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Evaluation of Bread Wheat Varieties against Yellow Rust (*Puccinia striiformis* f. sp *tritici*) in Silte and Gurage Zone, Southern Ethiopia

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Abstract

Yellow rust disease caused by *Puccinia striiformis* f. sp. *tritici* is one most important fungal diseases of wheat in highland of Ethiopia. Field experiments were conducted in twelve Ethiopian bread wheat cultivars under natural conditions during two seasons (2019 and 2020) at two locations (Alicho wuriro and Geta) differ climatologically in Ethiopia. The bread wheat varieties were field evaluated for the response of yellow rust in randomized complete block design with three replications. The combined data analysis over the two year indicated that all tested wheat varieties including susceptible Digalu showed variable response to the disease and no variety was found completely resistant to yellow rust. Remarkable difference was observed in terminal disease severity and AUDPC values of the disease. The highest of AUDPC values of 2375% days and 1512% days were recorded on susceptible Digalu and Hidase, respectively. The lowest AUDPC of 265.5% days on Shorima and 474.2% days on Danda'a were recorded at Alicho wuriro and Geta, respectively. Highly significant ($p \leq 0.05$) variations were noted among the varieties tested over seasons for spike length, thousand kernel weight and grain yields. The cultivars Danda'a and Shorima had great values for average grain yield potential at both locations in spite of the fact that maximum severity were observed in these varieties. The bread wheat varieties Danda'a and Shorima exhibited the best level of resistance to yellow rust infection. However the resistance gene of these varieties will be break through time due the involvement of new race or prevailing environmental factor. Therefore, continues releases and utilization of new resistant cultivar is an important strategy to improve the grain yield and quality of produce in the country.

Keywords: AUDPC; Bread wheat; Grain yield; Severity; Yellow rust

Introduction

Wheat (*Triticum s*pp.) is the most widely grown cereal crop in the world and one of the central pillars of global food security. It is the world's second most important cereal crop next to rice [1]. Bread wheat (*Triticum aestivum* L.) is an important food security crop in Africa. There are about 4.6 million farm households who are directly dependent on wheat farming as a major source of food and cash in Ethiopia [2]. Wheat is highly nutritious, such that besides being rich in carbohydrates, it has protein content that exceeds all other cereal crops [3]. Ethiopia is the first and largest wheat producer in sub-Saharan Africa [4]. It is an important crop commodity, which could contribute a major part in achieving the country's agricultural policy objective of food grain self-sufficiency. The crop ranks third in terms of total production next to teff and maize [5]. In Ethiopia wheat is produced between 6° N and 16° N and 35° E and 42° E, at altitudes ranging from 1500 m.a.s.l to 3000 m.a.s.l [6]. Wheat is predominantly grown by subsistence farmers in Ethiopia [7]. The major wheat producing regions of the country are Oromia region (West Shewa, North Shewa, East Shewa, Arsi, Bale, South West Shewa, Horoguduro and West Arsi); Amhara region (North Gonder, South Gonder, South Wollo, North Shewa, East Gojjam and West Gojjam); Tigray region (Eastern and South West zone) and SNNPR region (Hadiya zone). In Ethiopia, wheat covered an area of 1.7 million hectare with a total production of 4.65 million ton. In spite of its huge importance the national average yield of wheat in Ethiopia is 3.04 t/ha during 2020/21 Meher season, which is far below the average of African and world yield productivity. This is probably due to a number of diseases that attack and reduce quality and quantity of produce. Among these diseases wheat rust is one of the major obligate pathogens affecting wheat production in Ethiopia. Of the three main rusts affecting wheat, stripe is the one that has proved the most difficult to manage in Ethiopia.

Wheat stripe or yellow rust, caused by *Puccinia striiformis* f. sp. *tritici* is one of the most widespread and destructive diseases of wheat worldwide [8]. The disease cause severe damage locally and globally, thereby contributing to food insecurity. Losses due to yellow rust have previously been quantified by different researcher. Yellow has produced heavy losses in the different parts of the world and is a future threat for global wheat production [9]. In most wheat producing areas, yield losses caused by yellow rust range from 2.7% to 96.7% depending on the degree of susceptibility of cultivar, timing of initial infection, rate of disease development, area of hotspot and duration of disease [10]. Infection during anthesis reduces root weight and the amount of yield [11]. Seed produced from crops damaged by yellow rust have low vigor and poor emergence after germination. This is because yellow rust reduces the sugar supply to the developing seed. Shriveling of kernel due to yellow rust reduced test weight and flour milling quality of bread wheat.

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There are several management options available to manage wheat yellow rust disease. Among these cultural practices and chemical control are utilized by farmers in different areas. However, they are not fully effective or applicable due to their high cost considering the poor resource wheat farmers. Resistance breeding is the most important approach for management of wheat yellow rust. Host resistance is the most economical and safest method for controlling the disease [12]. Several efforts were made towards resistant cultivars development in Ethiopia and several bread wheat cultivars with various levels of rust resistance were released for production. However, due to genetic variability of pathogen the resistance levels of current wheat cultivar are endangered which consistently affect their yield performance. Silte and Gurage zones are considered to be suitable for wheat cultivation in southern Ethiopia. However, the production of wheat in this area is threatened by the yellow rust disease. Therefore, the present study was designed with the objective of evaluating bread wheat varieties response to yellow rust.

Materials and Methods

Description of the experimental areas

These experiments were undertaken at Alicho wuriro and Geta research substation in two successive growing seasons 2019 and 2020. Both experimental sites are situated under major wheat growing areas of Southern region characterized by Dega agro ecologies. Geographically, Alicho wuriro is located at 07°56'96"N, 38°09'39"E and 2870 masl. The mean annual rainfall of the area is 1021 mm representing highland agro ecology. The mean annual average temperature is 9.5°C. The soil type is dominated by clay loam soil (Pellic vertisole). Geta substation is located at 07°47'52"N, 37°43'36"E and 2974 m.a.s.l. It receives mean annual rainfall of 910 mm and mean annual average temperature of 11.8°C, representing highland and high rainfall agro ecology. The soil type is dominated by sandy loam soil (Cromic luvisole). Both locations represent the yellow rust prone areas of Southern Region and characterized by bimodal rainfall, the short rainy season extending from March to May and the main rainy season from June to September.

Experimental design and treatments

Appropriate design of Randomized Complete Block Design (RCBD) with three replications was used for the experiment. Twelve bread wheat varieties namely, Ogolcho, Huluqa, Danda'a, Shorima, Honkolo, Kingbird, Hidase, Kekeba, Digalu, Lemu, Bodene and Wane currently under production and having different level of resistance to yellow rust were grown under field conditions to evaluate their response to yellow rust. Artificial inoculation was not carried out due to high yellow rust disease pressure and highly hot spotted experimental sites naturally. The tested bread wheat varieties were sown in experimental plots of 1.2 m × 2.5 m or (3 m^2) each contains 6 rows, spaced 0.2 m apart). The space between plots and blocks were 0.5 m and 1 m, respectively. Wheat varieties were planted at the recommended seed rate of 125 $kgha^{-1}$. Plots were sown manually in rows at appropriate time based on crop calendar of the areas. At planting the recommended rate of 41 kg^{-1} and 46 $kgha^{-1}$ were applied. Three to four times hand weeding were carried out during the crop growing season to make the plots weed free.

Disease assessment

Disease severity of yellow rust was recorded by estimating the approximate percentage of leaf area affected at 10 days interval starting from appearance of the disease symptom up to physiological maturity of the crop based on the modified Cobb's scale [13]. A total of four consecutive assessments were made for disease and each observation was converted into a Coefficient of Infection (CI) by the methods outlined by given in which the values of severity were multiplied by constant number of host response given, *i.e.,* immunity=0, R=0.2, MR=0.4, MRMS=0.6, MS=0.8, MSS=0.9 and S=1 [14-16]. Disease severity and average of coefficient of infection were calculated using the formula described blow.

Disease severity

$$\text{Disease severity} = \left(\frac{\text{Area of plant tissue affected}}{\text{Total area of plant tissue examined}}\right) * 100 \quad (1)$$

$$\text{ACI} = \left(\frac{\text{Disease Severity} * \text{constant for respons}}{\text{Total number of observation recorded}}\right) \quad (2)$$

Analysis of disease progress

Area under Disease Progress Curve (AUDPC): Calculated using the CI values from the original rust severity data by using the following formula as suggested by Arama, et al.

$$AUDPC = \sum_{i=1}^{n-1} \left(\left(\frac{x_i + x_i + 1}{2}\right)(t_i + 1 - t_i)\right) \quad (3)$$

Where, x_i=the average coefficient of infection of i^{th} record, X_{i+1}=the average coefficient of infection of $i+1^{th}$ record and $t_{i+1}-t_i$=number of days between the i^{th} record and $i+1^{th}$ record and n=number of observations.

Yield parameter assessment

All agronomic data were recorded from four central rows on each experimental unit. Details of the agronomic parameters measured are the following.

Plant Height (PH) (cm): Average of the height of 5 randomly selected plants from each plot were measured from the ground level to top of the ear at maturity excluding awns.

Spike Length (SL) (cm): The average length of spikes from 5 randomly taken plants from the four central rows of each plot was measured.

Kernels Per Spike (KPS): The numbers of kernels of main tillers on each of 5 randomly selected plants were counted and the average of 5 plants was used for data analysis.

Thousand Kernels Weight (TKW) (g): The weight of one thousand kernels was counted by carefully using a seed counter, adjusting to 12.5% moisture content and weighing them using sensitive balance.

Grain Yield (GY): Grain yield was adjusted to a moisture content of 12.5% and measured from the four central rows each plot and converted in to kg/ha^{-1}.

Statistical analysis

Data from each of the two locations were subjected to Analysis of Variance (ANOVA) and combined analyses over the years has been done according to using SAS computer software package version 9.3 [18,19]. Comparison of treatment means was made using Least Significant Difference test (LSD) 5% of probability level. The relationship between disease parameters with yield and yield components were correlated using the Proc-Corr Pearson's correlation procedures.

Results and Discussion

Significant variations in grain yield and some agronomic characteristics were observed among tested bread wheat varieties. Data on parameters regarding yield potential has been presented.

Terminal severity

There were significant (P<0.05) variations among the varieties in levels of severity of yellow rust at both location. The highest terminal rust severity (88%, 62%.5, 57% and 55%) was recorded on the variety Digalu, Wane, Ogolcho and Bodene, respectively at Alicho wuriro. While the lowest terminal rust severity of 29% on Shorima and 28.5% on Danda'a were recorded at Alicho wuriro and Geta, respectively. Enough variability existed across the two locations for yellow rust severity among the bread wheat varieties. This might be due to the evolvement of new race or pathotype or the involvement of exotic race of pathogen. Continuous monoculture (in terms of growing susceptible cultivars such as Hidase) may also contribute for development of disease.

The occurrence of yellow rust disease was relatively early in relation wheat growth stage. The disease has been occurred during stem elongation in some early matured varieties like kekeba at both locations resulting in a severe infection. The growth and development of wheat was adversely affected by yellow rust at both locations. The disease was severe in all leaves of the plant including the flag leaves in all tested bread wheat varieties except the relatively resistant ones. There was also reduction and destruction of the green leaf tissues and loss of photosynthetic area on infected leaves, withering of leaves and severe defoliation in unsprayed plots of susceptible and moderately susceptible bread wheat varieties on early growth stage. The result of this study was in agreement with the previous work by which found that early disruption of the plant's photosynthetic capacity and competition with reproductive structures by the pathogen, leave less assimilate available for grain fill than situations where rust infection occurs later [20].

Average coefficient of infection

A considerable gap has been exists among the varieties in their average coefficient infections at both locations. The highest ACI at Alicho 91.6% and 86.3% were recorded from Digalu and Hidase, respectively whereas at Geta 85% and 83.5% were recorded from Digalu and Kekeba, respectively. The lowest ACI of 13.6% from Honkolo and 16% from Danda'a were recorded at Alicho and Geta respectively. The maximum severity on susceptible varieties like Digalu and kekeba showed the presence of enough rust pressure across locations with a maximum at ACI. This indicated the presence of sufficient genetic variability for the level of resistance/susceptibility among the varieties investigated. The wide distribution in yellow rust occurrence across season could be due to the climatic conditions, the quantity of pathogen source and time of infection. Climatic variations among the two locations influence the interaction between yellow rust and wheat. The disease pressure in each environment influenced the performance of wheat varieties. Cool weather during the wheat growing season largely coincided with the environmental conditions favorable for yellow rust development. Similarly, suggested that factors influence occurrence of yellow rust epidemics on winter wheat [21].

Area under disease progress curve

There was significant (p<0.05) differences among the bread wheat varieties with regard to Area Under Diseases Progress Curve (AUDPC). The highest of AUDPC values of (2375% days, 1512%days and 1308% days were recorded on Digalu, Hidase and Ogolcho, respectively. The lowest AUDPC of 265.5% days on Shorima and 474.2% days on Danda'a were recorded at Alicho wuriro and Geta, respectively. Area under disease progress curve is the true measures of disease parameter because it is directly related with the yield loss. The resistance level of bread wheat cultivar was estimated by AUDPC. This is because; AUDPC represents both the amount of rust infection and the rate at which the disease or pathogen has increased during an epidemic. The bread wheat variety Danda'a and Shorima showed the lowest AUDPC and gives the better grain yield. The result of the study is in agreement with the finding of who reported that the more resistant cultivars had very low AUDPC. However no varieties showed immune rust reaction throughout of the disease assessment. This might be due to the breakdown of major gene or minor gene which doesn't give the highest protection of rust. Therefore using resistant wheat lines or resistance genes will protect wheat production from yellow rust infection and consequently yield losses.

Therefore using resistant wheat lines or resistance genes will protect wheat production from yellow rust infection and consequently yield losses (Figure 1).

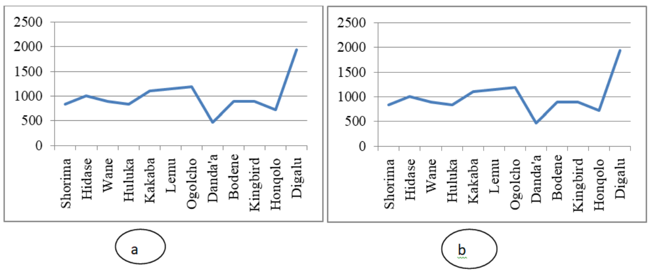

Figure 1: Disease progress of yellow rust on each treatment at Alicho wuriro (a) and Geta (b).

Plant height

The finding of the present study showed that wheat varities at both locations did not vary significantly in terms of plant height at both locations. The highest plant height 88.3 cm was obtained from the Danda'a followed by 87.16 cm from the Shorima which were non-significant with each other, while the lowest plant height 62.44 cm were noted from the bread wheat variety Hidase. Few varieties revealed the better in plant in spite of maximum diseases pressure. However variation among the varieties on plant heights was not only due to diseases but also reflect the genetic differences of cultivar.

Spike length

Analysis of variance depicted highly significant (P<0.05) differences among spike length of different bread wheat varieties to the yellow rust. Spike length is one of the most important parameter contributing toward grain yield. The highest spike length of 11.2 cm was obtained on Shorima followed by Huluka (10.5 cm) and then Wane (10.3 cm). The least spike length (6.7 cm) was obtained by susceptible variety (Digalu). The reductions on spike length due to yellow rust contributed to the lowest grain yield. However, most of the evaluated cultivars exhibited better performance in spike length even if under maximum disease severities. Considerable amount of variations were prevalent across these locations among varieties on spike length. However the variations on spike length among the varieties were not only due to disease, but also reflect their diverse genetic background of cultivar.

Thousand kernel weight

The performance of wheat cultivars in terms of thousand kernel weight revealed significant differences among bread wheat varieties at two locations. The maximum TKW of 47.8 g from Shorima and 45.1 g from Danda'a were obtained at Alicho wuriro and Geta, respectively. Whereas the minimum TKW of 28.1 g and 24.5 g were obtained from the variety Digalu at Alicho wuriro and Geta, respectively. Digalu variety had the least TKW and grain yield value was totally susceptible to the yellow rust. The variability in thousand kernel weight was more prominent across locations. This indicted that yellow rust negatively affected the kernel quality and quantity of produce. The result of the current finding is in agreement with the work done by who suggested that shriveling of wheat kernels reduces flour yield. Similarly indicated that yellow affected grains resulted in lower dough strength (the physical strength to resist extension), which in turn, could affect baking quality. The disease had considerable impact on TKW of varieties tested on the experiment. Therefore developing high yielding and disease resistant varieties that also have a broad range of adaptation under variable agro climatic conditions is mandatory to fulfill burning issues.

Grain yield

There were significant (P<0.05) differences in grain yield values among the bread wheat varieties, both at Alicho wuriro and Geta in both seasons (Tables 1 and 2). The maximum grain yield of 3954 kgha^{-1} at Alicho wuriro and 3945 kgha^{-1} at Geta were obtained from moderately resistant varieties of Shorima and Danda'a respectively, whilst the lowest grain yield of 2107.7 kgha^{-1} and 2073.1 kgha^{-1} were obtained from susceptible variety of Digalu at Alicho wuriro and Geta, respectively. Highest grain yield differences and losses were recorded among variety due to heavy disease pressure at both locations. Similarly suggested that variability in yield was dependent on extent of disease pressure. Inverse relation was present between the disease level and grain yield and this implies that, yellow rust disease directly affects the kernel quality leading to shriveling of wheat grains. There is also great variation on grain yield among the varieties between two locations. Theses variability may come from availability in temperature, humidity, moisture and the microclimate of crop present at these locations. The present results agree with those of who reported that the season was mainly responsible for variation of the agronomic traits in two rowed winter malting barley. The frequent occurrence and variability of disease on bread wheat varieties during the season asserted the broad virulence spectrum of yellow rust population and its economic significance in areas. Most of the varieties respond negatively to the disease but, few of them perform in a good crop stand and preferred by farmer in the areas. Danda'a has been several preferred advantages by farmers. The variety has great tillering capacity, more spike and longer stems also provide more straw to be used by farmer. Most farmers in areas grow the same variety which is susceptible to yellow rust disease. Therefore adoption of recently released bread wheat variety is important to combat the yellow rust pathogen as a sustainable strategy.

Variety	TS (%)	ACI (%)	AUDPC (% days)	PH (cm)	SPL (cm)	TSW (g)	GY (kg/ha-1)
Shorima	29.1	15	265.5	80.00	11.2	47.87	3954.4
Hidase	62.5	86.3	1512.5	74.27	9.80	39.23	2873.0
Wane	45.0	33.7	900.0d	75.55	10.3	42.50	3223.1
Huluka	47.5	25.6	866.7	76.43	10.5	34.58	2820.5
Kakaba	37.5	30.6f	787.5	77.70	9.93	43.90	3488.7
Lemu	54.1	54.1	1095.8	77.91	9.88	37.23	2555.6
Ogolcho	57.5	79.6	1308.3	77.56	9.85	34.90	2813.5
Danda'a	43.3	16.6	979.2	78.35	9.76	37.45	3158.2
Bodene	55.0	63.3	1118.3	71.60	8.57	34.79	2784.3
Kingbird	47.5	42.3	1085.3	75.85	8.80	39.73	2879.8
Honqolo	46.7	13.6	950.0	70.20	8.95	34.67	2494.5
Digalu	88.0	91.6	2375	71.26	7.60	28.12	2107.7
LSD (0.05)	9.53	6.07	310.5	6.62	0.93	5.15	360.91
CV (%)	16.1	7.79	23.8	7.58	8.36	11.92	10.67

Note: LSD $_{0.05}$=List Significant Difference at 5%; CV (%)=Coefficient of Variation at (%). Means in same column followed by the same letters are not significantly different. TS: Terminal rust Severity; ACI: Average Coefficient Infections; AUDPC: Area Under Disease Progress Curve; PH: Plant Height; SL: Spike Length; TKW: Thousand Kernel Weight; GY: Grain Yield

Table 1: The effect of yellow rust on yield parameters of bread wheat varieties at Alicho wuriro during 2019-2020 main cropping seasons.

Variety	TS (%)	ACI (%)	AUDPC (% days)	PH (cm)	SL (cm)	TKW (g)	GY (kg/ha-1)
Shorima	37.5	36.3	837.0	74.5	9.05	33.1	3590.8
Hidase	45.17	51.6	1008.3	70.6	8.13	34.3	2710.7
Wane	37.1	42.6	887.5	75.4	9.15	36.4	3496.3
Huluka	35.5	48.6	833.4	76.7	8.52	37.3	3582.4
Kakaba	53.0	83.5	1104.2	75.3	8.62	35.1	3094.1
Lemu	45.8	80.0	1150.0	75.0	9.23	36.9	2673.3
Ogolcho	51.3	82.5	1191.7	70.9	7.83	34.9	2399.9
Danda'a	28.5	16.0	474.2	76.8	8.10	45.1	3948.5
Bodene	37.5c	55.0	900.0	75.5	8.20	35.8	2780.1
Kingbird	38.6	48.6	900.0	77.6	8.47	33.1	2651.3
Honqolo	30.5	28.0	729.2	70.5	7.6	34.0	2377.4
Digalu	86.0	85.0	1937.5	72.0	6.77	24.5	2073.1
LSD (0.05)	12.4	14.1	202.3	6.42	0.85	5.86	641.7
CV (%)	24.6	16.5	17.6	7.51	9.5	14.5	18.8

Note: LSD $_{0.05}$=List Significant Difference at 5%, CV (%)=Coefficient of Variation at (%). Means in same column followed by the same letters are not significantly different. TS: Terminal Severity, ACI: Average Coefficient Infections; AUDPC: Area Under Disease Progress Curve; PH: Plant Height; SL: Spike Length; TKW: Thousand Kernel Weight; GY: Grain Yield

Table 2: The effect of yellow rust on yield parameters of bread wheat varieties at Geta during 2019-2020 main cropping seasons.

Correlation analysis between disease and agronomic variables

The Pearson correlation coefficient analysis revealed that grain yield displayed significantly different positive correlation with a spike length (r=0.70**) and thousand kernel weigh (r=0.86**) (Table 3). These is an indication of that the yield components is largely responsible for the determination of grain yield in individual plants On the other hand grain yield, TKW and spike length displayed significantly negative correlation with yellow rust (r=-0.97**, r=-0.89**, r=-0.32*), respectively (Table 4). The correlations were relatively strong indicating that severity had high negative impact on TKW and grain yield reduction. Similarly, found a significant correlation between mean disease severity of leaf rust and percentage loss in thousand kernels and grain yield of bread wheat. A strong negative correlation was also observed between the ACI and AUDPC with that of grain yield r=-0.97**, r=-0.93** respectively. This result indicated that cultivars which were severely infected showed higher ACI and AUDPC value.

	TRS	AUDPC	ACI	SL	PH	TKW	GY
TRS							
AUDPC	0.91**						
ACI	0.87**	0.99**					

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SL	-0.32*	-0.34*	-0.35*				
PH	-0.21^{ns}	-0.19^{ns}	-0.17^{ns}	0.22^{ns}			
TKW	-0.89**	-0.82**	-0.83**	0.74**	0.15^{ns}		
GY	-0.95**	-0.92**	-0.95**	0.70**	0.20^{ns}	0.86**	

Note: **refers to mean values Significant at=0.01, *refers mean square values Significant at=0.05, ns: refers mean square values not significant at=0.05, TRS: Terminal Rust Severity; AUDPC: Area Under Disease Progress Curve; ACI: Average Coefficient of Infection; SL: Spike Length; PH: Plant Height; TKW: Thousand Kernel Weight; GY: Grain Yield

Table 3: Correlation between disease parameters and yield and yield components at Alicho wuriro.

	TRS	AUDPC	ACI	SL	PH	TKW	GY
TRS							
AUDPC	0.89**						
ACI	0.91**	0.95**					
SL	-0.30*	-0.32*	-0.37*				
PH	-0.18^{ns}	-0.21^{ns}	-0.20^{ns}	0.20^{ns}			
TKW	-0.85**	-0.85**	-0.85**	0.71**	0.19^{ns}		
GY	-0.97**	-0.93**	-0.97**	0.68**	0.16^{ns}	0.82**	

Note: **refers to mean values Significant at=0.01, *refers mean square values Significant at=0.05, ns: refers mean square values not significant at=0.05, TRS: Terminal Rust Severity; AUDPC: Area Under Disease Progress Curve; ACI: Average Coefficient of Infection; SL: Spike Length; PH: Plant Height, TKW: Thousand Kernel Weight; GY: Grain Yield

Table 4: Correlation between disease parameters and yield and yield components at Geta.

Conclusion

It could be deliberated from this study that all tested bread wheat varieties had significant variation for most of crop parameters. Significant reduction in Spike Length (SL), Grain Yield (GY), Thousand Kernel Weight (TKW) was occurred due to yellow rust epidemic. Almost all tested varieties are affected by yellow rust at both site, however the level of severity was different. The most commonly grown cultivars such as Shorima, Honkolo and Danda'a has been showed moderately resistant and Ogolcho, Huluka, Kingbird, Kekeba and Bodene showed moderately susceptible reaction type within two consecutive season at both site. The some varieties responded differently to yellow rust severities at different locations due to weather variables. Both environmental and pathogenic variability significantly affected the yield performance of the varieties across locations whereby creating significant difference among varieties in their resistance and susceptibility to yellow rust infection. The result of this study indicates that it is difficult to find a wheat variety which is resistant against yellow rust but, it is important to use relatively resistant ones in order to reduce the risk due to the disease. Therefore, Danda'a and Shorima are the best choice of variety gives the better grain yield recommended for the areas. However, the performance of theses varieties will be decreases due to change in weather condition for prevailing pathogen. Therefore evaluation of high yielding, stable genotypes having good quality are considered and pre-requisite to secure wheat production in the regions. There is also a need to broader genetic base and to replace old varieties with new and improved ones. Recommendation of several varieties will also help farmers to select best one and also adequate supply of improved varieties to farmers.

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