Research in Plant Sciences, 2015, Vol. 3, No. 3, 43-48
Available online at http://pubs.sciepub.com/plant/3/3/1

DOI:10.12691/plant-3-3-1

Status of Wheat Septoria Leaf Blotch (*Septaria tritici* Roberge in Desmaz) in South West and Western Shewa Zones of Oromiya Regional State, Ethiopia

Abera Takele[1], Alemu Lencho[1,*], Getaneh W/Ab[2], Endale Hailu[2], Bekele Kassa[3]

[1]College of Agriculture and Veterinary, Plant Sciences Department Ambo University, Ethiopia
[2]Ethiopian Institute of Agricultural Research, Ambo Plant protection Research Center
[3]Holeta Agricultural Research Center, Addis Ababa
*Corresponding author: alemulencho@yahoo.com

Received July 31, 2015; Revised September 10, 2015; Accepted October 08, 2015

Abstract Septoria leaf blotch (*Septaria tritici)* is one of the most yield limiting diseases of wheat production in Ethiopian highlands. Survey was conducted during October to November, 2014 so as to assess the incidence and severity of the disease in 14 districts of South-west and West Shewa zones. A total of 97 wheat farms within 64 farmer's associations were observed. The incidence of Septoria leaf blotch varied from 75 - 100% and severity index ranged from 4 to 89%. In West Shewa, the mean incidence was 99.8% and in Southwest Shewa it was 96.8% while the mean severity index was 53% and 55%, respectively. When wheat was preceded by cereals, the mean incidence of Septoria leaf blotch was 100% and severity index was 70%. Whereas when wheat was followed by pulse crops, the incidence reduced to 96% and Severity index to 45%. The highest mean incidence of 100% and mean severity index of 61% were recorded on bread wheat variety Danda'a, and on local variety the incidence was 100% and severity index was 67%. In the highlands of 2500-3500 m.a.s.l incidence and severity substantially increased up to 100% and 62% respectively Septoria leaf blotch incidence and severity were much more pronounced in varieties sown during July than August and September. All released commercial varieties were found to be susceptible to the pathogen, and yet the disease remained to be a threat to the production of wheat in all surveyed areas and subsequent control strategies urgently need to be devised.

Keywords: *survey, wheat Septoria leaf blotch, incidence and severity index, prevalence*

Cite This Article: Abera Takele, Alemu Lencho, Getaneh W/Ab, Endale Hailu, and Bekele Kassa, "Status of Wheat Septoria Leaf Blotch (*Septaria tritici* Roberge in Desmaz) in South West and Western Shewa Zones of Oromiya Regional State, Ethiopia." *Research in Plant Sciences*, vol. 3, no. 3 (2015): 43-48. doi: 10.12691/plant-3-3-1.

1. Introduction

Bread wheat (*Triticum aestivum*) is one of the most important small grain cereals produced worldwide [7]. Ethiopia is the second largest wheat producing country in Africa after South Africa [9,25]. Wheat production zones in Ethiopia lie between 6^0 and 16^0 North, and 35^0 and 42^0 East, at altitudes ranging from 1500 to 3000 m.a.s.l [4]. The major wheat production regions are Oromia, Tigray, Amahara [3]. The areas under wheat production were estimated to be about 1.5 million hectares and the national average of wheat production is 3.2 million metric tons. It ranks fourth after Teff (*Eragrostis tef*), Maize (*Zea mays*) and Sorghum (*Sorghum bicolor*) in area coverage and in total production. In Oromia region, wheat has been selected as one of the target crops in the strategic goal of attaining regional food self-sufficiency and is the back bone of the region. West Shewa produced about 100.014 tons from 46003 ha, with an average yield of 2.2 ton and Southwest Shewa zones produced 121.654 tons from 57,264 ha with mean of 2.1ton/ha. The area under wheat cultivation has increased in the last few years, however, the productivity of the crop in Ethiopia in general and in Oromia region in particular is still low [8]. Among the biotic yield limiting factors, diseases are the most important; of these Septoria leaf blotch (*Septiria tritici*), Rusts(*Puccinia spp*), Fusarium head blight (*Fusarium gramnearum*), Leaf spot (*Helminthosporium spp*) and tan spots (*Helminthosporium tritici*-repentis) are the foremost diseases [2]. Septoria complex diseases in wheat was differentiated into two major species worldwide. Surveys conducted earlier revealed that Septoria leaf blotch has been found to be one of the major diseases of wheat [12]. At Holeta Agricultural Research Center where Septoria leaf blotch known to be hot spot 80- 98 % incidence was recorded in susceptible wheat varieties [10,13,15]. Despite frequent occurrence of severe epidemics of Septoria leaf blotch disease in the wheat areas, there is no information on the status of the pathogen distribution and intensity in the South-west and West Shewa zones of Oromia region as of today. Therefore the objective of this research was to assess the status of septoria leaf blotch in wheat.

2. Materials and Methods

2.1. The Study Areas

Road side survey was carried out during 1st October to 30th November, 2014 in 14 districts of South West and West Shewa zones of Oromia Regional state of Ethiopia. West Shewa Zone is located at 8^0 17 ˙ 8º57´N latitude and 37^0 08- 38º07´ E longitude, within altitudes ranges of 1380-3300 m.a.s.l. The annual average rain fall was 1115mm. The mean maximum and minimum temperature of the area is 11.7 °C and 25.4°C, respectively. South West Shewa zone: is located at 8º16-9º 56´ N latitude and 37 º 05´-38 º 46´ E longitudes with altitude ranges of 1600-3576 m.a.s.l. It receives annual rainfall ranging from 900 - 1900 mm. The mean minimum and maximum temperature of the area were 10°C and 35°C, respectively.

2.2. Distribution and Intensity Septoria Leaf Blotch

A total of 97 wheat farms from 64 farmers Association (Fas) (1-8 FA from a district) were assessed. The disease was evaluated at booting to dough growth stages (ZGS 40 – GS 90) as per [27]. The farms were visited at an interval of 5-10 km. Disease assessment was made as per [22] along the two diagonals of wheat field using 0.25 m^2 quadrant at five spots in an X fashion. The mean incidence and severity of the five quadrants were considered [1,20]. Altitude was recorded using Global Positioning System (GPS). The growth stages were recorded visually using previously established scales [24,26] and date of planting was obtained from the farm owners. Furthermore, agronomic data such as, wheat varieties sown, date of sowing, fertilization, cropping patterns and planting density, field history (Preceding crops), and environmental parameters like the onset of rainy season were recorded during the survey

2.3. Data Analysis

The data collected were subjected to descriptive statistical analysis. The geographical distribution and intensity of Septoria leaf blotch map was prepared using Computer Software (Archview, GIS) Version_8.2(not shown).

3. Result and Discussion

3.1. Wheat Septoria Leaf Blotch in South - West and West Shewa Zones

3.1.1. Intensity and Prevalence of Septoria Leaf Blotch at Different Growth Stages of Wheat

In the surveyed two zones, wheat farms were at different growth stages. Of the total field assessed 14.3% were at booting to heading 49% at flowering to milk and 36.7% at dough to maturity growth stages. Disease incidence and severity at flowering to milk stage were found to be 100 and 75%, respectively. At dough to maturity growth stages the incidence was 100, and the severity was 74%. The highest incidence of 95.8% and lowest severity index 13% were recorded at booting to heading growth stage of the crop. This results are also consistent with logic previously stated [19], 'where, the flag leaf which is the critical growth stage of the crop during which Septoria leaf blotch was reached its maximum severity level but not the ones fully develop at booting to heading growth stages as compared to flowering to milk and dough to maturity growth stages of the crop.

3.1.2. Intensity and Prevalence of Wheat Septoria Leaf Blotch across Farmer's Associations (FAs)

The disease was widely distributed in all farmers associations of the districts and the incidence varied from 75% up to 100%. The overall mean incidence for the 64 farmers association of the two zones reached 98.4. Septoria leaf blotch incidence of 100% and severity of 89-100% were recorded in farmers association Obi, Urago Kalacha, Chiri, Kata, Doyo Kora, Soyama ganji. However, the lowest mean severity 4.9 to 11% of Septoria leaf blotch was recorded in Gute buli, Meti citu, Olma busa, Belo, Altufa cabo and Ireti. The incidence ranged from 75-100% and mean incidence (75%) of the Septoria leaf blotch was recorded in Olma busa farmer associations of Dawo district. Incidence of 100% was recorded in 61 out of 64 farmers association located at altitudes ≥ 2000 m.a.s.l, Relatively in Altufa chabo FA in Ambo district the incidence was 90%. The highest severity index recorded 80, 78, 69 and 69% was noted in Saden sodo, Bacho, Dendi and Ejere districts respectively (Table 1). The study is in agreement with studies made earlier. At farmer association level, the average incidence recorded in Olma busa was 75%, in Dawo and Altufa cabo was 90% in Ambo districts, while the highest mean incidence of 100% was also recorded in 89 **FAs** in 12 districts. This study revealed that Septoria leaf blotch is prevalent at higher altitudes along with favorable agro climatic factors [2]. The disease incidence and severity recorded showed similar trend in all farmers association.

3.1.3. Intensity and Prevalence of Wheat Septoria Leaf Blotch across Districts

Prevalence of wheat Septoria leaf blotch was 100% in all the districts (Table 1). The rationale could probably be the frequent cultivation of susceptible local and improved varieties, which were early sown crops as source of initial inoculum loci, and favorable environmental conditions for the disease development. All cultivars in surveyed areas were late maturing type and susceptible to the disease which provided favorable environment for diseases development. More than 98 % of surveyed areas were categorized under high wheat Septoria leaf blotch incidence, while 2% were under medium incidence. In Wanchi, Amaya, Waliso, Bacho and S/sodo districts in Southwest Shewa and Dandi, Ejere, Toke kutaye, Chaliya, Mida kegny, Elfata and Walmara districts in West Shewa zone exhibited 100% incidence. While, severity was grouped under low and high disease category, ranged from 10 to 60% disease severity index respectively (Table 2). Than South West Shewa Zone 95.8%. The highest average severity index was 80% in Saden sodo, and 78% in Bacho followed by 69% in Dandi and Ejere districts (Table 1). The lowest mean severity index of 31% was recorded at Elfata district. The lowest and highest Severity index of 4-89%, 44-89%, 19.8-89% and 37-100% were recorded at

Saden sodo, Bacho, Dandi and Ejere districts, respectively. The mean severity index was recorded in both West Shewa (53%) and Southwest Shewa zones (55%). The overall mean severity index was 54% for all districts in West Shewa and South west Shewa zones.

Table 1. Wheat Septoria leaf blotch incidence and severity in the farmers Associations of 14 districts of South West and West Shewa zones during cropping season 2014

Zone	Districts	Altitude	No. of PA	No. fields assessed	Prevalence. (%)	Incidence (%)		Severity Index (%)	
						Range	Mean	Range	Mean
South West Shewa	Wanchi	2089-2859	6	9	100	100	100	4 - 89	49
	Amaya	2009-2344	2	3	100	100	100	11-89	51
	Waliso	1935-2487	10	17	100	100	100	4-74	44
	Bacho	2172-2433	6	10	100	100	100	25-89	78
	Saden sodo	2231-2476	2	3	100	100	100	44-89	80
	Dawo	2173-2279	2	4	100	75-100	90	11-78	35
	Mean/Total	1935-2859	28	46	100	75-100	96.8	4-89	55
West Shewa	Dendi	2172-2499	8	12	100	100	100	11-89	69
	Ejere	2149-2594	3	5	100	100	100	33-89	69
	Ambo	2172-2755	10	13	100	80-100	99	33-56	37
	Toke kutaye	2304-2406	3	5	100	100	100	4-89	59
	Chaliya	2326-2904	7	10	100	100	100	4-89	54.2
	Midakeng	2810-2891	3	4	100	100	100	11-89	44
	Elfata	2876	1	1	100	100	100	31	31
	Wolmera	2498	1	1	100	100	100	61	61
	Mean/Total	2498-2876	36	51	100	80-100	99.8	4-89	53
Mean/Total		1935-2904	64	97	100	75-100	98.3	4-89	54

Table 2. Category/ class of wheat Septoria leaf blotch incidence and severity in South West and West Shewa zones during main season of 2014

	Districts	**Disease incidence**						**Disease severity index**					
		L	%	M	%	H	%	L	%	M	%	H	%
South West Shewa	Wanchi	-	-	-	-	9	100	2	22.22	3	32.14	4	44.44
	Amaya	-	-	-	-	3	100	-	-	2	66.66	1	33.33
	Waliso	-	-	-	-	17	100	8	46.81	4	21.28	5	31.91
	Bacho	-	-	-	-	10	100	-	-	3	32.38	7	67.86
	S/sodo	-	-	-	-	3	100	-	-	1	33.33	2	66.66
	Dawo	2	50	-	-	2	50	2	50	2	50	-	-
Mean/Total		2	50	-		44	91.7	12	19.83	15	39.47	19	40.7
West Shewa	Dandi	-	-	-	-	12	100	2	16.67	3	25	7	58.33
	Ejere	-	-	-	-	5	100	-	0	2	33.34	3	66.66
	Ambo	-	-	-	-	13	100	8	61.54	3	23.08	2	15.38
	Tokekutaye	-	-	-		5	100	-	0	3	66.66	2	33.33
	Chaliya	-	-	-	-	10	100	2	20	6	60	2	20
	Mida keny	-	-	-	-	4	100	2	50	-	-	2	50
	Elfata	-	-	-	-	1	100	1	100	-	-	-	-
	Walmara	-	-	-	-	1	100	-	0	1	100	-	-
Mean/Total						51	100	15	31.03	18	38.3	18	31

L=low disease class, **M** = medium disease class and **H**=high disease.

3.1.4. Wheat Septoria Leaf Blotch in Relation to Date of Planting

Among the surveyed 97 wheat fields 29 were sown in June and had wheat Septoria leaf blotch mean incidence and severity 100% and 52% respectively. On the other hand, 49 fields were sown in July and 100% incidence was observed, and severity index that ranged 31-89% with mean severity index of 63%. Futhermore, 19 fields were sown in August and the incidence ranged from 90-100% with mean incidence value of 98% and disease severity index ranged from 4.9-89% with mean severity index of 47%. Based on these findings, it appeared that, incidence of disease was higher in June to July sown wheat than in August sown. Usually July sown wheat reaches flowering and grain filling in November and this probably coincides with cool and wet weather, which favors growth, reproduction and spread of Septoria pathogen. The most

devastating and yield loss up to 60% may occurred due to Septoria leaf blotch, in the case of early onset of the disease and incidence ranging from 80- 98 % have been recorded on susceptible cultivars [2]. Late sowing significantly reduced septoria development and the severity had no effect on kernel weight and yield [10]. In the surveyed area both late and early sowed were practiced for the several reasons, of which early planting is done to escape frost damage and sometimes from Septoria leaf blotch as it occurs at the end of October. Late planting is also practiced to minimize the effect of rain that coincides with physiological maturity. Wheat Septoria leaf blotch is more important in late early sown and late maturing cultivars

3.1.5. Variety Grown and Wheat Septoria Leaf Blotch

In the surveyed areas farmers were found to raise five different kinds of wheat varieties namely, local, Kubsa, Digelu, Kakaba and Danda'a. As shown in Tables 3, the most widely grown variety Digelu occupied 42 fields in the surveyed districts of West Shewa and South west Shewa zones. Kakaba, Kubsa, Danda'a and Local, each covered 21, 22, 6 and 6 of the surveyed fields, respectively. Danda'a and Local cultivars were more affected with Septoria leaf blotch. The farmer's perception is also that, the local and Danda 'a yields were low as the varieties were infected more with foliar diseases than others varieties and consequently both varieties were sown rarely on farmers' fields in the surveyed districts. Mean incidence of wheat Septoria leaf blotch was greater than 94% and 28 fields sown with Digelu variety out of 42 had greater than 32% severity index. Wheat Septoria leaf blotch severity index indicated that the disease in most areas of the surveyed districts infected this variety. Similarly, Kakaba was sown in 21 fields, of which 18 fields had severity index of greater than 32%. The fields which were sown with Kubsa variety had incidence of 100%, while 16 of the fields showed greater than 32% severity index. Local and Danda'a also sown on 6 fields each had the mean incidence 100% and Severity index 61%. The study showed that, all cultivars were affected by wheat Septoria leaf blotch. SLB was infection observed on all cultivars grown in all fields, but the severity index of the disease was variable among the varieties grown.

Table 3. Wheat Septoria leaf blotch incidence and severity based on cultivars grown in the two zones during the main season of 2014

Cultivar	Number of field assessed	Incidence %		Severity Index %	
		Range	Mean	Range	Mean
Digelu	42	75-100	94.4	4-89	42
Kakaba	21	100	100	25-78	50
Danda'a	6	100	100	33-89	61
Kubsa	22	100	100	33-89	52
Local	6	100	100	59-89	67
Mean /Total	97	75-100	98.36	4-89	54

3.1.6. Effect of Preceding Crop on Disease Intensity and Prevalence

The prevalence, incidence and severity index were higher where wheat followed by cereals (wheat, barley and oat) (Table 4). Where three or more consecutive wheat crops were sown with cereals, 100% incidence and 70% severity was recorded. Similarly, the prevalence and incidence were high in fields where wheat was followed by grain legumes (Field pea, Faba bean, and Haricot bean. Mean incidence of the disease after oil crop (Linseed or Flax, Niger seed, and Rape seed and fallow land were 100% and 98%, respectively. However, the mean severity index was 45% where wheat followed by pulses after oil crops and fallow land the severity index were 63% and 38% in their order. The effect of preceding crop on Septoria leaf blotch confirmed that there was a reduction in severity when wheat was grown after grain legume and fallow land. The results also indicated that, wheat followed by wheat showed high severity index 70% than other crops. The infected stable or residue, of previous wheat crop becomes the source of ascospores for infection. These results were consistent with finding of [21] who indicated that infected crop residues and volunteer wheat plants are important sources of primary inoculums. Pycnidiospores survive in pycnidia on infected stubble for several months. In some countries, ascospores released from pseudothecia are important sources of primary inoculums (Table 4).

Table 4. Effect of preceding crop on disease incidence and severity for 14 districts of South west and West Shewa Zone during maincropping season of 2014

Previous crop	Number of fields Assessed	Prevalence (%)	Incidence (%)		Severity Index (%)	
			Range	Mean	Range	Mean
Cereal	19	100	100	100	46-89	70
Pulse	38	100	80-100	96	11-68	45
Oil	26	100	100	100	31-89	63
Fallow	14	100	90-100	98	4.9 -76	38
Total/Mean	97	100	80-100	98.36	4.9-89	54

3.1.7. Intensity and Prevalence of Wheat Septoria Leaf Blotch across Altitude Ranges

As indicated in Table 5 out of 97 wheat fields assessed 58(59.8%) of the fields were located within altitude range of 1500-2500 m.a.s.l, while the remaining 39 (40.2%) fields were found between 2500-3500 m.a.s.l. The prevalence of the disease was 100% at both altitudes ranges. This could be due to favorable weather conditions

for disease onset, development and spread in this season in all altitudes assessed. Similarly, the highest incidence of 100 % and mean severity value of 62% of Septoria leaf blotch were recorded at altitude range of 2500-3500 m.a.s.l. This implies that the incidence and severity of disease increased at high altitude than mid altitude. To the contrary, the range and mean value of incidence and severity at altitude range of 1500-2500 reduced to 98% and 46% respectively. The overall mean incidence and severity of the diseases for both altitudes range of the study areas reached 99.75% and 65%, respectively.

Table 5. Prevalence, Incidence and severity of Wheat Septoria leaf blotch in different agro ecologies of South and West Shewa zones, cropping season of 2014

Major ecological Zone	Altitude range (m.a.s.l)	Number of field assessed	Prevalence%	Incidence %		Severity Index	
				Range	mean	Range	Mean
Mid altitude	1500-2500	58	100	75-100	98.01	4.9-89	46
Highland	2500-3500	39	100	100	100	11-89	62
Total/ mean		97	100	75-100	99.75	4.9-89	54

Source: Ministry of Agriculture (MOA), 2000. Agro ecological zone of Ethiopia, Addis Ababa, Ethiopia.

4. Conclusion and Recommendation

4.1. Conclusion

Survey results in the fourteen districts of South west and West Shewa zones revealed that, Septoria leaf blotch was the most prevalent foliar disease with variable degree of incidence (75-100%) and severity (4-89%). The disease prevalence was 100% in all the areas. The surveyed areas were categorized as high wheat incidence 98% areas, while, only 2% surveyed fields were categorized under low wheat Septoria leaf blotch. The disease was severe in sadden Sodo district, with mean severity index of 89%, followed by 78%, 69% and 69% at Bacho, Dandi and Ejere districts, respectively. Elfata district sulfurs least from Septoria leaf blotch threat with severity index of 31%. On the other hand, 29 fields in surveyed area were planted in July and the disease incidence varied from 75-100% with severity index of 65%. Relatively, in the wheat crop sown during August, 48 (49.8%) surveyed area of the fields the incidence was 100% and Severity index was 79%. In this surveyed area 16 (16.84%), 6(6.4), 3(3.36), 53(54.54%), 19(18.43) fields were covered with Kubsa, Danda'a, Local, Digelu and Kekeba, respectively. Hence, the, corresponding Septoria leaf blotch severity indexes were, 52, 61, 67, 42, 50% and the incidence being 100% in all varieties with exception of Digelu variety(94.4%). The areas that were covered during the surveys lie within altitudes ranging from 1500-3500 m.a.s.l. and the incidence was almost similar (90-100%), although the severity index was variable (11-89%). The highest severity was recorded in the high lands. Of the 97 wheat fields assessed, around 88.88 % of the fields were found within altitude range of 1500-2500 m.a.s.l, while the remaining 11.11% were found between 2500-3500 m.a.s.l. altitudes. This pathogen was widely distributed in south west and west Shewa zones, and is major threat to wheat production.

4.2. Recommendation

Data suggest that, Septoria leaf blotch was widely distributed in both zones, and yet remained to be a major threat to wheat production. Therefore, much more, attention should be given to the variability's of the pathogen if any, and screening genotypes for subsequent breeding strategies against the Septoria leaf blotch. Moreover**,** finally, the farming communities need to be advised and/or trained on timely application of efficient systemic fungicides against the pathogen. The effects of cultural practice with particular emphasis in July can be verified and included as part of integrated diseases management.

References

[1] Abd.El. *et al.,* Biological control of disease cereal crops, Pp.1-20. 2004.

[2] Ayele B., and Temesgen, K., Review of relative infection of Research on Diseases of small cereals crops *in:* Abraham Tadesse(*ed*). Increasing crop production through improved plant protection. *Vol I*. pp-375-418. 2008.

[3] Bekele H. *et al.,* Barley yield loss due to net blotch and leaf rut in Bale high lands *Pest mgt. J.Eth*. 5: 45-53. 2001.

[4] Belay Sime and Tanner D.G., Yield potential and weather risks associated with wheat production in Ethiopia. Proceeding of the Tenth Regional wheat Workshop of eastern, Central and southern Africa. Addis Ababa, Ethiopia, pp 316-324. 1999.

[5] Braun *et al*., Multi-location testing as a tool to identify plant response to global climate change. In M. P. Reynolds, (ed.) Climate change and crop production. CABI Climate Change Series, U.K. pp. 115-138. 2010.

[6] CIMMYT., Wheat – Global alliance for improving food security and the livelihoods of the resource-poor in the developing world. Proposal submitted by CIMMYT and ICARDA to the CGIAR Consortium Board. August 30, 2011. CIMMYT, 2000, 1998/99. World Wheat Facts and Trends. Global Wheat Research in a Changing World, Challenges and Achievements, CIMMYT, D.F, Mexico. pp390-400. 2011.

[7] Curtis *et al*., Bread wheat Improvement and production No. 30. Food and Agriculture Organization of the United Nations, Rome Italy 554 pp. 2002.

[8] Central Statistical Agency (CSA)., Crop Production Forecast Sample Survey for the year 2013/2014. Report on Area and Crop Production forecast for Major Crops (For Private Peasant Holding, Meher Season) Addis Ababa, Ethiopia, 7-10. 2013.

[9] CSA., Agricultural sample survey: Report on area and production for major crops. Statistical Bulletin. Addis Ababa, Ethiopia. 388pp. 2012.

[10] Eshetu Bekele and Zerihun Kassaye., Integrated management of septoria blotch of wheat: Effects of sowing date. Variety and fungicide Pest *mgt. J*. Eth. 7:11-18. 1986.

[11] Eshetu Bekele, 1985. Review of research on disease of barley, teff and wheat in Ethiopia. *In* (Tsedeke Abate (*ed*). A review of Crop protection Research in Ethiopia. Proceedings of the first crop protection Symposium. IAR Addis Ababa Ethiopia pp79-108. 2003.

[12] Eyal *et al.,*. The Septoria diseases of wheat: Concepts and methods of disease management. CIMMYT. Mexico, D.F. 63: 1087-1091. 1987.

[13] Getinet *et al*., Wheat disease survey in Ethiopia, 1988. *In* Tanner, D.G, M van Ginkel, and W. M. Wangi (*eds*).The six regional

wheat workshops for eastern, central and Southern Africa Mexico, D.F.CIMMYT; pp 153-165. 1990.

[14] Hailu, G., Bread wheat breeding and genetic research in Ethiopia. In: Hailu, G, Tanner, D.G. and Mangistu, H. (*eds*).Wheat production and research in Ethiopia: A historical perspective. Addis Ababa. IAR/ CIMMYT. pp 73-93. 1991.

[15] Mengeistu *et al*.,. Wheat pathology research in Ethiopia *In*: Hailu Gebremariam, Tanner D.G, and Mengestu Huluka (*eds*). Wheat research in Ethiopia. A historical prospective. Addis Ababa, IAR / CIMMYT. pp173- 217.1991.

[16] Quaedvlieg *et al*.,. Zymoseptoria gen. nov.: a new genus to accommodate Septoria-like species occurring on *graminicolous* hosts. Persoonia: Molecular *Phylogeny and Evolution of Fungi*, 26: 57-69. 2011.

[17] Royle, D. L., Understanding and predicting epidemics: a commentary based on selected pathosystems. *Plant Pathology* 43: 77-78. 1989.

[18] Saari, E. E., and Prescott, L. M. A scale for appraising the foliar intensity of wheat diseases. Plant Dis. Rep. 59: 377-380. 1975.

[19] Shaner, G. and Buechley, G.. Epidemiology of leaf blotch of soft red winter whea, caused by *Septoria tritici* and *Stagonospora nodorum*. Plant Dis. 79:928938. 1995.

[20] Sharma R.C. and Duveiller. E.,. Advancement toward new Septoria Blotch resistance Wheat's in south Asia. *Crop Sci*. 47:961-968. 2007.

[21] Shaw M.W, Royle D.J. Airborne inoculums as a major source of *Septoria tritici* (*Mycosphaerella graminicola*) infections in winter wheat crops in the UK. Plant *Pathology* 38: 35-43. 1989.

[22] Stubbs *et al*., Cereal disease methodology manual.29, 421-442.1986.

[23] Thomas MR, Cook RJ, King JE. Factors affecting development of *Septoria tritici* in winter wheat and its effect on yield. *Plant pathology*, 38(2): 246-257. 1989.

[24] Totman, D.R., and R.J. Makepeace., An explanation of the decimal code for growth stages of cereals, with Illustrations. Ann. Appl. Biol. 93:221-234. 1979.

[25] White *et al.,* An Agro - Climatologically Characterization of Bread Wheat Production Areas in, Ethiopia. NRG - GIS Series 01-01. Mexico, D.F.: CIMMYT. 34p. 2001

[26] Zadocks *et al*.,1974. Decimal code for growth stages of cereals. Weed Res. 14:415-421. 1974.

[27] Zadoks, J.C., On the conceptual basis of crop loss assessment: the threshold theory. Anmtc.LR eui.ewo JP hgt opattrc LogU 29' 455-473. 1985.