Studies on genetic variability and associations of Fruit and Shoot Borer Infestation for yield attributing traits in transgressive segregating populations of brinjal (*Solanum melongena* L.)

Abstract

Significant variability is available in the F_2 population of brinjal. Top crosses of brinjal Bilichandu badane × mullu badane produced from F_1 generation were in augmented design at ZARS Shimogga in Kharif 2017. They have several characteristics of plant breeding significance with sufficient scope for added improvement to growing conditions. The F_2 study showed significant variation for nine quantitative traits. Close estimates between GCV and PCV values indicated lesser influence of environmental factors on the expression of traits under study. In this investigation, the proportion of genetic contribution of high GCV, PCV coupled with high broad sense heritability and genetic advance to the overall phenotypic expression of the studied traits like number of fruits per plant, number primary branches, number of flowers per plant was high, indicating predominant control of additive genes, and these traits could be improved upon by selection without progeny testing. High magnitude of heritability for most of the characters suggested the progress of improvement in yield and its components.Differences in mean values of parents for various characters indicated involvement of diverse parents in the crosses studied.The F_2 plants exceeded either of the parents for most of the characters, which seems to be due to transgressive segregation.

Introduction:

Brinjal (*Solanum melongena* L,) is one of the mostcommon, widespread and principal vegetable crops grown in India and is also considered as the king of vegetables. The crop is highly productive and known as the poor man's crop. It belongs to the family *Solanaceae* and is native of Indo-Burma region and China (Vavilov, 1926). It stands second in area and production after China and occupies an area of 6.69lakh hectares with an annual production of 124.01 lakh metric tonnes and average productivity of 19 tonnes per hectare (Anonymous, 2016). Brinjal occupies an area of 15.8 thousand hectares with an annual production of 4.03 lakh metric tonnes and productivity of 25.4 tonnes per hectare in Karnataka.

Brinjal or eggplant is a perennial but grown commercially as annual crop. Inflorescence is often solitary but some time it constitutes a cluster of 2-5 flowers. Solitary or

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clustering nature of inflorescence is a varietal character. Flower is complete and hermaphrodite. Heterostyly is a common feature, and fruit setting flower consist of long (70-86.7%) and medium styled (12-55.6%) flower. The non-fruit setting flowers consist of short styled and pseudo styled. It ranks fair in nutritional value (carbohydrates, proteins, and fiber). It is an essential source of carbohydrate (4.0 g), protein (1.4 g), fiber (1.3 g), vitamin-A (124 IU), phosphorus (47 mg), potassium (2.0 mg) and iron (0.3 mg) and recommended for diabetes, asthma, cholera, bronchitis and it protects the brain cell membranes from damage.

Material and methods:

The field experiment under present investigation was conducted with top two crosses from F_1 including 1 check fromPrivate company seeds, Shivamogga. Crosses were made between as line × testes, among them, top crosses were selected.

This experiment was conducted at ZAHRS, Shivamogga. The experimental material consisted of the F_2 population and checks. Sowing was carried out at 3rd week of July 2017. The seedlings were transplanted in main field after 22 days at a spacing of 90 cm between rows and 60 cm between plant to plant. The crop was raised by following recommended package of practices.

Portrays were filled with a mixture of vermicompost and coco peat; seeds were sown and watered. These portray were covered with black polythene to build up humidity for better and early germination of seeds. After germination, polythene cover was removed, and watering was done either in the morning or evening hours. The main field was prepared to fine tilt by repeated ploughing and harrowing, and the FYM @ 25 t/ha was incorporated into the soil. Ridges and furrows were prepared at a spacing of 90 cm. Seedlings were planted on ridges at a spacing of 60 cm (*Anon.*, 2012). A total of 24 plants were planted on each ridge with a plot area of 6.75 m^2. A healthy crop was laid by adopting standard agronomic practices.

Observations were recorded from all plants. The characters studied were days to first flowering, plant height (cm), number of primary branches per plant, number of flowers/plant, fruit length (cm), fruit width (cm), number of fruits/plant, number of fruits per cluster, fruit yield/plant (kg).

Results and discussion:

Phenotypic coefficient of variation

The PCV estimates were relatively high for numbers of flowers, number of fruits per cluster, number of primary branches, number of fruits per plant. This indicates the higher magnitude of variability present in the populations. Moderate PCV values were observed plant height, fruit yield per plant, fruit length. Low values of PCV were observed for days to first flowering followed by fruit width (cm). Present results are in accordance with high PCV for number of fruits per cluster (Lokesh *et al*., 2013), number of primary branches (Muniappan *et al*., 2010, Lokesh *et al*., 2013, Arunkumar *et al*., 2014), number of fruits (Sherly and Shanthi., 2008, Reena and Mehta., 2009, Muniappan *et al*., 2010, Arunkumar *et al*., 2014, Samlindsujin *et al*., 2017), moderate PCV, fruit yield per plant (Ansari *et al*., 2010), fruit lenght (Ansari., 2010), low PCV for Days to first flowering (Ansari., 2010). (Table.1.)

Genotypic coefficient of variation

High values of GCV were observed for a number of primary branches per plant followed by a number of flowers and number of fruits per plant. This indicates the higher magnitude of variability present in the populations. Moderate GCV values were observed for a number of fruits per cluster and plant height. Low values of GCV were observed for days to first flowering followed fruit length, days to 50 percent flowering, fruit width and fruit yield per plant. Present results are in accordance with high GCV for number of primary branches per plant (Muniappan *et al*., 2010, Arunkumar *et al*., 2014), number of fruits per plant (swaroop and sharma., 2000, Negi *et al*., 2000, Samlindsujin *et al*., 2017, Sherly and Shanthi., 2008 and Muniappan *et al*., 2010), moderate GCV for number of fruits per cluster (Ansari.,2000), low GCV fruit yield per plant(das and Mishra., 1995 and Ansari., 2000).

The difference between PCV and GCV estimates indicates the relative influence of environment on the characters, which in turn decides the extinct of their heritability. If the difference for any character is low, the environmental effect is low, and hence it results in high heritability, while wide differences between PCV and GCV indicate considerable influence by the environmental factors leading to low heritability estimates. In the population, Bilichandu badane × Mullu badane high heritability was observed for all the characters studied like number of primary branches per plantfollowed by days to first flowering, plant height, fruit width, number of flowers and number of primary branches per plant and low heritability observed for fruit length, number of fruits per cluster and fruit yield per plant. Present results are in accordance with high heritability for plant height (Rajeshkumar *et al.*, 1998, Lolesh *et al*., 2013), fruit width and fruit yield per plant (Muniappan *et al.*, 2010., Samlindsujin *et al* 2017), numbers of branches per plant (Muniappan *et al.*, 2010), number of

flowers per plant (kumar *et al* ., 2000), fruit width (Samlindsujin *et al*., 2017), number of fruits per plant (Samlindsujin *et al* 2017), low heritability for fruit length (Ansari., 2010), number of fruits per clusters (Ansari., 2010).

Genetic Advance as percent mean (GAM)

In the population Bilichandu badane × Mullu badane, high GAM was observed for number of primary branches followed for number of flowers per plant, number of fruits per plant and plant height. Moderate GAM was observed for days to first flowering, number of fruits per cluster. Low heritability coupled with GAM was observed for days to 50 percent flowering, fruit width, fruit length, fruit yield per plant.Present results are in accordance with genetic advance as per cent mean for plant height Lokesl *et al*. (2013), number of fruits per plant Ansari *et al*. (2010), Muniappan *et al*. (2010), number of primary branches Samlindsujin *et al*. (2017), Nayak and Nagre (2013). Moderate for number of fruits per cluster Ansari *et al*. (2010). Low for days to first flowering (Ambade., 2008) got contrasting results for days to first flowering.

The descriptive statistical parameters *viz.*, Mean, Range, Skewness, And Kurtosis with respect to all the nine characters in F_2 generation of cross of Brinjal *viz.*, Bilichandu badane × Mullu badane are presented in Table.2.

Platykurtic and positively skewed distribution suggested the involvement of relatively large number of segregating genes with majority of them having decreasing effects and dominance based complementary type of interaction in the inheritance of number of flowers

Table 1 Estimates of genetic variability parameters for yield and its attributing traits in F_2 generation of Cross Bilichandu badane × Mullu badane

Sl. No.	Characters	Co-efficient of variation		h^2 bs (%)	GAM (%)
		PCV (%)	GCV (%)		
1	Days to first flowering	9.00	8.32	85.32	15.82
2	Plant height (cm)	14.46	13.05	81.51	24.27
3	Number of flowers per plant	26.31	20.66	61.70	33.43
4	Number of fruits per cluster	49.86	19.16	14.77	15.17
5	Number of primary branches	46.60	43.15	85.73	82.30
6	Fruit yield per plant (g)	13.47	3.855	08.20	2.27
7	Number of Fruits per plant	26.25	20.59	61.50	33.25
8	Fruit width (cm)	6.083	4.87	64.15	8.03
9	Fruit length (cm)	16.25	7.62	21.97	7.35

Table 2: Descriptive statistics for nine characters in F_2 generation of cross Bilichandu badane × Mullu badane

Sl. No.	Characters	Mean of Bilichandu badane	Mean of Mullu badane	Mean of F_2	Range		Skewness	Kurtosis	Kurtosis Type
					Min.	Max.			
1	Days to first flowering	50.00	45.00	50.20	37.00	57.00	-0.46	-0.89	P
2	Plant height (cm)	73.20	87.80	84.27	53.00	120.0	-0.02	0.36	P
3	Number of flowers per plant	31.00	27.80	27.19	18.00	49.00	0.04	0.38	P
4	Number of fruits per cluster	1.00	2.00	1.00	1.00	5.00	1.93	4.49	L
5	Number of primary branches	1.60	5.60	4.57	4.00	12.00	0.77	0.27	P
6	Fruit yield per plant (g)	1047.22	1108.00	1123.23	615.15	2765.28	1.43	3.08	M
7	Number of Fruits per plant	31.00	27.80	27.18	20.00	49.00	0.04	0.40	P
8	Fruit width (cm)	4.31	3.07	4.38	3.23	5.17	-0.49	3.07	M
9	Fruit length (cm)	5.71	5.87	6.65	4.54	10.85	0.40	0.41	P

per plant, number of primary branches per plant, number of fruits per plant, fruit length (cm) exhibiting this kind of inheritance. Maximizing the genetic gain in respect of the traits with positively skewed distribution requires immense selection from the existing variability (Roy, 2000). However, negatively skewed platykurtic distribution is evidence for the involvement of a large number of dominant genes with the majority of them having increasing effects and duplicate type of epistasis in the inheritance of days to first flowering, plant height. These traits have evolved with dominance and dominance based duplicate epistasis which helps to protect the individual plant from deleterious alleles arising from existing variability (Roy, 2000). Positively skewed leptokurtic distribution suggested the involvement of a relatively fewer number of segregating genes with the majority of them having decreasing effects in the inheritance of a number of fruits per cluster.

Table 3 : Top ten transgressive segregant obtained for number of fruits per plant, fruit yield per plant in F_2 generation of Bilichandu badane × Mullu badane.

Sl.No	Plant number	Number of fruits per plant	Fruit yield per plant (g)
1	P-7	29	2929.85
2	P-31	26	1732.76
3	P-54	28	1857.95
4	P-69	24	1592.53
5	P-93	41	2765.28
6	P-116	30	2023.38
7	P-155	23	1190.57
8	P-158	24	1266.85
9	P-178	20	1059.47
10	P-189	28	1749.17

Transgressive segregants are that genotype, which surpassed the limits of both the parents in desirable direction for any of the character in segregating generations, especially in

F_2 generation. Combinations of favourable genes (positive alleles) from different parents and additive gene action are the main reasons for the occurrence of transgressive segregants.

The significant superior performance of segregants may be due to the contribution of some component characters. Plant number 7 exhibited highest fruit yield per plant which may be due to contribution of component characters like number of fruits per plant, number of primary branches and fruit yield per plant. While the superior performance of plant number 93 due to component traits like number of fruits per plant, number of flowers per plant, plant height and fruit yield per plant. Whereas superior performance of plant number 116 may be due to component traits like number of fruits per plant, number of flowers per plant, plant height, fruit length and fruit yield per plant.

Table 4 : The degree of resistant or susceptible to fruit borer infestation was assigned as per the scale F_2 of cross Bilichandu badana × Mullu badane

Reaction	Plants
Tolerant(≤15)	101
Moderately tolerant (16-25%)	78
Susceptible (26-40%)	17
Highly susceptible(≥40%)	4

Based on the fruit borer 200 F_2 plants of Bilichandu badane × Mullu badane were classified in to resistant, tolerant susceptible and very susceptible.

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5.5.1. Reaction to Fruit borer reaction.

Among the 200 F_2 plants 101, 78, 17 and 4 plants recorded as tolerant, moderately tolerant susceptible and very susceptible respectively for fruit borer. In general, it was observed that the incidence of fruit borer increased with the age of the crop. Generally in vegetative phase population was comparatively less in all the plants than near maturing crop. Similar results were reported by Nirmala and Irene (2016) supports present investigation.

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Conclusion:

The present investigation leads to the identification of superior promising individual plants in F_2 segregating generation in the cross Bilichandu badane × Mullu badane. It would be worthwhile to evaluate the performance of progenies derived from desirable transgressive segregants in future generations for their further use in breeding programmes.

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