantial difference between fungicide treatments (test and check fungicides) and nil application (unsprayed plot). On the other hand, test and check fungicides showed yield advantages over nil application of 20.2 q/ha and 26 q/ha, respectively (Table 1). When test fungicide was applied to control yellow rust disease, no pytotoxicity was seen. As a result, on the highly susceptible variety Kubsa, test fungicide Tamir 250 g/l and check fungicide Rex Duo at a rate of 0.5 L/ha controlled yellow rust more effectively than unsprayed check (Table 1).

Table 1. *Verification of the Tamir 250 g/l fungicide's efficacy against the severity of the yellow rust disease, bread wheat production, and yield components in the Bale highlands during the main cropping season of 2019–20.*

Treatments	Fungicide rate (l/ha)	Yellow Rust Severity (%)	PH (cm)	GY (kg/ha)	TKW	HLW
Tamir	0.5	11.0 b	86.0ab	3220 a	35.8a	77.20b
Rex Duo	0.5	14.00b	82.5ab	3800a	38.70a	79.40 a
Nil	-	60.00a	73.50b	1200b	23.5 b	68.95b
Mean		17.68	82.56	3090.00	35.12	77.44
CV (%)		21.78	6.56	14.38	8.89	3.50
LSD (0.05)		9.1117	12.81	1051.3	7.387	6.416

PH= Plant Height, GYD = Grain yield, TKW = Thousand Kernel Weight, HLW = Hectoliter Weight, LSD = Least significant difference among treatment means ($p \leq 5\%$), CV= Coefficient of variation, Means with the same letter within a column are not significantly different

5. Conclusions and Recommendation

The results of the analysis of variance showed that in terms of controlling the yellow rust disease in wheat, the test fungicide (Tamir 250 g/l) at a rate of 0.5 lit/ha did not differ from the check fungicide (Rex Duo). It also produced results that were comparable in terms of plant height, grain yield, thousand kernel weight, and hectoliter weight. In addition, Tamir 250 g/l (0.5 lit/ha) showed an increase in grain production over nil fungicide application but was equivalent to the check fungicide (Rex Duo). Tamir also controlled yellow rust. At a rate of 0.5 lit/ha, the candidate fungicide Tamir 250 g/l decreased the severity of the yellow rust disease to the lowest level. Therefore, it is advised that Tamir 250 g/l fungicide be registered as an alternative for Rex Duo in order to prevent the yellow rust (Pucciniastriiformisf.sp. tritici) disease in wheat in Ethiopia.

Abbreviations

ANOVA	Analysis of Variance
LSD	List Significant Difference
L	Litre
KG	Kilogram
g/l	Gramper Liter

Author Contributions

Addis Shiferaw: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

Zerihun Eshetu: Conceptualization, Formal Analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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