Table 3. Available micronutrients contents in Kanjamalai hill soils

| | Micronutrients | | | |
|---|---|---|---|---|
| Micronutrient content | Cu | Zn | Mn | Fe |
| Range (ppm) | 1.6 - 11.7 | 0.4 - 3.4 | 9.8 - 93.4 | 12.4 - 41.0 |
| Mean (ppm) | 4.2 | 2.2 | 47.8 | 29.0 |
| Percentage calculation | | | | |
| 1.2 ppm | 0.0 | 39.0 | 0.0 | 0.0 |
| 1.2 - 2.0 ppm | 21.0 | 28.0 | 0.0 | 0.0 |
| 2.0 - 4.0 ppm | 46.0 | 29.0 | 0.0 | 0.0 |
| 4.0 - 8.0 ppm | 26.0 | 4.0 | 6.0 | 0.0 |
| 8.0 - 12.0 ppm | 7 | 0.0 | 39.0 | 6.0 |
| 12.0 ppm | 1.0 | 0.0 | 55.0 | 94.0 |
| Critical level 0.2 | 1.2 | 2.0 | 4.5 | |
| Standard deviation | 1.6 | 0.9 | 27.5 | 6.5 |
| Coefficient of variation | 34.0 | 37.0 | 59.0 | 26.0 |

require appropriate soil conservation practices, to control the soil erosion.

The data on the micronutrients (available) are presented in Table 3. The mean value for Cu, Zn, Mn and Fe are 4.2, 2.2, 47.8 and 25.0 ppm respectively. Considering the critical level of 1.2 ppm for Zn, (Tandon, 1991) 39 per cent soils registered deficiency in Zn and need application of Zinc for increasing the efficiency of the crop production. Cu, Mn and Fe having a critical level of 0.2, 2.0 and 4.5 ppm. (Tandon, 1991) respectively, all tested soils show adequate supply of the nutrients. The level of micronutrients in the soil tested are in order of Mn Fe Zn respectively.

## REFERENCES

ALAGESABOOPATHY, C (1994). Medico-Botanical Survey of plants in Kanjamalai hills of Salem, Tamil Nadu. **Annual Sciences of Life XIV (1 & 2) : 112 - 116.**

SANKARARAJ, L., RAJENDRAN, G., NAIR, K.S. and RATNAM, C. (1983). **Soils of Salem District, Tamil Nadu.** Soil survey and Land Use Organisation, Coimbatore, Tamil Nadu.

STALIN, P., THAMBURAJ, S and SHANMUGAM, K (1991). **Soil Fertility in Shevaroy hills,** Bulletin. Horticultural Research Station, Yercaud, Tamil Nadu.

TANDON, H.L.S. (1991). **Secondary and Micronutrients in Agriculture.** FD Co., New Delhi.

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# INTERRELATION SHIP, MULTIPLE REGRESSION AND PATH ANALYSIS OF CHLOROPHYLL CONTENT AND SEED YIELD ATTRIBUTES IN RAINFED SOYBEAN

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## ABSTRACT

Evaluation of 40 genotypes of soybean indicated the presence of chlorophyll 'b' (FIN), chlorophyll 'a' (ON), chlorophyll 'b' (FIN), total chlorophyll (FIN) and total chlorphyll (ON). Carotene per cent (FIN) showed a strong association with chlorophyll 'b' (FIN), total chlorophyll (FIN) and total chlorophyll (ON). Multiple regression showed the importance of chlorophyll 'b' (FIN) and total chlorophyll (FIN) for number of leaflets/plant, carotene per cent (FIN) for days to 50% flowering, chlorophyll 'a' (FIN) for days to maturity and total chlorophyll (FIN) for seed yield/plant, which was also supported by the results of path coefficient.

KEY WORDS : Chlorophyll 'a', 'b' and total, rainfed, soybean

It is a continuous process in plant breeding to improve the existing varieties. The selection of the parents having high genetic variability is a basic requirement in any successful hybridisation to produce desirable combinations for selecting high yielding genotype. Multivariate analysis by means of Mahalanobis $D^2$ statistics is a powerful tool in quantifying the degree of divergence among biological population. The information in this aspect is scanty in soybean and therefore, the present study was undertaken to identify suitable stable donors having wider genetic distance and a high interrelationship in respect of chlorophyll 'a', chlorophyll 'b', carotene percent and total chlorophyll through correlaiton, multiple regression and path coefficient.

Table 1. Correlation between different chlorophyll components and with leaf- lets/plant ($Y_1$) days to maturity ($Y_3$) and 50% flowering ($Y_2$) and seed yield/plant ($Y_4$)

| Characters | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | $X_1$ | $X_2$ | $X_3$ | $X_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chlorophyll 'a' at FIN ($X_1$) | 0.22* | 0.04 | 0.25** | 0.22* | 0.0 | 0.45** | 0.42** | 0.06 | -0.06 | 0.14 | 0.16 |
| Chlorophyll 'a' at ON ($X_2$) | | 0.16 | 0.63** | -0.03 | 0.07 | 0.18* | 0.42** | -0.09 | -0.05 | 0.03 | -0.05 |
| Chlorophyll 'b' at FIN ($X_3$) | | | 0.31** | 0.31** | -0.26** | 0.54** | 0.17 | -0.12 | 0.03 | -0.06 | -0.09 |
| Chlorophyll 'b' at ON ($X_4$) | | | | 0.06 | -0.04 | 0.32** | 0.82** | -0.04 | 0.11 | 0.02 | 0.06 |
| Carotene % at FIN ($X_5$) | | | | | 0.14 | 0.54** | 0.32** | 0.09 | 0.23* | 0.10 | -0.04 |
| Carotene % at ON ($X_6$) | | | | | | -0.08 | 0.15 | 0.07 | 0.10 | 0.07 | 0.07 |
| Total chlorophyll at FIN ($X_7$) | | | | | | | 0.40** | 0.25** | 0.13 | 0.07 | 0.13 |
| Total chlorophyll at ON ($X_8$) | | | | | | | | -0.01 | 0.12 | 0.05 | 0.07 |

*, ** Significant at 5% and 1% probability levels, respectively. FIN - Flower - Initiation Node, and ON - Other Node

## MATERIALS AND METHODS

A set of 40 genotypes of soybean collected from different agro- climatic regions of the country was sown in randomised block design in three replications during *kharif* under rainfed condition. The rows and plants were spaced 45 cm and 10 cm apart, respectively. Other agronomic practices recommended for the region were followed. Thirty punches (one $cm^2$/punch) fresh green tissue of leaves were taken from the flower initiation node i.e. fourth node (FIN) and same from other node (ON) i.e. node other than flower initiation node. Chlorophyll and carotene content in soybean leaves were measured as per normal methods (Singh, 1977). The amount of chlorophyll content chlorophyll 'a', chlorophyll 'b', total chlorophyll and carotene content were expressed on fresh weight basis.

Correlation coefficient, multiple regression and path coefficient were done as per usual methods (Snedecor and Cochram, 1968 ; Dewey and Lu 1959)

## RESULTS AND DISCUSSION

A Chlorophyll 'b' (ON) has a highly significant association with chlorophyll 'a' (FIN), chlorophyll 'a' (ON), chlorophyll 'b' (FIN), total chlorophyll (FIN) and total chlorophyll (ON). Carotene per cent (FIN) showed a high significant correlation with chlorophyll 'b' (FIN), total chlorophyll (FIN) and total chlorophyll (ON). Total chlorophyll expressed a high interrelationship with chlorophyll 'a' (FIN), chlorophyll 'b' (FIN), total chlorophyll (ON) and number of leaflets/plant, whereas total chlorophyll (ON) has strong associatin with chlorophyll 'a' (FIN) and chlorophyll 'a' (ON). A high significant negative

Table 2. Multiple regression equation alongwith contribution to number of leaflets/plant ($Y_1$)

| Multiple linear regression equation | Contribution to number of leaflets/plant |
|---|---|
| $Y_1 = 17.6502^{**}-4.5439^{***} x_1+1.1301^{**}x_2-13.8557^{**}x_3+9.7575^{**}x_4- 0.2282x_5+ 0.6870^{**}x_6+13.6978^{**}x_7-6.4328^{**}x_8$ | 97.97 |
| $Y_1 = 22.3918^{**}-4.9732^{**}x_1- 0.9780^{**}x_2 14.5752^{**}x_3+8.4863^{**}x_4=13.3677^{**}x_7-5.6262^{**}x_8$ | 65.53 |
| $Y_1 = 21.0867^{**}-12.2801^{**}x_3+11.5174^{**}x_7-3.2346^{**}x_8$ | 79.36 |
| $Y_1 = 18.2061^{**}-12.0121x3+10.1443x7$ | 35.11 |

Table 3. Multiple regression equation along with contribution to days to 50% flowering ($Y_2$)

| Multiple linear regression equation | Contribution to 50% flowering |
|---|---|
| $Y_2 = 32.0378-3.1709x_1-0.7093x_2- 2.6839x_3 8.8080x_4+1.0261x_5 0.4202x_6+1.4362x_7-2.8992x_8$ | 88.16 |
| $Y_2 = 35.1244-2.622x_1-0.61x_2-2.2554x_3+7.806x_4+1.216x_5-2.1362x_8$ | 75.31 |
| $Y_2 = 35.4781-3.0438x_1-0.5061x_2+4.0534x_4+0.9064x_5$ | 53.95 |
| $Y_2 = 35.7322+0.8599x_5$ | 35.33 |

Table 4. Multiple regression equation along with contribution to days to maturity ($Y_3$)

| Multiple linear regression equation | Contribution to days to maturity |
|---|---|
| $Y_3$= 83.087**+7.3718**$x_1$+0.0202**$x_2$- 4.7075**$x_3$4+1.0125**$x_5$+0.4263**$x_6$+ 0.6908**$x_7$-3.5081$x_8$ | 95.93 |
| $Y_3$= 86.2248**+7.5462**$x_1$-4.7726**$x_3$+4.2411**$x_4$+1143**$x_5$-2.945**$x_8$ | 83.96 |
| $Y_3$= 86.8902**+6.808$x_1$-3.9329**$x_3$+0.8603**$x_5$ | 70.51 |
| $Y_3$= 90.249**-7.7248**$x_1$ | 30.91 |

Table 5. Multiple regression equation along with contribution to seed yield/plant ($Y_4$)

| Multiple linear regression equation | Contribution to seed yield/plant |
|---|---|
| $Y_4$= 9.4821**+2.5971$x_1$-0.7745$x_2$-3.6747$x_3$+603261$x_4$- 0.5194$x_5$+0.5207$x_6$+3.5253$x_7$-2.576$x_8$ | 71.01 |
| $Y_4$= 14.6512-0.5523$x_2$-4.0921$x_3$+2.6096$x_4$-0.6094$x_5$+3.8872$x_7$ | 60.94 |
| $Y_4$= 15.4493**-3.8794$x_3$-0.5871$x_5$+3.9498$x_7$ | 33.45 |
| $Y_4$= 11.8979**+1.5326$x_7$ | 35.51 |

*, ** Significant at 5 and 1% probability levels, respectively

correlation had been observed between chlorophyll 'b' (FIN) and carotene per cent (ON). A significant positive association was found in between chlorophyll 'a' (FIN) and chlorophyll 'a' (ON), chlorophyll 'a' (FIN) and carotene per cent (FIN), chlorophyll 'a' (ON) and total chlorophyll (FIN), and carotene per cent (FIN) and days to maturity.

Multiple regression equation based on all the characters had contributed variability 97.97% in number of leaflets/plant (Table 2), whereas the best combination of two characters chlorophyll 'b' (FIN) and total chlorophyll (FIN) contributed 35.11% variability in number of leaflets/plant, which was also confirmed by the direct effect of path coefficient. Partial regression coefficient of characters except, chlorophyll 'a' (FIN), chlorophyll 'b' (FIN), carotene in per cent (FIN) and total chlorophyll (ON) were positive. Multiple

Table 6. Partitioning of correlation in direct (diagonal) and indirect (offdiagonal with respect to days to 50% flowering (A), Seed yield/plant (B) and number of leaflets/plant (C)

| Characters | | Correlation with A,B and C | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | X | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ |
| Chlorophyll 'a' | A | -0.14 | -0.04 | -0.01 | 0.12 | 0.06 | 0.00 | 0.06 | -0.10 | -0.06 |
| FIN ($X_1$) | B | 0.11 | -0.05 | -0.01 | 0.09 | -0.03 | 0.00 | 0.14 | -0.09 | 0.16 |
| | C | -0.10 | -0.04 | -0.02 | 0.07 | -0.01 | 0.00 | 0.27 | -0.12 | 0.06 |
| Chlorophyll 'a' | A | -0.03 | -0.20 | -0.03 | 0.29 | -0.01 | 0.01 | 0.02 | -0.10 | -0.05 |
| ON ($X_2$) | B | 0.03 | -0.22 | -0.04 | 0.21 | 0.00 | 0.01 | 0.06 | -0.09 | -0.05 |
| | C | -0.02 | -0.17 | -0.07 | 0.17 | 0.00 | 0.01 | 0.11 | -0.12 | -0.09 |
| Chlorophyll 'b' | A | -0.01 | -0.03 | -0.16 | 0.14 | 0.08 | -0.03 | 0.07 | -0.04 | 0.03 |
| FIN ($X_3$) | B | 0.01 | -0.04 | -0.22 | 0.10 | -0.04 | -0.03 | 0.16 | -0.04 | -0.09 |
| | C | -0.00 | -0.03 | -0.43 | 0.08 | -0.01 | -0.02 | 0.33 | -0.05 | -0.12 |
| Chlorophyll 'b' | A | -0.04 | -0.13 | -0.05 | 0.47 | 0.02 | -0.00 | 0.04 | -0.20 | 0.10 |
| ON ($X_4$) | B | 0.03 | -0.14 | -0.07 | 0.34 | -0.01 | -0.01 | 0.10 | -0.18 | 0.06 |
| | C | -0.03 | -0.11 | -0.13 | 0.27 | -0.00 | -0.00 | 0.19 | -0.24 | -0.04 |
| Carotene % FIN | A | -0.03 | 0.01 | -0.05 | 0.03 | 0.27 | 0.01 | 0.07 | -0.08 | 0.23 |
| ($X_5$) | B | 0.03 | 0.01 | -0.07 | 0.02 | -0.14 | 0.02 | 0.16 | -0.07 | -0.04 |
| | C | -0.02 | 0.01 | -0.13 | 0.02 | -0.03 | 0.01 | 0.33 | -0.09 | 0.09 |
| Carotene % ON | A | -0.00 | -0.02 | 0.04 | -0.02 | 0.04 | 0.10 | -0.01 | -0.04 | 0.10 |
| ($X_6$) | B | 0.00 | -0.02 | 0.06 | -0.02 | -0.02 | 0.12 | -0.03 | -0.03 | 0.07 |
| | C | -0.00 | -0.01 | 0.11 | -0.01 | -0.00 | 0.09 | -0.05 | -0.04 | 0.07 |
| Total Chlorop | A | -0.06 | -0.04 | -0.08 | 0.15 | 0.14 | -0.01 | 0.12 | -0.10 | 0.13 |
| hyll ($X_7$) FIN | B | 0.05 | -0.04 | -0.12 | 0.11 | -0.07 | -0.01 | 0.30 | -0.09 | 0.13 |
| | C | -0.05 | -0.03 | -0.23 | 0.09 | -0.02 | -0.01 | 0.61 | -0.11 | 0.25 |
| Total Chloro- | A | -0.06 | -0.08 | -0.03 | 0.38 | 0.09 | 0.02 | 0.05 | -0.25 | 0.12 |
| phyll ($X_8$) ON | B | 0.04 | -0.09 | -0.04 | 0.28 | -0.04 | 0.02 | 0.12 | -0.22 | 0.07 |
| | C | -0.04 | -0.07 | -0.07 | 0.22 | -0.01 | 0.01 | 0.24 | -0.29 | -0.01 |

Residual effects are R(A) -0.64, R(B) -0.64 and R(C) -0.69

regression equation based on all traits was contributed variability 88.16% to days to 50% flowering (Table 3), whereas the best character carotene per cent (FIN) contributed 35.33% variability in days to 50% flowering. Partial regression coefficient of characters were positive for chlorophyll 'b' (ON), carotene per cent (FIN), carotene per cent (ON) and total chlorophyll (FIN) and negative for chlorophyll 'a' (FIN), chlorophyll 'a' (FIN & ON), chlorophyll 'b' (FIN) and total chlorophyll (ON).

Regression equation based on all the characters had contributed 95.93% variability in days to maturity and the best character chlorophyll 'a' (FIN) contributed variability in days to maturity (Table 4). Partial regression coefficient of attributes were positive for chlorophyll 'a' (FIN), chlorophyll 'a' (ON), chlorophyll 'b' (ON) and carotene per cent (FIN), carotene per cent (ON) and total chlorophyll (FIN) and negative for chlorophyll 'b' (FIN) and total chlorophyll (ON). Multiple linear regression equation based on all characters showed contribution 71.01 % variability to seed yield/plant (Table 5) and the best character total chlorophyll (FIN) has contributed variability to seed yield/plant, which was also confirmed by the direct effects of path coefficient. Partial regression coefficients of characters were positive for chlorophyll 'a' (FIN), chlorophyll 'b' (ON), carotene per cent (ON) and total chlorophyll (FIN) and negative for chlorophyll 'a' (ON), chlorophyll 'b' (FIN), carotene per cent (FIN) and total chlorophyll (ON).

Partitioning of correlation showed the maximum direct effect by chlorophyll 'b' (ON) for days to 50 per cent flowering and seed yield/plant (Table 6). Carotene per cent (FIN) and total chlorophyll (FIN) indicated higher direct value to days to 50% flowering. Total chlorophyll (FIN) and carotene per cent (ON) had higher direct effects on seed yield/plant. Chlorophyll 'b' (ON) and carotene per cent (ON) showed higher direct effects on number of leaflets/plant.

## REFERENCES

DEWEY, D.R. and LU, K.K. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. **Agron. J., 41:** 515-518.

SINGH, A. (1977). **Practical Plant Plant Physiology.** Kalyani Pub., New Delhi, pp. 188-189.

SNEDECOR, G.W. and COCHRAN, W.G. (1968). **Statistical Methods** OXFORD & IBH Pub. Co.

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# RESEARCH NOTES

## PHYSIOLOGICAL VARIABILITY FOR GROWTH AND YIELD IN RAINFED PEARL MILLET

Pearl millet (*Pennisetum glaucum* (L.) R.Br.) is drought tolerant cereal crop and is generally grown on water thirsty and nutrient hungry soils. About 97 per cent of its area is under rainfed condition. Aberrant monsoon behaviour resulted in low pearl millet yield. Dry land practices have shown tremendous potential to increase and stabilise pearl millet productivity (Kaushik and Gautam, 1991). The growth and yield of crop depends on the interaction between environmental factors with numerous physiological processess of the plant. Physiological analysis of growth involves study of chronological processess that characterise the differences in growth and yield. As research related to these aspects is meagre in rainfed pearl millet, investigation was, therefore, undertaken to study the physiological analysis of growth and yield variation in rainfed pearl millet.

An experiment was conducted in a split plot design with three replications at the Agricultural College Farm, College of Agriculture, Pune under rainfed condition. The combination of three planting layoats (normal sowing, compartment bunding sowing and ridges and furrows sowing) and two moisture conservation techniques (no mulch and with mulch) were tried, in main plots and three fertilizer levels (control, 30 kg N + 15 Kg $P_2O_5$/ha and 60 Kg N + 30 kg $P_2O_5$/ha) in sub plots. The pearl millet hybrid MH 179 was used in the study. It is a cross between M.S. 81 A x ICMP