Determination of Giftii bio pesticide rate for the control of Fussarium head blight disease of wheat in Arsi area.

Abstract

The average national yield is about 2.8 t/ha. However, poor yields are partially attributed by losses from Fusarium head blight (FHB), septoriaSpp, and rust diseases three main biotic threats to wheat productivity in Ethiopia and around the world. These losses are made worse by climate change, and a sizable amount of wheat which makes up 9% of the country's total cereal production is imported annually to make up the difference. In order to control FHB in wheat-potential areas in 2022 and 2023, the trial seeks to ascertain the proper rate of new product (GBP). Fertilizer application, weed control, and planting at the suggested seed rate were all part of the trial. Plant surfaces were treated with a mixture of test bio pesticides and a check fungicide and tap water. Grain yield, HLW, and TKW were measured, and bleached spikes were used to gauge the severity of the disease. In Kulumsa, Fusarium head blight (FHB) was shown to be more severe over the course of two years in the trial field. The productivity of sensitive cultivars Boru demonstrated higher yield with various treatments of G_BP and standard check Nativo 300Sc compared to untreated plots. The study also looked at the effect of G_BP on other agronomic variables. In terms of grain yield, weight of thousand kernels, and floor contents of Boru, the results indicate that 1liter/hectar of G_BP bio pesticides are comparable to standard check Nativo 300Sc. At 5% degree of freedom, however, they differ considerably from the untreated plot and are not significant from standard check.

Key words:Biotic, Threat, Severity, Sensitive, Standard

1. Introduction

The primary source of calories and plant-based protein in human diets, wheat is one of the most significant staple grains in the world (Rodríguez-kábana and Canullo, 1992). With over 220 million hectares planted each year under a variety of meteorological circumstances and agro-ecological amplitudes, it is currently the most commonly grown cereal in the world, with an annual production of roughly 670 million tons (Shiferaw et al., 2013).

With a production of 750 million tons (MT) on roughly 220 million hectares, wheat is regarded as one of the most significant crops for food security globally, according to Tadesse et al. (2019). It is the most crucial crop for maintaining food security and ranks first among the world's produced cereal crops (>200 mha annually), according to Shiferaw et al. (2020). The development of the agricultural sector in general and the food security situation of farm households in particular are greatly aided by this key cereal crop (Anteneh and Asrat 2020). More than one-third of the world's population relies on bread wheat (Triticum aestivum L.) as a staple diet, making it the most popular cereal grain worldwide (Mitiku and Eshete, 2016).

Ethiopia produces over 1.8 × 106 hectares of bread (Triticum aestivum L.) and durum (Triticum turgidum L. var. durum) wheat, mostly as highland rain-fed crops, making it the greatest producer of wheat in sub-Saharan Africa (CSA, 2020). In order to cut wheat imports from 1.7 million metric tons in 2019 to zero by 2023, Ethiopia's Ministry of Agriculture and Natural Resources has planned to boost wheat production from 2.7 metric tons per hectare in 2019 to 4 metric tons per hectare by 2023 (Diriba and Ababa, 2019). "Wheat belts" are regions that produce a lot of bread wheat, such the Bale, Arsi, and Shewa zones of Oromia regional state (Mume et al., 2019). Unlike durum wheat, which is mostly grown on vertisols with poor drainage, bread wheat is grown on better-drained soils and at slightly higher elevations (>2400 m a l) (Tadesse et al., 2019).

Although well-managed fields employing disease-free cultivars can achieve yields >5 t/ha in the highlands, the national mean yield is at 2.8 t/ha (CSA, 2020). Rust diseases, septoria, and FHB, which have long been among the main biotic threats to wheat production globally, are partially to blame for low mean yields (Wan et al., 2013). Climate change, a widespread issue that has imposed numerous problems on modern agriculture in general and wheat production in particular, exacerbates the loss of crop yield and quality (Ahmed et al., 2020). A sizable amount of wheat is imported annually to fill the national deficit, which represents 9% of the country's total grain production, because the existing supply of wheat cannot keep up with demand (Diriba, 2020).

Fusarium graminearum is the primary cause of Fusarium head blight (FHB), one of the most damaging diseases affecting wheat and small grains globally. Mycotoxins generated by Fusarium pathogens jeopardize the safety of food and feed, and yield and quality losses can be catastrophic (McMullen et al., 2012).

During anthesis, a complicated and crucial stage of reproductive growth, Fusarium fungus spread and infect wheat heads through open florets (Kang et al., 2000). According to Brown et al. (2010), the fungus are biotrophic during infection, but necrotrophic intracellular colonization follows biotrophic growth after host cell death is triggered. The switch from biotrophy to necrotrophy may be triggered by the production of the trichothecene toxin deoxynivalenol (DON), which is specifically induced during colonization [Bönnighausen et al., 2019, Maclean et al., 2008].

Light to moderate rainfall for as little as two or three days can promote illness. The ideal temperature range for infection is 75°F to 85°F (24°C to 29°C); but, infection will happen at lower temperatures under extended periods of high moisture and humidity. Other wheat heads may become infected by the extra spores produced by the original infection on the wheat head. In uneven wheat stands with late flowering tillers, this secondary infection can be particularly troublesome. Infection will continue as long as climatic conditions are suitable, and wheat plants are at sensitive growth phases.

The timing of application, spray coverage, and disease pressure all affect how well a fungicide suppresses FHB. Nowadays, a number of fungicides are approved for use against wheat FHB, and their levels of protection differ. According to research, early blooming is the best time to apply fungicides in the triazole class (Feekes 10.5.1). If circumstances that promote disease growth persist after Feekes 10.5.1 and circumstances preclude an application at Feekes 10.5.1, fungicide treatments may still be effective after early blossoming.

Therefore, In 2022 and 2023 GC cropping season the trial was laid out to determine the appropriate rate of new product (GBP) for the control of Fusarium head blight diseases of wheat in wheat potential areas of the country.

2. Methodology used

2.1 Experimental materials used

The trial was carried out at Kulumsa research center in Arsi zone Southeastern Ethiopia. Bread wheat variety Boru was planted at recommended seed rate by row planting method on five plots of 1.2 m x 2m (2.4m^2). The recommended fertilizer rate was applied during planting. Weeds were managed by hand weeding. A check fungicide Nativo 300Sc at the rate of 0.75 l/ha and a test biopesticides of different rate, 1.5 l/ha of G_BP/50% above campony recommendation, 0.5 l/ha of G_BP/50% below company recommendation and campony recommendation 1l/ha were mixed with tap water at the rate of 200 l/ha using knapsack sprayer and sprayed on the plant surfaces starting from the diseases occurrence (Early heading) every two week at different growth stage on the three of the plots of 2.4m^2 at each location and replication. The standard check Nativo 300Sc at recommended rate applied at each location and replication. The leftover one plot at each replication was received no fungicide spray check treatment. Disease Severity (DS) was determined as the proportion of bleached spikes with in randomly thrown quadrants. In each fields severity was rated on scale of 0 to 9, where: 1=no symptoms, 2=<5%, 3=5-15%, 4=16-25%, 5=26-45%, 6=46-65%, 7=66-85%, 8=86-95%, 9=96-100% Miedaner, et al., (1996). The grain yield, HLW and TKW also recorded following the standard procedures. The agronomic traits were analyzed using R-Software package.

3. Results

The current experiments were set up in areas where the aforementioned weather conditions suitable to disease development and susceptible wheat cultivar were grown. Cultivars that were considered resistant to other diseases and remained in production and available in farmer's field were susceptible to Fussarium head blight disease at the moment due to the sporadic nature in an area, Arsi zone. A variety of biotic and abiotic stresses threaten Ethiopian wheat production, with fusarium head blight diseases being the most difficult to manage and affecting wheat production in areas with high elevation and favorable weather conditions. In this sense, resistant cultivars by themselves are unable to withstand the current state of affairs in our nation. This well-known statement has become a thing of the past because of the Fussarium problem in some places, particularly in Arsi, West Arsi, and Bale, which were regarded as the wheat belt and made Ethiopia the bread basket of East Africa up until this point. It is essential to support our cultivars systematically with chemical pesticides and other products, such as biopesticides, at the right amount, rate, and time of application in order to maintain consistent wheat production and support the genetic constituents of the wheat cultivars' resistance behavior.

3.1. Impacts of G_BP to fusarium diseases at Kulumsa over years

Figure 1 below shows how yellow rust responds to novel biopesticides used to manage yellow rust in several hotspot locations in Arsi. The findings show that the last time fusarium head blight was severe.

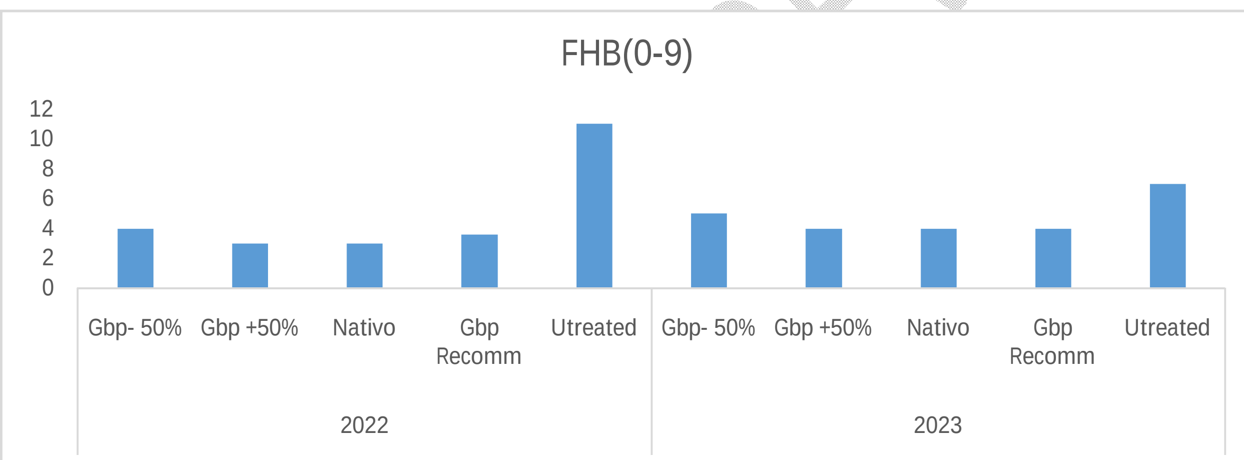

Figure 1. Response of fusarium head blight to different rates of G_BP

As previously mentioned, for the two years in a row on the trial field, FHB was higher in Kulumsa. According to the field response, the 1 l/ha and 1.5 l/ha of G_BP product are superior to the 50%-/0.5 l/ha of G_BP products and untreated plots, and they are comparable to standard check Nativo 300Sc at field conditions throughout the year.

3.2. Impacts of G_BP to different agronomic traits

The strain from diseases has a significant impact on the productivity and output of several commodities. Primarily if sensitive wheat cultivars and favorable climatic conditions were sown in regions where FHB is a prevalent issue.

3.2.1. Grain yield

Table 1 below shows that the vulnerable kinds' productivity in comparison to the untreated plot, Boru produced higher yields in all years under high disease pressure when treated with various G_BP and standard check Nativo 300Sc treatments. In comparison to the other treatments and the standard check Nativo 300Sc, the G_BP product rate 50% + (1.5l/ha) and the company-recommended G_Bp (1l/ha) demonstrated a greater yield with a mean grain yield of 51.03 Q/ha. At every year, the company's suggested G_BP rate, bio pesticide demonstrated superior yield, which is statistically equivalent to a standard check.

Table 1. Mean values of agronomic treatments

Trt	**GYLD Q/ha**	**TKW**	**HLW**
Nativo 300Sc/ standard Check	**55.733a**	**39.772a**	**69.953a**
50%+ G_BP(1.5li/hec)	**51.033ab**	**39.340 ab**	**70.693a**
company recommendation(1li/he)	**50.467ab**	**38.042ab**	**69.057ab**
50%- G_BP(0.5 li/hec)	**47.733bc**	**35.088bc**	**67.443bc**
Untreated Plot	**36.050c**	**32.832c**	**66.717c**
Mean	**48.203**	**37.015**	**68.773**
LSD (5%)	**11.3**	**4.5**	**2.3**
CV	**19.65**	**10.30**	**2.84**

In general, the G_BP, biopesticides with varying rates evaluated at various sites demonstrated yield advantages that were comparable to the standard check Nativo 300Sc and significantly superior than the untreated plots in every year.

3.2.2. TKW and HLW

The TKW and HLW of all treatments across all locations, as shown in table 1 above, are statistically significant, leading us to the conclusion that the G_BP biopesticides are comparable to the standard check, Nativo 300Sc, in terms of both the floor contents of the Boru variety that received varying levels of G_BP product and the weight of thousands of kernels.

4. Conclusion

Throughout the year, grain yield was significantly higher than the untreated control, and foliar bio pesticide G_BP, applied at a rate of 1 l/ha mixed with 200 l/ha of water, significantly reduced the severity of the FHB at field condition and improved yield, HLW, and TKW at both years comparable to the check fungicide Nativo 300Sc and also by far better than unsprayed fields during all years. Therefore, as an extra option for wheat yield and related trait increment in Ethiopia, G_BP at a rate of 1l/ha is highly advised for registration by the concerned government body, and usage to reduce fusarium head blight in wheat production and productivity all over the country by boosting its immunity to the aforementioned diseases.

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