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# Screening of $F_1$ hybrids generated through diallel mating design for bacterial wilt resistance in brinjal under mid-hill conditions of Himachal Pradesh

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**Abstract**

**Bacterial wilt is the most destructive disease in the tropical, subtropical, and temperate regions of the world, causing a heavy economic loss in eggplant. The chemical control of the disease is not effective and the cultivation of bacterial wilt resistant varieties is the only solution to overcome the disease, but cultivated resistant varieties are gradually becoming susceptible to the disease. Thus, an experiment was conducted to screen out twenty $F_1$s developed through diallel mating design along with parents *viz*., Res-1, Res-2, H-8, Arka Nidhi, and Arka Keshav for bacterial wilt resistance under mid-hill conditions of Himachal Pradesh over the seasons. These were categorized according to the Sitaramiah scale (1981) as the observation was recorded on plant survival. The cross combinations were found immune, highly resistant, and moderately resistant to bacterial wilt and can be utilized to develop resistant cultivar(s) through crop improvement.**

**Key words:** Eggplant, diallel, bacterial wilt, categorization.

Eggplant (*Solanum melongena* L.) also known as brinjal and aubergine, is an important vegetable crop of family *Solanaceae*, grown in tropical, subtropical, and temperate regions of the world (Pathania *et al*. 2005, Pathania *et al*. 2007, Sharma *et al*. 2019). Worldwide productivity of eggplant is 26.45 tonnes/ha (Anonymous 2013) which is much higher than its productivity (17.54 tonnes/ha) in India (Anonymous 2018). Bacterial wilt caused by *Ralstonia solanacearum* is the major restrictive factor resulting in low productivity of eggplant in India. The disease is characterized by yellowing of foliage, stunted plant growth, sudden wilting of the plants at the flowering stage, and brownish discoloration of vascular tissues (Santhosha *et al*. 2015). Due to the soil-borne nature and broad host range of the pathogen, conventional management strategies like cultural methods such as crop rotation, adjusting the date of planting are not effective (Bi-hao *et al*. 2009). Chemical control of the disease is not very effective due to high expenses and pesticide residue. Therefore, the development of bacterial wilt resistant varieties is the most successful strategy (Rathore *et al*. 2019) to counter bacterial wilt incidence. Keeping, this under view, the present experiment has been designed to screen eggplant varieties and $F_1$s for bacterial wilt resistance under the mid-hill conditions of Himachal Pradesh.

## Materials and Methods

The experiment was conducted at Vegetable Research Farm, Department of Vegetable Science and Floriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during *kharif,* 2018, and 2019. The experimental farm is located at an altitude of 1290.8 m above mean sea level (amsl) with $32^0$ 6′ North latitude and $76^0$ 3′ East longitude, represents the mid-hill zone of Himachal Pradesh. The location is characterized by a humid and temperate climate with an annual rainfall of 2,500 mm of which 80% is received from June to September. The soil is classified as acidic having a pH ranging from 5.0-5.8. Experimental material consisted of five bacterial wilt resistant parents viz., Res-1 (P1), Res-2 (P2), H-8(P3), Arka Nidhi (P4) and Arka Keshav (P5) and twenty $F_1$s developed through diallel mating design were laid out in randomized block design (RBD) with three replications planted at 60cm×45cm spacing in bacterial wilt sick plots. Inter-cultural operations were carried out as per the recommended package of practices. The number of plants that succumbed due to bacterial wilt was counted at 30, 60 and 90 days after transplanting

and plant survival was calculated using the following formula:

$$\text{Plant survival} = \frac{\text{Number of plants surviving in each entry}}{\text{Total number of plants in the entry}} \times 100$$

Parents and $F_1$ hybrids were categorized according to scale given by Sitaramiah (1981) based on the plant survival (Table 1).

Arka Kusumkar and Pusa Purple Long (PPL) were planted as susceptible check-in between the plots to spread the inoculum throughout the field. Confirmation of bacterial wilted plants was done through a bacterial streaming test (ooze test).

## Results and Discussion

The experiment was conducted in bacterial wilt sick plots as bacterial wilt caused by *Ralstonia solanacearum* is a soil-borne disease. The experimental site is characterized by heavy rainfall from June to September and soil is classified as acidic. In all the cross combinations and parents, no wilt incidence was recorded at 30 days after transplanting during both the years as plant survival was reported to be 100 % (Table 2). Whereas, 60 days after transplanting a few of the cross combinations and parents exhibited some degree of wilt incidence. At 90 days after transplanting, P1×P3, P2×P1, P3×P4, and P2 during both the years and whereas P5×P1 and P3 during 2019 reported more than 1% and less than 10% wilt incidence therefore , classified as highly resistant. P1×P2, P3×P2, P4×P2, P5×P2 during both the years and P3 during 2018 exhibited more than 10 per cent but less than 50 per cent wilt incidence and were classified as moderately resistant. Parents, P1, P4, P5 and cross combinations P1×P4, P1×P5, P2×P3, P2×P4, P2×P5, P3×P1, P3×P5, P4×P1, P4×P3, P4×P5, P5×P3 and P5×P4 during both the years reported no bacterial wilt incidence and were categorized as immune. Susceptible checks were found highly susceptible during both the years. Singh *et al*. (2019) reported PPL as a susceptible variety. Arka Nidhi was found to be a resistant variety (Santhosha *et al*. 2015). Bhavana and Singh (2016) identified two resistant lines to bacterial wilt at 90 DAT with 84 % of plant survival. Kumar *et al*. (2019) categorized genotypes into highly resistant to highly susceptible, depending on the percentage of wilted plants. Magar *et al*. (2016) evaluated the $F_4$ progenies of eggplant that were found tolerant to bacterial wilt. Neelambika *et al*. (2018) identified superior progenies resistant to bacterial wilt in $F_4$ generation in eggplant. Pandiyaraj *et al*. (2019) also categorized the germplasm into immune, resistant, and susceptible based on the wilt percentage or plant survival. Therefore, these cross combinations can be further utilized for crop improvement programme in eggplant for bacterial wilt resistance.

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**Table 1. Scoring of plants for their resistance to bacterial wilt disease as per the scale proposed by Sitaramiah *et al.* (1981)**

| Score | Infection (per cent) | Categories/grouping |
|---|---|---|
| 1. | 0 per cent plant wilted | Immune |
| 2. | 1 to 10 per cent plants wilted | Highly resistant |
| 3. | 11 to 50 per cent plants wilted | Moderately resistant |
| 4. | 51 to 70 per cent plants wilted | Moderately susceptible |
| 5. | 71 to 100 per cent plants wilted | Highly susceptible |

**Table 2. Plant survival and categorization of parents and hybrids according to Sitaramiah Scale 1981**

| | | Plant survival at 30 DAT (%) | | Plant survival at 60 DAT (%) | | Plant survival at 90 DAT (%) | | Reaction | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 | 2018 | 2019 |
| Pa rent | P1 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P2 | 100.00 | 100.00 | 92.68 | 95.83 | 92.68 | 95.83 | Highly resistant | Highly resistant |
| | P3 | 100.00 | 100.00 | 90.32 | 95.83 | 87.09 | 95.83 | Moderately resistant | Highly resistant |
| | P4 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P5 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| $F_1$s | P1×P2 | 100.00 | 100.00 | 93.18 | 75.00 | 86.36 | 75.00 | Moderately resistant | Moderately resistant |
| | P1×P3 | 100.00 | 100.00 | 95.56 | 95.83 | 95.56 | 95.83 | Highly resistant | Highly resistant |
| | P1×P4 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P1×P5 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P2×P1 | 100.00 | 100.00 | 97.56 | 95.83 | 92.68 | 95.83 | Highly resistant | Highly resistant |
| | P2×P3 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P2×P4 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P2×P5 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P3×P1 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P3×P2 | 100.00 | 100.00 | 77.78 | 75.00 | 60.00 | 58.33 | Moderately resistant | Moderately resistant |
| | P3×P4 | 100.00 | 100.00 | 93.33 | 91.67 | 91.11 | 91.67 | Highly resistant | Highly resistant |
| | P3×P5 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P4×P1 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P4×P2 | 100.00 | 100.00 | 86.36 | 83.33 | 86.36 | 83.33 | Moderately resistant | Moderately resistant |
| | P4×P3 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P4×P5 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P5×P1 | 100.00 | 100.00 | 100.00 | 91.67 | 100.00 | 91.67 | Immune | Highly resistant |
| | P5×P2 | 100.00 | 100.00 | 85.00 | 75.00 | 70.00 | 75.00 | Moderately resistant | Moderately resistant |
| | P5×P3 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | P5×P4 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | Immune | Immune |
| | Arka Kusumkar | 86.66 | 92.86 | 53.33 | 52.38 | 13.33 | 0.00 | Highly Susceptible | Highly Susceptible |
| | PPL | 86.66 | 95.24 | 46.66 | 47.62 | 6.66 | 0.00 | Highly Susceptible | Highly Susceptible |

DAT: days after transplanting

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