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Characterization of Barley Entries for Spot Blotch Resistance

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A B S T R A C T

Barley (*Hordeum vulgare* L.) belonging to Gramineae family is an important cereal in the countries which have arid and semi-arid type. Among the different diseases occurring on barley, spot blotch or foliar blight caused by *Bipolaris sorokiniana* (Sacc.) Shoemaker is more damaging than other diseases, causing major reduction in quality and grain yield of barley crop. This disease can be managed by repeated fungicide applications, however, deployment of resistant varieties still remains on the top priority. Out of the 262 barley entries screened for two consecutive years under artificial epiphytotic conditions, five entries consisting of four germplasm lines viz., BL-1309, BL-1313, BL-1532, BL-1562 and one variety PL-891 were resistant towards the disease whereas thirty-three entries and two hundred and eighteen entries exhibited moderately resistant and moderately susceptible reaction respectively. Disease score of more than 78 was recorded in six entries namely, BL-1500, BL-1540, BL-1542, BL-1576, BL-1652 and PL-426 (susceptible check), exhibiting susceptible reaction towards disease. Thus, the barley entries which are resistant to spot blotch disease under artificial inoculated conditions during two years of testing under field conditions can be utilized as donars by breeders to incorporate spot blotch resistance in good yielding cultivars, which are prior found to be susceptible to the disease.

Introduction

Barley (*Hordeum vulgare* L.) is an important cereal of Gramineae family which is serving as the major portion of diet of the people and feed for animals. In the world, barley is cultivated on an area of nearly 50 million hectares with annual production of more than 140 million tons (Mt) (Tricase *et al.*, 2018). It is a dominant crop in the countries which have arid and semi-arid type of climate, which thus favours development and yield of the crop. In the world, following wheat, maize and rice crop, barley occupies the fourth position as important cereal based crop belonging to graminaceous family (Taner *et al.*, 2004). In Punjab, barley covers an area of 7.7 thousand hac with production of 30,000 tonnes and average yield of 38.80 quintals/hectare (Anonymous 2019). Due to damaging effect of different diseases, pests and poor crop management practices, the

average yield of barley in India is reported to be comparatively lower than several other countries. Among the different diseases occurring on barley, spot blotch or foliar blight caused by *Bipolaris sorokiniana* (Sacc.) Shoemaker (teleomorph: *Cochliobolus sativus*) is more damaging than other diseases, causing major reduction in grain quality and yield of this crop (Nutter *et al.,* 1985; Arabi and Jawahar 2003). Yield losses of 25-45% in barley crop have been reported in Kazakhstan and 41% in Russia due to this pathogen (Iftikhar *et al.,* 2009). Although spot blotch is generally associated with warm conditions, but a survey of barley diseases conducted in higher altitudes of Trans Himalayan - Ladakh region of Indiaby Vaish *et al.,* (2011) estimated yield losses of 6% to 53% due to *B. sorokiniana* causing spot blotch of barley.

The infection of this disease at seedling stage starts as small brownish black spots on leaf sheaths and which thus progresses from lower to upper plant parts during crop development (Kutcher *et al.,* 1994). Higher level of resistance in different barley germplasm lines is difficult to achieve owing to the genetic changes in the pathogen population, influence of the environment on disease development and the quantitative nature of resistance (Wilcoxson *et al.,* 1990).The spot blotch disease frequently hinders the commercial production of barley in the north-eastern states of India. Due to the changing agronomic practices and the quick replacement of local varieties with high-yielding cultivars have thus led to the appearance of this disease in the north-western regions of the country as well where it was earlier found to be insignificant (Bala and Kaur 2008). Foliar fungicide treatments can be used to control the spot blotch on barley, however, considering the environmental issues, deployment of resistant cultivars still remains on the top priority and thus offers the most economically and environmentally safe means of disease control (Singh *et al.,* 2017). Thus, the aim of the present study was to evaluate different barley accessions/germplasm lines and released popular varieties for two successive years under artificial inoculated conditions so as to identify resistance sources against spot blotch disease which could serve as donors in breeding for resistance programmes.

Materials and Methods

The material under study consisted of two hundred and sixty-two entries including released varieties and advanced breeding lines procured from Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana and Indian Institute of Wheat and Barley Research (IIWBR), Karnal. In order to find new resistance sources among these barley entries against *Bipolaris sorokiniana*, field experiments were conducted for two successive cropping seasons i.e. 2017-18 and 2018-19.Each entry was sown as paired rows of one meter length with 20 cm distance between rows along with susceptible check i.e. PL 426 which was repeated after every 10 entries.

Mass inoculum of the pathogen was prepared in the laboratory by inoculating pure culture of the pathogen i.e. *Bipolaris sorokiniana* on autoclaved sorghum seeds in separate flask, which were then kept in incubator at 25±2° C. After the full growth of the pathogen on the substrate, spores were harvested in distilled water which act as conidial suspension. All these barley entries were spray inoculated at maximum tillering stage with conidial suspension having spore concentration of 10^6conidia/ml during evening hours for ensuring successful infection (Chaurasia *et al.,* 1999). After 12 days of inoculation, the characteristic brown coloured spots developed on leaves which further coalesce to form a large necrotic area thus producing the

characteristic symptom of spot blotch disease. Disease assessment was done by recording the disease severity on leaves at three different crop growth stages *viz*. flowering, milk and hard dough stage by employing the standard double digit scale (00-99) given by Saari and Prescott (1975).

The left and right side of the double digit indicate the per cent disease severity score of blight on flag leaf (F) and flag-1 leaf (F-1) respectively. Since these two leaves remain green at milk stage and contribute most to the grain filling process, hence reduction of grain yield is directly related to disease severity in these two leaves (Singh *et al.,* 2005). The area under disease progress curve (AUDPC) was also calculated for each entry from the disease score recorded at weekly intervals at different growth stages by the formula given by Roelfs *et al.,* (1992) and all the entries were categorized based on their AUDPC values and terminal disease severity by using described scale ranging from highly resistant to susceptible (Table 1) (Van der Plank, 1968; Duveiller *et al.,* 1998).

$$AUDPC = \sum_{i=1}^{a} [\{(Y_i + Y_{(i+1)}) / 2\} \times (t_{(i+1)} - t_i)]$$

Where,

Yi = disease score at time ti and,
X_i and X_{i+1} are disease severity on i and i+1 date, respectively
t_i is the no. of days between i and i+1
n is the number of observations recorded.

Results and Discussion

The most important measure to counteract the attack of pathogen for longer durations is use of resistant cultivars. The results obtained from the evaluation of two hundred and sixty-two barley entries evaluated for two consecutive years against *B. sorokiniana* under artificial inoculated conditions, revealed that all the entries showed almost similar reaction towards the disease during both the years of testing (Table 2). None of the cultivar or germplasm line exhibited highly resistant reaction.

Five entries consisting of four germplasm lines viz., BL-1309, BL-1313, BL-1532, BL-1562 and one variety PL-891 were resistant towards the disease having disease score of less than 35, whereas disease score between 36 to 57 was observed in 33 entries, thus exhibiting moderately resistant reaction. Disease score of more than 69 was recorded in six entries namely, BL-1500, BL-1540, BL-1542, BL-1576, BL-1652 and PL-426 (susceptible check), exhibiting susceptible reaction towards disease, while in rest of the entries, disease score was recorded between 58-69, thus exhibiting moderately susceptible reaction (Table 3).

In context with the present findings, Verma *et al.,* (2013) had also carried out multilocation evaluation of 5458 barley germplasm accessions for resistance to spot blotch under artificial inoculated conditions for four cropping seasons at four different locations and reported that out of these accessions, only 28 accessions were found to be resistant towards spot blotch disease. Similarly, eighty five barley germplasm accessions were screened under artificial inoculated conditions against leaf blight disease by Jain *et al.,* (2014) and out of which 68 entries were found to be resistant while rest of the entries exhibited moderately resistant to susceptible reaction towards disease. Singh *et al.,* (2018) also evaluated 62 wheat genotypes under natural epiphytotic conditions against *Bipolaris sorokiniana*, among which eight genotypes having disease severity between 34.26 to 35.0 per cent were observed as resistant.

Table.1 Categorization of disease reaction based on severity score of spot blotch disease

Sr. No.	Disease Reaction	Range of values (DD)*
1	Immune	00-01
2	Resistant (R)	12-24
3	Moderately Resistant (MR)	34-46
4	Moderately Susceptible (MS)	56-68
5	Susceptible (S)	78-89
6	Highly Susceptible (HS)	99

*First and second value respectively, represents percent blighted area on the flag leaf and flag-1 leaves. Values 1,2,3,4,5,6,7,8, and 9, respectively correspond to 10,20,30,40,50,60,70,80 and 90 percent blighted area

Table.2 Reaction of different barley entries against *B. sorokiniana* during two consecutive years of testing (2017-18 and 2018-19)

Germplasm lines/ varieties	Foliar blight score (dd)*			AUDPC**	DR**	Foliar blight score (dd)*			AUDPC	DR**
	F	D	H D			F	D	H D		
	2017-18					2018-19				
BL 1301	23	35	58	372.5	MS	22	34	58	365.0	MS
BL 1309	11	12	23	145.0	R	12	14	24	160.0	R
BL 1313	1	11	23	115.0	R	11	12	23	145.0	R
BL 1314	12	24	35	237.5	MR	12	24	35	237.5	MR
BL 1319	13	35	58	362.5	MS	13	37	58	365.0	MS
BL 1322	13	36	58	365.0	MS	12	25	58	297.5	MS
BL 1325	12	26	46	275.0	MR	12	26	47	277.5	MR
BL 1335	24	36	59	387.5	MS	24	35	58	380.0	MS
BL 1338	25	36	58	387.5	MS	25	36	58	387.5	MS
BL 1340	22	34	58	365.0	MS	22	35	58	367.5	MS
BL 1363	24	37	58	390.0	MS	24	37	58	390.0	MS
BL 1367	25	47	69	470.0	MS	25	46	68	462.5	MS
BL 1368	22	34	58	365.0	MS	22	35	58	367.5	MS
BL 1669	24	45	58	425.0	MS	24	36	58	377.5	MS
BL 1375	24	45	58	430.0	MS	24	45	58	430.0	MS
BL 1378	22	45	59	422.5	MS	22	45	58	422.5	MS
BL 1390	25	45	65	450.0	MS	25	45	65	450.0	MS
BL 1397	23	34	45	340.0	MR	13	34	45	315.0	MR
BL 1400	13	25	37	250.0	MR	2	25	37	222.5	MR
BL 1403	23	44	58	417.5	MS	23	44	56	417.5	MS
BL 1404	24	46	58	435.0	MS	24	46	58	432.5	MS
BL 1411	25	47	59	445.0	MS	25	47	58	442.5	MS
BL 1413	12	34	58	364.0	MS	12	34	58	342.5	MS
BL 1416	12	25	47	272.5	MR	12	24	47	267.5	MR
BL 1420	13	37	59	365.0	MS	13	37	58	362.5	MS
BL 1421	23	37	58	387.5	MS	23	36	58	382.5	MS
BL 1429	24	45	58	435.0	MS	24	45	58	425.0	MS
BL 1430	13	36	58	365.0	MS	13	36	58	357.5	MS
BL 1440	22	35	58	370.0	MS	22	35	58	372.5	MS
BL 1443	22	35	58	362.5	MS	23	37	58	365.0	MS
BL 1451	23	45	58	425.0	MS	23	46	58	430.0	MS
BL 1470	13	37	58	364.5	MS	13	36	58	362.5	MS
BL 1473	13	35	58	367.5	MS	13	35	58	372.5	MS
BL 1475	34	46	67	482.5	MS	34	46	67	482.5	MS
BL 1500	25	46	79	490.0	S	25	46	78	487.5	S
BL 1501	25	45	67	455.0	MS	25	45	67	455.0	MS

BL 1502	33	45	59	455.0	MS	33	45	58	452.5	MS
BL 1503	22	34	58	365.0	MS	22	34	58	370.0	MS
BL 1504	12	24	36	240.0	MR	12	24	35	237.5	MR
BL 1505	24	36	58	382.5	MS	24	36	58	382.5	MS
BL 1506	23	44	58	420.0	MS	23	44	58	422.5	MS
BL 1507	13	36	58	357.5	MS	13	36	58	365.0	MS
BL 1508	22	45	67	447.5	MS	22	45	67	447.5	MS
BL 1509	24	37	58	390.0	MS	24	37	58	390.0	MS
BL 1510	34	46	58	460.0	MS	34	46	59	457.5	MS
BL 1511	22	34	58	367.5	MS	22	34	58	370.0	MS
BL 1512	24	46	58	435.0	MS	24	46	58	432.5	MS
BL 1513	32	44	58	440.0	MS	32	44	58	440.0	MS
BL 1514	13	36	58	357.5	MS	13	36	58	357.5	MS
BL 1515	22	35	58	370.0	MS	22	34	58	365.0	MS
BL 1516	13	24	48	272.5	MR	13	24	46	267.5	MR
BL 1517	13	26	47	280.0	MR	13	26	47	280.0	MR
BL 1518	23	34	46	342.5	MR	23	34	46	342.5	MR
BL 1519	22	35	58	375.0	MS	22	35	58	370.0	MS
BL 1520	22	34	45	337.5	MR	22	34	46	340.0	MR
BL 1521	33	45	58	452.5	MS	33	45	58	452.5	MS
BL 1522	13	34	65	365.0	MS	13	34	58	364.5	MS
BL 1523	12	34	58	410.0	MS	22	46	58	410.0	MS
BL 1524	12	35	58	365.0	MS	12	36	58	365.0	MS
BL 1525	13	34	68	372.5	MS	13	34	67	370.0	MS
BL 1526	23	36	58	380.0	MS	23	34	58	370.0	MS
BL 1527	13	25	37	250.0	MR	13	24	37	245.0	MR
BL 1528	22	44	58	420.0	MS	22	36	58	380.0	MS
BL 1529	12	34	58	362.5	MS	12	34	58	364.5	MS
BL 1530	23	35	67	400.0	MS	23	35	67	400.0	MS
BL 1531	13	44	59	395.0	MS	13	34	58	365.0	MS
BL 1532	11	23	24	202.5	R	1	23	24	177.5	R
BL 1533	23	36	58	382.5	MS	23	36	58	380.0	MS
BL 1534	25	37	67	415.0	MS	25	37	68	417.5	MS
BL 1535	24	46	68	460.0	MS	24	46	67	457.5	MS
BL 1536	23	45	58	425.0	MS	23	45	58	425.0	MS
BL 1537	22	34	58	370.0	MS	22	34	58	370.0	MS
BL 1538	13	34	67	370.0	MS	12	34	67	367.5	MS
BL 1539	22	45	58	425.0	MS	22	35	58	375.0	MS
BL 1540	25	57	79	545.0	S	25	57	79	545.0	S
BL 1541	22	56	67	502.5	MS	22	56	68	505.0	MS
BL 1542	34	56	78	560.0	S	34	56	78	560.0	S
BL 1543	23	35	67	400.0	MS	23	35	67	400.0	MS
BL 1544	11	36	58	365.0	MS	11	24	58	290.0	MS
BL 1545	22	34	58	370.0	MS	12	34	58	365.0	MS
BL 1546	25	47	69	470.0	MS	25	47	68	467.5	MS
BL 1547	22	34	58	362.5	MS	22	34	58	365.0	MS
BL 1548	24	45	58	427.5	MS	13	34	58	362.0	MS
BL 1549	13	23	46	262.5	MR	13	24	46	267.5	MR
BL 1550	14	35	67	377.5	MS	13	35	67	375.0	MS
BL 1551	12	35	58	365.0	MS	12	35	58	367.5	MS
BL 1552	22	34	58	367.5	MS	11	33	58	362.5	MS
BL 1553	23	45	67	450.0	MS	23	45	67	450.0	MS
BL 1554	13	37	59	365.0	MS	23	35	59	370.0	MS
BL 1555	23	37	58	387.5	MS	23	35	58	377.5	MS
BL 1556	24	45	58	425.0	MS	24	35	58	375.0	MS
BL 1557	12	23	46	260.0	MR	12	23	46	260.0	MR
BL 1558	12	25	45	267.5	MR	12	25	45	267.5	MR

BL 1559	13	35	58	363.0	MS	12	35	58	367.5	MS
BL 1560	13	35	58	367.5	MS	13	35	58	363.0	MS
BL 1561	23	44	67	445.0	MS	23	44	67	445.0	MS
BL 1562	11	12	23	145.0	R	1	12	23	120.0	R
BL 1563	23	36	58	380.0	MS	23	36	58	380.0	MS
BL 1564	13	36	58	357.5	MS	13	36	58	365.0	MS
BL 1565	23	34	46	342.5	MR	23	34	46	342.5	MR
BL 1566	24	38	58	395.0	MS	24	36	58	385.0	MS
BL 1567	22	33	58	362.0	MS	22	34	58	365.0	MS
BL 1568	24	46	58	435.0	MS	24	46	58	435.0	MS
BL 1569	32	44	58	440.0	MS	32	44	59	440.0	MS
BL 1570	13	35	58	362.5	MS	13	35	58	352.5	MS
BL 1571	23	35	58	375.0	MS	23	35	57	375.0	MS
BL 1572	22	37	58	367.5	MS	13	24	57	295.0	MS
BL 1573	24	35	67	402.5	MS	24	35	67	402.5	MS
BL 1574	23	45	68	452.5	MS	23	45	68	452.5	MS
BL 1575	22	43	58	410.0	MS	22	35	58	370.0	MS
BL 1576	25	57	79	545.0	S	25	57	79	545.0	S
BL 1577	34	46	67	482.5	MS	34	46	67	482.5	MS
BL 1578	13	34	58	365.0	MS	13	34	58	347.5	MS
BL 1579	13	35	58	367.5	MS	13	35	58	363.0	MS
BL 1580	13	37	59	365.0	MS	13	37	59	365.0	MS
BL 1581	23	34	58	372.5	MS	23	37	58	377.5	MS
BL 1582	22	35	58	365.0	MS	22	24	58	367.5	MS
BL 1583	22	245	58	362.5	MS	22	35	58	362.5	MS
BL 1584	13	36	67	380.0	MS	13	36	67	380.0	MS
BL 1585	12	24	46	265.0	MR	12	24	46	265.0	MR
BL 1586	24	35	58	380.0	MS	24	36	58	385.0	MS
BL 1587	23	36	59	368.0	MS	13	36	58	365.0	MS
BL 1588	25	37	58	392.5	MS	25	37	58	392.5	MS
BL 1589	23	35	57	375.0	MS	23	35	58	375.0	MS
BL 1590	24	36	47	357.5	MR	24	36	47	357.5	MR
BL 1591	23	36	58	382.5	MS	23	35	58	377.5	MS
BL 1592	25	36	58	387.5	MS	25	36	58	387.5	MS
BL 1593	22	35	67	397.5	MS	11	35	67	370.0	MS
BL 1594	33	44	67	470.0	MS	23	44	67	445.0	MS
BL 1595	25	46	68	462.5	MS	25	46	68	462.5	MS
BL 1596	22	34	58	370.0	MS	22	34	58	370.0	MS
BL 1597	23	24	36	267.5	MR	23	24	35	265.0	MR
BL 1598	22	34	58	372.5	MS	22	34	58	365.0	MS
BL 1599	24	45	58	427.5	MS	24	45	58	427.5	MS
BL 1600	24	46	58	435.0	MS	24	46	58	435.0	MS
BL 1601	22	45	59	422.5	MS	13	45	58	395.0	MS
BL 1602	25	45	66	452.5	MS	25	46	66	457.5	MS
BL 1603	23	44	58	417.5	MS	23	45	58	422.5	MS
BL 1604	24	46	58	435.0	MS	24	46	58	435.0	MS
BL 1605	25	47	58	442.5	MS	25	47	58	440.0	MS
BL 1606	13	37	58	362.5	MS	13	37	58	365.0	MS
BL 1607	23	37	59	390.0	MS	23	37	59	390.0	MS
BL 1608	24	45	59	427.5	MS	24	46	58	432.5	MS
BL 1609	13	36	58	365.0	MS	13	36	58	365.0	MS
BL 1610	13	37	59	367.5	MS	13	35	58	370.0	MS
BL 1611	23	35	58	377.5	MS	23	35	58	377.5	MS
BL 1612	34	46	67	482.5	MS	34	46	67	482.5	MS
BL 1613	12	26	57	302.5	MS	23	45	58	377.5	MS
BL 1614	25	45	67	455.0	MS	25	45	67	455.0	MS
BL 1615	33	45	59	455.0	MS	33	45	58	452.5	MS

BL 1616	24	45	58	427.5	MS	24	45	58	427.5	MS
BL 1617	23	45	68	452.5	MS	23	45	68	452.5	MS
BL 1618	13	36	58	357.5	MS	13	36	58	365.0	MS
BL 1619	22	45	67	447.5	MS	22	45	67	447.5	MS
BL 1620	24	37	58	390.0	MS	23	37	58	387.5	MS
BL 1621	34	46	58	460.0	MS	34	46	58	460.0	MS
BL 1622	22	35	58	372.5	MS	23	35	58	375.0	MS
BL 1623	24	46	68	460.0	MS	24	46	68	460.0	MS
BL 1624	32	44	58	440.0	MS	32	44	59	442.5	MS
BL 1625	13	37	59	365.0	MS	13	36	59	362.0	MS
BL 1626	13	35	58	370.0	MS	23	35	59	368.0	MS
BL 1627	25	36	58	385.0	MS	25	36	58	385.0	MS
BL 1628	23	35	58	377.5	MS	23	35	58	375.0	MS
BL 1629	24	36	58	385.0	MS	24	36	58	385.0	MS
BL 1630	25	35	58	380.0	MS	25	35	58	380.0	MS
BL 1631	22	36	58	380.0	MS	11	36	58	362.5	MS
BL 1632	33	35	67	425.0	MS	33	35	67	425.0	MS
BL 1633	24	37	58	390.0	MS	24	37	58	390.0	MS
BL 1634	25	47	69	470.0	MS	25	47	68	467.5	MS
BL 1635	22	34	58	365.0	MS	22	34	58	370.0	MS
BL 1636	24	45	58	427.5	MS	24	45	59	427.5	MS
BL 1637	23	45	58	427.5	MS	13	45	58	402.5	MS
BL 1638	22	46	59	427.5	MS	22	46	59	427.5	MS
BL 1639	25	45	67	455.0	MS	25	45	68	457.5	MS
BL 1640	23	44	58	417.5	MS	23	46	58	422.5	MS
BL 1641	25	47	59	445.0	MS	25	47	59	445.0	MS
BL 1642	13	36	58	357.5	MS	13	36	58	367.5	MS
BL 1643	24	45	58	427.5	MS	24	45	58	425.0	MS
BL 1644	13	36	58	365.0	MS	13	36	58	365.0	MS
BL 1645	13	36	58	367.5	MS	23	37	59	372.5	MS
BL 1646	34	46	67	482.5	MS	34	46	67	482.5	MS
BL 1647	25	44	67	450.0	MS	25	44	68	452.5	MS
BL 1648	33	45	59	455.0	MS	33	45	58	452.5	MS
BL 1649	23	45	66	447.5	MS	23	46	66	452.5	MS
BL 1650	13	36	58	364.5	MS	13	36	58	352.5	MS
BL 1651	12	36	58	362.5	MS	12	34	59	342.5	MS
BL 1652	24	56	78	535.0	S	24	56	78	535.0	S
BL 1653	25	47	68	467.5	MS	24	47	68	465.0	MS
BL1654	24	45	58	427.5	MS	25	46	58	435.0	MS
BL 1655	22	45	58	422.5	MS	22	45	58	425.0	MS
BL 1656	23	46	58	422.5	MS	23	45	56	422.5	MS
BL 1657	13	36	59	345.0	MS	13	34	58	365.0	MS
BL 1658	23	24	46	292.5	MR	23	34	46	342.5	MR
BL 1659	13	37	58	362.5	MS	13	37	58	362.5	MS
BL 1660	13	36	58	365.0	MS	13	36	58	355.0	MS
BL 1661	23	34	58	372.5	MS	23	34	56	367.5	MS
BL 1662	13	37	59	365.0	MS	13	37	58	362.0	MS
BL 1663	24	45	57	427.5	MS	24	46	59	432.5	MS
BL 1664	23	36	58	382.5	MS	23	36	58	382.5	MS
BL 1665	22	36	58	362.5	MS	22	45	58	370.0	MS
BL 1666	22	25	48	300.0	MR	22	25	47	297.5	MR
BL 1667	13	37	59	365.0	MS	13	34	58	365.0	MS
BL 1668	23	44	67	445.0	MS	23	44	67	445.0	MS
BL 1669	13	36	58	367.5	MS	13	36	58	377.5	MS
BL 1670	22	45	67	447.5	MS	22	45	67	447.5	MS
BL 1671	22	34	58	367.5	MS	12	34	59	372.5	MS
BL 1672	13	34	58	365.5	MS	13	34	58	367.5	MS

BL 1673	22	36	58	380.0	MS	22	36	59	377.5	MS
BL 1674	23	35	58	375.0	MS	23	35	58	377.5	MS
IBYT-18-4	24	35	58	375.0	MS	24	35	58	375.0	MS
IBYT-18-5	13	36	58	370.0	MS	13	36	59	365.0	MS
IBYT- 18-6	25	37	58	392.5	MS	25	37	58	392.5	MS
IBYT-18-8	23	35	59	375.0	MS	23	35	58	377.5	MS
IBYT-18-9	24	36	48	360.0	MR	24	36	48	360.0	MR
IBYT-18-12	24	36	59	387.5	MS	24	36	58	365.0	MS
IBYT-18-16	25	36	58	387.5	MS	25	36	57	385.0	MS
IBYT-18-18	24	37	59	387.5	MS	24	37	68	415.0	MS
IBYT-18-21	22	36	58	380.0	MS	22	36	58	380.0	MS
INBYT-HI-18-3	33	44	67	470.0	MS	33	45	67	475.0	MS
INBYT-HI-18-9	24	37	58	390.0	MS	23	37	58	387.5	MS
INBYT-HI-18-11	13	26	47	280.0	MR	13	26	47	280.0	MR
INBYT-HI-18-13	25	47	69	470.0	MS	25	47	69	470.0	MS
INBYT-HI-18-18	22	35	58	362.5	MS	12	36	59	364.0	MS
INBYT-HI-18-22	24	45	58	427.5	MS	24	45	58	427.5	MS
5thGSBYT-18-3	24	46	58	435.0	MS	24	46	58	435.0	MS
5thGSBYT-18-4	22	45	59	422.5	MS	22	46	59	427.5	MS
5thGSBYT-18-6	25	45	65	450.0	MS	25	45	65	450.0	MS
5thGSBYT18-7	23	44	59	417.5	MS	23	46	59	425.0	MS
5thGSBYT-18-15	24	46	58	435.0	MS	24	46	58	435.0	MS
5thGSBYT-18-16	25	47	59	445.0	MS	25	47	59	445.0	MS
5thGSBYT-18-19	23	36	47	355.0	MR	13	36	47	330.0	MR
5thGSBYT-18-21	13	37	59	365.0	MS	13	36	59	365.0	MS
5thGSBYT-18-22	23	37	58	387.5	MS	23	37	58	387.5	MS
IBON-18-46	24	45	58	427.5	MS	23	45	58	425.0	MS
IBON-18-47	12	23	45	257.5	MR	12	23	46	260.0	MR
IBON-18-59	13	36	57	365.0	MS	13	36	58	365.0	MS
IBON-18-60	12	25	45	267.5	MR	12	24	45	262.5	MR
IBON-18-82	23	36	58	377.5	MS	13	36	58	368.5	MS
IBON-18-97	34	46	67	482.5	MS	34	46	67	482.5	MS
IBON-18-100	12	26	46	275.0	MR	12	25	46	270.0	MR
IBON-18-108	25	46	67	460.0	MS	25	46	68	462.5	MS
INBON-HI-18-7	33	45	59	455.0	MS	33	45	58	452.5	MS
INBON-HI-18-11	24	36	58	382.5	MS	13	36	58	365.0	MS
INBON-HI-18-26	23	45	68	452.5	MS	23	45	67	450.0	MS
INBON-HI-18-48	13	36	58	367.5	MS	13	36	58	367.5	MS
INBON-HI-18-49	22	45	67	447.5	MS	22	45	67	447.5	MS
INBON-HI-18-55	24	37	58	390.0	MS	24	36	59	382.5	MS
5thGSBON-18-65	34	46	68	485.0	MS	34	46	68	485.0	MS
5thGSBON-18-79	22	34	58	367.5	MS	22	34	58	367.5	MS
5thGSBON-18-84	24	46	68	460.0	MS	14	46	68	435.0	MS
5thGSBON-18-94	32	44	58	440.0	MS	32	44	58	442.5	MS
5thGSBON-18-104	13	37	59	365.0	MS	13	37	58	362.5	MS
DWRUB 52	23	35	47	350.0	MR	23	35	47	350.0	MR
DWRB-92	34	46	58	460.0	MS	34	46	58	460.0	MS
DWRB-123	23	36	46	352.5	MR	23	36	47	355.0	MR
PL-807	24	36	47	357.5	MR	24	35	47	352.5	MR
PL-891	1	12	13	95.0	R	1	12	23	120.0	R
BH 902	15	26	37	260.0	MR	15	26	37	260.0	MR
BH 946	13	25	36	247.5	MR	13	25	36	247.5	MR
RD 2849	26	37	38	345.0	MR	26	37	38	345.0	MR
RD 2917	13	25	38	252.5	MR	13	25	37	250.0	MR
PL-426	56	78	89	752.5	S	46	78	89	727.5	S

*F- Flowering, D- Dough, HD- Hard Dough stage; ** DS- Disease Reaction

Table.3 Categorization of barley entries based on their disease reaction during two cropping seasons (2017-18 and 2018-19)

Range of value (DD)*	Disease reaction	Range of AUDPC	Barley entries	Total no. of entries
00-13	Highly resistant	0.00	-NIL-	0
14-35	Resistant	1-180	BL-1309, BL-1313, BL-1532, BL- 1562 and PL-891	5
36-57	Moderately Resistant	181-360	BL-1314, BL-1325, BL-1397, BL-1400, BL-1416, BL-1504, BL-1516, BL-1517, BL-1518, BL-1520, BL-1527,BL-1549, BL-1557, BL-1558, BL-1565, BL-1585, BL-1590, BL-1597, BL-1658, BL-1666, IBYT-18-9, INBYT-HI-18-11, 5thGSBYT-18-19, IBON-18-47, IBON-18-60, IBON-18-100, DWRUB-52, DWRB-123, PL-807, BH-902, BH-946, RD-2849, RD-2917,	33
58-69	Moderately Susceptible	361-500	BL-1301, BL-1319, BL-1322, BL-1335, BL-1338, BL-1340, BL-1363, BL-1367, BL-1368, BL-1369, BL-1375, BL-1378, BL-1390, BL-1403, BL-1404, Bl-1411, BL-1413,, BL-1420, BL-1421, BL-1429, BL-1430, Bl-1440, BL-1443, BL-1451, BL-1470, BL-1473, BL-1475, bl-1500, BL-1501, BL-1502, BL-1503, BL-1505, BL-1506, BL-1507, BL1508, BL-1509, BL-1510, BL-1511, BL-1512, BL-1513, BL-1514, BL-1515, BL-1519, BL-1521, BL-1522, BL- 1523, BL-1524, BL-1525, BL-1526, BL-1528, BL-1529 BL-1530, BL-1531, BL-1533, BL-1534, BL-1535, BL-1536, BL-1537, BL-1538, BL-1539, BL-1541, BL-1543, BL-1544, BL-1545, BL-1546, BL-1547, BL-1548,BL-1550, BL-1551, BL-1552, BL-1553, BL-1554, BL-1555, BL-1556,, BL-1559, BL-1560, BL-1561, BL-1563, BL-1564, BL-1566, BL-1567, BL-1568, BL-1569, BL-1570, BL-1571, BL-1572, BL-1573, BL-1574, BL-1575, BL-1577, BL-1578, BL-1579, BL-1580, BL-1581, BL-1582, BL-1583, BL-1584, BL-1586, BL-1587, BL-1588, BL-1589, BL-1591, BL-1592, BL-1593, BL-1594, BL-1595, BL-1596, BL-1598, BL-1599, BL-1600, BL- 1601, BL-1602, BL-1603, BL-1604, BL-1605, BL-1606, BL-1607, BL-1608, BL-1609, BL-1610, BL-1611, BL-1612, BL-1613, BL-1614, BL-1616, BL-1617, BL-1618, BL-1619, BL-1620, BL-1621, BL-1622, BL-1623, BL-1624, BL-1625, BL-1626, BL-1627, BL-1628, BL-1629, BL-1630, BL-1631, BL-1632, BL-1633, BL-1634, BL-1635, BL-1636, BL-1637, BL-1638, BL-1639, BL-1640, BL-1641, BL-1642, BL-1643, BL-1644, BL-1645, BL-1646, BL-1647, BL-1648, BL-1649, BL-1650, BL-1651, BL-1653, BL-1654, BL-1655, BL-1656, BL-1657, BL-1659, BL-1660, BL-1661, BL-1662, BL-1663, BL-1664, BL-1665, BL-1667, BL-1668, BL-1669, BL-1670, BL-1671, BL-1672, BL-1673, BL-1674, DWRB-92, IBYT-18-4, IBYT-18-5, IBYT-18-6, IBYT-18-8, IBYT-18-12, IBYT-18-16, IBYT-18-18, IBYT-18-21, INBYT-HI-18-3, INBYT-HI-18-9, INBYT-HI-18-13, INBYT-HI-18-18, INBYT-HI-18-22, 5thGSBYT-18-3, 5thGSBYT-18-4, 5thGSBYT-18-6, 5thGSBYT-18-7, 5thGSBYT-18-15, 5thGSBYT-18-16, 5thGSBYT-18-21, 5thGSBYT-18-22, IBON-18-46, IBON-18-59, IBON-18-82, IBON-18-97, IBON-18-108, INBON-HI-18-7, INBON-HI-18-11, INBON-HI-18-26, INBON-HI-18-48, INBON-HI-18-49, INBON-HI-18-55, 5thGSBON-18-65, 5thGSBON-18-79, 5thGSBON-18-84, 5thGSBON-18-94, 5thGSBON-18-104.	218
>69	Susceptible	500 and above	BL-1500, BL-1540, BL-1542, BL-1576, BL-1652, PL-426	6

*****First and second value represents percent blighted area on the flag leaf and flag-1 leaves respectively. Values 1,2,3,4,5,6,7,8, and 9correspond to 10,20,30,40,50,60,70,80 and 90 percent blighted area respectively

Bipolaris sorokiniana is also known to cause foliar blight or spot blotch disease in wheat crop as well. Screening of two hundred wheat germplasm accessions against this pathogen by Latwal *et al.,* (2016) has revealed that on the basis of their AUDPC values over two years of testing, four accessions were found to be highly resistant whereas eventy eight exhibited resistant reaction towards disease. Similarly, screening of 126 barley genotypes against *B. sorokiniana* in inner tarai region of Nepal was also carried out by Subedi *et al.*, (2020) and among these genotypes resistance was observed in eight genotypes while, thirty two genotypes exhibited moderately resistant reaction.

Therefore, in the present findings, the barley entries resistant to spot blotch disease in their field testing for two successive seasons under artificial inoculated conditions were able to keep the disease intensity on the plant to very low level and thus can act as useful source in incorporating spot blotch resistance in high yielding cultivars of barley which are prior found to be susceptible to the disease.

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