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CORRELATION AND PATH COEFFICIENT ANALYSIS STUDIES ON PHYSICOMORPHIC RESISTANCE ATTRIBUTING CHARACTERS IN BRINJAL GENOTYPES AGAINST SHOOT AND FRUIT BORER *LEUCINODESORBONALIS* (GUENEE.)

Ch. Chinnabbai[1], S. Dayakar[2], A. Sujatha[1], P. Anil Kumar[3], S.K. Nafeez Umar[4] and V. Sekhar[5]

[1]Department of Entomology, Dr YSR HU, Venkataramannagudem, India
[2]Department of Entomology, Agricultural College, Rajamahendravaram, India
[1]Department of Entomology, Dr. YSRHU, Venkataramannagudem, India
[3]Department of Plant Pathology, Agricultural College, Bapatla, India
[4]Department of Statistics and Computer Applications, Agricultural College, Bapatla, India
[5]Department of Statistics, College of Horticulture, Venkataramannagudem, India
Email : samithch@gmail.com

ABSTRACT

Physicomorphiccharacteristics of leaf, shoot and fruit of sixty brinjal genotypes and their association with shoot and fruit borer infestation was studied at college of Horticulture, Venkataramannagudem during kharif 2017-18 in augmented block design.The per cent shoot infestation showed positive and highly significant correlation with shoot thickness (r = 0.9403), significantly high negative correlation with trichomes on leaf lamina (r = -0.9755) and trichomes on shoot (r = -0.9484). Shoot thickness, trichomes on leaf lamina and trichomes on shoot have direct negative effect on per cent shoot infestation. The per cent fruit infestation showed positive correlation with fruit length (r = 0.9403), fruit diameter (r = 0.9755), pedicel length (r = 0.0009), plant height (r = 0.1966), number of branches (r = 0.1921) and plant spread (r = 0.0379) while a significant and negative correlation with calyx length (r = -0.3298). Fruit length, fruit diameter, pedicel length, plant height and number of brancheshad positive direct effect (0.0835, 0.2657, 0.0519, 0.1479, 0.2345) on per cent fruit infestation whilecalyx length, plant spread had direct negative effect (-0.3332, -0.1969) on per cent fruit infestation. The magnitude of negative direct effect found to be more than that of positive direct effect. Trichomes on leaf showed highly significant negative correlation with shoot infestation whereas calyx length showed highly significant negative correlation with fruit infestation.

Keywords : *Brinjal, correlation, path analysis.*

Brinjal or Eggplant [*Solanum melongena* L.] belongs to the family Solanaceae which is one of the most important commercial vegetable crops in the world, especially in the tropics and subtropics (1). It is being grown extensively in India, Bangladesh, Pakistan, China, Philippines. India is the second major producer of brinjal in the world after China. Among the major pests infesting the crop, shoot and fruitborer is the most limiting factor distributed all through the brinjal growing regions of India and fruit damage due to the pest was reported from 30% to 100% in different states in general and up to 70% in Andhra Pradesh in particular (2).

Different management approaches like cultural, host plant resistance, biological, chemical etc. are integrated to minimize the damage of the pest on the crop. The most important and effective way to manage an insect pest is the use of host plant resistance mechanism. IPM system along with host plant resistance is yielding promising and encouraging resultsand hence, development of insect resistant varieties is a potential objective of the crop scientists.

Some varieties of brinjal exhibit marked physico-morphic characteristics which enhance durable resistance against *L. orbonalis*. Egg plant varieties with hairy leaves and prickles on stem restricted the movement of larvaeresulted in lowest percentage of fruit infestation (3). Oviposition and larval infestation of brinjal shoot and fruit borer was inhibited by dense pubescence on leaves. Cuticle thickness and trichomes have always been the key factors in host plant resistance mechanisms (4). Development of high yielding as well as shoot andfruit borer tolerance cultivar of brinjal requires knowledge ofexisting genetic variation and also the extent of associationamong plant characters and their relationship with resistance against shoot and fruit borer (5).

Correlation and path co-efficient analysis are the important biometrical technique to determine the characters contributing in host plant resistance. The characters that are positively correlated with levels of infestation are of considerably important to plant breeder for selection purpose.

Correlation coefficient analysis assesses the mutual relationship between plant characters and establishes the components upon which selection is to be done for improvement in development of resistant/tolerant variety. Path co-efficient analysis reveals the direct and indirect effect of various componentsthus providing understanding of the direct and indirect contribution of each character towards resistance.

In the light of the above scenario, the present study was undertaken with the specific objective to investigate the relationship between physicomorphic resistance attributing characters in brinjal genotypes and level of shoot and fruit borer infestation.

MATERIALS AND METHODS

The present experiment was conducted at college of Horticulture, venkataramannagudem during kharif 2017-18. Sixty genotypes and three check cultivars of brinjal were screened against shoot and fruit borer in augmented block design.The seedlings were transplanted in the main field at 35-40 DAS in a single row of 5m length with a spacing of 70 cm x 60 cm. The checks were planted in a randomized manner after every eight test genotypes in each block. Recommended agronomic package of practices were adopted for raising the crop excluding the plant protection measures.Five plants were tagged in each genotype and checks at random. Observations were recorded on morphological characters such as trichome density on leaf lamina, trichome density on shoot, shoot thickness (cm), plant height (cm), number of branches per plant, plant spread, length of pedicel, length of calyx, length of fruit, diameter of fruit, fruit colour and fruit shape. The shoot infestation was recorded by counting the healthy as well as infested shoots (withered tender shoots) from randomly tagged plants of each genotype and checks at fortnightly intervals from 15 days after transplantation to final harvest. Mean per cent shoot infestation of each genotype was calculated. Data on fruit infestation was recorded from the randomly tagged plants of each genotype at each harvest. The per cent fruit infestation was worked out on number basis.

Genotypic and phenotypic correlation coefficients were estimated according to the formula (6). The significance of the phenotypic and genotypic correlation coefficients was tested as given by (7). Path coefficient analysis suggested by (8) was used to calculate the direct and indirect contribution of various traits responsible to shoot and fruit infestation.

RESULTS AND DISCUSSION

Correlation coefficient between physicomorphic characters of shoot and shoot infestation : In the present study, correlation coefficient computed among six characters in all possible combinations at phenotypic and genotypic levels has been presented in Table-1. In general, the magnitude of genotypic correlation coefficient was higher than the corresponding values of the phenotypic correlation coefficientsuggesting a strong inherent relationship in different pairs of characters in brinjal genotypes.

The per cent shoot infestation showed positive and highly significant correlation with shoot thickness (r = 0.9403), significantly high negative correlation with trichomes on leaf lamina (r = -0.9755), significantly high negative correlation with trichomes on shoot (r = -0.9484), non-significant correlation with plant height (r =0.1899), number of branches (r = 0.2395) and plant spread (r = 0.0557).

Shoot thickness and plant height are significantly and positively correlated with shoot infestation whereas non-significant positive correlation was observed with number of branches and plant spread. Shoot thickness and trichomes on leaf lamina, trichomes on shoot showed highly significant negative correlation.

Trichomes on leaf lamina showed highly significant positive correlation with trichomes on shoot whereas non significant negative correlation was observed with plant height, number of branches and plant spread. Trichomes on shoot showed non significant negative correlation with plant height, number of branches and plant spread. Plant height showed positive and highly significant correlation with number of branches and plant spread among them.

Path coefficient analysis between physicomorphic characters of shoot and shoot infestation : Path coefficient is a standardized partial regression coefficient which splits the correlation coefficient into the measures of the direct and indirect effects of a set of independent variables on the dependent variable. This analysis provides a method for separating out the direct and indirect effect of causal factors which affect the shoot infestation.

The correlation coefficients between shoot, leaf and plant characters were further partitioned into direct and indirect effects are presented in Table-2.

The results indicated that, the character shoot thickness had negative direct effect (-0.0763) on per cent shoot infestation. Its indirect effects via trichomes on leaf lamina,trichomes on shoot, number of branches and plant spread were positive, while its indirect effect via plant height was negative.

Trichomes on leaf lamina had negative direct effect (-0.8376) on per cent shoot infestation. Its indirect effects via shoot thickness and plant height are positive while indirect effects via trichomes on shoot, number of branches and plant spread are negative.

Trichomes on shoot had negative direct effect (-0.2197) on per cent shoot infestation. Its indirect effects via shoot thickness and plant height were positive while indirect effects via trichomes on leaf lamina, number of branches and plant spread were negative. In the current studies, the trichomeson leaf lamina seem to have asignificant role towards non preference for oviposition.

Table-1 : Genotypic and phenotypic correlation between physicomorphic characters of shoot and shoot infestation caused by *Lorbonalis.*

Character	Shoot thickness	Trichomes on leaf lamina	Trichomes on shoot	Plant height	Number of branches	Plant spread
Shootthickness	1.0000					
Trichomes on leaf lamina	-0.9650**	1.0000				
Trichomes on shoot	-0.9383**	0.9508**	1.0000			
Plant height	0.2633*	-0.2105	-0.1839	1.0000		
Number of branches	0.2363	-0.2020	-0.2045	0.5562**	1.0000	
Plant spread	0.0382	-0.0380	-0.0249	0.5693**	0.5421**	1.0000
Per cent shoot infestation	0.9403**	-0.9755**	-0.9484**	0.1899	0.2395	0.0557

**Significance at 1% level, *Significance at 5% level

Table-2 : Genotypic and phenotypic path coefficient analysis between physicomorphic characters and shoot infestation caused by *Lorbonalis***.**

Character	Shoot thickness	Trichomes on leaf lamina	Trichomes on shoot	Plant height	Number of branches	Plant spread
Shoot thickness	-0.0763	0.0736	0.0715	-0.0201	-0.0180	-0.0029
Trichomes on leaf lamina	0.8083	-0.8376	-0.7964	0.1764	0.1692	0.0318
Trichomes on shoot	0.2062	-0.2089	-0.2197	0.0404	0.0449	0.0055
Plant height	-0.0135	0.0108	0.0094	-0.0511	-0.0284	-0.0291
Number of branches	0.0149	-0.0127	-0.0129	0.0350	0.0630	0.0341
Plant spread	0.0006	-0.0006	-0.0004	0.0093	0.0088	0.0163
Total correlation with per cent shoot infestation	0.9403**	-0.9755**	-0.9484**	0.1899	0.2395	0.0557

Underlined Figures show direct effects Residual effect : 0.1998, **Significant at 1% level, *Significant at 5% level

Correlation between physicomorphic characters of fruit and fruit infestation in brinjalgenotypes : Correlation between seven characters (fruit and plant) was worked out in all possible combinations at phenotypic and genotypic levels as shown in Table 3. The per cent fruit infestation showed positive correlation with fruit length (r = 0.9403), fruit diameter (r = 0.9755), pedicel length (r = 0.0009) while a significant and negative correlation with calyx length (r = -0.3298), positive correlation with plant height (r = 0.1966), number of branches (r = 0.1921) and plant spread (r = 0.0379).

Fruit length showed non-significant and positive correlation with fruit diameter (r = 0.1494) and pedicle length (r = 0.2006) whereas non-significant and negative correlation was seen with calyx length (r = -0.0044), plant height (r = -0.1669), number of branches (r = -0.0424) and plant spread (r = -0.1343). Fruit diameter showed non-significant and positive correlation with calyx length (r = 0.0362) whereas non-significant negative correlation was observed with pedicel length (r = -0.1394), plant height (r = -0.1394), number of branches (r = -0.1081) and plant spread (r = -0.0112).

Pedicel length showed non-significant positive correlation with calyx length (r = 0.2196) and plant height (r = 0.1320). Significant positive correlation was observed with number of branches(r = 0.3093) and plant spread (r = 0.2516).Calyx length showed non-significant positive correlation with number of branches (r = 0.0052) whereas non-significant negative correlation was observed with plant height (r = -0.2234) and plant spread (r = -0.0738). Plant height had positive and highly significant correlation with number of branches (r =0.5562) and plant spread (r = 0.5693).Number of branches showed positive and highly significant correlation with plant spread (r = 0.5421).

Path coefficient analysis between physicomorphic characters of fruit and fruit infestation : The correlation coefficients between different fruit characters were further partitioned into direct and indirect effects and are presented in Table-4.

The results indicated that, the fruit length had positive direct effect (0.0835) on per cent fruit infestation. Its indirect effects via fruit diameter (0.0397), pedicel length (0.0104), calyx length (0.0015), plant spread (0.02640 were positive. Its indirect effects via plant height (-0.0247), number of branches (-0.0099) were negative. Fruit diameter had direct positive effect (0.2657) on per cent fruit infestation. Its indirect effects via fruit length (0.0125), plant spread (0.0022) was positive. Its indirect effects via pedicel length (-0.0072), calyx length (-0.0121), plant height (-0.0247) and number of branches (-0.0099) were negative.

Pedicel length had positive direct effect (0.0519) on per cent fruit infestation. Its indirect effects via fruit length (0.0167), plant height (0.0195) and number of branches

Table-3 : Genotypic and phenotypic correlation matrix between physico-morphic characters and fruit infestation caused by *L.orbonalis.*

Character	Fruit length	Fruit diameter	Pedicel length	Calyx length	Plant height	Number of branches	Plant spread	Per cent fruit infestation
Fruit length	1.0000							
Fruit diameter	0.1494	1.0000						
Pedicel length	0.2006	-0.1394	1.0000					
Calyx length	-0.0044	0.0362	0.2196	1.0000				
Plant height	-0.1669	-0.1394	0.132	-0.2234	1.0000			
Number of branches	-0.0424	-0.1081	0.3093*	0.0052	0.5562**	1.0000		
Plant spread	-0.1343	-0.0112	0.2516*	-0.0738	0.5693**	0.5421**	1.0000	
Per cent fruit infestation	0.1268	0.2151	0.0009	-0.3298**	0.1966	0.1921	0.0379	1.0000

**Significant at 1% level, *Significant at 5% level.

Table-4 : Genotypic and phenotypic path coefficient analysis between physicomorphic characters and fruit infestation caused by *L. orbonalis.*

Character	Fruit length	Fruit diameter	Pedicel length	Calyx length	Plant height	Number of branches	Plant spread
Fruit length	0.0835	0.0125	0.0167	-0.0004	-0.0139	-0.0035	-0.0112
Fruit diameter	0.0397	0.2657	-0.037	0.0096	-0.037	-0.0287	-0.003
Pedicel length	0.0104	-0.0072	0.0519	0.0114	0.0068	0.016	0.0131
Calyx length	0.0015	-0.0121	-0.0732	-0.3332	0.0744	-0.0017	0.0246
Plant height	-0.0247	-0.0206	0.0195	-0.033	0.1479	0.0823	0.0842
Number of branches	-0.0099	-0.0254	0.0725	0.0012	0.1304	0.2345	0.1271
Plant spread	0.0264	0.0022	-0.0495	0.0145	-0.1121	-0.1067	-0.1969
Total correlation with per cent fruit infestation	0.1268	0.2151	0.0009	-0.3298**	0.1966	0.1921	0.0379

Underlined Figures show direct effects Residual effect: 0.8693, **Significant at 1% level, *Significant at 5% level

(0.0725) were positive while indirect effects via fruit diameter (-0.037), calyx length (-0.0732) and plant spread (-0.0495) were negative. Calyx length had direct negative effect (-0.3332) on per cent fruit infestation. Its indirect effects via fruit diameter (0.0096), pedicel length (0.0114), number of branches (0.0012) and plant spread (0.0145) were positive while its indirect effects via fruit length (-0.0004), plant height (-0.0330) were negative.

Plant height had direct positive effect (0.1479) on per cent fruit infestation. Its indirect effects via pedicel length (0.0068), calyx length (0.0744) and number of branches (0.1304) were positive. Its indirect effects via fruit length (-0.0139), fruit diameter (-0.037) and plant spread (-0.1121) were negative. Number of branches had direct positive effect (0.2345) on per cent fruit infestation. Its indirect effects via pedicel length (0.016) and plant height (0.0823) were positive while its indirect effects via fruit length (-0.0035), fruit diameter (-0.0287), calyx length (-0.0017) and plant spread (-0.1067) were negative.

Plant spread had direct negative effect (-0.1969) on per cent fruit infestation. Its indirect effects via pedicel length (0.0131), calyx length (0.0246), plant height (0.0842), number of branches (0.1271) were positive and its indirect effects via fruit length (-0.0112) and fruit diameter (-0.003) were negative.

The path coefficient analysis in the present study revealed that the highest magnitude of positive direct effect on per cent fruit infestation was exerted by fruit diameter (0.2657) followed by number of branches (0.2345) and plant height (0.1479). It indicates that selection of a genotype based on fruit diameter would result in an appreciable improvement in reduction of per cent fruit infestation. The negative direct effect on shoot infestation was shown by trichomes on leaf (-0.8376), trichomes on shoot (-0.2197) whereas on fruit infestation was shown by calyx length (-0.3332) and plant spread (-0.1969). The magnitude of negative direct effect found to be more than that of positive direct effect. Trichomes on leaf showed highly significant negative correlation with shoot infestation whereas calyx length showed highly significant negative correlation with fruit infestation.

This indicated that the trichomes on leaf, calyx length of fruit should be taken as an important parameter during the selection of a resistant or tolerant genotype. Fruit diameter was not only found to have maximum direct effect on per cent fruit infestation, but it also contributed substantial positive indirect effect for fruit length (0.0125) followed by plant spread (0.0022). Therefore, during selection, these characters should also be taken into consideration.

Some of these characters were studied by other workers and are discussed for further confirmation. Long, wide calyx and heavy weighted fruit were highly correlated to susceptibility of shoot and fruit borer infestation (9). Resistant brinjal genotypes had thicker fruit skin and less fruit girth were the resistant characters against shoot and fruit borer (10). Fruit characters viz., length and diameter of fruit, pericarp thickness as well as fruit colour of brinjal genotypes had no exact impact on the preference of fruit borer, whereas a positive correlation with fruit infestation and length of pedicel and calyx was observed (11).

Fruit length (r = -0.6400), fruit diameter(r = 0.7475), calyx length (r = 0.6897) showed significantly positive correlation with per cent fruit infestation (12). A positive and strong correlation with fruit girth (r = 0.638), pedicel length (r = 0.444) and fruit numbers (r = 0.014), but negatively strong correlation with fruit length (r = -0.343). The calyx diameter and fruit diameter has significant positive association with fruit infestation. Fruit infestation was positively but not significantly correlated with length of pedicel (r = 0.059) and calyx (r = 0.057) (13). The genotype ABSR-2 produced maximum yield, less shoot and fruit infestation, lowest pedicel and calyx length could be used as resistant cultivar for further shoot and fruit borer resistance breeding programme (14). Fruit length (r = 0.2340, calyx length (r = o.437), pedicel length (r = 0.388) showed positive correlation with per cent fruit infestation (15). Correlation Coefficient indicated that shape index has significant negative association with fruit infestation (r = 0.32), whereas thickness of mesocarp was positive and significantly correlated (r = 0.511) (16).

The present findings are more or less corroborating with the above reports. However, the set of genotypes used were different from that used in the study. It was found in the present study that among the sixty genotypes of brinjal, IC 136061 showed moderately resistant response against shoot and fruit borer infestation owing to the characters like high trichome density, purple colour, oblong fruit and other physicomorphic traits.

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