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***Short Communication***

# Phenotypic trait association studies in brinjal upon drought stress

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## ABSTRACT

**Eggplant is popularly known as poor man's vegetable. With respect to present situation of climatic challenges, fruit yield of eggplant is reduced due to drought or moisture stresses. In view of this condition, an experiment was aimed to study character association between yield and yield components in eggplant. The resultant outcome from correlation analysis computed among nine eggplant characters indicated that traits like plant height and total plant length at harvesting, fruit length and number of fruits per plant significantly correlated with fruit yield per plant. Whereas, traits like plant height and total plant length observed at harvesting stage, number of days for flower initiation, number of primary branches, fruit length and average fruit weight were significantly associated with fruit yield per plant under moisture stressed condition.**

**Keywords:** Brinjal, drought, fruit yield, moisture stress and phenotypic correlation.

Brinjal is one of the most important solanaceous vegetables next to tomato, potato and chilli. Brinjal is enriched with high net content of nutrients like carbohydrates, proteins, and edible good fats, along with some minerals, vitamins, antioxidants and secondary metabolites. Eggplant is basically originated from India during 300 B.C. to 300 A.D. and distributed all across the country. Brinjal is economically grown as annual crop though it is a perennial plant. Eggplant mainly bears gradient violet big solitary flower but some cultivars or species bears clustered inflorescence with variable tinge color with five petals, five sepals, five stamens and variable length of stigma *i.e.,* long styled, medium styled and short styled flowers.

Eggplant is hardy crop and even sustains prolonged stress periods but many studies have been reported there was decrease in fruit yield upon increased moisture deficiency. In eggplant upon increased drought there would be sequential decrease in fruit length, circumference, width, average fruit weight, plant height, days for flower initiation and increased number of fruits and branches (Faizan *et al.,* 2021c) which would be drought susceptible traits. Whereas, increased leaf chlorophyll, membrane stability index, relative tissue water, epiculticular wax, root length, volume and number of secondary roots would be drought tolerant character for genotype selection (Faizan *et al.,* 2021b) more over upon drought induction cytological and molecular changes will also occur like certain gene expressivity (Faizan *et al.,* 2021a).

Screening genotypes based on particular trait or a character can be done on its genetic values like phenotypic and genotypic coefficient of variance, broad sense heritability as well genetic advance over mean that would help breeder to understand or find out material genetic variability and study influence of environment over trait exhibition while selecting elite genotypes. As fruit yield is a dependent trait majorly governed by additive gene action with the association of different traits. Therefore, it was directed that association studies of yield and yield components is an elementary protocol to find out elite genotypes upon correlated trait or character. Character association or correlation analysis is an appropriate statistical method to quantify the degree, range and explain nature of relationship sharing between two variables based on its intensity of association.

Our primary aim was to study the effect of moisture stress on physiological, root, yield and yield components and evaluation of genetic values present in research incurred material for experiment. In addition to these, in this experiment we are aiming to exhibit yield component association or relationship towards fruit yield.

Country wide collected fifty eggplant genotypes (Table 1) were sown in portray after treating with carbendazim and etiolated for three days and after 30 days of sowing seedlings were transplanted into pots. Experiment was designed with factorial completely random design which includes two factors *viz.,* (a) drought conditions (Normal moisture condition/control

**Table 1. List of eggplant genotypes used in the present experiment**

| S. No. | Genotype | Source of collection |
|---|---|---|
| 1. | Pusa Upkar | IIVR, Varanasi Uttar Pradesh |
| 2. | Arka Kranti | |
| 3. | Bhagyamati | |
| 4. | Pusa Ankur | |
| 5. | Pusa Bindu | |
| 6. | Punjab Sadabahar | |
| 7. | Aruna | |
| 8. | Shobha | |
| 9. | Swarna Manjari | |
| 10. | CH-215 | |
| 11. | Jawahar Brinjal-8 | |
| 12. | Jawahar Brinjal-69 | |
| 13. | R-2580 | Vegetable Research Station Kalyanpur, Uttar Pradesh |
| 14. | R-2594 | |
| 15. | R-2591 | |
| 16. | Malapur Local | |
| 17. | L-2232 | |
| 18. | R-2581 | |
| 19. | L-2230 | |
| 20. | M4 | College of Horticulture, Mudigere |
| 21. | M21 | |
| 22. | M17 | |
| 23. | Mattigulla | |
| 24. | Ramdurga | |
| 25. | Melavanki | |
| 26. | M19 | |
| 27. | Very Green Long | Zonal Research Station, Chianky, Palamu, Jharkhand |
| 28. | IIHR-322 | |
| 29. | Pant Samrat | |
| 30. | IIHR-7 | |
| 31. | Long Green | |
| 32. | Swarna Pratibha | |
| 33. | Swarna Mani | |
| 34. | Early Round Market | Hiriyur Local Collection (Chitradurga, Karnataka) |
| 35. | Rampur Local | |
| 36. | Hebbal Gulla | |
| 37. | Round Green | |
| 38. | IC354140 | NBPGR, New Delhi |
| 39. | IC90785 | |
| 40. | IC99676- Long | |
| 41. | IC99676- Round | |
| 42. | IC90691 | |
| 43. | IC354597-Round | |
| 44. | Suvarna GP098 | Suvarna Seeds Pvt. Ltd. |
| 45. | Vijaya ARBH98 | Vijaya Seeds Pvt. Ltd. |
| 46. | CO-2 | TNAU, Coimbatore, Tamil Nadu |
| 47. | *S. macrocarpon* | College of Horticulture, Bangalore |
| 48. | *S. indicum* | |
| 49. | *S. torvum* | |
| 50. | *S. mammosum* | |

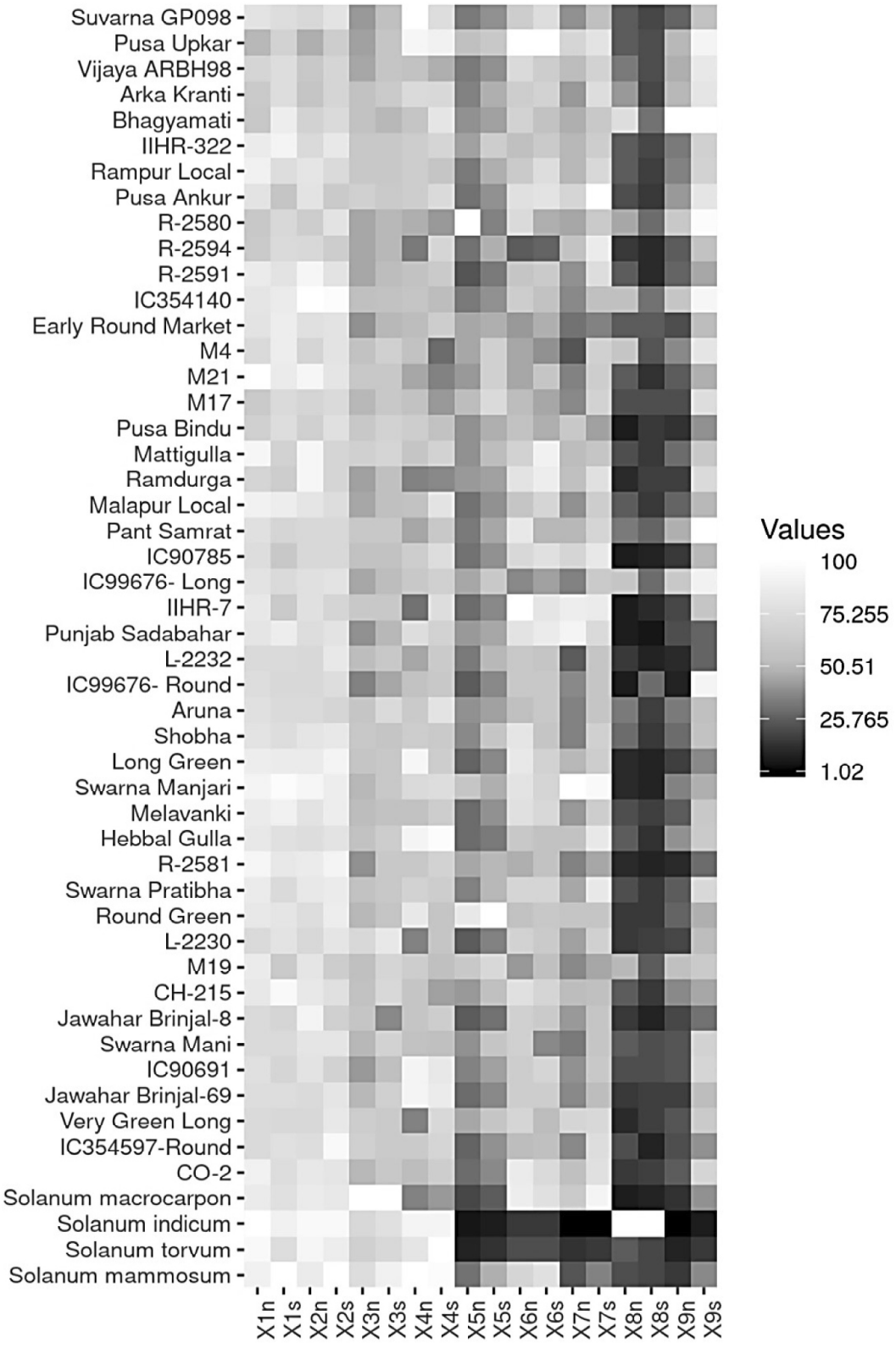


Fig. 1. Heatmap for comparative mean performance of eggplant genotypes over growth and yield parameters.

$X_1$- Plant height @ 90 DAT (cm), $X_2$- Total plant length @ 90DAT (cm), $X_3$- No. of days for flower initiation, $X_4$- No. of primary branches/plant, $X_5$- Fruit length (cm), $X_6$- Fruit circumference (cm), $X_7$- Ave. fruit weight (g), $X_8$- No. of fruits / plant, $X_9$- Fruit yield (g/plant); S- Moisture stress condition, n- Normal moisture conditions.

**Table 2. Estimates of phenotypic correlation coefficients for 12 different characters in eggplant genotypes under normal moisture and moisture stress**

| Trait | Moisture condition | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | $X_9$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $X_1$ | $r_n$ | 1.000 | 0.768*** | 0.299*** | 0.161* | -0.332*** | -0.196* | -0.16* | -0.009 | -0.372** |
| | $r_s$ | 1.000 | 0.669*** | 0.181* | 0.043 | 0.019 | -0.163* | -0.308*** | 0.145 | -0.294*** |
| $X_2$ | $r_n$ | | 1.000 | 0.267*** | -0.032 | -0.323*** | -0.17* | -0.177* | 0.004 | -0.318*** |
| | $r_s$ | | 1.000 | 0.315*** | 0.096 | -0.132 | -0.243*** | -0.373** | 0.17* | -0.412*** |
| $X_3$ | $r_n$ | | | 1.000 | -0.074 | -0.371*** | 0.053 | -0.07 | 0.061 | -0.152 |
| | $r_s$ | | | 1.000 | 0.057 | -0.144 | -0.029 | -0.17* | 0.127 | -0.316*** |
| $X_4$ | $r_n$ | | | | 1.000 | -0.062 | -0.083 | -0.149 | 0.141 | -0.044 |
| | $r_s$ | | | | 1.000 | -0.386*** | 0.025 | -0.194* | 0.158 | -0.263*** |
| $X_5$ | $r_n$ | | | | | 1.000 | 0.118 | 0.258*** | 0.017* | 0.409*** |
| | $r_s$ | | | | | 1.000 | 0.089 | 0.165* | -0.282* | 0.272*** |
| $X_6$ | $r_n$ | | | | | | 1.000 | 0.651*** | -0.426** | 0.147 |
| | $r_s$ | | | | | | 1.000 | 0.527*** | -0.481** | 0.141 |
| $X_7$ | $r_n$ | | | | | | | 1.000 | -0.507** | 0.138 |
| | $r_s$ | | | | | | | 1.000 | -0.592** | 0.392*** |
| $X_8$ | $r_n$ | | | | | | | | 1.000 | 0.533*** |
| | $r_s$ | | | | | | | | 1.000 | 0.036 |
| $X_9$ | $r_n$ | | | | | | | | | 1.000 |
| | $r_s$ | | | | | | | | | 1.000 |

* - Significance @ 0.5 ($r$>0.16), ** - Significance @ 0.01 ($r$>0.209), *** - Significance @ 0.005 ($r$>0.228), *** - Significance @ 0.001 ($r$>0.266) ; $r_{n:}$ correlation for normal moisture plants; $r_s$ : correlation for moisture stressed plants.

$X_1$- Plant height @ 90 DAT (cm), $X_2$- Total Plant Length @ 90DAT (cm), $X_3$- Number of days for flower initiation, $X_4$- Number of primary branches/plants, $X_5$- Fruit length (cm), $X_6$- Fruit circumference (cm), $X_7$- Average fruit weight (g), $X_8$- Number of fruits per plant, $X_9$- Fruit yield (g/plant).

and moisture stress condition); (b) 50 eggplant genotypes with three replications. Moisture stress was induced for about 15 days during two critical stages of eggplant *i.e.,* flower initiation and fruit initiation stage. Furthermore, drought level was monitored by tensiometer regulated at 85 centibars. Upon experimentation, traits like number of days taken for flower initiation, plant height, total plant length, number of primary branches per plants, fruit length, fruit circumference, average fruit weight, number of fruits per plant, fruit yield per plant were recorded. Phenotypic correlation coefficient was done for moisture stress ($r_s$) and normal moisture condition ($r_n$) with the help of WINDOWSTAT *V.7.2*.

The phenotypic correlation coefficient was calculated by using mean data (Fig. 1) obtained from fifty eggplant genotypes after analyzing for variation. Significant variation was observed for all the eight traits except for the number of days for flower initiation.

Plant yield is a complex trait and direct selection for this character based on genetic estimates alone is not enough. Fruit yield is dependent on various other indirect component traits like plant height, number of branches, fruit length, fruit circumference, average fruit weight, *etc.* An acquaintance on the relationship between these traits helps in attaining the improved yield. A phenotypic correlation coefficient is an important appliance for the breeder which helps in selection of genotype for a complex trait through the selection of simpler traits. In this aspect, several studies reported significant relationships among the different pairs of the assorted characters of eggplant (Abd-El-Hadi *et al.,* 2004, Melad *et al.,* 2005). The phenotypic correlation of coefficient for both normal moisture ($r_n$) and moisture stress condition ($r_s$) has been presented in Table 2.

Fruit yield per plant in normal moisture has recorded a significant association with four traits *viz*., negative association with plant height at harvesting stage ($r_n$= -0.372), total plant length at harvesting stage ($r_n$= -0.318) and positive association with fruit length ($r_n$= 0.409) and number of fruits per plant ($r_n$= 0.533). Whereas, in case of moisture stress condition, six characters *viz*., negative association with plant height at harvesting stage ($r_S$=-0.294), total plant length at harvesting stage ($r_S$= -0.412), number of days for flower initiation ($r_S$= -0.316), number of primary branches ($r_S$= -0.263) and positive association with fruit length ($r_S$= 0.272) and average fruit weight ($r_S$= 0.392) had significant correlation with fruit yield per plant.

Under normal moisture condition, fruit yield per plant had a non-significant association with number of days for flower initiation, number of primary branches per plants, fruit circumference and average fruit weight. Whereas, under moisture stress condition fruit circumference and number of fruits per plant are non-significantly associated with fruit yield per plant. Under normal moisture, fruit yield per plant had significant association with plant height and total plant length at harvesting, fruit length and stage number of fruits per plant. This explains that fruit yield per plant increases upon increase in degree of the traits and these traits are having strong inherent association with fruit yield per plant.

However, under moisture stress, plant height and total plant length at harvesting stage, number of days for flower initiation, number of primary branches, fruit length and average fruit weight showed significant association with fruit yield per plant. This explains that throughout moisture stress fruit yield increases upon decreased rate plant height and total plant length at harvesting stage, number of days for flower initiation and number of primary branches. Whereas, fruit length and average fruit weight increased upon moisture stress condition this because of material which incurred for experimentation constitutes of maximum drought tolerant germplasm.

The positive significant association between fruit length, average fruit weight and number of fruits per plant with fruit yield per plant is in conformity with the findings of Kranthi and Celine (2013); Singh and Kumar (2004); Nayak and Nagre (2013); Akter and Rahman (2019). However, the negative significant correlation between plant height and total plant length at harvesting stage, number of days for flower initiation and number of primary branches with fruit yield per plant is similar with the resulted reported by Gobu (2015); Dhaka and Soni (2014); Thirumurugan (1997), Reddy (2003) and Murugavel (2006).

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