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FIELD BASED ASSESSMENT OF FOLIAR BLIGHTS DISEASE OF WHEAT (*Triticum aestivum* L.)

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Abstract

Wheat, the third major staple crop of Nepal has been suffered from many diseases. Various diseases are the major limiting factors of considerable wheat production, one of them is Spot blotch. Spot blotch caused by *Bipolaris sorokiniana* is a major disease of wheat in warm and humid regions of the Nepal. The fungus has a worldwide distribution but as a pathogen it is the most aggressive under the conditions of high relative humidity and temperature associated with the low fertility of soils in South Asia, South America, Africa, and Australia. The yield loss due to the disease is very significant Nepal. This experiment was conducted to identify the genotypes (crossing) having good level of resistance against spot blotch. The experiment set was received from CIMMYT comprises 52 entries and arranged in alpha lattice design with two replication in 2012/13 at NWRP, Bhairahawa condition. Three times diseases scoring were done in double digit method and calculated the Area under disease progress curve (AUDPC). Heading days, days to maturity, plant height and test weight were found highly significant but the grain yield and AUDPC were not significant among the entries. However, the grain yield and test weight (50.5 gm) were found higher where the AUDPC was lower recorded in genotype 6719 (4046 kg/ha and AUDPC 488.33) followed by genotype 6737 (3765 Kg/ha and AUDPC 576.9) and genotype 6718 (3550 kg/ha and AUDPC 596.33).

Key words: Foliar blight, AUDPC, Wheat, Genotype

Introduction

Spot blotch disease is a major constraint of successful wheat cultivation in Terai regions of Nepal. It occurs every wheat season in warm wheat growing areas of country in moderate to severe level of infection. Foliar blight disease cause by *Bipolaris sorokiniana* and *Pyrenophora tritic-repentis,* which is a serious disease of wheat in warmer area of South Asia (Dubin and Duveiller, 2000). A survey by wheat researchers from tropical and sub-tropical countries such as Indonesia, Bangladesh, Vietnam, Thailand, Philippines, China, Nepal, India, Zambia, Zimbabwe and Tanzania indicated that the most economically important foliar pathogen was *C. sativus* with yield loss estimates, based on field observations, ranging from 5-20% on an annual basis (Dubin and Ginkel, 1991). The dark brown necrotic spots (boat shaped) occur on the coleoptiles, leaves, crowns, stems, and roots with or without yellow halo around these necrotic spot. Darkening of the sub crown internodes is a characteristic symptom. Lesions on the leaves start as a few mm that extend as elongated dark brown spots greater than 1-2 cm (Chand et al., 2002). Later such spots coalesce each other thus result blight on large leaf portion. As the disease progresses the spots join together forming large blotches that cover the leaves and eventually killing it. On leaves, conidia develop readily under humid conditions and spread over several centimeters before coalescing and inducing the death of the leaf tissue. An abundant production of conidia can be observed on old lesions under humid conditions and chlorotic streak is sometimes seen diffusing from the border of the lesion as a result of toxin production (Chowdhury et al., 2013). Stunting and reduced tillering may be observed in heavily infected plants which may lead to premature death, resulting in white heads. Kernels become shriveled and roots become dark brown and rotted. Yields may be reduced due to root rot even though symptoms are not well-developed. Yellowing due to toxin production is sometimes observed fungicide trials confirmed that the losses from spot blotch ranged from 10-25% in Nepal, Bangladesh and India (Singh et al., 1998), but were considerably larger (60%) in China (Chang and Wu, 1997). One trial in Bangladesh showed that some cultivars of wheat could have losses ranging from 56% (resistant cultivars) to 82% (susceptible cultivars) after leaves were artificially inoculated at the flag leaf growth stage and irrigated after inoculation. Study demonstrated that leaf blight by *C. sativus* could be an important yield limiting factor in the hot humid areas of the world (Bazlur Rashid and Jalauddin, 1987). Beside from grain yield, there were considerable losses in grain weight of up to 50% (Karwasra et al., 1998). This is due to lack of resistant wheat varieties, less use of fungicides and inefficiency of other control measures is responsible for the regular epidemic of disease (Bhandari, 2011). The losses due to the disease in Nepal ranged from 23-40% depending on genotypes and other environmental factors (Mahto, 1999; Bhandari and Tripathi, 2005).

Material and Methods

The experiment was carried out at national Wheat Research Program (NWRP), Bhairahawa. Geographically, the station located 105 meters above sea level and 27°32' north latitude and 83°25' east longitude. . The climate at NWRP is subtropical. The recorded maximum temperature in summer is 44.6°C and minimum temperature in winter is 4.8°C. The average annual rain fall is 1700 mm, with maximum and minimum mean temperature of June and January is 30.8 0C and 14.7 0C respectively. The experiment was sown 7^{th} Dec. 2013, in alpha lattice design with two replications and fifty two entries. Each entry was planted two rows of two meter long. The cropping geometry was 25 cm by 25 cm. Chemical fertilizer 120:60:40 Kg, $NPK.ha^{-1}$ applied. Half dose of nitrogen and all P and K was applied at the time of planting while remaining half does of N was applied at time of first irrigation and other cultural practices were used as general agronomic cultivation practices for wheat production. The crossing details and its respective code were presented in table 1. The obtained data were analyzed by using CropStat 7.2 software. Since the disease severity increases very fast in the field and small differences indicating partial resistance need to be observed, disease evaluation is usually based on the area under disease progress curve (AUDPC) calculated from minimum three field observations and it starts after the flowering stage of the crop. Severity of disease was recorded by visually assessing with double digit method. Spot blotch severity can be visually scored for each plot at weekly intervals using the double-digit scale (00-99) developed as a modification of Saari and Prescott's severity scale to assess wheat foliar diseases (Saari and Prescott, 1975; Eyal et al.,1987). The first digit (D1) indicates the disease progress in height and the second digit (D2) refers to severity measured the diseased leaf area. For each score, percentage of diseased leaf area (%DLA) was estimated based on the following formula:

$$\% DLA = ((D1/9) \times (D2/9) \times 100)$$

Individual scores were recorded over a three-weeks period. The AUDPC was calculated using the percent severity estimates corresponding to the three to four ratings as outlined by Das et al. (1992) and shown below:

$$AUDPC = \sum_{i=1}^{n-1} \left[(X_i + X_{i+1}) / 2 \right] (t_{i+1} - t_i),$$

Where, xi = disease severity on the i^{th} date, ti = i^{th} day, and n = number of scoring dates. The AUDPC measures the amount of disease as well as the rate of progress, and has no units.

Result and Discussion

The heading days, maturity days, grain yield and 1000 grain weights were found highly significant but the plant height and AUDPC were found non-significant (Table 2).The genotypes 6719 gave highest yield and lowest AUDPC among the tested genotypes (4046 $Kg.ha^{-1}$ and 488.33) respectively, followed by genotype 6737 (3765 $Kg.ha^{-1}$ and AUDPC 576.9) and genotype 6718 (3550 $Kg.ha^{-1}$and 596.33) (Table 2). However, the test weight was highest in genotype 6718 (50.5 gm) and plant height was found lowest (80cm), maturity at 110 days, where AUDPC was lowest. Even the grain yield found more in genotypes (code) 6750, 6741, 6705, 6744, 6707, 6737, 6710, 6738, 6730, 6711, 6740, 6713, 6746 and 6736 were not selected either crossing block or advanced lines because they had more amounts of diseases and its progress rate (Table 2). On the basis of low AUDPC, higher grain yield, and lower maturity days genotypes 6719, 6737, 6714, 6716, 6715, 6745, 6747, 6733, 6732, 6704, and 6710 were promoted to advanced lines (AL). Similarly, the genotypes 6718 and 6722 were promoted in crossing block (CB). The materials in AL and CB are used for developing spot blotch tolerant development or tolerant donor for new variety development (Fig. 1). The weather information during the wheat growing cycle is presented in Figure 2.

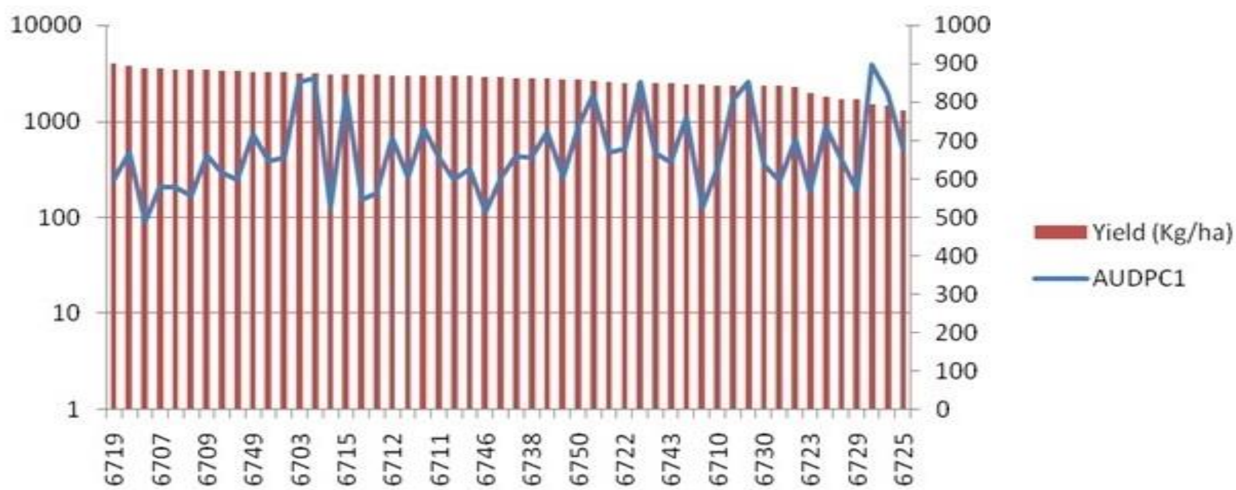

Figure 1: Relation between yield $Kg.ha^{-1}$ and AUDPC for AL and CB Selected genotypes

Table1: Crossing name and its respective code of tested wheat genotypes during 2012/2013.

Crossing	Code
MILAN/KAUZ//DHARWAR DRY/3/BAV92/4/CHONTE	6701
1447/PASTOR//KRICHAUFF/5/2*SERI*3//RL6010/4 *YR/3/PASTOR/4/BAV92	6702
PBW343*2/KUKUNA/3/PFAU/WEAVER//KIRITATI/5/CHEN/AE.SQ//2 *OPATA/3/BAV92/4/JARU	6703
ALTAR 84/AE. SQU ARROSA (221)//	6704
KA/NAC//TRCH/3/VORB	6705
AGT YOUNG/VORB	6706
VORB*2/5/CROC_1/AE.SQUARROSA (224)//OPATA/3 /RAC655/4/SLVS/PASTOR	6707
TOB/ERA//TOB/CNO67/3/PLO/4/VEE#5/5/ KAUZ/6/FRET2/7/VORB	6708
T.DICOCCON PI254157/AE.SQUARROSA (879)/4/ MILAN/KAUZ//PRINIA/3/BAV92/5/2*SKAUZ/BAV92	6709
BAV92//IRENA/KAUZ/3/HUITES	6710
WBLL1/KUKUNA//TACUPETO F2001/3/KIRITATI	6711
SERI.1B*2/3/KAUZ*2/BOW//KAUZ/4/FRANCOLIN #1/5/MUNAL	6712
ATTILA/3*BCN//BAV92/3/TILHI/4/SUP152/5/SUP152	6713
CHIH95.7.4//INQALAB 91*2/KUKUNA	6714
CHIH95.7.4//INQALAB 91*2/KUKUNA	6715
CHIR3/4/SIREN//ALTAR 84/AE	6716
KACHU/KINDE	6717
CS/TH.SC//3*PVN/3/MIRLO/BUC	6718
D67.2/PARANA 66.270//AE.SQUARROSA (320)/3 /CUNNINGHAM/4/VORB	6719
ND643/2*TRCH//MUTUS/3/SUP152	6720
ATTILA*2/PBW65//MURGA	6721
ISENGRAIN/3/CROC_1/AE.SQUA	6722
BAJ #1/TECUE #1	6723
WAXBILL	6724
KFA/2*KACHU	6725
MUNAL #1	6726

Contd. Table 1.

BAV92//IRENA/KAUZ/3/HUITES/4/KIRITATI//PRL/2*PASTOR	6727
CHIBIA//PRLII/CM65531/3/SKAUZ/BAV92/4/MUNAL #1	6728
STLN/MUNAL #1	6729
QUAIU #1*2/JUCHI	6730
BL2064//SW89-5124*2/FASAN/3/TILHI*2/5/KAUZ// ALTAR 84/AOS/3/KAUZ/4/SW94.15464	6731
PBW343*2/KHVAKI*2/3/	6732
PBW343*2/KHVAKI//JUCHI	6733
CROC_1/AE.SQUARROSA (205)//BORL95/3/PRL/SARA// TSI/VEE#5/4/FRET2/5/KINDE	6734
FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/KIRITATI/2*TRCH	6735
FRET2/KUKUNA//FRET2/3/FRNCLN	6736
SKAUZ*2/FCT´S´//VORB	6737
BAJ #1/FRNCLN	6738
WEAVER/TSC//WEAVER/3/WEAVER/4/2*SERI.1B*2/3/KAUZ*2 /BOW//KAUZ/5/WHEAR/VIVITSI//WHEAR	6739
DANPHE #1/3/HUW234+LR34/PRINIA//PFAU/WEAVER	6740
PBW65/2*PASTOR/3/KIRITATI//ATTILA*2/PASTOR/4/DANPHE #1	6741
ATTILA/3*BCN//BAV92/3/PASTOR/4/TACUPETO F2001*2/ BRAMBLING/5/PAURAQ	6742
KACHU/PVN//KACHU	6743
SUP152*2/TECUE #1	6744
VORB/4/KRICHAUFF/FINSI/3/UR	6745
CHUANMAI 42*2/3/PFAU/WEAVER*2//TRANSFER#12,P88.272.2	6746
VORB/SOKOLL	6747
CHIRYA.3	6748
SONALIKA	6749
FRANCOLIN #1	6750
Local check resistant (Gautam)	6751
Local check susceptible (Bhrikuti)	6752

Table 2: Details yield parameters and AUDPC of tested wheat genotypes

Code	Heading (Days)	Maturity (Days)	Plant height (cm)	Grain Yield ($Kg.ha^{-1}$)	1000 grain weight (gm)	AUDPC
6750	79	110	98	4715	36.8	814.3
6741	84	111	87	4556	35.3	960.7
6705	82	112	92	4533	37.9	713.1
6744	82	112	89	4504	34.5	710.9
6712	80	110	83	4413	43.9	821.1
6707	83	111	97	4402	38	768.6
6734	81	112	89	4379	37.2	798.1
6738	82	111	91	4341	35	681.2
6730	83	112	89	4279	37.1	812.9
6711	83	112	91	4266	36.8	719.4
6740	82	111	91	4204	42.5	699.7
6713	80	110	85	4203	40.4	680.6
6746	81	110	86	4074	45.5	771.4
6719	**84**	**111**	**91**	**4046**	**39**	**596.3**
6736	80	110	89	4019	42.7	800.2
6739	82	111	85	4019	35.2	789.4
6731	81	111	89	3989	36.1	812.9
6708	84	112	88	3903	35.4	710
6720	80	109	86	3902	42.2	775.4
6724	87	113	85	3892	28.2	672.8
6727	83	113	91	3879	33.1	763.2
6735	81	111	88	3849	41.1	709.2
6729	84	113	91	3841	31	678.2
6706	82	114	86	3815	33.8	667.8
6737	**83**	**109**	**85**	**3765**	**38**	**669.8**
6726	89	114	95	3609	31.4	684.2
6701	84	112	92	3576	37.3	647.5
6718	**85**	**110**	**80**	**3550**	**50.5**	**488.3**
6721	83	112	91	3509	34.8	699.5

Contd. table: 2

6725	86	112	87	3491	33.2	674
6743	83	112	89	3485	32.8	730.1
6728	82	111	94	3392	42	855.4
6709	81	110	88	3356	40.3	778.6
6723	80	111	90	3344	33.8	728.6
6742	86	112	88	3318	36.2	848.2
6714	**85**	**111**	**92**	**3296**	**40**	**617.9**
6716	**85**	**110**	**83**	**3296**	**39**	**596.3**
6717	82	111	88	3271	31.7	740.1
6752	**83**	**109**	**88**	**3203**	**44**	**818.8**
6748	84	111	86	3188	31.7	734.3
6703	82	111	91	3152	35	719.8
6749	78	109	91	3056	43.8	1041
6715	**84**	**109**	**93**	**3050**	**38**	**646**
6745	**89**	**113**	**92**	**2953**	**39.5**	**604.9**
6751	**86**	**111**	**78**	**2949**	**39**	**626.5**
6702	86	113	90	2926	31.3	679.7
6747	**89**	**113**	**85**	**2986**	**40**	**604.9**
6733	**84**	**109**	**83**	**2799**	**39.5**	**659**
6732	**86**	**109**	**80**	**2549**	**45.5**	**667.6**
6722	**88**	**113**	**80**	**2515**	**43**	**678.4**
6704	**85**	**111**	**80**	**2419**	**41.5**	**762.7**
6710	**87**	**112K**	**80**	**2369**	**38**	**633**
G. mean	82.3	111.2	89.69	3844	36.6	706.4
F	HS	HS	NS	HS	HS	NS
CV%	1.5	0.7	4	10.5	7.1	17.6
(LSD)5%	2.56	1.6	7.2	806.2	5.2	24.8

NS: Not significant, HS: Highly significant at 0.05 probability, respectively.

Conclusion

Among the tested genotypes, on the basis of yield and yield attributing characters twelve genotypes were upgraded in advanced line testing for further investigation to identified the tolerant and high yielding varieties. Two genotypes which were tolerant to foliar blight were used in crossing blocks for further uses. However, wheat genotypes, which have shown constantly tolerant reaction against spot blotch in different locations, may be utilized as such or resistance transferred using cyclic breeding program into commercial varieties to meet the immediate challenge posed by spot blotch in Nepal.

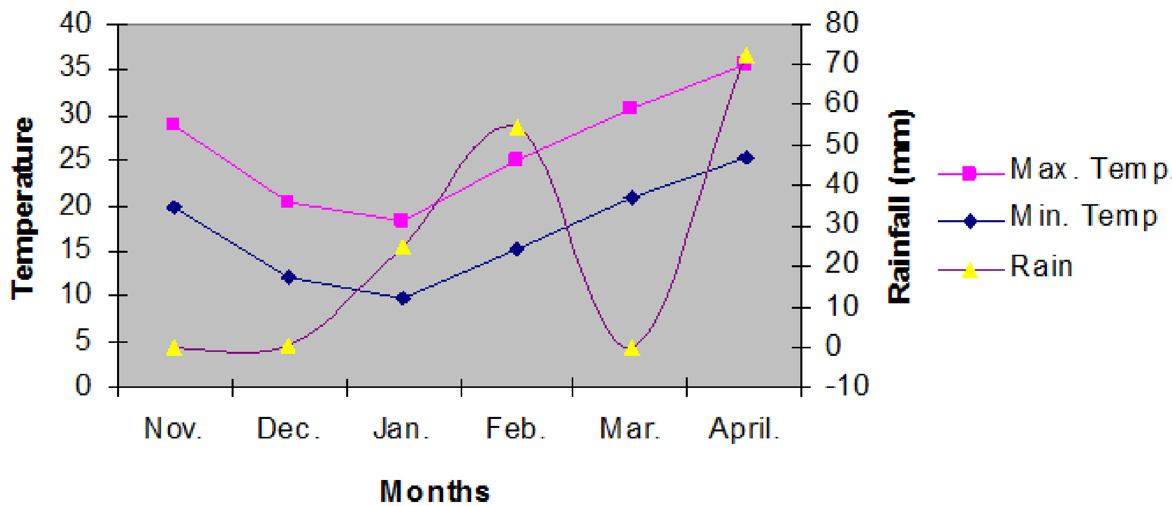

Figure: 2. Weather information during the wheat growing season at NWRP during 2012-13 (Source: NWRP, 2012-13)

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