Evaluation of F_1 crosses of brinjal (*Solanum melongena* L.) landraces for fruit yield, quality and tolerance to bacterial wilt

Abstract

Field experiment was carried out at All India Coordinated Research Project on Vegetable Crops, OUAT, Bhubaneswar, Odisha, India in order to identify the superior F_1 crosses for marketable fruit yield quality and resistance to bacterial wilt. All total 21 F_1 crosses evolved from seven distinctly diverse local landraces of brinjal along with a hybrid check, Mahy Green were evaluated by adopting Randomized Block Design and replicated twice in *rabi* 2021-2022. Results revealed significant variations among various fruit quality attributes (TSS: 4.32 ^{0}Brix to 6.00 ^{0}Brix and ascorbic acid content of fruit: 5.10 mg100g^{-1} to 7.10 mg100g^{-1}), incidence of bacterial wilt (30 DAT: 0.00% to 4.17%, 60 DAT: 0.00% to 12.50% and 90 DAT: 0.00% to 20.83%). Out of 21 crosses, nine cross showed immune reaction to bacterial wilt at 90 DAT. The marketable fruit yield plant^{-1} varied significantly from 1.00 kg to 1.99 kg. The F_1 cross *viz.* BBSR-08-2 × Selection from BBSR-145-1(1.99 kg) recorded significantly highest fruit yield plant^{-1} followed by BBSR-08-2 × BBSR-10-25(1.87 kg) and BBSR-08-2 × BBSR-10-26 (1.81 kg). Thus, it may be concluded that, F_1 crosses obtained from local landraces of brinjal *viz.*, BBSR-08-2 × Selection from BBSR-145-1, BBSR-08-2 × BBSR-10-25 and BBSR-08-2 × BBSR-10-26 may be recommended for higher marketable fruit yield, fruit quality and over all resistance to bacterial wilt for higher profit. These local landraces may also be used for future brinjal improvement programme towards development varieties with higher fruit yield quality and resistance to bacterial wilt.

Key words: Brinjal, F_1 crosses, fruit quality, bacterial wilt

Introduction

Brinjal or eggplant (*Solanum melongena* L. 2n=24) is one of the most cultivated solanaceous fruit vegetable, cultivated predominantly in tropical and sub tropical regions of the world [1]. It is a flexible crop adapted to different agro-climatic regions and can be grown throughout the year. It is an important crop in the tropical regions of world and is being grown commonly in India, China, Turkey, Japan, Italy, Indonesia, Iraq, Syria, Spain and Phillipines [2]. Its immature fruits are generally used as vegetable and other culinary preparations, unripe fruit is essentially consumed as cooked vegetable in various forms and the dried shoots are used as firewood in rural areas. Brinjal is consumed by many ways like salad, bhaji, stuffed brinjal, bhartha, pickles etc., has make the brinjal is more popular vegetables in India. Its fruits are widely consumed in various culinary preparations and are rich source of protective nutrients [3]. Brinjal fruits are rich source of minerals like calcium, phosphorus and magnesium along with fatty acids [4]. Brinjal fruits are also known for its medicinal properties in curing diabetic, asthma, cholera, bronchitis, diarrhea, blood cholesterol [5].

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Although brinjal is cultivated in different parts of India, but the productivity low as the area is majorly covered by 50.0% of OP/HYV and 32.2% of local types against 17.8 % of hybrids [6]. In India, Odisha stands second in brinjal production with share of 16.34% [7]. Odisha being a major producer, the productivity in the state is very low primarily due to prevalence of local landraces which possess low yield potential but greater resistance towards biotic and abiotic stresses along with better fruit quality.

The brinjal cultivation in the state is acutely affected by various biotic and abiotic stresses. Among the biotic stress, bacterial wilt is the most devastating disease in solanaceous vegetable grown in India including Odisha [8]. In brinjal, the disease limits its production from 4.24 to 86.14 per cent Sabita et al. [9] while in hot and humid climate, it can cause up to as high as 100% losses [10]. Recently, this disease has risen to alarming proportion in the plains of India including in state of Odisha due to its severity.

Therefore, there is urgency in brinjal crop improvement programme by proper utilization of local landraces through adoption of appropriate breeding method. In other hand there is a need to exploit heterosis for fruit yield quality attributes of local landraces and to incorporate the bacterial wilt resistance or tolerance with wider adaptability in developed varieties. Keeping these facts in view, the present investigation was carried out for identification of F_1 crosses of local landraces of brinjal for fruit yield, quality and tolerance to bacterial wilt.

Materials and Methods

The present experiment was conducted at All India Coordinated Research Project on Vegetable Crops, OUAT Bhubaneswar, Odisha during *rabi* 2021-2022. Six distinctly divergent local landraces of brinjal *viz*., BBSR-08-02, BBSR-10-25, BBSR-10-26, BBSR-9-6, BSR-195-3 and Selection from BBSR-145-1 and one bacterial wilt susceptible variety, Arka Neelanchal Shyama (ANS) were used in the hybridization programme. The resultant 21 F_1 crosses evolved through half diallel mating (excluding the reciprocals) along with seven parents and one hybrid check Mahy Green of Mahyco Private Limited, India, were evaluated by adopting RBD and replicated twice for fruit yield and fruit quality and reaction to bacterial wilt disease in *rabi* 2021-2022 . Recommended package of practices were adopted uniformly for raising of the crops. Observations were recorded for fruit yield, fruit quality and percentage of incidence of bacterial wilt at 30 days after transplanting (DAT), 60 DAT and 90 DAT. TSS was determined by digital refractometer and expressed in °Brix. The ascorbic acid content of brinjal fruit samples were calculated using the volumetric technique [11]. Wilting percentage at was calculated as per following the formula [12]:

$$W\% = (Nw/Nt) \times 100,$$

Where,

Nw = number of wilted plants

Nt = total number of plants

The individual germplasm was categorized 0-5 scale based on the PDI value [13].

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Scale	Wilting % (PDI)	Disease Reaction
0	No symptoms	Immune
1	1.00 to 20.00	Highly resistant / HR
2	21.00 to 40.00	Moderately resistant/ MR
3	41.00 to 60.00	Moderately susceptible/ MS
4	61.00 to 80.00	Susceptible/ S
5	> 80.00	Highly susceptible/ HS

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All the observed data were subjected to statistical analysis [14].

Results and Discussion

Incidence of bacterial wilt

Bacterial wilt in brinjal is caused by soil–borne pathogen, *Ralstonia solanacearum* (Smith) which belongs to the family β-proteobacteria, non-spore forming, gram negative and rod shaped bacterium. The wilt infection is characterized by sudden wilting of the foliage followed by collapse of the entire plant. The wilting symptoms include dropping and yellowing of leaves, vascular discolouration [15] and stunted plant growth. Drying of the plants at the time of flowering and fruiting are also the symptoms of wilt. A white milky stream of bacterial oozes comes out when the infected cut stem dipped in water is used as the diagnostic symptom for bacterial wilt [16]. The cultural and chemical disease management methods such as soil fumigation, crop rotation, adjustment of planting date and application of chemicals are limited due to its broad distribution, vascular nature, wide host range, great variability and ability to survive in soil and water [17].

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In brinjal incidence of bacterial wilt is a serious problems in many part of world including India. It has been reported that yield loss ranges from 10 to 100% in hot and humid tropical areas with acidic soil [9, 18]. Hence, development of new F_1 cross(es) with resistant or tolerance to bacterial wilt definitely increase yield potential of genotype.

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The data recorded on bacterial wilt incidence at 30 DAT and 60 DAT (Table-1) revealed that, the incidence of bacterial wilt (%) varied from 0.00 to 4.17 and 0.00 to 12.50, respectively. At 30 DAT, all the F_1 crosses exhibited 0.00 or immune reaction to bacterial wilt except BBSR-09-6 × ANS and BBSR-195-3 × ANS (4.17). However, at 60 DAT maximum disease incidence was recorded due to transition from vegetative phase to reproductive phase. At 60 DAT, out of 21 F_1 crosses, 11 crosses exhibited immune reaction to bacterial wilt. Similar reports on peak of bacterial wilt incidence in brinjal was also observed by Antony et al.[19].

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In the present study, the result showed significant variations towards bacterial wilt at 90 DAT ranging from 0.00 to 20.83 under sick plot conditions. Among the F_1 crosses, the crosses *viz.* BBSR-08-2 × BBSR-10-25, BBSR-08-2 × BBSR-10-26, BBSR-08-2 × BBSR-09-6, BBSR-08-2 × BBSR-195-3, BBSR-10-25 × BBSR-10-26, BBSR-10-25 × BBSR-09-6, BBSR-10-26 × BBSR-195-3, BBSR-10-26 × Selection from BBSR-145-1 and BBSR-195-3 × Selection from BBSR-145-1 showed immune reaction to bacterial wilt, which may be used as parent in future stress breeding programme. Bhubaneswar, Odisha is considered as one of the hot spots for bacterial wilt disease mainly due to hot and humid climate and acidic soil [20], so genotype exhibiting immune reaction under this condition will definitely show resistance or tolerance bacterial wilt disease in other location of country.. Similar results were also confirmed by Tripathy et al. [21] under Bhubaneswar conditions. Many of the F_1 crosses showed highly resistance (0.00%) to bacterial wilt because, the cross involving one of the resistant parent contributed to impact high resistance to the disease which was also earlier reported by Khapte et al. [22] and Barik et al. [23] in brinjal. In the F_1 crosses BBSR-195-3 × Selection from BBSR-145-1, the resistance to bacterial wilt might be due to initial suppression of wilt at the time of observation due to requirement of longer incubation period. Similar report was also reported by Gopalkrishnan et al. [13]. The local landraces, BBSR-08-2, BBSR-10-25 and BBSR-10-26 were also reported as immune to bacterial wilt under sick plot of AICRP vegetable crops, OUAT, Bhubaneswar [21].

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Fruit yield

Yield being a complex character affected by various biotic and abiotic factors. In the present investigation, marketable fruit yield refers to the quantity of salable fruit produced excluding the small and borer infested fruits, rotten fruits etc. From economic cultivation of brinjal point of view, the producer always interested to grow resistant/ tolerant variety(ies) with higher marketable fruit yield, as only marketable fruit yield will enhance both productivity and profitability. **A** perusal of data presented in the Table-1 revealed significant variations for marketable fruit yield plant^{-1}. The marketable yield plant^{-1} (kg) varied from 1.00 (BBSR-10-25 × Selection from BBSR-145-1) to 1.99 (BBSR-08-2 × Selection from BBSR-145-1) with a grand mean value of 1.41. Significantly highest fruit yield plant^{-1} (1.99 kg) was recorded by F_1 cross, BBSR-08-2 × Selection from BBSR-145-1 than the rest of the F_1 crosses except BBSR-08-2 × BBSR-10-25 (1.87) where *statistical parity* was observed. Out of 21 F_1 crosses, eight crosses *viz*., BBSR-08-2 × BBSR-10-25, BBSR-08-2 × BBSR-10-26 , BBSR-08-2 × BBSR-09-6, BBSR-08-2 × BBSR-195-3 , BBSR-08-2 × Selection from BBSR-145-1 , BBSR-10-25 × BBSR-195-3, BBSR-10-26 × BBSR-195-3 and BBSR-10-26 × Selection from BBSR-145-1 exhibited higher fruit yield plant^{-1} than the check, Mahy Green (1.41 kg). Similaly, the unmarketable yield plant^{-1} (kg) was highest in BBSR-09-6 × BBSR-195-3 (0.20) as that of minimum in BBSR-08-2 × Selection from BBSR-145-1 and BBSR-08-2 × BBSR-10-26 (0.10). Maurya and Yadav [2] also reported the marketable fruit yield plant^{-1} in brinjal F_1 crosses ranging from 0.97 kg to 2.13 kg. The results are in agreement with the findings of Nirmala et al. [24] and Bajpai et al. [25].

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Fruit quality attributes

TSS (Total Soluble Solids) value affects the taste of the fruit, because it can indicate the level of sweetness of the fruit. TSS is dominated by total sugar content and a small portion of soluble proteins, amino acids and other organic materials [26]. Higher TSS gives the good fruit taste, and consumer preference will be more for such fruits [27]. Observations recorded on TSS revealed significant variations (Table-2). The TSS (^{0}Brix) content of fruit varied from 4.32 (BBSR-195-3 × Selection from BBSR-145-1) to 6.00 (BBSR-08-2 × BBSR-10-26). The maximum TSS content was recorded by the cross BBSR-08-2 × BBSR-10-26 followed by BBSR-08-2 × BBSR-10-25 (5.50), BBSR-08-2 × ANS and BBSR-10-26 × Selection from BBSR-145-1 (5.35). Similar observations on TSS of brinjal fruit have been reported by Tripathy et al. [28] and Koundinya et al. [29]ranging from 3.50 to 4.80 and 4.00 to 6.8, respectively.

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Generally, the higher ascorbic acid content would increase the nutritive value of the fruits, which would help better retention of colour and flavor [30]. Similarly, the ascorbic acid content of fruits (mg100g^{-1}) varied from 5.10 (BBSR-09-6 × Selection from BBSR-145-1) to 7.10 (BBSR-10-26 × BBSR-195-3). The maximum ascorbic acid content was recorded by BBSR-10-26 × BBSR-195-3 closely followed by BBSR-08-2 × BBSR-195-3 (6.73) and BBSR-08-2 × ANS (6.71) where *statistical parity* was observed. Kadivec et al. [31] also reported wide variation for ascorbic acid content in brinjal ranging from 3.36 to 9.27 in brinjal.

Thus it may be concluded from the present study that, out of 21 F_1 crosses obtained from local landraces of Odisha brinjal, the F_1 crosses *viz*., BBSR-08-2 × BBSR-10-25, BBSR-08-2 × Selection from BBSR-145-1 and BBSR-08-2 × BBSR-10-26 may be recommended for commercial cultivation not only due to resistance to bacterial wilt but also significantly higher marketable fruit yield with relatively superior fruit quality attributes. These local landraces may also be used for future brinjal improvement programme towards development varieties with higher fruit yield quality and resistance to bacterial wilt.

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Table-1 ; Performance of F_1 crosses for bacterial wilt incidence, marketable fruit yield and unmarketable fruit yield

Sl No.		% BW incidence at 30 DAT	% BW incidence at 60 DAT	% BW incidence at 90 DAT	Marketable yield plant^{-1} (kg)	Un marketable Yield plant^{-1} (kg)
1	BBSR-08-2 × BBSR-10-25	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.87	0.11
2	BBSR-08-2 × BBSR-10-26	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.81	0.10
3	BBSR-08-2 × BBSR-09-6	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.75	0.13
4	BBSR-08-2 × BBSR-195-3	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.76	0.11
5	BBSR-08-2 × Selection from BBSR-145-1	0.00 (0.71)	0.00 (0.71)	4.17 (1.84)	1.99	0.10
6	BBSR-08-2 × Arka Neelanchal Shyama	0.00 (0.71)	8.33 (2.97)	12.50 (3.55)	1.39	0.13
7	BBSR-10-25 × BBSR-10-26	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.05	0.12
8	BBSR-10-25 × BBSR-09-6	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.29	0.11
9	BBSR-10-25 × BBSR-195-3	0.00 (0.71)	0.00 (0.71)	4.17 (1.84)	1.71	0.10
10	BBSR-10-25 × Selection from BBSR-145-1	0.00 (0.71)	4.17 (1.84)	8.33 (2.97)	1.00	0.13
11	BBSR-10-25 × Arka Neelanchal Shyama	0.00 (0.71)	8.33 (2.97)	12.50 (3.55)	1.19	0.13
12	BBSR-10-26 × BBSR-09-6	0.00 (0.71)	4.17 (1.84)	8.33 (2.97)	1.35	0.15
13	BBSR-10-26 × BBSR-195-3	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.77	0.12
14	BBSR-10-26 × Selection from BBSR-145-1	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.58	0.18
15	BBSR-10-26 × Arka Neelanchal Shyama	0.00 (0.71)	4.17 (1.84)	8.33 (2.97)	1.40	0.14
16	BBSR-09-6 ×BBSR-195-3	0.00 (0.71)	8.33 (2.97)	12.50 (3.55)	1.33	0.20
17	BBSR-09-6 × Selection from BBSR-145-1	0.00 (0.71)	4.17 (1.84)	8.33 (2.97)	1.31	0.14
18	BBSR-09-6 × Arka Neelanchal Shyama	4.17 (1.84)	8.33 (2.97)	12.50 (3.55)	1.34	0.15
19	BBSR-195-3 × Selection from BBSR-145-1	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.37	0.13
20	BBSR-195-3 × Arka Neelanchal Shyama	4.17 (1.84)	12.50 (3.55)	20.84 (4.60)	1.26	0.13
21	Selection from BBSR-145-1 × Arka Neelanchal Shyama	0.00 (0.71)	8.33 (2.97)	16.67 (4.14)	1.24	0.19
22	BBSR-08-2	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.15	0.11
23	BBSR-10-25	0.00 (0.71)	0.00 (0.71)	0.00(0.71)	1.06	0.11
24	BBSR-10-26	0.00 (0.71)	0.00 (0.71)	0.00(0.71)	1.36	0.12
25	BBSR-09-6	0.00 (0.71)	8.33 (2.97)	8.33 (2.97)	1.24	0.15
26	BBSR-195-3	0.00 (0.71)	4.17 (1.84)	4.17 (1.84)	1.57	0.14
27	Selection from BBSR-145-1	0.00 (0.71)	4.17 (1.84)	4.17 (1.84)	1.23	0.17
28	Arka Neelanchal Shyama	12.50 (3.55)	25.00 (5.05)	29.17 (5.43)	1.26	0.12
29	Mahy Green (Check)	0.00 (0.71)	4.17 (1.84)	12.50 (3.55)	1.41	0.15
	GM	0.72 (0.88)	4.02 (1.70)	6.46 (2.16)	1.41	0.13
	SE(m)±	0.32	0.58	0.51	0.06	0.01
	CD (P=05)	0.92	1.67	1.47	0.17	0.04
	CV %	50.46	47.92	33.07	5.82	14.26

*Figures in parenthesis indicates the square root transformed values

Table-2 Performance of F_1 crosses for fruit quality attributes

Sl No.		TSS (^{0}Brix)	Ascorbic acid content (mg100g^{-1})
1	BBSR-08-2 × BBSR-10-25	5.50	6.00
2	BBSR-08-2 × BBSR-10-26	6.00	6.21
3	BBSR-08-2 × BBSR-09-6	5.02	6.09
4	BBSR-08-2 × BBSR-195-3	5.19	6.73
5	BBSR-08-2 × Selection from BBSR-145-1	5.01	6.07
6	BBSR-08-2 × Arka Neelanchal Shyama	5.35	6.71
7	BBSR-10-25 × BBSR-10-26	5.24	6.09
8	BBSR-10-25 × BBSR-09-6	5.06	5.71
9	BBSR-10-25 × BBSR-195-3	5.15	5.92
10	BBSR-10-25 × Selection from BBSR-145-1	5.16	6.28
11	BBSR-10-25 × Arka Neelanchal Shyama	5.15	5.94
12	BBSR-10-26 × BBSR-09-6	5.09	6.13
13	BBSR-10-26 × BBSR-195-3	5.30	7.10
14	BBSR-10-26 × Selection from BBSR-145-1	5.35	5.68
15	BBSR-10-26 × Arka Neelanchal Shyama	4.92	5.88
16	BBSR-09-6 ×BBSR-195-3	5.01	5.35
17	BBSR-09-6 × Selection from BBSR-145-1	5.14	5.10
18	BBSR-09-6 × Arka Neelanchal Shyama	4.98	5.96
19	BBSR-195-3 × Selection from BBSR-145-1	4.32	6.13
20	BBSR-195-3 × Arka Neelanchal Shyama	4.73	5.97
21	Selection from BBSR-145-1 × Arka Neelanchal Shyama	5.22	5.75
22	BBSR-08-2	4.43	5.40
23	BBSR-10-25	4.50	5.00
24	BBSR-10-26	4.29	5.23
25	BBSR-09-6	4.19	4.95
26	BBSR-195-3	4.29	5.01
27	Selection from BBSR-145-1	4.55	4.30
28	Arka Neelanchal Shyama	4.91	5.51
29	Mahy Green (Check)	4.51	5.13
	GM	4.95	5.77
	SE(m)±	0.17	0.25
	CD (P=05)	0.48	0.72
	CV %	4.74	6.10