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Original Research Article

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Characterization of Barley Entries for Spot Blotch Resistance

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ABSTRACT

Keywords

Barley, Spot blotch, *Bipolaris sorokiniana*, screening

Article Info

Accepted: 04 September 2020 Available Online: 10 October 2020 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 average yield tonnes and 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 practices the quick agronomic and replacement of local varieties with highyielding cultivars have thus led to the appearance of this disease in the northwestern 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 considering barley. however, 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 $25\pm2^{\circ}$ 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 10⁶ conidia/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,

 Y_i = 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 epiphytotic conditions against natural Bipolaris sorokiniana, among which eight genotypes having disease severity between 34.26 to 35.0 per cent were observed as resistant.

| 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 |

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

*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 yearsof testing (2017-18 and 2018-19)

| Germplasm lines/ varieties | Foliar blight score (dd)* | | AUDPC** | DR** | Folia | r blight (dd)* | score | 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 |

| | 22 | 17 | 50 | 1550 | 1.60 | 22 | 4.7 | 50 | 150 5 | 100 |
|--------------------|----------|----------|----------|----------------|----------|----------|----------|----------|----------------|----------|
| 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 79 | 505.0 | MS S |
| BL 1542 | 34 | 56 | 78 | 560.0 400.0 | S MS | 34 23 | 56 25 | 78 | 560.0 400.0 | |
| BL 1543 | 23 | 35 36 | 67 58 | 365.0 | MS | | 35 | 67 58 | 290.0 | MS |
| BL 1544 | 11 | | | | | 11 | 24 | | | MS |
| BL 1545 BL 1546 | 22 25 | 34 47 | 58 69 | 370.0 470.0 | MS MS | 12 25 | 34 47 | 58 68 | 365.0 467.5 | MS MS |
| BL 1540 BL 1547 | | | 58 | | | 23 | | 58 | | |
| BL 1547 BL 1548 | 22 24 | 34 45 | 58 | 362.5 427.5 | MS MS | 13 | 34 34 | 58 | 365.0 362.0 | MS MS |
| | 13 | 23 | | | | 13 | 24 | 46 | | |
| BL 1549 BL 1550 | 13 | 35 | 46 67 | 262.5 377.5 | MR MS | 13 | 35 | 40 67 | 267.5 375.0 | MR MS |
| BL 1550 BL 1551 | 14 | 35 | 58 | 365.0 | MS | 13 | 35 | 58 | 367.5 | MS |
| BL 1551 BL 1552 | 22 | 33 | 58 | 367.5 | MS | 12 | 33 | 58 | 362.5 | MS |
| BL 1552 BL 1553 | 22 | 45 | 67 | 450.0 | MS | 23 | 45 | 67 | 450.0 | MS |
| BL 1555 BL 1554 | 13 | 37 | 59 | 365.0 | MS | 23 | 35 | 59 | 370.0 | MS |
| BL 1555 | 23 | 37 | 59 | 387.5 | MS | 23 | 35 | 58 | 377.5 | MS |
| BL 1555 BL 1556 | 23 | 45 | 58 | 425.0 | MS | 23 | 35 | 58 | 375.0 | MS |
| BL 1550 BL 1557 | 12 | 23 | 46 | 260.0 | MR | 12 | 23 | 46 | 260.0 | MR |
| BL 1557 BL 1558 | 12 | 25 | 40 | 267.5 | MR | 12 | 25 | 40 | 267.5 | MR |
| DL 1538 | 12 | 23 | 45 | 207.5 | MK | 12 | 23 | 43 | 207.5 | WIK |

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| BL 1602254566452.5MS254666457.5MSBL 1603234458417.5MS234558422.5MSBL 1604244658435.0MS244658435.0MSBL 1605254758442.5MS254758440.0MSBL 1606133758362.5MS133758365.0MSBL 1607233759390.0MS233759390.0MSBL 1608244559427.5MS244658432.5MSBL 1609133658365.0MS133658365.0MSBL 1610133759367.5MS133558370.0MSBL 1611233558377.5MS233558377.5MSBL 1612344667482.5MS344667482.5MSBL 1613122657302.5MS234558377.5MSBL 1614254567455.0MS234558377.5MSBL 1614254567455.0MS234558377.5MSBL 1614254567455.0 </th <th></th> | | | | | | | | | | | |
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| | BL 1613 | 12 | 26 | | 302.5 | MS | 23 | 45 | 58 | | |
| BL 1615 33 45 59 455.0 MS 33 45 58 452.5 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 |

| | | | | 10 | 3.69 | | | - | 10 | 1.69 |
|--------------------|----|----------|----------|----------------|------|----|----------|----------|----------------|----------|
| 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 | 23 | 36 | 58 | 385.0 | MS | 23 | 36 | 58 | 385.0 | MS |
| BL 1629 | 25 | 35 | 58 | 380.0 | MS | 25 | 35 | 58 | 380.0 | MS |
| BL 1630 BL 1631 | 23 | 36 | 58 | 380.0 | MS | 11 | 36 | 58 | 362.5 | MS |
| | 33 | 35 | 67 | 425.0 | MS | 33 | 35 | 67 | 425.0 | |
| BL 1632 | 24 | 35 | 58 | 425.0 390.0 | MS | 24 | 35 37 | 58 | 425.0 390.0 | MS MS |
| BL 1633 | 24 | 47 | 58 69 | | | 24 | | 58 68 | | MS |
| BL 1634 | | | | 470.0 | MS | | 47 | | 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 1005 BL 1664 | 24 | 36 | 58 | 382.5 | MS | 24 | 36 | 58 | 382.5 | MS |
| BL 1665 | 23 | 36 | 58 | 362.5 | MS | 23 | 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 1007 BL 1668 | 23 | 44 | 67 | 445.0 | MS | 23 | 44 | 67 | 445.0 | MS |
| BL 1008 BL 1669 | 13 | 36 | 58 | 367.5 | MS | 13 | 36 | 58 | 377.5 | MS |
| BL 1670 | 22 | 45 | 67 | 447.5 | MS | 22 | 45 | 58 67 | 447.5 | MS |
| | 22 | 45 34 | 58 | 367.5 | MS | 12 | 45 34 | 59 | 372.5 | |
| BL 1671 | | | | | | | | | | MS |
| BL 1672 | 13 | 34 | 58 | 365.5 | MS | 13 | 34 | 58 | 367.5 | MS |

| BL Ior 22 36 58 370.0 MS 22 35 58 377.5 MS IBYT-18-4 24 35 58 375.0 MS 24 35 58 377.5 MS IBYT-18-5 13 36 55 37 58 392.5 MS 23 55 38 377.5 MS IBYT-18-9 24 36 48 300.0 MR 23 55 88 377.5 MS IBYT-18-12 24 36 48 300.0 MR 24 36 58 387.5 MS 24 37 68 415.0 MS IBYT-18-12 22 36 58 387.5 MS 24 57 385.0 MS 145 67 475.0 MS IBYT-18-18 24 47 79.00 MS 33 34 57 MS 387.5 MS 377.5 MS 387.5 | | | | | | | | | | | |
|---|----------------|----|----|----|-------|----|----|----|----|-------|----|
| IBYT-IB-4 24 35 58 375.0 MS 24 35 58 375.0 MS IBYT-IB-6 25 37 58 392.5 MS 25 37 58 392.5 MS 23 35 59 375.0 MS 23 35 58 377.5 MS IBYT-IB-9 24 36 48 300.0 MS 24 36 48 360.0 MS 24 36 58 377.5 MS 148 360.0 MS 178 78 387.5 MS 24 37 68 380.0 MS 178 78 387.0 MS 178 78 380.0 MS 178 78 380.0 MS 178 78 380.0 MS 178 78 380.0 MS 178 178.0 MS 178 78.0 MS 178 178.0 MS 178.0 178.0 178.0 178.0 178.0 | | | | | 380.0 | MS | | 36 | | | MS |
| IBYT: IB-6 13 36 58 370.0 MS 13 36 59 375.0 MS 23 35 58 392.5 MS 23 35 58 377.5 MS IBYT: IB-9 24 36 44 300.0 MR 24 36 48 300.0 MR IBYT: IB-12 24 36 58 387.5 MS 24 36 58 380.0 MS IBYT: IB-16 25 36 58 380.0 MS 24 36 58 380.0 MS IBYT: IB-13 34 67 470.0 MS 23 37 58 380.0 MS INBYT: HI-13-3 34 67 470.0 MS 25 47 69 470.0 MS 24 45 58 427.5 MS MMS IMS 13 66 470.0 MS 150 142.5 MS 145.0 58 425.0 | | | | | | | | 35 | | 377.5 | MS |
| IBYT: 18-6 25 37 58 392.5 MS 23 35 58 377.5 MS IBYT: 18-9 24 36 48 360.0 MR 24 36 48 360.0 MR 24 36 58 377.5 MS 24 36 58 387.5 MS 24 36 58 380.0 MS 24 37 68 415.0 MS IBYT: 18-16 22 36 58 380.0 MS 23 37 58 380.0 MS 23 37 58 387.5 MS INBYT: 118-21 24 43 58 470.0 MS 23 37 58 387.5 MS INBYT: 118-13 25 47 69 470.0 MS 23 37 58 387.5 MS INBYT: 118-18 24 46 58 435.0 MS 24 45 58 427.5 MS | IBYT-18-4 | 24 | | | | MS | 24 | 35 | 58 | | |
| IBYT-18-9 23 35 59 375.0 MS 23 35 58 377.5 MS IBYT-18-12 24 36 59 387.5 MS 24 36 58 365.0 MS IBYT-18-16 25 36 57 385.0 MS 24 36 58 380.0 MS IBYT-18-13 22 36 58 380.0 MS 22 36 58 380.0 MS INBYT-111-18-1 12 26 47 280.0 MS 23 37 58 380.0 MS INBYT-111-18-13 13 26 47 280.0 MR 13 26 47 280.0 MR 13 26 47 280.0 MS 158 487.5 MS 144 58 447.5 158 447.5 58 427.5 MS 166.5 450.0 MS 59 427.5 MS 59 427.5 MS <th>IBYT-18-5</th> <th>13</th> <th>36</th> <th>58</th> <th>370.0</th> <th>MS</th> <th>13</th> <th>36</th> <th>59</th> <th>365.0</th> <th>MS</th> | IBYT-18-5 | 13 | 36 | 58 | 370.0 | MS | 13 | 36 | 59 | 365.0 | MS |
| IBYT-I8-9 24 36 48 300.0 MR 24 36 48 300.0 MR IBYT-I8-16 25 36 59 387.5 MS 24 36 58 380.0 MS IBYT-I8-18 24 37 59 387.5 MS 24 37 68 415.0 MS IBYT-I8-21 22 36 58 380.0 MS 22 36 58 380.0 MS 23 37 58 370.0 MS 23 37 58 387.5 MS 170.0 MS 180 471 280.0 MR 13 26 47 280.0 MR 132 26 470.0 MS 170.0 MS 170.0 MS 180 171.18.18 23 44 55 837.5 MS 24 46 58 435.0 MS 180.59 171.55 MS 24 46 58 435.0 MS <td< th=""><th>IBYT- 18-6</th><th></th><th>37</th><th>58</th><th></th><th>MS</th><th>25</th><th>37</th><th>58</th><th>392.5</th><th>MS</th></td<> | IBYT- 18-6 | | 37 | 58 | | MS | 25 | 37 | 58 | 392.5 | MS |
| IBYT-18-12 24 36 59 387.5 MS 24 36 58 365.0 MS IBYT-18-16 25 36 58 387.5 MS 24 37 68 415.0 MS IBYT-18-21 22 36 58 380.0 MS 22 36 58 380.0 MS 12.3 768 415.0 MS INBYT-18-18-3 33 44 67 470.0 MS 33 45 67 475.0 MS INBYT-118-18-11 3 26 47 280.0 MR 13 26 47 280.0 MR 12 36 99 364.0 MS INBYT-118-16-12 24 45 58 427.5 MS 24 46 58 435.0 MS 24 46 58 435.0 MS 51665877-18-42 46 58 435.0 MS 5165877-18-45 58 447.5 MS 53 | IBYT-18-8 | 23 | 35 | 59 | 375.0 | MS | 23 | 35 | 58 | 377.5 | MS |
| IBYT-18-16 25 36 58 387.5 MS 22 36 57 385.0 MS IBYT-18-21 22 36 58 380.0 MS 23 37 58 387.5 MS INBYT-H1-18-13 25 47 69 470.0 MS 23 37 58 387.5 MS INBYT-H1-18-11 23 26 47 280.0 MR 13 26 47 280.0 MR INBYT-H1-18-12 24 45 58 435.0 MS 24 45 58 435.0 MS 24 46 58 435.0 MS 25 45 65 450.0 MS 25 47 59 445.0 MS 50 MS 50 MS 50 MS 50 450 <th>IBYT-18-9</th> <th>24</th> <th>36</th> <th>48</th> <th>360.0</th> <th>MR</th> <th>24</th> <th>36</th> <th>48</th> <th>360.0</th> <th>MR</th> | IBYT-18-9 | 24 | 36 | 48 | 360.0 | MR | 24 | 36 | 48 | 360.0 | MR |
| IBYT-18-18 24 37 59 387.5 MS 24 37 68 415.0 MS INBYT-IB-21 22 36 58 380.0 MS 33 44 67 470.0 MS 33 45 67 475.0 MS INBYT-IH-18-3 33 44 67 470.0 MS 23 37 58 387.5 MS INBYT-IH-18-13 25 47 69 470.0 MS 23 47 69 470.0 MS 12 36 59 364.0 MS INBYT-IH-18-13 25 47 69 470.0 MS 24 45 58 427.5 MS 24 46 58 435.0 MS 24 46 58 435.0 MS 24 46 58 435.0 MS 5thGSBYT-18-4 25 45 65 450.0 MS 5thGSBYT-18-15 23 46 59 425.0 M | IBYT-18-12 | 24 | 36 | 59 | 387.5 | MS | 24 | 36 | 58 | 365.0 | MS |
| IBYT-18-21 22 36 58 380.0 MS 22 36 58 380.0 MS INBYT-H1-18-3 33 44 67 470.0 MS 23 37 58 387.5 MS INBYT-H1-18-11 13 26 47 290.0 MR 13 26 47 280.0 MS 15 36 55 364.0 MS 15 15 15 44 58 435.0 MS 24 46 58 435.0 MS 15 56 457.0 MS 15 56 47 59 442.0 MS 14 46 58 435.0 MS 56 56 450.0 MS 56 | IBYT-18-16 | 25 | 36 | 58 | 387.5 | MS | 25 | 36 | 57 | 385.0 | MS |
| INBYT-HI-18-3 33 44 67 470.0 MS 33 45 67 475.0 MS INBYT-HI-18-10 24 37 58 390.0 MS 23 37 58 387.5 MS INBYT-HI-18-13 25 47 69 470.0 MS 23 36 59 364.0 MS INBYT-HI-18-13 22 24 45 58 427.5 MS 24 45 58 427.5 MS SthGSBYT-18-4 24 46 58 427.5 MS 24 46 59 447.5 MS SthGSBYT-18-4 22 45 65 450.0 MS 24 46 58 435.0 MS 24 46 58 435.0 MS 24 46 58 435.0 MS 545 550.0 MS 545.0 MS 545.0 MS 545.0 MS 550.0 MS 550.0 MS <t< th=""><th>IBYT-18-18</th><th>24</th><th>37</th><th>59</th><th>387.5</th><th>MS</th><th>24</th><th>37</th><th>68</th><th>415.0</th><th>MS</th></t<> | IBYT-18-18 | 24 | 37 | 59 | 387.5 | MS | 24 | 37 | 68 | 415.0 | MS |
| INBYT-HI-18-9 24 37 58 390.0 MS 23 37 58 387.5 MS INBYT-HI-18-13 26 47 280.0 MR 13 26 47 280.0 MS INBYT-HI-18-18 22 35 58 362.5 MS 12 36 59 364.0 MS SthGSBYT-18-3 24 45 58 427.5 MS 24 45 59 364.0 MS SthGSBYT-18-4 22 45 59 422.5 MS 24 46 58 435.0 MS SthGSBYT-18-6 24 45 54 450.0 MS 25 45 65 445.0 MS SthGSBYT-18-10 23 36 47 390.0 MS 23 46 59 445.0 MS SthGSBYT-18-10 23 36 47 390.0 MS 23 45 58 445.0 MS 58 | IBYT-18-21 | 22 | 36 | 58 | 380.0 | MS | 22 | 36 | 58 | 380.0 | 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 24 45 58 427.5 MS SthGSBYT-18-4 22 445 58 427.5 MS 24 46 58 435.0 MS SthGSBYT-18-4 22 45 59 422.5 MS 22 46 59 427.5 MS SthGSBYT-18-16 23 44 59 445.0 MS 24 46 58 435.0 MS 58 435.0 MS 58 58 435.0 MS 25 47 59 365.0 MS 13 36 47 330.0 MS 13 36 58 365.0 MS 13 36 58 <th>INBYT-HI-18-3</th> <th>33</th> <th>44</th> <th>67</th> <th>470.0</th> <th>MS</th> <th>33</th> <th>45</th> <th>67</th> <th>475.0</th> <th>MS</th> | INBYT-HI-18-3 | 33 | 44 | 67 | 470.0 | MS | 33 | 45 | 67 | 475.0 | MS |
| INBYT-HI-18-13 25 47 69 470.0 MS 25 47 69 470.0 MS INBYT-HI-18-12 23 35 58 362.5 MS 12 36 59 364.0 MS ShGSBYT-18-3 24 46 58 437.5 MS 24 46 58 435.0 MS 24 46 58 435.0 MS ShGSBYT-18-4 22 445 59 417.5 MS 25 45 65 450.0 MS ShGSBYT-18-16 25 47 59 445.0 MS 25 47 59 445.0 MS 5 450.0 MS 5 MS 50 50 50 MS < | INBYT-HI-18-9 | 24 | 37 | 58 | 390.0 | MS | 23 | 37 | 58 | 387.5 | 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 46 58 435.0 MS sthGSBYT-18-4 22 45 59 422.5 MS 22 46 59 427.5 MS sthGSBYT-18-6 25 45 65 450.0 MS 25 46 59 425.0 MS sthGSBYT-18-15 24 46 58 435.0 MS 24 46 58 435.0 MS 51 37 59 445.0 MS 51 36 47 30.0 MR 51 36 47 33.0 MS 51 365.0 MS 13 36 47 33.0 MS 51 365.0 MS 13 36 57 365.0 MS 13 36 59 365.0 MS 13 <t< th=""><th>INBYT-HI-18-11</th><th>13</th><th>26</th><th>47</th><th>280.0</th><th>MR</th><th>13</th><th>26</th><th>47</th><th>280.0</th><th>MR</th></t<> | INBYT-HI-18-11 | 13 | 26 | 47 | 280.0 | MR | 13 | 26 | 47 | 280.0 | MR |
| INBYT-HI-18-22 24 45 58 427.5 MS 24 45 58 427.5 MS SthGSBYT-18-4 22 45 59 422.5 MS 22 46 59 427.5 MS SthGSBYT-18-6 25 45 65 450.0 MS 25 45 65 450.0 MS SthGSBYT-18-6 23 44 59 417.5 MS 23 46 59 425.0 MS SthGSBYT-18-16 25 47 59 445.0 MS 25 47 59 445.0 MS 25 47 59 445.0 MS SthGSBYT-18-19 23 36 47 59 365.0 MR 13 36 59 365.0 MS 23 37 58 387.5 MS 23 37 58 387.5 MS 13 36 59 365.0 MS BON-18-46 12 23 <th>INBYT-HI-18-13</th> <th>25</th> <th>47</th> <th>69</th> <th>470.0</th> <th>MS</th> <th>25</th> <th>47</th> <th>69</th> <th>470.0</th> <th>MS</th> | INBYT-HI-18-13 | 25 | 47 | 69 | 470.0 | MS | 25 | 47 | 69 | 470.0 | MS |
| SthGSBYT-18-3 24 46 58 435.0 MS 24 46 58 435.0 MS SthGSBYT-18-4 22 45 65 430.0 MS 22 44 59 442.5 MS 22 45 65 450.0 MS SthGSBYT18-7 23 44 59 417.5 MS 23 46 59 425.0 MS SthGSBYT-18-15 24 46 58 435.0 MS 24 46 59 445.0 MS SthGSBYT-18-12 23 36 47 355.0 MR 13 36 47 330.0 MR SthGSBYT-18-22 23 37 58 387.5 MS 23 37 58 387.5 MS BON-18-40 12 23 45 58 427.5 MR 12 23 46 260.0 MR BON-18-50 13 36 58 377.5 | INBYT-HI-18-18 | 22 | 35 | 58 | 362.5 | MS | 12 | 36 | 59 | 364.0 | MS |
| SthGSBYT-18-4 22 45 59 422.5 MS 22 46 59 427.5 MS SthGSBYT-18-6 25 45 65 4400 MS 25 445 65 4400.0 MS SthGSBYT-18-15 23 46 59 427.5 MS 23 46 59 445.0 MS SthGSBYT-18-16 25 47 59 445.0 MS 24 46 58 435.0 MS SthGSBYT-18-16 23 36 47 350.0 MS 13 36 59 365.0 MS SthGSBYT-18-21 13 37 59 365.0 MS 13 36 59 365.0 MS BON-18-47 12 23 45 257.5 MR 12 23 46 260.0 MR BON-18-60 12 23 36 58 365.0 MS 13 36 58 365.0 < | INBYT-HI-18-22 | 24 | 45 | 58 | 427.5 | MS | 24 | 45 | 58 | 427.5 | MS |
| SthGSBYT-18-6 25 45 65 450.0 MS 25 45 65 450.0 MS SthGSBYT18-7 23 44 59 417.5 MS 23 46 59 425.0 MS SthGSBYT18-16 25 47 59 445.0 MS 24 46 58 435.0 MS SthGSBYT-18-19 23 36 47 355.0 MR 13 36 47 330.0 MR SthGSBYT-18-19 23 37 58 387.5 MS 23 37 58 387.5 MS 23 45 58 425.0 MS BON-18-46 24 45 58 427.5 MR 12 23 46 260.0 MR 18 36 57.0 MS 13 36 58 365.0 MS 13 36 58 365.0 MS 13 36 58 365.0 MS 13 | 5thGSBYT-18-3 | 24 | 46 | 58 | 435.0 | MS | 24 | 46 | 58 | 435.0 | MS |
| SthGSBYT18-7 23 44 59 417.5 MS 23 46 59 425.0 MS SthGSBYT-18-15 24 46 58 435.0 MS 24 46 58 435.0 MS SthGSBYT-18-10 23 36 47 355.0 MR 13 36 47 330.0 MR SthGSBYT-18-12 23 37 58 387.5 MS 23 37 58 387.5 MS SthGSBYT-18-22 23 37 58 387.5 MS 23 45 58 425.0 MS IBON-18-46 24 45 58 427.5 MS 23 45 58 365.0 MS IBON-18-47 12 23 45 267.5 MR 12 23 46 260.0 MR IBON-18-50 12 25 45 267.5 MR 12 24 45 MS IBON | 5thGSBYT-18-4 | 22 | 45 | 59 | 422.5 | MS | 22 | 46 | 59 | 427.5 | MS |
| SthGSBYT-18-15 24 46 58 435.0 MS 24 46 58 435.0 MS SthGSBYT-18-16 25 47 59 445.0 MS 25 47 59 445.0 MS SthGSBYT-18-21 13 37 59 365.0 MS 13 36 47 330.0 MR SthGSBYT-18-22 23 37 58 387.5 MS 23 37 58 387.5 MS BON-18-46 24 45 58 427.5 MS 23 37 58 387.5 MS BON-18-47 12 23 45 257.5 MR 12 24 45 262.5 MS BON-18-59 13 36 58 377.5 MS 13 36 58 365.0 MS BON-18-80 12 25 46 67 482.5 MS 34 46 67 482.5 MS <th>5thGSBYT-18-6</th> <th>25</th> <th>45</th> <th>65</th> <th>450.0</th> <th>MS</th> <th>25</th> <th>45</th> <th>65</th> <th>450.0</th> <th>MS</th> | 5thGSBYT-18-6 | 25 | 45 | 65 | 450.0 | MS | 25 | 45 | 65 | 450.0 | MS |
| SthGSBYT-18-16 25 47 59 445.0 MS 25 47 59 445.0 MS SthGSBYT-18-19 23 36 47 355.0 MR 13 36 47 30.0 MR SthGSBYT-18-22 23 37 58 387.5 MS 23 37 58 387.5 MS BON-18-46 24 45 58 427.5 MS 23 45 58 425.0 MS BON-18-47 12 23 45 257.5 MR 12 24 45 262.5 MR BON-18-50 12 25 45 267.5 MR 12 24 45 262.5 MR BON-18-80 12 25 46 67 482.5 MS 36 58 365.0 MS BON-18-100 12 26 46 275.0 MR 12 25 46 67 452.5 MS | 5thGSBYT18-7 | 23 | 44 | 59 | 417.5 | MS | 23 | 46 | 59 | 425.0 | MS |
| SthGSBYT-18-19 23 36 47 355.0 MR 13 36 47 330.0 MR SthGSBYT-18-21 13 37 59 365.0 MS 13 36 59 365.0 MS SthGSBYT-18-22 23 37 58 387.5 MS 23 37 58 387.5 MS IBON-18-46 24 45 58 425.0 MS 13 36 58 365.0 MS IBON-18-47 12 23 45 257.5 MR 12 24 45 262.5 MR IBON-18-59 13 36 58 377.5 MS 13 36 58 368.5 MS IBON-18-80 12 26 46 67 482.5 MS 14 46 67 482.5 MS 13 36 58 365.0 MS IBON-18-100 12 26 46 7440.0 MS </th <th>5thGSBYT-18-15</th> <th>24</th> <th>46</th> <th>58</th> <th>435.0</th> <th>MS</th> <th>24</th> <th>46</th> <th>58</th> <th>435.0</th> <th>MS</th> | 5thGSBYT-18-15 | 24 | 46 | 58 | 435.0 | MS | 24 | 46 | 58 | 435.0 | MS |
| SthGSBYT-18-21 13 37 59 365.0 MS 13 36 59 365.0 MS SthGSBYT-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 46 57.5 MR 12 23 46 260.0 MR IBON-18-60 12 25 45 267.5 MR 12 24 45 262.5 MR IBON-18-60 12 25 45 267.5 MR 13 36 58 365.0 MS IBON-18-180 12 25 46 67 482.5 MS 33 45 58 382.5 MS 13 36 58 365.0 MS IBON-H1-18-17 33 45 58 367.5 MS | 5thGSBYT-18-16 | 25 | 47 | 59 | 445.0 | MS | 25 | 47 | 59 | 445.0 | MS |
| SthGSBYT-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-18-60 12 25 45 267.5 MR 12 24 45 262.5 MR IBON-18-60 12 25 45 267.5 MR 12 24 45 262.5 MR IBON-18-97 34 46 67 482.5 MS 34 46 67 482.5 MS 13 36 58 385.5 MS 13 36 58 452.5 MS 13 36 58 365.0 MS 13 36 58 365.0 MS 13 36 58 365.0 MS 18 <th>5thGSBYT-18-19</th> <th>23</th> <th>36</th> <th>47</th> <th>355.0</th> <th>MR</th> <th>13</th> <th>36</th> <th>47</th> <th>330.0</th> <th>MR</th> | 5thGSBYT-18-19 | 23 | 36 | 47 | 355.0 | MR | 13 | 36 | 47 | 330.0 | MR |
| 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 MS IBON-18-60 12 25 45 267.5 MR 13 36 58 368.5 MS IBON-18-100 12 26 46 67 482.5 MS 33 45 59 455.0 MS 33 45 58 462.5 MS IBON-18-18 13 36 58 382.5 MS 13 36 58 367.5 MS IBON-HI-18-26 23 45 67 447.5 MS | 5thGSBYT-18-21 | 13 | 37 | 59 | 365.0 | MS | 13 | 36 | 59 | 365.0 | 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 68 462.5 MS IBON-18-108 25 46 67 460.0 MS 25 46 68 462.5 MS INBON-HI-18-11 24 36 58 367.5 MS 13 36 58 365.0 MS | 5thGSBYT-18-22 | 23 | 37 | 58 | 387.5 | MS | 23 | 37 | 58 | 387.5 | MS |
| 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 67.0 MR IBON-18-108 25 46 67 460.0 MS 25 46 68 462.5 MS IBON-1H-18-10 24 36 58 382.5 MS 13 36 58 367.5 MS 13 36 58 367.5 MS 13 36 58 367.5 MS 13 36 58 3 | IBON-18-46 | 24 | 45 | 58 | 427.5 | MS | 23 | 45 | 58 | 425.0 | 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 33 45 58 452.5 MS INBON-HI-18-7 33 45 59 455.0 MS 33 45 58 452.5 MS INBON-HI-18-11 24 36 58 367.5 MS 13 36 58 367.5 MS INBON-HI-18-49 22 45 67 447.5 MS 14 46 68 485.0 MS <tr< th=""><th>IBON-18-47</th><th></th><th>23</th><th>45</th><th>257.5</th><th></th><th>12</th><th>23</th><th></th><th>260.0</th><th>MR</th></tr<> | IBON-18-47 | | 23 | 45 | 257.5 | | 12 | 23 | | 260.0 | 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-18-100 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-18-11 24 36 58 382.5 MS 13 36 58 367.5 MS INBON-HI-18-49 22 45 67 447.5 MS 24 36 59 382.5 MS | IBON-18-59 | | | | | MS | | 36 | | | |
| 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 58 352.5 MS 13 36 58 365.0 MS INBON-HI-18-26 23 45 67 447.5 MS 13 36 58 367.5 MS 14 46 68 485.0 MS 516GSBON-18-94 32 44 58 367.5 MS 34 | IBON-18-60 | 12 | 25 | 45 | 267.5 | MR | 12 | 24 | 45 | 262.5 | MR |
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| 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-18-26 23 45 67 447.5 MS 23 45 67 447.5 MS INBON-HI-18-48 13 36 58 367.5 MS 13 36 58 367.5 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 14 46 68 435.0 MS 5thGSBON-18-84 24 46 68 440.0 MS 14 46 68 435.0 MS | IBON-18-100 | | | | | | | | | | |
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| INBON-HI-18-48133658367.5MS133658367.5MSINBON-HI-18-49224567447.5MS224567447.5MSINBON-HI-18-55243758390.0MS243659382.5MS5thGSBON-18-65344668485.0MS344668485.0MS5thGSBON-18-79223458367.5MS223458367.5MS5thGSBON-18-84244668460.0MS144668435.0MS5thGSBON-18-94324458440.0MS324458442.5MS5thGSBON-18-104133759365.0MS133758362.5MS5thGSBON-18-104133759365.0MR133758362.5MSDWRUB 52233547350.0MR233547350.0MRDWRB-92344658460.0MS344658460.0MSDWRB-123233647357.5MR233647355.0MRPL-807243647357.5MR243547352.5MRBH 902152637260.0MR152637260.0MR <th></th> | | | | | | | | | | | |
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| INBON-HI-18-55243758390.0MS243659382.5MS5thGSBON-18-65344668485.0MS344668485.0MS5thGSBON-18-79223458367.5MS223458367.5MS5thGSBON-18-84244668460.0MS144668435.0MS5thGSBON-18-94324458440.0MS324458442.5MS5thGSBON-18-104133759365.0MS133758362.5MS5thGSBON-18-104133759365.0MS133758362.5MS0WRUB 52233547350.0MR233547350.0MR0WRB-92344658460.0MS344658460.0MS0WRB-123233647357.5MR233647355.0MRPL-807243647357.5MR243547352.5MRPL-8011121395.0R11223120.0RBH 902152637260.0MR152637260.0MRBH 946132536247.5MR132536247.5MRRD 2849 | | | | | | | | | | | |
| SthGSBON-18-653446668485.0MS344668485.0MSSthGSBON-18-79223458367.5MS223458367.5MSSthGSBON-18-84244668460.0MS144668435.0MSSthGSBON-18-94324458440.0MS324458442.5MSSthGSBON-18-94324458440.0MS324458442.5MSSthGSBON-18-104133759365.0MS133758362.5MSDWRUB 52233547350.0MR233547350.0MRDWRB-92344658460.0MS344658460.0MSDWRB-123233646352.5MR233647355.0MRPL-807243647357.5MR243547352.5MRPL-8911121395.0R11223120.0RBH 902152637260.0MR152637260.0MRBH 946132536247.5MR132536247.5MRRD 2849263738345.0MR263738345.0MRRD 291713< | | | | | | | 22 | | | | |
| SthGSBON-18-79223458367.5MS223458367.5MSSthGSBON-18-84244668460.0MS144668435.0MSSthGSBON-18-94324458440.0MS324458442.5MSSthGSBON-18-104133759365.0MS133758362.5MSDWRUB 52233547350.0MR233547350.0MRDWRB-92344658460.0MS344658460.0MSDWRB-123233646352.5MR233647355.0MRPL-807243647357.5MR243547352.5MRPL-8911121395.0R11223120.0RBH 902152637260.0MR152637260.0MRBH 946132536247.5MR132536247.5MRRD 2849263738345.0MR263738345.0MRRD 2917132538252.5MR132537250.0MRPL-426567889752.5S467889727.5S | | | | | | | | 36 | | | |
| SthGSBON-18-84244668460.0MS144668435.0MSSthGSBON-18-94324458440.0MS324458442.5MSSthGSBON-18-104133759365.0MS133758362.5MSDWRUB 52233547350.0MR233547350.0MRDWRB-92344658460.0MS344658460.0MSDWRB-123233646352.5MR233647355.0MRPL-807243647357.5MR243547352.5MRPL-8911121395.0R11223120.0RBH 902152637260.0MR132536247.5MRBH 946132536247.5MR132536247.5MRRD 2849263738345.0MR263738345.0MRRD 2917132538252.5MR132537250.0MRPL-426567889752.5S467889727.5S | | | | | | | | | | | |
| SthGSBON-18-94324458440.0MS324458442.5MSSthGSBON-18-104133759365.0MS133758362.5MSDWRUB 52233547350.0MR233547350.0MRDWRB-92344658460.0MS344658460.0MSDWRB-123233646352.5MR233647355.0MRPL-807243647357.5MR243547352.5MRPL-8911121395.0R11223120.0RBH 902152637260.0MR132536247.5MRBH 946132536247.5MR132536247.5MRRD 2849263738345.0MR263738345.0MRRD 2917132538252.5MR132537250.0MRPL-426567889752.5S467889727.5S | | | | | | | | | | | |
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| PL-426 56 78 89 752.5 S 46 78 89 727.5 S | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | 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 croppingseasons (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-1577, 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-1522, 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-1551, BL-1552, BL-1553, BL-1546, BL-1555, BL-1556, BL-1559, BL-1560, BL-1561, BL-1563, BL-1564, BL-1555, BL-1556, BL-1559, BL-1560, BL-1571, BL-1573, BL-1573, BL-1574, BL-1575, BL-1576, BL-1577, BL-1578, BL-1579, BL-1570, BL-1571, BL-1572, BL-1573, BL-1574, BL-1575, BL-1580, BL-1581, BL-1581, BL-1582, BL-1582, BL-1583, BL-1584, BL-1586, BL-1587, BL-1580, BL-1581, BL-1581, BL-1582, BL-1593, BL-1594, BL-1595, BL-1580, BL-1594, BL-1595, BL-1596, 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-1610, BL-1610, BL-1610, BL-1612, BL-1621, BL-1622, BL-1623, BL-1624, BL-1625, BL-1626, BL-1627, BL-1623, BL-1633, BL-1634, BL-1632, BL-1633, BL-1634, BL-1642, BL-1643, BL-1644, BL-1645, BL-1643, BL-1644, BL-1645, BL-1644, BL-1645, BL-1644, BL-1644, BL-1645, BL-1646, BL-1647, BL-1648, BL-1649, BL-1650, BL-1661, BL-1662, BL-1655, BL-1656, BL-1657, BL-1650, BL-1661, BL-1662, BL-1663, BL-1664, BL-1665, BL-1667, BL-1668, BL-1669, BL-1670, BL-1651, BL-1662, BL-1657, BL-1659, BL-1650, BL-1660, BL-1664, BL-1665, BL-1667, BL-1668, BL-1669, BL-1670, BL-1655, BL-1656, BL-1667, BL-1668, BL-1669, BL-1670, BL-1655, BL-1656, BL-1667, BL-1668, BL-1669, BL-1670, BL-1655, BL-1657, BL-1659, BL-1650, BL-1660, BL-1664, BL-1665, BL-1667, BL-1668, BL-1669, BL-1669, BL-1667, BL-1668, BL-1664, BL-1664, BL-1667, BL-1668, BL-1668, BL-1669, BL-1660, BL-1661, BL-1662, BL-1657, BL-1659, BD-1 | 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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