Journal of Crop and Weed, 9(2):172-176(2013)

Identification of parameters for selection of superior brinjal genotypes under healthy and fruit and shoot borer (*Leucinodes orbonalis* Guen.) infested conditions

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Received: 29-09-2012, Revised 21-11 -2013, Accepted: 25-11-2013

ABSTRACT

This investigation was carried out with fifteen brinjal genotypes during 2008-10 to examine the direct and indirect effects of different growth and yield characters on yield of healthy and Leucinodes orbonalis infested genotypes through path analysis. Observations on growth and yield attributing characters viz. plant height, stem girth, number of twigs plant^{-1}, number of secondary branches, total number of twigs plant $^{-1}$, number of leaves plant $^{-1}$, length of leaf, leaf breadth, fruit length, fruit breadth, fruit stalk length, fruit stalk diameter, fruit volume, number of fruits plant $^{-1}$ and fruit weight plant $^{-1}$ were recorded for the study. Simple correlation studies of these parameters with yield under two conditions revealed that fruit number per plant had the highest significant positive correlation followed by fruit stalk length and fruit length in both the cases. Partitioning of correlation values through path analysis study showed that fruit stalk length and fruit length in both the cases exhibited direct significant positive and negative effect on fruit yield, respectively. It was evident from the results that fruit stalk length and fruit number per plant should be given priority when selection for the varietal improvement would be taken up even from both fields.

Key words: Brinjal genotypes, *Leucinodes orbonalis* and path analysis

Brinjal or aubergine is an important crop of West Bengal and India as well. It has wide climatic adaptability and is grown in almost all sorts of climates except severe winter. Fruit and shoot borer (*Leucinodes orbonalis* Guen.*)* of brinjal (*Solanum melongena* L.) is a serious pest right from the foot hills of the Himalayas to the coastal saline belts of West Bengal and seriously hampers plant growth and fruit yield to a considerable extent incurring a huge economic loss to the growers; it can cause a crop loss to the extent of 70% even after repeated insecticidal spray (Singh and Pandita, 2009). It attacks the crop throughout its life cycle. No conclusive control measure of brinjal fruit and shoot borer (BFSB) is still available. There is hardly any brinjal genotype that shows immunity or high degree of field resistance to BFSB. So, one can rarely think of any selection of superior brinjal genotypes based on direct or indirect influence of yield attributing characters from a BFSB – free field situation. No attempt has yet been made to identify common yield attributing character(s) helping selection of superior type(s) from brinjal germplasm pools with low to high degree of BFSB infestation, with or without pesticidal loads. India being the place of origin of brinjal (Bhaduri,1951; Vavilov, 1951) has pool of germplasms with a great deal of variability. The selection with respect to desired character could be made possible from the cafeteria of such genotypic variability. There are reports by many earlier workers of varietal resistance to BFSB (Senapati, 2003, Gill and Chadha, 1979, Mukhopadhayay and Mandal, 1994).

Fruit yield is an interactive resultant of many growth variables and yield attributing characters. The superiority of a genotype can not be ascertained by its yield performance *per se* but the parameters that directly or indirectly influence yield should be considered for a rewarding selection. So to identify the main yield attributing character(s) that would be instrumental for selection of superior genotypes, grown under both healthy and BFSB infested conditions, the present study was undertaken. It is not emphatically clear from the introducing paragraph as to why one should think for selection from BFSB infested plants.

MATERIALS AND METHODS

Two sets of experiment involving a healthy plant block (with plant protection measures against BFSB) and a BFSB affected block (natural occurrence without plant protection) were carried out during the spring-summer seasons of 2008-10 at the Regional Reseach Station, Coastal Saline Zone, Kakdwip (21"32' to 22"40' N latitude and 87"30' to 89" E longitude with a mean sea level of 7m), South 24 Pargans, West Bengal, India. The esperimental soil was sandy loam with organic matter – 0.57%, bulk density -1.25g $^{-1}$ cm, sand – 18.6 %, silt – 38.5 % , clay – 40.9 %, pH - 6.5, EC - 2.0dsm^{-1}, available N – 175 kg $^{-1}$, available P – 15.2 kg $^{-1}$ ha, available K - 504.7 kg $^{-1}$ ha,. The experiments were laid out in RBD with three replications, involving 15 diverse genotypes *viz.* KB-13, Sagar Local, KS-224, Pusa Kranti, Shyamal, Pusa Purple Long, AB-1, B-B-16-2, Madanpur Local, KB-22, Milky White, Puli, KS-223, Muktajhuri and Orissa Green. The plants were spaced at 90 x 90 cm. and recommended cultural practices were followed (Bose and Som, 1986). Protected plots were

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sprayed alternately with Padan (Cartaf hydrochloride 50% SP) @ 1 g $^{-1}$ and Dursban (Chlorpyriphos 20% EC) @ 3 ml $^{-1}$ of water at 15 days interval starting from seven days after transplanting. Path analysis was done on growth and yield characters (Table-1). Observations were recorded on the basis of average performance of five plants plot $^{-1}$. Eight morphological and seven yield attributing characters were recorded separately from both the sets of experiments (pest infested without measures against BFSB and protected). Statistical analysis was done by the help of SPSS software.

RESULTS AND DISCUSSION

Simple correlation co-efficient of growth and yield attributes of fifteen brinjal genotypes were worked out separately for healthy and BFSB infested conditions (Table -1). The results of the experiment indicated that the fruit number per plant, fruit stalk length and fruit length in healthy, and twig number per plant, additionally, in fruit and shoot borer infested conditions exhibited significant positive correlation with fruit weight per plant. But the degree of correlation was much higher in fruit number per plant than others. It is obvious and predictable that number of fruits per plant would have positive contribution towards yield. The results obtained here, were in agreement with the findings of Sharma *et al.* (1985) and Behera *et al.* (1998).Yield is the resultant effect of direct, indirect, positive and negative contributions of many growth and yield attributes and may be influenced by biotic stress (Panja *et al.*, 2008). To identify the parameter(s) having maximum direct and indirect contributions towards yield, path analyses were done for both healthy (Table - 2) and fruit and shoot borer infested (Table-3) blocks by partitioning correlation values of different growth variables and yield components with fruit yield per plant.

Under healthy condition, fruit stalk length showed the highest positive direct contribution towards yield including exertion of significant positive indirect contribution via twig number per plant, plant height and fruit stalk diameter (Table-2). As the fruit length exhibited significantly higher direct maximum negative effect towards yield and the fruit stalk length and fruit no. per plant via this parameter showed significant indirect negative contribution towards yield, so fruit length should be kept out of consideration during selection. It is apparent from the result that fruit stalk length not only had significant direct contribution on yield but other two parameters namely fruit number per plant and fruit length did contribute much towards yield via this parameter. So, fruit stalk length appeared to be an important parameter for direct or indirect selection of brinjal genotypes under healthy condition.

Under fruit-shoot borer infested condition, fruit number per plant and fruit stalk length had direct significant positive contribution to yield (Table-3). The former made significant positive contribution to yield via fruit stalk length. The strong direct contribution of fruit stalk length to yield was influenced negatively by indirect contribution of fruit length and stem girth. Fruit length had direct negative effect on fruit yield but such an effect was counteracted by the significant positive effect of fruit stalk length. Twig number per plant did not have any direct contribution to yield. In spite of indirect significant negative effect of twig number per plant on yield via plant height, it exerted significant indirect positive influence on yield through stem girth. For direct selection of a genotype from shoot borer infested condition, fruit number per plant and fruit stalk length should be given emphasis but the latter could be considered for indirect selection also.

However, comparing the results of path analysis, between the healthy and BFSB infested plants, it can be concluded that fruit stalk length is the most important parameter for selection of genotypes from fruit-shoot borer infested and uninfested genotypes.

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Table 1: Correlations among different growth and yield characters of healthy and brinjal fruit and shoot borer infested eggplant.

		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
X_2	H	0.828**														
	I	0.861**														
X_3	H	0.905**	0.773**													
	I	0.892**	0.901**													
X_4	H	0.632*	0.522*	0.794**												
	I	0.578*	0.653**	0.741**												
X_5	H	0.589*	0.490	0.690**	0.900**											
	I	0.439	0.581*	0.577*	0.878**											
X_6	H	0.028	-0.216	0.017	-0.050	-0.011										
	I	-0.230	-0.493	-0.349	-0.315	-0.213										
X_7	H	-0.320	-0.100	-0.447	-0.630*	-0.469	-0.330									
	I	-0.180	-0.004	-0.165	-0.572*	-0.391	-0.016									
X_8	H	-0.102	-0.066	-0.288	-0.453	-0.388	0.036	0.615*								
	I	0.023	-0.203	-0.180	-0.407	-0.332	-0.287	0.429								
X_9	H	-0.234	-0.062	-0.076	0.257	0.334	-0.069	-0.042	-0.304							
	I	-0.279	-0.003	-0.093	0.118	0.348	0.138	0.101	-0.376							
X_{10}	H	0.258	0.175	0.230	-0.006	0.033	0.079	0.210	0.457	-0.659**						
	I	0.298	0.136	0.275	0.048	0.004	-0.029	0.134	0.507	-0.636**						
X_{11}	H	-0.108	-0.060	-0.013	0.336	0.274	-0.252	-0.129	-0.198	0.793**	-0.480					
	I	-0.170	-0.035	-0.002	0.186	0.308	0.036	0.031	-0.247	0.829**	-0.435					
X_{12}	H	0.520*	0.294	0.544*	0.452	0.494	0.231	-0.251	0.131	-0.403	0.771**	-0.177				
	I	0.461	0.273	0.468	0.532*	0.484	-0.041	-0.379	0.201	-0.394	0.738**	-0.180				
X_{13}	H	0.027	0.135	0.132	0.199	0.220	0.155	0.019	0.184	-0.078	0.689**	0.061	0.666**			
	I	0.473	0.436	0.513*	0.602*	0.517*	-0.002	-0.344	0.084	-0.093	0.538*	-0.017	0.759**			
X_{14}	H	0.018	0.185	0.128	0.268	0.262	-0.309	-0.009	-0.227	0.667**	-0.523*	0.571*	-0.412	-0.285		
	I	0.080	0.268	0.200	0.193	0.335	0.030	0.161	-0.331	0.596*	-0.343	0.577*	-0.291	-0.166		
X_{15}	H	0.246	0.218	0.289	0.125	0.238	0.130	0.201	0.405	-0.298	0.882**	-0.209	0.790**	0.791**	-0.337	
	I	0.321	0.212	0.347	0.205	0.275	0.081	0.076	0.425	-0.285	0.869**	-0.180	0.804**	0.721**	-0.242	
Y	H	0.192	0.328	0.332	0.386	0.424	-0.202	0.078	-0.002	0.498	0.061	0.509	0.121	0.306	0.754**	0.332
	I	0.218	0.362	0.416	0.357	0.488	0.068	0.118	-0.178	0.493	0.120	0.554*	0.164	0.318	0.811**	0.317

Note: H = Healthy; I = Fruit and shoot borer Infested; * = Significant at 5% level, ** = Significant at 1% level. r_{tab} 0.05= 0.51 , r_{tab} 0.01 = 0.641.
[X_1= Plant height (cm), X_2= Stem girth (mm), X_3=Primary branches, X_4=. Secondary branches, X_5=. Twig no. /plant, X_6= Leaf no. /plant, X_7=. Leaf length (cm), X_8= Leaf breadth (cm), X_9 = Fruit length (cm), X_{10}= Fruit breadth (cm), X_{11}=Fruit stalk length (cm), X_{12}= Fruit stalk diameter (mm), X_{13}= Fruit volume (cc), X_{14}=Fruit no. /plant, X_{15}= Average fruit weight (g) , Y = Average non-infested fruit yield].

Table 2: Path analysis showing direct and indirect effects of different attributes on fruit yield of healthy brinjal plants.

Parameters	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	Yxy
X_1. Plant height (cm)	**-6.69****	1.98**	4.62**	-2.66**	3.63**	0.06	-0.22	-0.02	1.45**	0.22	-0.56*	-0.67**	-0.02	0.00	0.06	0.19
X_2. Stem Girth (mm)	-5.54**	**2.39****	3.94**	-2.20**	3.01**	-0.47	-0.07-	-0.01	0.38	0.15	-0.31	-0.94**	-0.11	0.04	0.06	0.33
X_3. Primary branches	-6.05**	1.84**	**5.10****	-3.34**	4.25**	0.04	-0.30	-0.05	0.47	0.20	-0.07	-1.74**	-0.11	0.03	0.08	0.33
X_4. Secondary branches	-4.23**	1.25**	4.05**	**-4.20****	5.54**	-0.11	-0.43	-0.09	-1.59**	-0.01	1.73**	-1.45**	-0.16	0.06	0.03	0.39
X_5. Twig no./plant	-3.94**	1.17**	3.52**	-3.79**	**6.16****	-0.02	-0.32	-0.07	-2.07**	0.02	1.41**	-1.58**	-0.18	0.06	0.06	0.42
X_6. Leaf no./plant	-0.19	-0.52*	0.09	0.21	-0.07	**2.19****	-0.22	0.01	0.43	0.07	-1.30**	-0.74**	-0.13	-0.07	0.03	-0.20
X_7. Leaf length (cm)	2.14**	-0.24	-1.28**	2.65**	-2.89**	-0.72**	**0.68****	0.12	0.26	0.18	-0.66*	0.80**	-0.02	0.00	0.05	0.09
X_8. Leaf breadth (cm)	0.68**	-0.16	-1.47**	1.91**	-2.39**	0.08	0.42	**0.19**	1.89*	0.40	-1.02**	-0.42	-0.15	-0.06	0.11	0.00
X_9. Fruit length (cm)	1.56**	-0.15	-0.39	-1.08**	2.06**	-0.15	-0.03	-0.06	**-6.20****	-0.57*	4.08**	1.30**	0.06	0.14	-0.08	0.51*
X_{10}. Fruit breadth (cm)	-1.73**	0.41	1.17**	0.03	0.20	0.17	0.14	0.09	4.09**	**0.87****	-2.47**	-2.47**	-0.56*	-0.11	0.23	0.06
X_{11}. Fruit stalk length (cm)	0.72**	-0.14	-0.07	-1.41**	1.71**	-0.55*	-0.09	-0.04	-4.92**	-0.42	**5.15****	0.57*	-0.05	0.12	0.05	0.53*
X_{12}. Fruit stalk diameter(mm)	-3.48**	0.70**	2.78**	-1.90**	3.04**	0.51*	-0.17	0.02	2.50**	0.67**	-0.91**	**-3.20****	-0.55*	-0.09	0.21	0.12
X_{13}. Fruit volume (cc)	-0.18	0.32	0.67**	-0.84**	1.35**	0.34	0.01	0.03	0.48	0.60*	0.31	-2.13**	**-0.82****	-0.06	0.21	0.31
X_{14}. Fruit no./plant	-0.12	0.44	0.65**	-1.13**	1.61**	-0.68**	-0.01	-0.05	-4.14**	-0.45	2.94**	1.32**	0.23	**0.21**	-0.09	0.75**
X_{15}. Avg. fruit weight (g)	-1.65**	0.52*	1.47**	-0.53*	1.46**	0.28	0.28	0.13	0.08	1.85**	0.76**	-1.08**	-2.53**	-0.65**	**-0.07**	0.33

Residual effect = 0.13 Diagonal elements are direct and off-diagonal elements are indirect effects.* Significant at 5% (r = 0.51), ** Significant at 1% level (r = 0.64)

Table 3: Path analysis showing direct and indirect effects of different yield attributes on yield of fruit and shoots borer infested brinjal.

Parameters	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	Y_{xy}
X_1. Plant height (cm)	-1.63**	1.60**	0.33	-0.29	0.01	-0.12	0.12	0.00	0.24	-0.02	-0.15	-0.10	-0.11	0.05	0.27	0.22
X_2. Stem Girth (mm)	-1.41**	**1.85****	0.34	-0.33	0.02	-0.26	0.00	0.00	-0.03	0.00	-0.03	-0.06	-0.10	0.18	0.18	0.36
X_3. Primary branches	-1.46**	1.67**	**0.38**	-0.37	0.02	-0.19	0.11	-0.02	0.08	-0.02	0.00	-0.10	-0.12	0.14	0.30	0.42
X_4. Secondary branches	-0.94**	1.21	0.28	**-0.50**	0.03	-0.17	0.39	-0.04	-0.10	0.00	0.16	-0.11	-0.14	0.13	0.18	0.36
X_5. Twig no./plant	-0.72**	1.08**	0.22	-0.44	**0.03**	-0.11	0.27	-0.03	-0.30	0.00	0.28	-0.10	-0.12	0.23	0.23	0.51*
X_6. Leaf no./plant	0.38	-0.91**	-0.13	0.16	-0.01	**0.54***	0.01	0.03	-0.12	0.00	0.03	0.01	0.00	0.02	0.07	0.07
X_7. Leaf length (cm)	0.29	-0.01	-0.06	0.29	-0.01	-0.01	**-0.68****	0.04	-0.09	-0.01	0.02	0.08	0.08	0.11	0.06	0.12
X_8. Leaf breadth(cm)	-0.04	-0.38	-0.08	0.20	-0.01	0.15	-0.29	**0.09**	0.33	-0.03	-0.21	-0.04	-0.02	-0.23	0.36	-0.18
X_9. Fruit length(cm)	0.46	-0.01	-0.03	-0.06	0.01	0.07	-0.07	-0.04	**-0.87****	0.04	0.74**	0.08	0.02	0.41	-0.24	0.52*
X_{10}. Fruit breadth(cm)	-0.49	0.25*	0.10	-0.02	0.00	-0.02	-0.09	0.05	0.55*	**-0.06**	-0.37	-0.16	-0.13	-0.24	0.74**	0.12
X_{11}. Fruit stalk length (cm)	0.28	-0.65*	-0.00	-0.09	0.01	0.02	-0.02	-0.02	-0.72**	0.03	**0.86****	0.04	0.00	0.40	-0.15	0.55*
X_{12}. Fruit stalk diameter(mm)	-0.75**	0.51*	0.18	-0.27	0.01	-0.02	0.26	0.02	0.34	-0.05	-0.15	**-0.21**	-0.18	-0.20	0.69**	0.16
X_{13}. Fruit volume (cc)	-0.77**	0.81**	0.19	-0.30	0.02	0.00	0.23	0.01	0.08	-0.03	-0.01	-0.16	**0.24**	-0.11	0.62*	0.32
X_{14}. Fruit no./plant	-0.13	0.50	0.08	-0.10	0.01	0.02	-0.11	-0.03	-0.52*	0.02	0.94**	0.06	0.04	**0.69****	-0.21	0.81**
X_{15}. Avg. fruit weight (g)	-0.52**	0.39	0.13	-0.10	0.01	0.04	-0.05	0.04	0.25	-0.06	-0.15	-0.17	-0.17	-0.17	**0.85****	0.32

Residual effect = 0.046; Diagonal elements are direct and off-diagonal elements are indirect effects. * Significant at 5% (r = 0.51), ** Significant at 1% level (r = 0.64)