

Research Article

Intraspecific Hybridization between Non-spiny and Spiny Brinjal for Developing Non-Spiny Brinjal without Deletion of Spiny Brinjal Qualities

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Abstract

An objective to develop Non-spiny brinjal without deletion of quality characters of spiny brinjal for consumers preference and also avoid hitting of spines to harvesters. Spiny brinjal (VRM-1Mullukathiri) is a pure line selection from Elavambadi village of Vellore district of Tamil Nadu. Spines are present in the leaf, stem and calyx of the fruit. VRM-1Mullukathiri is high yielding (30-35 t/h²) and most suitable for North-Eastern Zone of Tamil Nadu. From this cross of Non-spiny x spiny cross combination, the VMB-012-008 was identified for big size fruit with green colour fruits. The crosses were attempted to develop non-spiny brinjal with spiny quality. The both parents of non spiny and spiny are pure for spiny and non spiny respective characters. The crossing percentage is ranged from 7.27 to 14.81 in spiny x non-spiny local type 3 and VRM1spiny x Non-spiny local type 1 respectively and Non-spiny x spiny crossing percentage ranged from 9.23 to 10.74 in Non-spiny type 2 x VRM1 spiny type 2 and non spiny local type 3 x VRM1 spiny type. The germination percentage was observed in parents ranged from 62 to 70 percent while in crosses

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combinations ranged from 68 to 70 percent. Hybrid lethality was very low in 22.05 percent in spiny VRM1 x Non-spiny type 3 and highest in spiny x Non-spiny 1. The hybrid break down was high of 77.95 percent in VRM 1 x non spiny 3 whereas low of 64.29 in spiny VRM1 x Non-spiny 1. The mean value for all the characters were recorded very high in non spiny 1 x spiny VRM1 cross combinations.

Keywords: Brinjal; Crossability; Percentage; Fruitset; Lethality percentage; Hybrid breakdown; Mean value of various characters in F₁

Introduction

The Brinjal (*Solanum melongena* L.) crop belongs to the family Solanaceae, contains 75 genera and over 2000 species. The vegetable crop is considered as a native of India where the majority of domestication of large cultivars happens. The brinjal is one of the most important vegetable used by the consumers in India. Preference for brinjal consumption is varied based on location. Many brinjal types are available in Tamil Nadu. Within 50 kilometers distance consumption of brinjal preference is completely changed. Spiny brinjal having peculiar habit even in maturity stage we can use for culinary purpose. The area for spiny brinjal cultivation is very high northern Tamil Nadu and also this type fetching high price comparatively with other brinjal at the rate of at least Rs. 5 per kg. The market value is also very high in these types. All the spiny brinjal growers happy with spiny brinjal cultivation because of continues demand. The drawback for spiny brinjal is always giving trouble to harvesters. To prevent this problem farmers are requested to scientist to eradicate this type without changing of colour, taste and qualities. Because of enquiries by the farmers through suitable research was started for developing Non spiny type without changing of characters. The research has been started in 2012 at TNAU, Agricultural Research Station, Virinjipuram, Vellore, Tamil Nadu, India.

Materials and Methods

The experimental materials namely VRM1 Spiny brinjal and non spiny local types 1,2,3 were taken for the research. Non spiny brinjal local types and Spiny brinjal variety VRM1 were raised during Rabi 2012-2013 in a crossing block. The direct and reciprocal crosses were affected following the method suggested by Boling et al. (1961) for hybridization [1]. Two types of genotypes comprised of four genotypes (only one pure variety is available in spiny brinjal namely VRM1 used as parent), three local non-spinybrinjal types were used as parents. Spines is present in all the parts of the brinjal plants viz., leaf, stem, leaves veins, peduncle, calyx, pre calyx, deep violet colour flower and ovate in spiny brinjal. Non spiny brinjal is concern the flower is light violet colour and no spines in the brinjal plant parts. The fruit shape is round. The numbers of plants survived over germinated seeds were taken to assess the lethality of F₁ hybrids.

$$\text{Hybrid lethality} = \frac{\text{No. of plants died}}{\text{No. of seeds germinated}} \times 100$$

Hybrid breakdown = Number of seeds taken for germination - Hybrid lethality

The fruit set from the above mentioned crosses were sown in two rows along with one row of male and female parents with a spacing of 75 x 30 cm during rabi season. The following quantitative traits were studied for all F₁ hybrids. Plant height (cm), Number of branches per plant, Length of branches (cm), Days to 50 per cent flowering, Number of flower per plant, Number of fruits per branch, Number of fruits per plant, Fruit weight(g), Fruit length (cm), Number of seeds per fruits, 1000 seed weight (g), Fruit yield per plant (g), Dry matter production and Days to maturity. The observations were recorded on five randomly selected competitive plants of each experimental unit. The crossed seeds from individual plant fruits were collected separately and were sown as F₁s during kharif 2013. Observations for all the quantitative traits were recorded.

Result and Discussion

The result of this parental crosses pertaining to crossability related characters, mean performance of F₁s morphology characters studies were carried out and revealed. The successful direct and reciprocal crosses between three non spiny brinjal 1,2,3 and one spiny brinjal VRM1 and the results were obtained from the following observations namely number of flower emasculated, number of flower crossed, fruit set and crossability percentage presented in Table 1. In this direct cross 250, 225, 275 flowers were emasculated in Non spiny brinjal local types 1,2 and 3 x Spiny brinjal VRM1 and 125, 130,121 flowers crossed from which 15.0, 12.0 and 13.0 numbers of crossed fruits obtained and 12.0, 9.23 and 10.74 fruit set percentage were recorded in above cross combinations respectively. In this reciprocal cross Spiny brinjal VRM1 x Non spiny brinjal local 1,2,3 parents 300, 235 and 210 flowers were emasculated and 135,106 and 110 flowered were crossed from which 20.0,8.0 and 8.0 Numbers of crossed fruits were obtained and 14.81, 7.54 and 7.27 fruit set percentage were recorded respectively (Table 1). Interspecific hybridization in *Vigna* species for many characters agree with this results by Pandiyan et al., [2-9] and in blackgram Pandiyan et al., (2008) [10]. The same results obtained by various others in different crops in soybean [11] in gingelly [12], in mungbean [13], in rice, [14], in pea plant [15], in soybean [16].

In Table 2, the parents and both direct and reciprocal cross combinations the following observations namely number of seeds germinated, hybrid lethality percentage, percentage of hybrid break down, percentage of germination and number of seedlings attained maturity were recorded. 100 seeds from each parent and crosses were used. In the parents from 100 seeds used for germination only 60 to 62 percent of seeds were germinated in non-spiny brinjal types where as in spiny brinjal 70 per cent seed germination was observed. In direct cross for

all non-spiny x spiny cross combinations 68 .00 percent seeds were germinated while reciprocal cross spiny x non spiny 68 to 70 percent seeds were germinated. The hybrid lethality percentage was very low of 22.05 recorded in Spiny brinjal VRM1 x Non-spiny brinjal local 3 where as Spiny brinjal VRM1x Non-spiny brinjal local 1 recorded 35.71 percent. In direct crosses the highest lethality percentage of 33.82 was observed in the Non-spiny brinjal local 1 x Spiny brinjal VRM 1 and lowest of 28.23 percentage recorded in the Non-spiny brinjal local 3 x Spiny brinjal VRM 1. In the reciprocal crosses highest percentage of hybrid lethality of 35.71 percentage in Spiny brinjal VRM1x Non spiny brinjal local 1 while lowest percentage of 22.05 recorded in Spiny brinjal VRM1 x Non-spiny brinjal local 3. In direct cross namely Non-spiny brinjal local 3 x Spiny brinjal VRM 1 recorded 71.77 percent of hybrid break down and lowest of 66.18 percent in Non spiny brinjal local 1 x Spiny brinjal VRM 1 where as in reciprocal crosses highest hybrid breakdown of 77.95 percent recorded in Spiny brinjal VRM1 x Non spiny brinjal local 3 while lowest percentage of 64.29 observed in Spiny brinjal VRM1x Non spiny brinjal local 1. The plants attained maturity after germination is varied among parents and both direct and reciprocal crosses. The plants survived after germination is highest number of 45 in Spiny brinjal VRM1 and non-spiny brinjal type 1 where very lowest of 38 numbers in Non-spiny brinjal local 3. The plants attain maturity after germination among the cross combinations, the highest number of 25 plants survived in Spiny brinjal VRM1x Non spiny brinjal local 1 and lowest of 15.0 in Spiny brinjal VRM1 x Non spiny brinjal local 3. In the direct crosses 23.0 number of plants attained in Non spiny brinjal local 1 x Spiny brinjal VRM 1 and lowest of 19.2 in Non spiny brinjal local 3 x Spiny brinjal VRM 1 in direct cross combinations. In reciprocal crosses a greater number of plants of 25 in Spiny brinjal VRM1x Non-spiny brinjal local 1 while lowest number of 15.0 in Spiny brinjal VRM1 x Non-spiny brinjal local 3. The same kind of results obtained in Interspecific hybridization [2-5] in *Vigna* species for many characters agree with this results [6-9] and in black gram [10].

In Table 3 the Mean performance of parents and hybrids both direct and reciprocal crosses of Non-spiny and spiny VRM1 and cross Non-spiny1 x Spiny VRM1, Non-spiny2 x Spiny VRM1, Non-spiny3 x Spiny VRM1 and Spiny VRM 1 x Non-spiny1, Spiny VRM 1 x Non-spiny2 and Spiny VRM 1 x Non-spiny3.

For various 13 characters like PHT- Plant height (cm), NOB- number of branches, BRL- Branch length (cm), DFF- Days to fifty percent flowering, NFP- Number of fruits per plant, FPL- Fruits peduncle length, CL- Calyx length (cm), FL- Fruit length (cm), FC- Fruit circumference (cm), FW- Average fruit weight (g), FY- Fruit yield per plant (kg), DFM. Days to full maturity (days)

Parents	No. of flowers emasculated	No. of flowers crossed	No. of crossed fruits obtained (fruits set)	% of fruit set or crossability percentage
Non-spiny brinjal local 1 x Spiny brinjal VRM 1	250	125	15.0	12.0
Non-spiny brinjal local 2 x Spiny brinjal VRM 1	225	130	12.0	9.23
Non-spiny brinjal local 3 x Spiny brinjal VRM 1	275	121	13.0	10.74
Spiny brinjal VRM1x Non-spiny brinjal local 1	300	135	20.0	14.81
Spiny brinjal VRM1 x Non-spiny brinjal local 2	235	106	8.0	7.54
Spiny brinjal VRM1 x Non-spiny brinjal local 3	210	110	8.0	7.27

Table 1: The crosses, fruit set and crossability percentage of different crossed parents.

Parents and Crosses	No. of crossed seeds obtained	No. of seeds germinated	Hybrid lethality (%)	% of hybrid break down	% of germination	No. of seedlings attained maturity
Non-spiny brinjal local 1	100	62	-	-	62	45.0
Non-spiny brinjal local 2	100	62	-	-	62	42.0
Non-spiny brinjal local 3	100	60	-	-	60	38.0
Spiny brinjal VRM1	100	70	-	-	70	45.0
Non-spiny brinjal local 1 x Spiny brinjal VRM 1	100	68	33.82	66.18	68	23.0
Non-spiny brinjal local 2 x Spiny brinjal VRM 1	100	68	30.88	69.12	68	21.0
Non-spiny brinjal local 3 x Spiny brinjal VRM 1	100	68	28.23	71.77	68	19.2
Spiny brinjal VRM1x Non- spiny brinjal local 1	100	70	35.71	64.29	70	25.0
Spiny brinjal VRM1 x Non- spiny brinjal local 2	100	68	30.88	69.12	68	21.0
Spiny brinjal VRM1 x Non- spiny brinjal local 3	100	68	22.05	77.95	68	15.0

Table 2: Germination percentage of parents and F1 hybrids for direct and reciprocal crosses

Parents /Crosses	1.PHT	2.NO	3.BRL	4.DFF	5.NFP	6.FPL	7.CL	8.FL	9.FC	10.AFW	11.FY	12.DFM
Non-spiny local type1.	85.0	13.0	65.2	75.0	25.0	4.0	3.0	5.0	8.5	32.0	1.2	150
Non-spiny local type 2.	80.0	10.2	62.5	68.0	24.5	3.2	2.8	4.8	7.2	30.2	1.0	140
Non-spiny local type3.	84.5	12.0	65.0	66.0	23.5	3.0	2.5	4.7	8.3	32.3	1.3	145
Spiny VRM1	90.5	14.6	78.0	70.0	24.3	4.3	3.0	5.0	9.9	40.8	1.3	150
Non-spiny 1.x Spiny VRM1	88.5	15.3	75.3	78.0	35.0	4.3	3.0	5.3	10.7	46.5	1.8	150
Non-spiny 2.x Spiny VRM1	85.3	14.3	72.5	78.0	34.5	4.2	3.0	5.2	10.2	43.2	1.8	140
Non-spiny 3.x Spiny VRM1	86.5	14.0	75.0	76.0	33.5	4.0	2.8	5.1	10.3	42.3	1.7	145
Spiny VRM1 x Nonspiny1.	92.5	15.6	82.0	72.0	34.3	4.5	3.0	5.6	10.9	46.8	1.9	150
Spiny VRM1 x Non-spiny2.	90.2	15.7	79.5	75.0	33.4	3.8	2.8	5.3	10.5	45.2	1.8	145
Spiny VRM1 x Non-spiny3.	89.5	16.2	73.5	72.0	32.4	3.9	2.9	5.2	10.3	43.2	1.8	145

1. Plant height (cm) 2. Number of branches per plant 3. Length of branches 4. Days to first flowering 5. No. fruits per plant 6. Fruit peduncle length (cm) 7. Calyx length (cm) 8. Fruit length (cm) 9. Fruit circumference (cm) 10. Average fruit weight (g) 11. Fruit yield per plant (kg) 12. Days to full maturity (days)

Table 3: Mean performance of parents and hybrids both direct and reciprocal crosses.

In Plant height (cm), Non-spiny1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 85.0, 80.0, 84.5 and 90.5 respectively. In the cross Non-spiny1 x Spiny VRM1 (88.5), Non-spiny 2 x Spiny VRM1 (85.3), Non-spiny3 x Spiny VRM1 (86.5) and Spiny VRM 1 x Non-spiny1 (92.5), Spiny VRM 1 x Non-spiny2 (90.2) and Spiny VRM 1 x Non-spiny3 (89.5) Number of branches per plant, in the parental species Non-spiny 1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 13.0,10.2,12.0 and 14.6 respectively. In the cross Non-spiny1 x Spiny VRM1 (15.3), Non-spiny2 x Spiny VRM1 (14.3), Non-spiny3 x Spiny VRM1 (14.0) and Spiny VRM 1 x Non-spiny1 (15.6), Spiny VRM 1 x Non-spiny2 (15.7) and Spiny VRM 1 x Non-spiny3 (16.2). Length of branch (cm), in the parental species Non-spiny1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 65.2,62.5,65.0 and 78.0 respectively. In the cross Non-spiny1 x Spiny VRM1 (75.3), Non-spiny2 x Spiny VRM1 (72.5), Non-spiny3 x Spiny VRM1 (75.0) and Spiny VRM 1 x Non-spiny1 (82.0), Spiny VRM 1 x Non-spiny2 (79.5) and Spiny VRM 1 x Non-spiny3 (73.5) Days to first flowering, in the parental species Non-spiny 1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 75.0, 68.0, 66.0 and 70.0 respectively. In the cross Non-spiny1 x Spiny VRM1 (78.0), Non-spiny2 x Spiny VRM1 (78.0), Non-spiny3 x Spiny VRM1 (76.0) and Spiny VRM 1 x Non-spiny1 (72.0), Spiny VRM 1 x Non-spiny2 (75.0) and Spiny VRM 1 x Non-spiny3 (72.0) Number of fruits per plant, in the parental species Non-spiny1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of

25.0,24.5,23.5 and 24.3 respectively. In the cross Nonspiny 1 x Spiny VRM1 (35.0), Non-spiny2 x Spiny VRM1 (34.5), Non-spiny 3 x Spiny VRM1 (33.5) and Spiny VRM 1 x Non-spiny1 (34.3), Spiny VRM 1 x Non-spiny2 (33.4) and Spiny VRM 1 x Non-spiny 3 (32.4). The fruit peduncle length (cm), in the parental species Non-spiny 1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 4.0,3.2,3.0 and 4.3 respectively. In the cross Non-spiny1 x Spiny VRM1 (4.3), Non-spiny2 x Spiny VRM1 (4.2), Non-spiny3 x Spiny VRM1 (4.0) and Spiny VRM 1 x Non-spiny1 (4.5), Spiny VRM 1 x Non-spiny2 (3.8) and Spiny VRM 1 x Non-spiny3 (3.9) Calyx length cm, in the parental species Non-spiny 1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 3.0, 2.8, 2.5 and 3.0 respectively. In the cross Non-spiny1 x Spiny VRM1 (3.0), Non-spiny2 x Spiny VRM1 (3.0), Non-spiny3 x Spiny VRM1 (2.8) and Spiny VRM 1 x Non-spiny1 (3.0), Spiny VRM 1 x Non-spiny2 (2.8) and Spiny VRM 1 x Non-spiny3 (2.9) Fruit length cm, in the parental species Non-spiny 1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 5.0, 4.8, 4.7 and 5.0 respectively. In the crosses, Non-spiny1 x Spiny VRM1 (5.3), Non-spiny2 x Spiny VRM1 (5.2), Non-spiny3 x Spiny VRM1 (5.1) and Spiny VRM 1 x Non-spiny1 (5.6), Spiny VRM 1 x Non-spiny2 (5.3) and Spiny VRM 1 x Non-spiny3 (5.2). Fruits circumference (cm) for this trait in the parental species Non-spiny1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 8.5, 7.2, 8.3 and 9.9 respectively. In the cross Non-spiny1 x Spiny VRM1 (10.7), Non-spiny2 x Spiny VRM1 (10.2), Non-spiny3 x Spiny VRM1 (10.3) and Spiny VRM

1 x Nonspiny1 (10.9), Spiny VRM 1 x Non-spiny2 (10.5) and Spiny VRM 1 x Non-spiny3 (10.3) Average fruit weight (g) in the parental species Non-spiny 1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 32.0, 30.2, 32.3 and 40.8 respectively. In the cross Non-spiny1 x Spiny VRM1 (46.5), Non-spiny2 x Spiny VRM1 (43.2), Non-spiny3 x Spiny VRM1 (42.3) and Spiny VRM 1 x Non-spiny1 (46.8), Spiny VRM 1 x Nonspiny2 (45.2) and Spiny VRM 1 x Non-spiny3 (43.2) Fruit yield (g) in the parental species Non-spiny 1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 1.2, 1.0, 1.3 and 1.3 respectively. In the cross Non-spiny1 x Spiny VRM1 (1.8), Non-spiny2 x Spiny VRM1 (1.8), Non-spiny3 x Spiny VRM1 (1.7) and Spiny VRM 1 x Non-spiny1 (1.9), Spiny VRM 1 x Non-spiny2 (1.8) and Spiny VRM 1 x Non-spiny3 (1.8) Days to full maturity, in the parental species Non-spiny 1, Non-spiny 2 and Non-spiny 3 and Spiny VRM1 registered highest value of 150,140,145 and 150 respectively. In the cross Non-spiny1 x Spiny VRM1 (150), Non-spiny2 x Spiny VRM1 (85.3), Non-spiny3 x Spiny VRM1 (140) and Spiny VRM 1 x Non-spiny1 (145), Spiny VRM 1 x Non-spiny2 (90.2) and Spiny VRM 1 x Non-spiny3 (150). This result agrees with Interspecific hybridization in *Vigna* species for many characters [2-5] in *Vigna* species for many characters agree with this result [6-9] and in blackgram [10]. Mean performance in interspecific progenies of brinjal [17]. The same result was obtained in different vegetable crops [18-20] and observed in brinjal crop [21-26]. Amirthanayagam (2001) [27] reported in okra (*Abelmoschus esculentus* (L.) Moench.). The same result of qualitative transformation was observed in *Solanum melongena* L. [28-30] and [31] Rao and Kumar (1980).

Botanical and morpho- agronomic description of New crossed line Non-spiny brinjal VMB -012-008

- Non-spiny brinjal VMB -012-008 is a cross derivative of Non-spiny Brinjal local 1 x VRM-1 Spiny brinjal of Thiruvannamalai and Vellore Districts, Tamil Nadu, India.
- Spines are absent in the leaf, stem and calyx of the fruit but the quality of the fruit remains same as VRM-1 Spiny Brinjal.
- It is cluster bearing in nature. Non spiny nature. Fruits are oval in shape, glossy green colour in colour
- It is of medium duration (140- 150days)
- Average single fruit weigh is 365 g
- Length of the fruit 15 cm and girth is 28.6 cm
- Number of fruits per plant is 10-12
- Yield per plant (Kg) 3.5 to 4.5
- Yield per ha (Kg) 45 to 50 tons
- Flesh content is more and seed content is less. Suitable for all types of culinary preparations, especially highly suitable for preparations of side dish to biryani, Main dish like sambar, vathalkushambu, poriyal and highly suitable for baggy for evening snacks
- Performs well under wide range of soil with good drainage facility and suitable to cultivate in all three seasons (Kharif, Rabi and summer)
- Tolerant to drought conditions and high temperature prevailing during summer months.
- It is found to be highly resistant to little leaf incidence and moderately resistant to Tobacco Mosaic Virus (TMV) and fruit and shoot borer
- Increased yield over check (%) 15.32

Conclusion

The crossing between the Non-spiny brinjal local 1 x Spiny brinjal VRM1 had well expressed almost all quantitative and qualitative characters in the new brinjal culture. The culture name has been given as VMB-012-008. It is green colour medium to big size fruits preferred by the consumers. Out of the best performing crosses, this cross had consecutively performed well over generations for growth, yield and non-spiny nature. This new brinjal culture can be used as donor in the appropriate breeding programme for developing non spiny brinjal types with retaining original native spiny brinjal taste in terms of quality.

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