Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.6, No.17, 2016

Effect of Septoria Trtici Blotch (Septoria tritici) on Grain Yield and Yield Components of Bread Wheat

Alemar Said*
Southern Agricultural Research Institute, Areka Agricultural Research Centre, Pobox79 Areka Ethiopia

Temam Hussien
College of Agricultural and Environmental Science, Haramaya University, Po Box: 38 Haramaya, Ethiopia

Abstract
Bread wheat (Triticum aestivum L.) is widely grown in most of the regions in Ethiopia, including Southern Nations Nationalities and Peoples Region (SNNPR). But, its bread production is affected by abiotic and biotic factors. Among biotic factors, Septoria tritici blotch (STB) caused by the ascomycete fungus Mycosphaerella graminicola (asexual stage: Septoria tritici) Septoria tritici is one of the important problems of wheat production in the country; including Haddiya-Kambata areas of SNNPR. It is characterized by necrotic lesions on leaves and stems that develop after infected cells collapse, and more prevalent during cool, wet weather. Field experiment was conducted at Hossana and Angecha in 2012 main cropping season to quantify the effect of this disease on yield and yield components of bread wheat varieties. Three different spray intervals of propiconazole (Tilt 250 EC) and one unsprayed plot for each of the three varieties (Alidoro, Galama and Gambo) were used to create different STB epidemic levels. Treatments were arranged in randomized complete block design (RCBD) with factorial arrangement in three replications. Severity on all leaves (i.e. the leaves except flag leaf) and on flag leaf was recorded independently. The result of the study showed that, grain yield loss of 41, 29 and 12% were recorded on susceptible variety; Gambo,, moderately susceptible variety; Galama, and moderately resistant variety; Alidoro, respectively. In addition, loss of 48% biomass, 36% kernels per spike and 46% spikes per meter square were incurred on natural epidemic plots of variety Gambo at Hossana. Loss on days to heading, days to maturity, plant height, spike length and number of tillers per meter square is statistically nonsignificant at ($P \leq 0.05$). In general, this diseased caused considerable loss on yield and yield components of all varieties under the study. Therefore, as it is potential wheat production problem, giving attention and developing all possible management strategy is very pertinent.
Keywords: wheat, Septoria tritice blotch, severity, yield loss

1. INTRODUCTION

Wheat is an important cereal crop in Ethiopia that is widely cultivated in a wide range of altitude of “Dega” and “woina dega” regions; ranging from 1500 to 3000 m.a.s.l. The most suitable area, however, falls between 1700 and 2800 m.a.s.l (Hailu, 1991; Bekele *et al*., 1994; Ethiopan ATA, 2013). It is produced exclusively under rainfed conditions. Its production is increasing more rapidly than all other cereal crops in the country (Amsal *et al*., 1995; CSA, 2000; CSA, 2012).

In Ethiopia, however wheat productivity has increased and more than 65% of cultivated wheat farms are with improved cultivars the average national productivity is not more than 2.5 t/ha (CSA, 2015) against the best performers and model farmers who managed to produce more than 6 t/ha (EIAR, 2012).

This low average productivity which is below potential yield is because of the frequent abiotic and biotic stresses that are prevailing during critical growth stages of the crop. Among the most prevailing biotic stresses, Septoria tritici blotch (STB) caused by *Septoria tritici* (teleomorph: *Mycosphaerella graminicola*) is one of the major leaf disease (Eshetu, 1986; Mengistu *et al*., 1991: as cited in Abreham, 2008; Ethiopian ATA, 2013).

This disease is sometimes called speckled leaf blotch, Septoria leaf blotch, *Septoria tritici* leaf blotch or septoria blotch. It is principally a wheat foliar pathogen, but it can also infect wheat heads. The disease begins on the lower leaves and gradually progresses to the flag leaf. Leaf sheaths are also susceptible to attack. In wet years, the STB fungus can move ontothe heads and cause brown lesions on the glumes and awns (Wolf, 2008; (Hershman, URL: http://www.ca.uky.edu,April 17, 2012).

The lesions of the *S.tritici* start as small yellow flecks; usually on lower leaves that are in contact with the soil. Flecks expand in to red brown rectangular lesions with 1.6-3.2 mm wide by 6.35-19 mm long with regular to irregular margin. These lesions often become light tan as they age and the fungal fruiting. The disease can be distinguished from other foliar diseases by the presences of small black fruiting bodies within the lesions. It is fevered by frequent rain fall, which splashes the spores onto upper leaves and heads where bit is more damaging (Wolf, 2008; Hershman, URL:http://www.ca.uky.edu).

In Ethiopia this disease is widely distributed over all wheat growing areas. In most of them its severity is very high. According to survey report of (Eshetu, 1986; Mengistu *et al*., 1991: in Abreham, 2008) the yield loss of wheat as the result of this disease reach up to 82% at hot spot areas on susceptible varieties.

In Ethiopia; information on effect of wheat *Septoria tritici* blotch (*Septoria tritici)* on its yield and yield components is limited on the result of field survey. To approve the previous result, quantification of loss of yield and yield components with field experiment was very important. Therefore, the objectives of this study were to quantify the effect of STB on yield and yield components of bread wheat.

2. MATERIALS AND METHODS

2.1. Experimental Site

The experiment was conducted at two research sites of Areka Agricultural Research Center (ARARC) i.e. Angecha and Hossana, both of which represent the high lands of major wheat production areas of Southern Nations Nationalities and peoples Region (SNNPR) with high rainfall and are expected to be the suitable environment (hot spot) of the disease (Fikre, 2010).

Hosanna site is found in Haddiya Zone which is located at 7°34' 04'' N and 37°51'22'' E at about 2306 m.a.s.l. It receives an average annual rainfall of 1153 mm. The monthly average minimum and maximum temperatures are 10.3^{0}C and 23°C, respectively. The dominant soil type is nitosol and slightly acidic. It belongs to the sub humid agro climatic zone (http://mapcarta.com/ April, 2012)

Angecha site is found in Kambata Tembaro Zone which is located at 7°20' N and 37°51'E at about 2320 m.a.s.l. It belongs to the sub-humid agro-climatic zone. Its average annual rainfall ranges from 1000-1200 mm. The dominant soil type is luvisol (ArARC, 2006).

.

2.2. Experimental Materials and Treatments

The experiment was conducted using three bread wheat varieties (Alidoro,Galama and Gambo) that are moderately resistant, moderately susceptible and susceptible to *Septoria tritici* blotch and relatively resistant to other diseases like wheat rusts (Ethiopian crop registration directory of 1995, 2005 and 2011).

Multiple levels of *Septoria tritici* blotch epidemics been created in experimental plots through the application of propiconazole (Tilt 250 E.C.) at different intervals of time. Tilt is a systemic fungicide effective against almost all cereal fungal diseases. The fungicide was applied at a rate of 0.5 l/ha (125 g a.i. ha^{-1}) in three different spray schedules viz., every 10, 20 and 30 days. The base for selection of 10 days intervals was relatively long latent period (14-21 days) of STB (Eyal *et al*., 1987; Shaw, 1990). The ten-day sprayed treatment had been started immediately as *Septoria tritici* leaf blotch symptom appeared; on 03 and 17 of September 2012 at Hossana and Angecha, respectively. The 20 and 30-day spray interval treatments started two and three weeks after onset of disease, respectively. Then spraying continued at the specified intervals until the crop attained its physiological maturity. Unsprayed plots were included for each variety to allow maximum *Septoria tritici* blotch development for comparison of the effect of disease levels on different parameters.

2.3. Experimental Design and Treatment management

The experiment was laid out using Randomized Complete Block Design (RCBD) in factorial arrangement with three replications. There were a total of 12 treatments of combinations of three levels of varieties and four levels of fungicide spraying frequencies. Each plot was consisted of 6 rows of 5 m length. The space between rows, plots and replications had been 0.2 m, 1 m and 2 m wide, respectively. Seed rate of 150 kg/ha, which is recommended for the area, had been used. Fertilizers at a rate of 23 kg/ha N and 46 kg/ha P_2O_5 were applied during planting and weeds controlled by hand weeding. Planting was done in July 20 and 23 / 2012 at Hossana and Angecha, respectively on previous year wheat cultivated field to increase inoculum potential. At both locations the land was ploughed four times by oxen.

To ensure uniform spread of inoculum and sufficient disease development, infector plants consisting of a mixture of different susceptible bread wheat varieties (Gambo and Galama) were bordered the plots perpendicular to rows of the plot by spreading row on both ends of the plots.

During fungicide sprays, plastic sheet was used to separate the sprayed plots from the adjacent plots in order to prevent inter-plot interference due to spray drift. This was achieved by covering the adjacent plots using plastic sheet fitted on the wooden poles at the time of spraying.

2.4. Data Collection

2.4.1. Disease data

Septoria tritici blotch severity was assessed on 10 randomly selected pre-tagged plants per plot at weekly interval from the time of disease appeared until the crop attained its physiological maturity. Severity on flag leaf was recorded independently. The average severity from the 10 plants per plot was used for analysis.

STB severity was scored visually using a double-digit (00 to 99), modified version of Saari and Prescott's scale (Eyal *et al*. 1987; Saari and Prescott, 1975.) for wheat foliar diseases. The first digit (*D*1) indicates disease progress in plant height and the second digit (*D*2) refers to severity measured as the diseased leaf area. For each score, percentage of disease severity was estimated based on the following formula:

% Severity = $(D1/9) \times (D2/9) \times 100$ (Saari and Prescott, 1975)

2.4.2. Agronomic data

At the field, number of days at 50% heading, 75% maturity, was recorded. Again total number of tillers in one-meter rows length in each plot was recorded and converted into one meter square area. In addition Number of fertile tillers in 0.25m^2 area was recorded and converted to one meter square area during analysis. The plant height; from ground level to the tip of the spike excluding the awns, and spike length of main tillers from ten pre tagged plants was measured in centimetre.

At harvest, the average number of kernels of main tiller of the ten pre tagged plants and the weight of total above ground parts per 4m^2 plot (Biomass) were measured from the plot area used for yield determination. Grain yield in gram per plot was recorded, adjusted to the weight at 12.5% moisture content. Then it was translated to kg/ha. Only four of the internal rows of the plots had been harvested for yield and biomass estimations. Also, the weight of thousand kernels sampled at random from the total grains harvested from each experimental plot was measured using sensitive balance.

2.5. Data Analysis

2.5.1. Analysis of variance (ANOVA)

Data on yield and yield components and all agronomic data were subjected to analysis of variance by using the methods described by Gomez and Gomez (1984) using SAS 9.0 computer software. Least Significant Difference (LSD) values were used to separate differences among treatment means.

2.5.2. Yield loss estimation

The relative losses in yield and yield components of each variety were determined as a percentage of that of the protected plots of the respective variety. Losses were calculated separately for each of the treatments with different levels of disease, as:

$$RL(\%) = \frac{(Y1-Y2)}{Y1} \times 100$$

Where, RL% =percentage of relative loss (reduction of the parameters; i.e. yield, yield component)

Y_1 = mean of the respective parameter on protected plots (plots with maximum protection)

Y_2 = mean of the respective parameter in unprotected plots (i.e. unsprayed plots or sprayed plots with varying level of disease).

3. RESULTS AND DISCUSSION

The experiment was planted in July 20, and 23 2012, at Hossans and Aangecha, respectively. It was harvested at the beginning of December 2012 at both locations. During the cropping season, intensity of the rainy was high up to the end of September and then it became very low at the latter growth stage of the crop. At both locations in the experimental field early leaves maturity was observed. This is might be the result of shortage of rain fall and STB infestation of the field by STB.

Septoria tritici blotch was first observed and recorded on 03 September 2012 at Hossana, at Zadoks growth stag (GS) of Z15, 23 (five leaves on main shoot & three tiller) on all experimental plots and infector rows. Disease severity reaches its maximum of 60, 76 and 78% on Alidoro, Galama and Gambo, respectively. At Angecha also, STB first appeared somewhat being late on 15 September 2012 at crop growth stage (GS) of Z30 (stem start to elongate) and its severity reaches its maximum of 35, 57 and 59% on Alidoro, Galama and Gambo, respectively (Alemar and Temam, 2016). The field was free from other foliar diseases like stem rust, leaf rust and yellow rusts at the growing season on both locations.

3.1. Relative Yield Loss

3.1.1. Grain yield

The most important and economic parameter, which affected by disease is grain yield. In this study, it was most significantly affected by *Septoria tritici* blotch. However relative grain yield loss was occurred on all treatments; there was significant difference among treatments.

At Hossana, the highest relative grain yield loss was recorded on unsprayed plots of Gambo, with loss percentage of 40.6% followed by every 30 days sprayed plot (30.7%) and then unsprayed plots of Galama (28.5%). Among unsprayed treatments, the lowest yield loss (11.8%) was recorded from Alidoro; which was moderately resistant to *Septoria tritici* blotch. On this variety grain yield losses of 2.4 and 10.3% were incurred on fungicide sprayed at 20 and 30 days intervals. The relative loss of unsprayed plot and at 30 days spray schedule on variety Alidoro were not statistically differ (Table 1).

On variety Galama, calculated relative grain yield loss was 11.2 % on every 20 days and 20.5 % on every 30 days sprayed plots. On all levels of fungicide sprayed intervals (every 10, 20 and 30 days) and unsprayed plots, relative yield loss on this variety showed significantly different each other. The highest relative loss of 28.5% was incurred on unsprayed plot followed by every 30 days sprayed plot (20.5%) (Table1). The result indicated that the more frequent fungicide application leads to the lowest yield loss and the highest yield recovery; regardless of other side effects of fungicide. This is due to the change on fungicide application frequency can change disease development level and in turn it changes the amount of yield loss.

Again on variety Gambo (susceptible variety to *Septoria tritici* blotch), the relative grain yield loss among different fungicide spray intervals showed significant difference each other. As shown above, the highest relative grain yield loss of 40.6% was calculated on unsprayed plot (natural epidemic) of this variety. This value was 70.9% and 29.8% higher than the loss on variety Alidoro and Galama under natural epidemic, respectively. This confirmed us the effect of host resistance level on yield loss (Temesgen *et al*., 2000; Elizabeth, 2012). The relative grain yield loss calculated on every 20 and 30 days sprayed plots were 13.9 and 30.7%, respectively (Table 1).

However, it was not as high as at Hosanna, also loss on grain yield was incurred due to *Septoria tritici* blotch on all three verities at Angecha. The highest loss (21.3%) was recorded on unsprayed plot of Gambo. On this variety the loss on every 20 days sprayed plot was 3%; which was statistically non significant. The grain yield loss on every 30 days sprayed plot was 13.5%. Again the highest loss of 10.2% on Alidoro and 15.5% on Galama were experienced on unsprayed plots of them; compared with their respective sprayed plots. The yield loss on every 30 days sprayed plots of Galama showed 13.7%; which revealed non significant deference from the loss on its unsprayed plot (Table 2).

On this study the grain yield loss under natural epidemics ranges from 11.8 (Alidoro) to 40.6% (Gambo) at hosanna and 10.2 (Alidoro) – 21.3% (Gambo) at Angecha. This agreed with STB can cause the grain yield loss up to 50% (Agrios, 1997 and Bockus *et al*., 2010). But, it could not reach up to 82% (Abreham, 2008). The overall loss on grain yield of Gambo was highest compared with the other two varieties under the experiment. It confirmed that susceptible genotypes showed higher yield losses as compared to resistant genotypes (Ahmad *et al*, 2010). In general; in this study, the pattern of grain yield loss was consistent with both fungicide sprayed intervals and crop resistant levels. The loss on grain yield of the three varieties was high at Hosanna; where the epidemics of *Septoria tritici* blotch was high, than Angecha.

Table 1. Yield and yield components of three bread wheat varieties and the corresponding relative losses due to *Septoria tritici* blotch under different spray intervals at Hossana in 2012.

variety	Spray interval (day)	NS/m^2	Loss (%)	NKPS	Loss (%)	BMW (t/ha)	Loss (%)	TKW (g)	Loss (%)	TW (kg/hl)	Loss (%)	GY (kg/ha)	Loss (%)
Alidoro	10	383bc	0	66a	0	15.0abc	0	46.0ab	0	81.4abc	0	4937bc	0
	20	340dc	11.2	64a	3.0	12.1de	19.3	44.7abc	2.8	80.4bc	1.2	4818bcd	2.4
	30	308de	19.6	62a	6.1	13.2cd	12.0	41.2bcd	10.4	80.8abc	0.7	4431def	10.3
	No spray	293de	23.4	57a	13.6	11.0efg	26.7	35.4ef	23.0	80.1c	1.6	4356ef	11.8
Galama	10	465a	0	57a	0	16.0a	0	47.0a	0	82.0ab	0	5130ab	0
	20	403b	13.3	56a	1.8	13.3bcd	16.9	40.4cde	14.0	82.3a	-0.4	4555cde	11.2
	30	270ef	41.9	56a	1.8	9.9fgh	38.1	37.3def	20.6	81.3abc	0.9	40779fg	20.5
	No spray	258ef	44.5	43b	24.6	9.6ghi	40.0	39.3cde	16.4	79.9c	2.6	3670h	28.5
Gambo	10	410ab	0	64a	0	15.1ab	0	49.5a	0	82.4a	0	5427a	0
	20	378abc	7.8	60a	6.3	11.8def	22.4	47.2a	4.6	82.4a	0	4674cde	13.9
	30	251ef	38.8	45b	29.7	8.9hi	41.4	35.4ef	28.5	81.9ab	0.6	3759gh	30.7
	No spray	221ef	46.1	41b	35.9	7.9i	48.0	31.8f	35.8	81.4abc	1.2	3226i	40.6
CV (%)		10.21		8.78		8.80		8.23		1.2		5.5	
SE		33.84		4.91		1.05		3.40		0.98		242	
LSD 0.05		58.86		10.60		1.92		5.56		ns		408	

Here:- NS=number of spikes, NKPS=number of kernels per spike, BMW= biomass weight, TKW= thousand kernels weight, GY= Grain yield, TW= test weight, GYR = grain yield recovery, CV = coefficient of variance, SE = standard error of the means, LSD = List significance difference, ns = non significant

Table 2. Yield and yield components of three bread wheat varieties and the corresponding relative losses due to *Septoria tritici* blotch under different spray intervals at Angecha in 2012.

variety	Spray interval(day)	NS/m^2	Loss (%)	NKPS	Loss (%)	BMW (t/ha)	Loss (%)	TKW (g)	Loss (%)	TW(kg/hl)	Loss (%)	GY (kg/ha)	Loss (%)
Alidoro	10	343de	0.0	73a	0.0	14.8ab	0.0	46.5bc	0.0	79.6dc	0	5022bc	0.0
	20	318ef	7.3	72a	1.4	13.9bcd	5.7	45.7bcd	1.7	80.0d	0.9	4763cd	5.1
	30	295fg	13.9	71ab	2.7	12.7def	14.2	45.4bcde	2.4	78.0e	2.0	4622d	8.0
	No spray	283g	17.5	70ab	4.1	11.9f	19.22	44def	5.4	77.3e	2.9	4512de	10.2
Galama	10	447a	0.0	64de	0.0	15.4a	0.0	45.8bcd	0.0	81.6a	0	5253ab	0.0
	20	423ab	5.4	62ef	3.1	14.4abc	6.9	45.1cde	1.5	80.9ab	0.7	5005bc	4.7
	30	407b	8.9	59f	7.8	13.3cdef	13.9	43.3ef	5.5	80.5b	0	4535de	13.7
	No spray	397bc	11.2	59f	7.8	12.1f	21.8	41.6f	9.2	80.3bc	1.4	4438de	15.5
Gambo	10	369cd	0.0	68bc	0.0	14.2abc	0.0	49.0a	0.0	81.5a	0	5381a	0.0
	20	349d	5.4	66cd	2.9	13.9bcde	2.3	47.6ab	2.9	81.5a	0	5219ab	3.0
	30	317ef	14.1	62def	8.8	13.3cdef	6.5	46.1bcd	5.9	81.2ab	0.3	4656d	13.5
	No spray	304fg	17.6	61ef	10.3	12.5ef	11.8	45.5bcde	7.1	81.6a	-0.1	4237e	21.3
CV (%)		5.22		3.34		4.30		3.20		0.58		3.06	
SE		18.51		2.19		0.58		1.46		0.47		146.76	
LSD 0.05		29.90ns		3.75ns		1.38ns		2.41ns		0.85		340.24	

Here:- NS=number of spikes, NKPS=number of kernels per spike, BMW= biomass weight, TKW= thousand kernels weight, GY= Grain yield, TW= test weight, GYR = grain yield recovery, CV = coefficient of variance, SE = standard error of the means, LSD = List significance difference, ns = non significant

3.1.2. Thousand Kernel weight

Thousand kernels weight (TKW) of the crop is one of the yield parameter which affected by foliar diseases of wheat. At Hosanna, among varieties which were involved in this study, TKW of Gambo was affected more than the other varieties. Its loss showed that 35.8% on unsprayed, 28.5% on every 30 days sprayed, 4.6% on every 20 days sprayed plots. Here, the loss on every 30 days sprayed plot showed non significant difference with the loss obtained on unsprayed plot. On variety Gambo loss of TKW increase as fungicide spray frequency decrease. On variety Alidoro, the maximum loss of 23% was incurred on its unsprayed plot. As so as Gambo, loss on TKW of Alidoro showed inversely proportional with fungicide spray frequency. However there was no statistically significant difference between them, in case of Galama the highest loss of 20.6% was obtained on every 30 days sprayed plot; rather than unsprayed one on which 16.4% of loss was recorded (Table 1). For all the three varieties the loss on TKW between every 10 days sprayed plots and unsprayed ones showed significant difference (Table 1). At angecha however TKW loss showed non significant difference throughout treatments, relatively high (9.2%) on unsprayed plot of Galama; followed by Gambo (7.1%) and then Alidoro (2.9%) were recorded (Table 2). It agreed with kernels from severely STB diseased wheat heads are usually shrivelled and lightweight (Hershman, URL: http://www.ca.uky.edu, April 17, 2012).

3.1.3. Biomass weight

At angecha, loss on biomass weight showed non significant difference for treatments (Table 2). It was significantly affected by *Septoria tritici* blotch at hosanna (Table 1). On natural epidemic plot, the highest loss on biomass weight indicated on Variety Gambo (48%) on which the highest disease severity was recorded. It was 40% and 26.7% on Galama and Alidoro, respectively. On Gambo (41.4%) and Galama (38.1%) loss on biomass weight on every 30 days sprayed plots showed non significant difference with their corresponding unsprayed plots.

However more frequent fungicide application was practised, the loss on every 20 days sprayed plot of Gambo (22.4%) showed non significant difference with unsprayed plot of Alidoro (26.7%). It indicated that, the more susceptible variety needs the more frequency of fungicide application. On variety Alidoro, biomass weight loss of 19.3% and 12% recorded on every 20 and 30 days sprayed plots, which is inconsistent with frequency of fungicide sprayed intervals (Table 1).

3.1.4. Number of kernels per spike

At Hosanna, once and again the highest loss on number of kernels per spike (35.9%) was recorded on susceptible variety Gambo under natural epidemic. This was followed by Galama (24.6%) and then Alidoro (13.6%) as their respective level of resistance. Loss acquired on number of kernels per spike showed non significant difference among treatments. But, loss on natural epidemic plot of Galama, natural epidemic plot of Gambo and every 30 days sprayed plot of Gambo showed statistically significant difference from other treatments (Table 1)

3.1.5. Number of spikes per meter square

The loss of kernels per spike on unsprayed plot of Gambo (46.1%), every 30 days sprayed plot of Gambo (38.8%), on unsprayed plot of Galama (44.5%) and every 30 days sprayed plot of Galama (41.9%) were shown statistically non significant difference among each other at Hossana. Loss of 11.2, 19.6, and 23.4% was recorded on variety Alidoro on every 20 & 30 days sprayed plots and unsprayed plot (Table 1). At Angecha, although the treatments showed non significant difference ($p \leq 0.05$) comparatively high percentage of loss was recorded on unsprayed plots than sprayed once. These were 17.5, 11.2 and 17.6% on Alidoro, Galama and Gambo consecutively (Table 2).

Table 3. Some agronomic parameters of three bread wheat varieties and the corresponding relative losses due to septoria tritici blotch under different spray intervals at Hossana in 2012.

variety	Spray interval (day)	DH	Loss%	DM	Loss%	PH (cm)	Loss%	SL (cm)	Loss%	NT/m^2	Loss%
Alidoro	10	76	0	124	0.0	104	0	11.2	0	472	0
	20	76	0	124	0.0	101	2.9	11.5	-2.7	426	9.7
	30	76	0	124	0.0	105	-1.0	11.8	-5.4	395	16.3
	No spray	76	0	123	0.8	105	-1.0	11.5	-2.7	403	14.6
Galama	10	79	0	128	0.0	100	0	10	0	585	0
	20	80	-1.3	127	0.8	99	1	10	0	545	6.8
	30	80	-1.3	127	0.8	97	3	9.8	2	527	9.9
	No spray	80	-1.3	126	1.6	100	0	9.6	4	505	13.7
Gambo	10	74	0	120	0.0	98	0	9.1	0	493	0
	20	74	0	120	0.0	103	-5.1	9.6	-5.5	483	2.0
	30	74	0	120	0.0	100	-2.0	9.6	-5.5	443	10.1
	No spray	74	0	117	2.5	100	-2.0	9.7	-6.6	403	18.5
CV (%)		0.5		0.5		2.6		4.2		11.1	
SE		0.4		0.6		2.6		0.4		52.5	
LSD 0.05		ns		ns		Ns		ns		ns	

DH = days to heading, DM = days to maturity, PH = plant height, SL = spike length, NT = number of tiller, CV = coefficient of variation, SE = standard error of the means, LSD = list significant difference, ns = non significant

Table 4. Some agronomic parameters of three bread wheat varieties and the corresponding relative losses due to septoria tritici blotch under different spray intervals at Angecha in 2012.

variety	Spray interval (day)	DH	Loss%	DM	Loss%	PH (cm)	Loss%	SL (cm)	Loss%	NT/m^2	Loss%
Alidoro	10	73	0.0	136	0.0	106	0.0	10.4	0.0	421	0.0
	20	74	-1.4	137	-0.7	106	0.0	9.7	6.7	387	8.1
	30	73	0.0	136	0.0	104	1.9	10.5	-1.0	372	11.6
	No spray	73	0.0	136	0.0	107	-0.9	11.1	-6.7	353	16.2
Galama	10	77	0.0	139	0.0	101	0.0	8.7	0.0	539	0.0
	20	77	0.0	139	0.0	99	2.0	8.3	4.8	514	4.6
	30	77	0.0	139	0.0	100	1.0	8.3	4.8	498	7.6
	No spray	77	0.0	138	0.7	103	-1.9	8.3	4.8	497	7.8
Gambo	10	71	0.0	132	0.0	104	0.0	8.5	0.0	437	0.0
	20	71	0.0	132	0.0	103	1.0	8.8	-3.5	420	3.9
	30	71	0.0	133	-0.8	104	0.0	8.3	2.4	366	16.2
	No spray	71	0.0	132	0.0	106	-1.9	8.5	0.0	388	11.2
CV (%)		1.2		0.8		2.8		4.8		7.1	
SE		0.9		1.0		2.9		0.4		30.5	
LSD 0.05		ns		ns		Ns		ns		ns	

DH = days to heading, DM = days to maturity, PH = plant height, SL = spike length, NT = number of tiller, CV = coefficient of variation, SE = standard error of the means, LSD = list significant difference, ns = non significant

In addition to that, however interaction was non significant maximum loss of 1.6, 2.6, and 1.2% of test weight was shown on Alidoro, Galama, and Gambo varieties respectively at Hossana (Table 1). More over the maximum loss of 0.8, 1.6 and 2.5% of days to maturity and 16.3, 13.7, and 18.5% loss on number of tillers per meter square were incurred on variety Alidoro, Galama, and Gambo respectively at Hossana (table 3). The loss on days to heading, plant height and spike length showed inconsistence result (table 3 & 4). Loss on test weight indicates, STB can affect not only the grain yield but also the Quality of the wheat grain As it is one of the grain quality parameter. This agreed with “STB can severely affect the grain quality of wheat” (Mahmod, 2011).

In general, reduction of grain yield and test weights are the result of reduced tillering of plants, reduced seed set, poor grain fill, loss of TKW and loss of shriveled grain with chaff during harvest (Hershman, URL: http://www.ca.uky.edu, April 17, 2012).

4. SUMMERY AND CONCLUSIONS

Variation on epidemic levels of the STB made deference on losses of grain yield and yield component among treatments. Because of STB, the loss of Grain yield and yield components was observed on three varieties at both locations. Out of all varieties under the study, Gambo incurred the highest loss in yield and yield components. At Hossana, 41%, 29% and 12% of grain yield loss was recorded on Gambo, Galama, and Alidoro, respectively. At Angecha, grain yield loss of 21% on Gambo, 16% on Galama and 10% on Alidoro were recorded. The lowest loss of 2.4% was experienced on every 20 days sprayed plot of Alidoro at Hosanna.

As onset of STB was at early growth stage of the crop, it significantly affected number of tiller per meter square. Maximum losses of 36% of TKW, 48% of BMW, 36% of number of kernels per spike and 46% of number of spikes per meter square were shown on unsprayed plots of Gambo at Hosanna. Again loss of 16, 40, 25, & 45% of TKW, biomass weight, kernels per spike, and spikes per meter square respectively were shown on unsprayed plots of Galama at Hossana. However interaction was non significant, maximum biomass loss of 12%, 10% of kernel loss per spike and 18% loss of spikes per meter square were incurred on variety Gambo And maximum loss 22% of BMW and 9.2% of TKW of Galama was recorded, at Angecha.

In general, this diseased caused considerable loss on yield and yield components of all varieties under the study. Therefore, as it is potential wheat production problem, giving attention and developing all possible management strategy is very pertinent.

5. REFFERENCES

Abreham Tadesse (ed.), 2008. Increasing crop production through improved plant protection-volume I. *Proceedings of the 14th annual conference of the plant protection society of Ethiopia* (PPSE), 19-22 December2006.

Agrios, G.N., 1997, Plant Pathology, 4th ed., *Academic Press*, New York, Pp244-256.

Ahmad, S.; M. Afzal, I.R. Noorka, V. Iqbal, N. Akhtar, Y. Iftkhar and M. Kamran, 2010. Prediction of Yield Losses in Wheat (*Triticum aestivum* L.*)* Caused By Yellow Rust in Relation to Epidemiological Factors: In Faisalabad University College of Agriculture, University of Sargodha, Pakistan. *Pakistan Journal of Bot*any 42(1): Pp401-407.

Alemar Said and Temam Hussien, (2016) Epidemics of *Septoria Tritici* Blotch and Its Development over Time; on Bread Wheat in Haddiya-Kambata Area of Southern Ethiopia. Journal of biology, Agriculture and Heathcare IISSN 2224-3208(paper) ISSN 2225-093X (online)vol.6, No.1 Pp47-57.

Amsal Tarekegn, D.G. Tanner and Getinet Gebeyehu. 1995. Improvement in yield of bread wheat cultivars released in Ethiopia from 1949 to 1987. *African Crop Science J*ournal 3: Pp41-49.

ArARC, 2007 (Areka A Agricultural Research Center), Progress report.of 2007

Bekele Geleta, Amanuel Gorfu and Getinet Gebeyehu. 1994. Wheat production and research in Ethiopia: constraints and sustainability. In: Tanner, D.G. (ed.). Developing Sustainable Wheat Production Systems. *The Eighth Regional Wheat Workshop for Eastern, Central and Southern Africa*. Addis Ababa, Ethiopia: CIMMYT.

Bockus, W.W., R.L. Bowden, R.M. Hunger, W.L. Morrill, T.D. Murray and R.W. Smiley, 2010 Compendium of Wheat Diseases and Pests, 3rd ed., *American Phytopathological Society*, St. Paul, MN, Pp43-44.

CSA (Central Statistical Authority). 2000. Agricultural Sample Survey 1999/2000. I. Report on Area and Production for Major Crops: Private Peasant Holding 'Meher' Season. *Statistical Bulletin 227*. CSA, Addis Ababa, Ethiopia.

CSA (Central Statistical Authority). 2005. Agricultural sample survey 2004/2005, report on area and production of crops. *Statistical bulletin*. No.331, Volume I. Addis Ababa.

CSA (Central Statistical Authority). 2012. Agricultural Sample Survey 2011/2012. I. Report on Area and Production for Major Crops: Private Peasant Holding 'Meher' Season. *Statistical Bulletin* . CSA, Addis Ababa, Ethiopia.

EIAR, 2012. Report on Ethiopia and EIAR hosted International wheat conference 2012.

Elizabeth, S.O., 2012. Responses of Wheat to Wheat to Infection by *Mycosphaerella graminicola.* A thesis submitted to the University of East Anglia for the degree of Doctor of Philosophy.

Eshetu Bekele, 1986. Review of research on diseases of barley, tef and wheat in Ethiopia. In: Abreham Tadesse (ed.).Increasing Crop Production Through Improved Plant Protection. 1: Pp381-385.

Ethiopian ATA, 2013. Rusts and major wheat and barley Diseases and pests in Ethiopia.A guide for identification, scoring and management of wheat and barley diseases.

Eyal, Z., A.L. Scharen, J.M. Prescott and M. van Ginkel, 1987. The Septoria Diseases of Wheat: *Concepts and Methods of Disease Management*. CIMMYT, D.F., Mexico.

Eyal, Z., A.L.Scharen, J.M. Prescott, M.V Ginkel, 1987. The Septoria diseases of wheat*: concepts and methods of disease management.* CIMMYT, Mexico City, Mexico. P52.

Fikre Handoro, 2010. Wheat Disease Survey. Awassa Agricultural Research Center progress report for, 2010.

Gomez, K.A. and A.A. Gomez, 1984. Statistical procedure for agricultural research. 2nd edition. *A Wiley Interscience Publications,* New York.

Hailu Gebre-Mariam., 1991. Bread wheat breeding and genetic research in Ethiopia. In Hailu Gebre-Mariam, Tanner D.G. and Mangistu Huluka (eds). Wheat research in Ethiopia: A historical perspectives. Addis Ababa. *Ethiopian Institute of Agricultural Research* /CIMMYT Pp73-93.

Hershman, D. E., 2012. Septoria Diseases of Wheat, ISSUED: 10_92 REVISED: http://www.ca.uky.edu/agc/pubs/ppa/ppa39/ppa39. Mexico, D.F. CIMMYT. Mexico. Pp46. Accessed April 17 2012.

Mahmod, T. G. S., R. G. F. Visser, O. Robert, J. D. Faris, T. A. J. van der Lee, G. H. J. Kema and T. L. Friesen, 2011. New broad-spectrum resistance to septoria tritici blotch derived from synthetic hexaploid wheat. *Springerlink.com on line* Pp1125-142, accessed date may 2 20013

Mengistu Huluka*,* Getaneh W*,* Yeshi *A,* Rebeka D*,* Ayele Badebo*,* 1991.Wheat pathology research in Ethiopia. *International Journal of Agronomy and Plant Production*.

Ponomarenko, A., S.B. Goodwin and G.H.J. Kema. 2011. Septoria tritici blotch (STB) of wheat. *Plant Health .Department of Botany and Plant Pathology,* Purdue University, West Lafayette, IN USDA-ARS, Crop Production and Pest Control Research Unit, Purdue University, West Lafayette, IN Plant Research International, Wageningen, The Netherlands 2012. *The American Phytopathological Society*.

Saari, E. E., and J.M. Prescott, 1975. A scale for appraising the foliar intensity of wheat disease. *Plant disease Report* 59: Pp377-380.

Shaw, M.W., 1990. Effects of temperature, leaf wetness and cultivar on the latent period of *Mycosphaerella graminicola* on winter wheat. *Plant Pathology* 39: Pp255-268.

Temesgen Kebede, Temam Hussien, and T.S. Payne.2000. Field response of bread wheat genotypes to Septoria tritici blotch. *Centro Internacional de Mejoramiento de Maiz y Trigo* (CIMMYT), Addis Ababa (Ethiopia).

Wolf, E.D., 2008. *Septoria Tritici Blotch, Kansas State University*