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## Varietal Screening of Wheat Genotypes/Varieties against Helminthosporium Leaf Blight (*Bipolaris sorokiniana*) at Rampur, Chitwan, Nepal

Aman Bhatta<sup>1\*</sup>, Dinesh Marasini<sup>2</sup>, Bishal Khadka<sup>1</sup>, Yogendra Raj Upadhy<sup>1</sup>, Sarita Lamichhane<sup>1</sup>, Dipa Shrestha<sup>1</sup>, Anuma Dangol<sup>1</sup>

<sup>1</sup>Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal

<sup>2</sup>Department of Agronomy, Agriculture and Forestry University, Rampur, Chitwan, Nepal

\*Corresponding author email: bhattaaman@gmail.com

### Abstract

Screening of 20 wheat varieties/genotypes obtained From National Wheat Research Program, Bhiarahawa, Nepal, against spot blotch, caused by *Bipolaris sorokiniana*, was conducted in a RCBD during December 2014 to April 2015 in field of agronomy research block at Institute of Agriculture and Animal Science (IAAS), Rampur, Chitwan, Nepal. Each variety/genotype has 3 plots of 1.25m<sup>2</sup> as replication. Disease incidence was recorded and intensity measured by calculation mean area under disease progress curve (AUDPC) from single digit disease scores taken at 78, 83, 88, 93 and 98 days after sowing (DAS) respectively. Yield and yield attributing characters were recorded. Genotypes with AUDPC values from 101-200, 201-400 and 401-600 were categorized as resistant, moderately resistant and susceptible respectively. Spot blotch started to appear after 63 DAS only on RR 21, in many varieties/genotypes it started to appear on an average of 68-69 DAS and in NL 1094 lastly on 82 DAS. The highest AUDPC values of wheat varieties/genotypes 419.26 and TGW 41.10g. Maximum disease was found during last week of March to first week of April as maximum and minimum temperature, rainfall and relative humidity were 34°C, 19°C, 25.5 mm and 78% respectively. The BL 3623 Gautam varieties/genotypes were resistant. These varieties/genotypes had lower disease and higher yield and yield attributing characters. Therefore they can be used as source or resistance to spot blotch in breeding programs. The variety RR 21 appears most susceptible to spot blotch, which can be used as a susceptible check.

**Keywords:** wheat; spot blotch; AUDPC

### Introduction

Wheat (*Triticum aestivum*) is one of the major staple food crops of the Nepal, which occupies the third position in both area and production (Devkota, 1993). Out of 22 released wheat varieties, NL297, Gautam, Bhrikuti, BL3235, Vijay, WK1204/5, Achyut, Triveni, BL1473, Annapurna, Pasang Lhamhu, and BL1032 are popular in Nepal. In addition, some local varieties/genotypes like Begali and Mudule (called red and white respectively) are also planted in some districts of Nepal (MOAD/ FAO/WEP, 2013). Annual average increase in wheat production is 10%, however, in 2012/ 2013, a marginal increment of 2% was recorded. The introduction and development of semi dwarf, high yielding superior varieties/genotypes has significant impact on wheat area and production.

Intensive farming system has brought new challenges for farmers, including the increased incidence of leaf blight, a fungal disease. The leaf blight disease represents a complex, collectively referred to as HLB. Two of the most common disease, spot blotch caused by fungi *Bipolaris sorokiniana* (Sacc in Sorok) spot blotch dominates in the warmer, humid areas where as tan spot, caused by *Pyrenophora tritici-repentis* prevails in the cooler season in southern Nepal. It is the major biotic constraint in the Gangetic plains especially in the rice-wheat cropping system and is the main

limiting factor for growing wheat in South-East Asia. The total area affected by spot blotch is estimated to be about 25 million hectares worldwide (Van Ginkel, 1997).

The magnitude and severity of HLB expanded from lower belt of terai (100masl) to hilly region (2400 masl) and became a serious disease in Nepal. The spot blotch was recorded in 1978 and its incidence has increased annually. On yield assessment on Bhairhawa research station, yield loss was up to 23.8 to 27% while on a farm trial it was up to 16% (Bhatta et al., 1998). In Nepal the seed infection was found between 5% to 89.1% and the germination of the seed ranged from 33.7 to 94 % (Shrestha et al., 1998).

Late harvesting of rice caused the delayed sowing of wheat; as a result the plant development coincides with foliar leaf blight during late February and early March. That is the main constraint of foliar blight on rice-wheat cropping system so the optimum time of plantation of wheat is November 15-30 (Alam and Shan, 1991). Further rice serves as a host for the spot blotch fungi and rice stubble plays its role as a substrate for the fungi after rice harvest (Saari, 1998) in wheat.

As *Bipolaris sorokiniana* is becoming a major pathogen causing highly destructive foliar disease and also common root rot of wheat in most of the wheat growing areas of the world, its management is in the urgent need to increase the

production of wheat as well for the food security. High temperature and high relative humidity favours the outbreak of the disease. Yield loss on research station up to 23.8 to 27%, and on a farm trial up to 16% due to HLB (Bhatta et al., 1998). Management of this disease by fungicides is not only costly but also hazardous and the convenient method to deal with it is the use of healthy and quality seed of resistant varieties/genotypes of wheat. Thus the present study evaluated the most resistant wheat variety against the HLB at Rampur, Chitwan through the monitoring of HLB and its interaction and virulence with the following objectives:

- To assess the HLB resistant varieties/genotypes of wheat in Chitwan condition,
- To find out the incidence and severity of HLB in vegetative and reproductive stage of wheat.

## Materials and Methods

### Location of Research

The experiment was conducted at IAAS Agronomy Research Farm, Rampur Chitwan, Nepal during November 2014 to April 2015. The site is situated in subtropical humid climatic belt of Nepal. The maximum temperature during winter rises up to 27 °C. The relative humidity (RH) commences rising up from May (average 50%) and reaches to maximum (100%) in December and January. The experimental field was under rice-wheat sequence.

### Varieties Used in Research

The 20 different wheat varieties/genotypes/genotypes on trial are shown in Table 1.

The experimental design was Randomized Complete Block Design (RCBD) with 3 replications. Total numbers of plots were 60 and size of each plot was 1×1.25 m<sup>2</sup>.

### Seed Germination

$$\text{Germination \%} = \frac{\text{number of seed germinated}}{\text{Total number of seed}} * 100$$

### Foliar Disease Assessment

For each disease rating, percent disease leaf area was assessed on the flag leaf (F) and penultimate leaf (F-1). Flag leaves could play more crucial role in grain filling that's why flag leaf is selected for disease scoring. The percent of diseased leaf area (DLA) was scored visually on flag leaf (F) and penultimate leaf (F-1) using following scale:

0= no symptoms\pinhead size, 1= less than 10%, 2= 10-25%, 3= 25-50%, 4= 50-75%, 5= 75-100%

The percent of diseased leaf area (DLA) was scored visually on flag leaf (F) and penultimate leaf (F-1). Ten randomly selected main tillers from each plot were tagged and used for disease scoring. Disease scoring was conducted after 78DAS, 83 DAS, 88DAS, 93DAS, 98DAS. Scoring was done by single digit method. After averaging flag leaf (F)

and penultimate leaf (F-1) severity, the area under disease progress curve (AUDPC) was calculated by using the formula given by Das et al. (1992). The AUDPC gives a quantitative measure of epidemic development and disease intensity (Renolds and Neher, 1997).

**Table 1:** List of different wheat varieties/ genotypes/ genotypes on trial used in the present study.

S.N.	Genotypes*	S.N.	Genotypes*
1	RR21	11	NL1094
2	UP262	12	NL1164
3	BL4316	13	NL1008
4	BL4341	14	NL971
5	BL3623	15	NL297
6	BL3872	16	Vijay
7	BL1022	17	Gautam
8	BL1473	18	Bhrikuti
9	BL1135	19	Achyut
10	NL1093	20	Aditya

Genotypes\* = wheat varieties/genotypes/genotypes on trial

### Disease Severity

$$= \frac{\text{sum of all numerical ratings} \times 100}{\text{number of sample plants} \times \text{highest rating}} (5)$$

Four disease scoring were recorded at 5 days interval to compute AUDPC. The AUDPC values were calculated using the following formula Das et al. (1992).

$$\text{AUDPC} = \sum_{i=1}^n (Y_{i+1} + Y_i) 0.5 (T_{i+1} - T_i)$$

Where,

Y<sub>i</sub> = disease severity on i<sup>th</sup> date

T<sub>i</sub> = date on which disease was recorded

n = numbers of dates on which disease was scored

### Yield and Yield Attributing Characters

Grain yield and thousand grain weight (TGW) were taken from each plot. To obtain TGW, 1000 grain plot<sup>-1</sup> of each genotype were counted, weighed separately and added to minimize counting error.

The statistical analysis included analysis of variance (ANOVA), least significant difference, correlation and regression analysis which were performed by using

statistical software programs Microsoft excel 2007, MSTAT and Gen Stat 15<sup>th</sup> edition.

## Result and Discussion

### *Disease Incidence*

Number of diseased seedlings and time of appearance of spot blotch disease on flag leaf varied among the varieties/genotypes. Out of 20 genotypes, highest number of diseased seedlings were recorded for BL 1135 (7) and

minimum number of diseased seedlings were recorded for Brikuti, NL971 and Vijay (2). Disease incidence on flag leaf varied from 63 DAS (for RR21) and 82 DAS (for NL 1094) (Table 2).

### *Area under Disease Progress Curve (AUDPC)*

Table 3 shows Number of diseased seedlings and disease incidence on flag leaf of different wheat varieties/genotypes observed on Rampur, Chitwan, Nepal, 2014-2015

**Table 2:** Number of diseased seedlings and disease incidence on flag leaf of different wheat varieties/genotypes observed on Rampur, Chitwan, Nepal, 2014-2015

Varieties/genotypes	No of diseased seedlings	Disease incidence on flag Leaf
BL 4341	3	70
NL 1164	4	67
NL1093	6	79
BL 1022	3	67
Aditya	5	66
Bhrikuti	2	68
BL 4316	3	66
NL 971	2	65
UP 262	4	66
NL 297	6	73
BL 3872	3	66
Gautam	4	77
Achyut	4	67
Vijay	2	73
BL 3623	3	65
NL 1008	2	68
BL 1473	4	67
BL 1135	7	69
RR 21	5	63
NL 1094	5	82

Note: Means followed by the same letter(s) within the column are not significantly different during DMRT at 0.05 level of significance

**Table 3:** Varieties/genotypes influenced the area under disease progress curve (AUDPC) of flag leaf and penultimate leaf for spot blotch of wheat at different observations at Rampur, Chitwan, Nepal, 2014-2015

Varieties/ Genotypes	AUDPC(flag leaf)				AUDPC(Penultimate leaf)			
	88 DAS	93 DAS	98 DAS	Total	88 DAS	93 DAS	98 DAS	Total
BL 4341	45.00 <sup>abc</sup>	133.33 <sup>a</sup>	220.00 <sup>ab</sup>	398.33 <sup>a</sup>	145.00 <sup>abcd</sup>	336.67 <sup>abcd</sup>	440.00 <sup>abcde</sup>	921.67 <sup>abcdef</sup>
NL 1164	56.67 <sup>abc</sup>	175.56 <sup>ab</sup>	263.89 <sup>abc</sup>	496.12 <sup>ab</sup>	148.89 <sup>abcd</sup>	342.23 <sup>abcd</sup>	431.67 <sup>abcde</sup>	922.78 <sup>abcdef</sup>
NL1093	61.67 <sup>abc</sup>	170.00 <sup>ab</sup>	276.67 <sup>abc</sup>	508.33 <sup>ab</sup>	187.23 <sup>bcd</sup>	366.67 <sup>bcd</sup>	450.00 <sup>bcde</sup>	1003.89 <sup>cdef</sup>
BL 1022	93.33 <sup>bcd</sup>	306.67 <sup>cd</sup>	476.67 <sup>g</sup>	876.67 <sup>cd</sup>	218.33 <sup>de</sup>	426.67 <sup>de</sup>	496.67 <sup>de</sup>	1141.67 <sup>efg</sup>
Aditya	82.23 <sup>abcd</sup>	205.56 <sup>abc</sup>	333.33 <sup>bcdef</sup>	621.12 <sup>ab</sup>	155.00 <sup>abcd</sup>	350.00 <sup>abcd</sup>	456.67 <sup>cde</sup>	961.67 <sup>bcdef</sup>
Bhrikuti	51.67 <sup>abc</sup>	160.00 <sup>ab</sup>	291.67 <sup>abcd</sup>	503.33 <sup>ab</sup>	141.67 <sup>abcd</sup>	296.67 <sup>abc</sup>	428.33 <sup>abcd</sup>	866.67 <sup>abcd</sup>
BL 4316	75.00 <sup>abcd</sup>	188.89 <sup>ab</sup>	298.89 <sup>abcd</sup>	562.78 <sup>ab</sup>	152.23 <sup>abcd</sup>	315.56 <sup>abcd</sup>	430.00 <sup>abcd</sup>	897.78 <sup>abcde</sup>
NL 971	30.00 <sup>a</sup>	166.11 <sup>ab</sup>	304.44 <sup>abcd</sup>	500.55 <sup>ab</sup>	81.67 <sup>a</sup>	243.33 <sup>a</sup>	385.00 <sup>ab</sup>	710.00 <sup>a</sup>
UP 262	94.44 <sup>bcd</sup>	217.78 <sup>abcd</sup>	345.00 <sup>cdef</sup>	657.22 <sup>bc</sup>	195.00 <sup>cde</sup>	396.67 <sup>cde</sup>	485.00 <sup>de</sup>	1076.67 <sup>def</sup>
NL 297	130.00 <sup>de</sup>	316.67 <sup>d</sup>	431.67 <sup>efg</sup>	878.33 <sup>cd</sup>	201.67 <sup>de</sup>	395.00 <sup>cde</sup>	476.67 <sup>de</sup>	1073.33 <sup>def</sup>
BL 3872	48.33 <sup>abc</sup>	120.00 <sup>a</sup>	213.33 <sup>a</sup>	381.67 <sup>a</sup>	110.00 <sup>abc</sup>	256.67 <sup>ab</sup>	381.67 <sup>a</sup>	748.33 <sup>ab</sup>
Gautam	46.11 <sup>abc</sup>	139.44 <sup>a</sup>	210.00 <sup>a</sup>	395.55 <sup>a</sup>	103.33 <sup>ab</sup>	252.78 <sup>ab</sup>	396.11 <sup>abc</sup>	752.22 <sup>abc</sup>
Achyut	85.00 <sup>abcd</sup>	208.33 <sup>abc</sup>	338.33 <sup>cdef</sup>	631.67 <sup>ab</sup>	188.33 <sup>bcd</sup>	341.67 <sup>abcd</sup>	443.33 <sup>abcde</sup>	973.33 <sup>bcdef</sup>
Vijay	71.67 <sup>abc</sup>	218.33 <sup>abcd</sup>	370.00 <sup>cdefg</sup>	660.00 <sup>bc</sup>	176.11 <sup>bcd</sup>	364.44 <sup>bcd</sup>	448.33 <sup>abcde</sup>	988.88 <sup>bcdef</sup>
BL 3623	36.67 <sup>ab</sup>	158.33 <sup>ab</sup>	296.67 <sup>abcd</sup>	491.67 <sup>ab</sup>	184.44 <sup>bcd</sup>	383.88 <sup>cde</sup>	471.67 <sup>de</sup>	1039.99 <sup>def</sup>
NL 1008	93.33 <sup>bcd</sup>	256.11 <sup>bcd</sup>	396.11 <sup>defg</sup>	745.55 <sup>bcd</sup>	216.67 <sup>de</sup>	420.00 <sup>de</sup>	468.33 <sup>de</sup>	1105.00 <sup>def</sup>
BL 1473	38.33 <sup>abc</sup>	176.67 <sup>ab</sup>	350.00 <sup>cdef</sup>	565.00 <sup>ab</sup>	185.00 <sup>bcd</sup>	386.11 <sup>cde</sup>	475.00 <sup>de</sup>	1046.11 <sup>def</sup>
BL 1135	173.33 <sup>e</sup>	316.67 <sup>d</sup>	445.00 <sup>fg</sup>	935.00 <sup>d</sup>	275.00 <sup>e</sup>	411.67 <sup>cde</sup>	478.33 <sup>de</sup>	1165.00 <sup>fg</sup>
RR 21	248.88 <sup>f</sup>	426.11 <sup>e</sup>	478.33 <sup>g</sup>	1153.33 <sup>e</sup>	365.56 <sup>f</sup>	496.67 <sup>e</sup>	500.00 <sup>e</sup>	1362.23 <sup>g</sup>
NL 1094	96.67 <sup>cd</sup>	218.33 <sup>abcd</sup>	320.00 <sup>abcde</sup>	635.00 <sup>ab</sup>	164.44 <sup>abcd</sup>	355.00 <sup>abcd</sup>	448.33 <sup>abcde</sup>	967.78 <sup>bcdef</sup>
SEM (±)	17.01	31.70	34.40	74.7	26.79	34.39	20.18	75.1
LSD(=0.05)	48.69	90.77	98.49	213.9	76.69	98.44	57.77	214.9
CV, %	35.50	25.70	17.90	20.5	25.8	16.7	7.8	13.2
Grand mean	82.90	213.90	333.00	630	179.8	356.9	449.6	986

Note: Means followed by the same letter(s) within the column are not significantly different during DMRT at 0.05 level of significance

### **Flag Leaf**

AUDPC values of flag leaf for spot blotch were significantly varied among the varieties/genotypes (Table 2). At 88 DAS, RR 21 had highest AUDPC (248.88) and it was significantly higher than all other varieties/genotypes. Lowest AUDPC was recorded for NL 971 (30.00) and it was statistically similar with most of the varieties/genotypes. At 93 DAS, RR 21 had highest AUDPC (426.11) and it was significantly higher than all other varieties/genotypes. Lowest AUDPC was recorded for BL 3872 (120.00) and it was significantly lower than most of the varieties/genotypes except BL4341 and Gautam it was statistically similar with most of the varieties/genotypes. At 98 DAS, RR 21 had highest AUDPC (478.33) and it was significantly higher than most of the tested varieties/genotypes but it was statistically similar with BL1022, NL 297, Vijay and NL1008. Lowest AUDPC was recorded for Gautam (210.00) and it was significantly lower than all other varieties/genotypes except BL 3872 and it was statistically similar with most of the varieties/genotypes. Totally, highest AUDPC was recorded for RR 21 (1153.33) and it was significantly higher than all other varieties/genotypes except BL 1135, which had statistical similar AUDPC. Lowest AUDPC was recorded for BL 3872 and it was significantly lower than other varieties/genotypes except BL 4341 and Gautam and statistically similar with most of the varieties.

### **Penultimate leaf**

AUDPC values of penultimate leaf for spot blotch were significantly varied among the varieties/genotypes (Table 2). At 88 DAS, RR 21 had the highest AUDPC (365.56) and it was significantly higher than other varieties/genotypes. Lowest AUDPC was recorded for NL 971 (81.67) and it was statistically similar with most of the varieties/genotypes. At 93 DAS, RR 21 again had the highest AUDPC (496.67) and it was found significantly higher than other varieties/genotypes except BL 1135, BL 1473, NL 1008, BL 3623 and few others. Lowest AUDPC was recorded for NL 971 (243.33) and it was statistically similar with most of the varieties. At 98 DAS, RR 21 again had the highest AUDPC (500.00) and it was significantly higher than few varieties but statistically similar with most of the varieties. Lowest AUDPC was recorded for BL 3672 (381.67) but it was statistically similar with most of the varieties. Highest total AUDPC value was found on RR 21 (1362.23) and it was statistically similar with BL 1135 and BL 1022 and significantly higher than all other varieties/genotypes and. The lowest AUDPC value was recorded for NL 971 and it was statistically similar with few varieties/genotypes.

### **Disease Incidence**

#### **Flag leaf**

The disease incidence values of flag leaf for spot blotch were significantly varied among varieties/genotypes only

up to 83 DAS i.e. 2<sup>nd</sup> observation and then insignificant among varieties/genotypes (Table 4). At 78 DAS, BL 1135 (93.33%) had the highest disease incidence percentage which is significantly higher than other varieties except BL 4316, Achyut and RR 21. Lowest disease incidence was recorded for BL 3872, BL 3623 and NL 1008 (6.67%) but they were statistically similar to other varieties/genotypes. At 83 DAS, BL 1135, Achyut and RR 21 had the highest disease incidence value (100%) which is significantly higher than other varieties/genotypes except NL 1164, BL 1022, Aditya, Bhrikuti, BL 4316, UP262 and BL 3872. Onward observation on 88, 93 and 98 DAS the disease incidence value became insignificant among varieties/genotypes.

#### **Penultimate leaf**

Disease incidence on penultimate leaf for spot blotch was significantly varied among the varieties/genotypes (Table 3) only up to 83 DAS i.e. second observations. At 78DAS, BL 1135 had highest disease incidence (96.67%) and it was significantly higher than other all varieties/genotype except Achyut and it was statistically similar with most of the varieties/genotypes. Lowest disease incidence was recorded for BL 3872 (22%) and it was significantly lower than all other varieties/genotypes but BL3623 and NL 1008 (23.33%) were significantly similar with BL 3872. At 83 DAS, RR 21 and BL 1135 had highest disease incidence (100%) and they were significantly higher than all other varieties/genotypes and statistically similar with most of the genotypes/varieties. Lowest disease incidence was recorded for BL4341 (53.33%) and it was statistically similar with few varieties/genotypes. After those observations, disease incidence among these varieties/genotypes was insignificant.

### **Disease Severity**

#### **Flag leaf**

Diseases severity values of flag leaf for spot blotch were significantly varied among the varieties/genotype (table 4). At 88 DAS, RR21 had highest disease severity (79.11) and it was significantly higher than other all varieties/genotype. Lowest disease severity was recorded for NL971(10.67) and it was statistically similar with most of the varieties/genotype except NL297, NL1008, BL1135, RR21, NL1094. At 93 DAS, RR21 had highest disease severity (91.33) and it was significantly higher than other all genotype except BL1022, NL297, NL1008, BL1135. Lowest disease severity was recorded for BL3872 (33.33) and it was statistically similar with most of the varieties/genotype except BL1022, NL297, NL1008, BL1135, RR21. At 98 DAS, BL1022, BL1135, RR21 had higher disease severity and it was statistically similar with Aditya, UP262, N2297, Achyut, Vijya NL1008, BL1473, and NL1094. Lowest disease severity was recorded for Gautam (44.67) and it was significantly lower than all other varieties/genotypes.

**Table 4:** Varieties/genotypes influenced the disease incidence of flag leaf and penultimate leaf for spot blotch of wheat at different observations at Rampur, Chitwan, Nepal, 2014-2015

Varieties/ Genotypes	Disease incidence (%) Flag leaf		Disease incidence (%) Penultimate leaf	
	78 DAS	83 DAS	78DAS	83DAS
BL 4341	10.00 <sup>ab</sup>	33.33 <sup>a</sup>	26.67 <sup>ab</sup>	53.33 <sup>a</sup>
NL 1164	16.67 <sup>abc</sup>	76.67 <sup>cd</sup>	40.00 <sup>ab</sup>	70.00 <sup>abcd</sup>
NL1093	10.00 <sup>ab</sup>	56.67 <sup>abc</sup>	36.67 <sup>ab</sup>	73.33 <sup>abcd</sup>
BL 1022	50.00 <sup>bcdef</sup>	90.00 <sup>cd</sup>	70.00 <sup>bcd</sup>	93.33 <sup>bcd</sup>
Aditya	33.33 <sup>abcde</sup>	70.00 <sup>bcd</sup>	56.67 <sup>abcd</sup>	90.00 <sup>bcd</sup>
Bhrikuti	53.33 <sup>cdef</sup>	70.00 <sup>bcd</sup>	86.67 <sup>cd</sup>	100.00 <sup>d</sup>
BL 4316	66.67 <sup>efg</sup>	76.67 <sup>cd</sup>	86.67 <sup>cd</sup>	90.00 <sup>bcd</sup>
NL 971	23.33 <sup>abcd</sup>	63.33 <sup>abc</sup>	36.67 <sup>ab</sup>	73.33 <sup>abcd</sup>
UP 262	53.33 <sup>cdef</sup>	86.67 <sup>cd</sup>	63.33 <sup>abcd</sup>	93.33 <sup>bcd</sup>
NL 297	50.00 <sup>bcdef</sup>	63.33 <sup>abc</sup>	56.67 <sup>abcd</sup>	83.33 <sup>abcd</sup>
BL 3872	6.67 <sup>a</sup>	70.00 <sup>bcd</sup>	22.00 <sup>a</sup>	83.33 <sup>abcd</sup>
Gautam	36.67 <sup>abcde</sup>	56.67 <sup>abc</sup>	63.33 <sup>abcd</sup>	80.00 <sup>abcd</sup>
Achyut	86.67 <sup>fg</sup>	100.00 <sup>d</sup>	93.33 <sup>d</sup>	96.67 <sup>cd</sup>
Vijay	30.00 <sup>abcde</sup>	56.67 <sup>abc</sup>	43.33 <sup>abc</sup>	90.00 <sup>bcd</sup>
BL 3623	6.67 <sup>a</sup>	33.33 <sup>a</sup>	23.33 <sup>a</sup>	66.67 <sup>abc</sup>
NL 1008	6.67 <sup>a</sup>	40.00 <sup>ab</sup>	23.33 <sup>a</sup>	63.33 <sup>ab</sup>
BL 1473	16.67 <sup>abc</sup>	63.33 <sup>abc</sup>	60.00 <sup>abcd</sup>	90.00 <sup>bcd</sup>
BL 1135	93.33 <sup>g</sup>	100.00 <sup>d</sup>	96.67 <sup>d</sup>	100.00 <sup>d</sup>
RR 21	60.00 <sup>defg</sup>	100.00 <sup>d</sup>	86.67 <sup>cd</sup>	100.00 <sup>d</sup>
NL 1094	23.33 <sup>abcd</sup>	56.67 <sup>abc</sup>	33.33 <sup>ab</sup>	80.00 <sup>abcd</sup>
SEM ( $\pm$ )	12.32	10.20	13.61	9.180
LSD (=0.05)	35.26	29.20	38.97	26.27
CV, %	58.20	25.90	39.70	19.00
Grand mean	36.70	68.2	55.20	83.50

Note: Means followed by the same letter(s) within the column are not significantly different during DMRT at 0.05 level of significance.

**Table 5:** Disease severity on flag leaf and penultimate leaf of varieties/genotype for spot blotch of wheat at different observation at Rampur, Chitwan, Nepal, 2014-2015

Varieties/ Genotypes	Disease severity (Flag leaf)			Disease severity (Penultimate leaf)		
	88DAS	93DAS	98DAS	88DAS	93DAS	98DAS
BL 4341	16.67 <sup>ab</sup>	36.67 <sup>a</sup>	51.33 <sup>ab</sup>	52.00 <sup>abcde</sup>	82.67 <sup>abcd</sup>	93.33 <sup>abc</sup>
NL 1164	20.00 <sup>ab</sup>	50.22 <sup>abc</sup>	55.33 <sup>abc</sup>	53.56 <sup>abcde</sup>	83.33 <sup>abcd</sup>	89.33 <sup>abc</sup>
NL1093	22.67 <sup>ab</sup>	45.33 <sup>ab</sup>	65.33 <sup>abcd</sup>	64.00 <sup>bcde</sup>	82.67 <sup>abcd</sup>	97.33 <sup>c</sup>
BL 1022	32.00 <sup>abcd</sup>	90.67 <sup>e</sup>	100.00 <sup>g</sup>	72.00 <sup>cdef</sup>	98.67 <sup>d</sup>	100.00 <sup>c</sup>
Aditya	28.22 <sup>abcd</sup>	54.00 <sup>abcd</sup>	79.33 <sup>cdefg</sup>	53.33 <sup>abcde</sup>	86.67 <sup>abcd</sup>	96.00 <sup>bc</sup>
Bhrikuti	18.00 <sup>ab</sup>	46.00 <sup>ab</sup>	70.67 <sup>bcdef</sup>	40.67 <sup>abc</sup>	78.00 <sup>abc</sup>	93.33 <sup>abc</sup>
BL 4316	20.00 <sup>ab</sup>	55.56 <sup>abcd</sup>	64.00 <sup>abcd</sup>	45.56 <sup>abcd</sup>	80.67 <sup>abcd</sup>	91.33 <sup>abc</sup>
NL 971	10.67 <sup>a</sup>	55.78 <sup>abcd</sup>	66.00 <sup>abcd</sup>	28.00 <sup>a</sup>	69.33 <sup>ab</sup>	84.67 <sup>a</sup>
UP 262	33.11 <sup>abcd</sup>	54.00 <sup>abcd</sup>	84.00 <sup>defg</sup>	64.67 <sup>bcde</sup>	94.00 <sup>cd</sup>	100.00 <sup>c</sup>
NL 297	46.67 <sup>cd</sup>	80.00 <sup>de</sup>	92.67 <sup>fg</sup>	65.33 <sup>bcde</sup>	92.67 <sup>cd</sup>	98.00 <sup>c</sup>
BL 3872	14.67 <sup>ab</sup>	33.33 <sup>a</sup>	52.00 <sup>ab</sup>	35.33 <sup>ab</sup>	67.33 <sup>a</sup>	85.33 <sup>ab</sup>
Gautam	16.44 <sup>ab</sup>	39.33 <sup>ab</sup>	44.67 <sup>a</sup>	31.33 <sup>a</sup>	69.78 <sup>ab</sup>	88.67 <sup>abc</sup>
Achyut	24.67 <sup>ab</sup>	58.67 <sup>abcd</sup>	76.67 <sup>bcdefg</sup>	54.67 <sup>abcde</sup>	82.00 <sup>abcd</sup>	95.33 <sup>abc</sup>
Vijay	26.67 <sup>abc</sup>	60.67 <sup>abcd</sup>	87.33 <sup>defg</sup>	63.78 <sup>bcde</sup>	82.00 <sup>abcd</sup>	97.33 <sup>c</sup>
BL 3623	11.33 <sup>a</sup>	52.00 <sup>abcd</sup>	66.67 <sup>abcde</sup>	62.22 <sup>bcde</sup>	91.33 <sup>cd</sup>	97.33 <sup>c</sup>
NL 1008	36.00 <sup>bcd</sup>	66.44 <sup>bcde</sup>	92.00 <sup>efg</sup>	80.00 <sup>ef</sup>	88.00 <sup>bcd</sup>	99.33 <sup>c</sup>
BL 1473	15.33 <sup>ab</sup>	55.33 <sup>abcd</sup>	84.67 <sup>defg</sup>	63.78 <sup>bcde</sup>	90.67 <sup>cd</sup>	99.33 <sup>c</sup>
BL 1135	48.67 <sup>d</sup>	78.00 <sup>cde</sup>	100.00 <sup>g</sup>	73.33 <sup>def</sup>	91.33 <sup>cd</sup>	100.00 <sup>c</sup>
RR 21	79.11 <sup>e</sup>	91.33 <sup>e</sup>	100.00 <sup>g</sup>	98.67 <sup>f</sup>	100.00 <sup>d</sup>	100.00 <sup>c</sup>
NL 1094	36.00 <sup>bcd</sup>	51.33 <sup>abc</sup>	76.67 <sup>bcdefg</sup>	57.33 <sup>abce</sup>	84.67 <sup>abcd</sup>	94.67 <sup>abc</sup>
SEM ( $\pm$ )	6.57	8.3	7.62	9.20	5.79	3.36
LSD (=0.05)	18.81	23.77	21.82	26.33	16.57	9.63
CV, %	40.9	24.9	17.5	27.50	11.80	6.10
Grand mean	27.8	57.7	75.5	58	84.80	95.03

Note: Means followed by the same letter(s) within the column are not significantly different during DMRT at 0.05 level of significance

#### Penultimate leaf

Disease severity of penultimate leaf for spot blotch were significantly varied among the varieties/genotypes (Table

5). At 88 DAS, RR21 had the highest disease severity percentage (98.67%) and it was significantly higher than other all varieties/genotype. It was statistically similar with



genotype BL1135, NL1008 and BL1022. The lowest disease severity was recorded for NL971 (28%) and it was statistically similar with most of the varieties/genotypes except Achyut, BL1022, UP262, NL297, Vijay, BL3623, NL1008, BL1473, BL1135, RR21, NL1093 and Bhrikuti. At 93 DAS, RR21 had the highest disease severity (100%) and it was significantly higher than other all varieties/genotype but statistically similar with most of the varieties/genotypes. The lowest disease severity was recorded for BL3872 (67.33%) and it was statistically similar with most of the varieties/genotypes except BL1022, BL3623, NL1008, BL1473, BL1135, RR21,

UP262, NL297 and RR21. At 98 DAS, RR21, BL1135, BL1022 and UP262 had the highest AUDPC (100%) and it was significantly higher than other all varieties/genotype but it was statistically similar with most of the varieties except, NL 971 and BL 3872. The Lowest disease severity was recorded for NL971 (84.67%) and it was significantly lower than all other varieties/genotypes.

#### *Plant Height, Thousand Grain Weight and Yield*

Plant height of the different wheat varieties/genotypes were significantly varied (Table 6).

**Table 6:** Plant height (cm), thousand grain weight (g), yield (kg/ha) of different wheat varieties/ genotypes observed at Rampur, Chitwan, 2014-2015

Varieties/genotypes	Plant height(cm)	Thousand grain weight (g)	yield (kg/ha)
BL 4341	108.36 <sup>abcd</sup>	39.57 <sup>efg</sup>	4077.33 <sup>bcd</sup>
NL 1164	110.26 <sup>ab</sup>	43.53 <sup>cdef</sup>	4418.67 <sup>abc</sup>
NL1093	107.81 <sup>abcd</sup>	41.30 <sup>defg</sup>	4706.67 <sup>ab</sup>
BL 1022	98.27 <sup>g</sup>	34.57 <sup>h</sup>	4208.00 <sup>abcd</sup>
Aditya	102.39 <sup>ef</sup>	43.73 <sup>cdef</sup>	4208.00 <sup>abcd</sup>
Bhrikuti	97.10 <sup>gh</sup>	38.33 <sup>ef</sup>	4661.33 <sup>ab</sup>
BL 4316	108.32 <sup>abcd</sup>	42.13 <sup>defg</sup>	4957.33 <sup>a</sup>
NL 971	108.22 <sup>abcd</sup>	43.33 <sup>cdef</sup>	4698.67 <sup>ab</sup>
UP 262	104.36 <sup>de</sup>	41.23 <sup>defg</sup>	4592.00 <sup>abc</sup>
NL 297	98.74 <sup>fg</sup>	44.87 <sup>bcd</sup>	4408.00 <sup>abc</sup>
BL 3872	93.94 <sup>h</sup>	48.47 <sup>ab</sup>	4960.00 <sup>a</sup>
Gautam	106.71 <sup>bcd</sup>	44.37 <sup>bcd</sup>	4744.00 <sup>ab</sup>
Achyut	110.32 <sup>ab</sup>	39.03 <sup>fg</sup>	3426.67 <sup>d</sup>
Vijay	108.54 <sup>abc</sup>	50.70 <sup>a</sup>	4400.00 <sup>abc</sup>
BL 3623	99.50 <sup>fg</sup>	47.97 <sup>abc</sup>	4952.00 <sup>a</sup>
NL 1008	98.50 <sup>fg</sup>	43.13 <sup>def</sup>	3258.67 <sup>e</sup>
BL 1473	104.32 <sup>de</sup>	48.80 <sup>ab</sup>	3792.00 <sup>cde</sup>
BL 1135	104.90 <sup>cde</sup>	37.60 <sup>gh</sup>	4386.67 <sup>abc</sup>
RR 21	110.97 <sup>a</sup>	41.10 <sup>defg</sup>	3930.67 <sup>bcd</sup>
NL 1094	111.71 <sup>a</sup>	43.40 <sup>cdef</sup>	4328.00 <sup>abc</sup>

**Table 6:** Plant height (cm), thousand grain weight (g), yield (kg/ha) of different wheat varieties/ genotypes observed at Rampur, Chitwan, 2014-2015

Varieties/genotypes	Plant height(cm)	Thousand grain weight (g)	yield (kg/ha)
SEM ( $\pm$ )	1.26	1.427	254.30
LSD (=0.05)	3.60	4.08	728.00
CV, %	2.1	5.8	10.10
Grand mean	104.66	42.86	4356

Note: Means followed by the same letter(s) within the column are not significantly different during DMRT at 0.05 level of significance

The highest plant height was recorded for NL 1094 which was significantly higher than all other varieties/genotypes except RR21. The lowest plant height was recorded for BL 3872 which was significantly lower than all other varieties/genotypes but statistically similar with Bhrikuti.

Thousand grain weight were significantly varied among the varieties/genotypes (Table 8). The maximum thousand grain weight had recorded to Vijay (50.70 g) which was significantly higher than all other varieties/genotypes but statistically similar with BL1473, BL3872, BL 3623. Lowest thousand grain weight was recorded for BL 1022 and it was significantly lower than all other varieties/genotypes.

Grain yield were significantly varied among the different varieties/genotypes (Table 5). BL3872 had highest grain yield (4960 kg ha<sup>-1</sup>) and it was significantly higher than other varieties except BL4316 and BL3623. NL1008 had lowest grain yield and it was significantly lower than all varieties/genotypes and statistically similar with genotype BL 1473, RR 21.

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