yield contributing traits *viz.*, 100 grain weight, plant height, total productive tillers, ear length and ear girth could be utilised for selection of best male sterile lines and *per se* performing testers for crossing to exploit the genetic potential of the genotypes.

References

Anantharaj, P. (2001). Studies on genetic variability, association and diversity in finger millet *(Eleusine coracana* (L.) Gaertn.) for yield, yield attributes and salinity tolerance. *M.Sc, Thesis*, TNAU, Coimbatore.

Burton, G.W. (1952). Quantitative inheritance in grasses. *Proc. 6th Int. Grassland Cong.*, **1:** 277-283.

Chen Ling, Cuishaoping and Sun Yiaobang. (1996). Analysis of the gene effect on ear characters in maize. *Ada Agricultural Boreali-Sinica*, **11(2):** 28-32.

Galeta, N., Mohammed, H. and Zelleke, H. (2005). Genetic variability and genetic advance in sorghum *(Sorghum bicolor* (L.) Moench) germplasm. *Crop Res.*, **30 (3):** 439-445.

Ghorpade, P.B. and Metta, L.V. (1993). Quantitative genetic studies in relation to population improvement in pearl millet. *Indian J. Genet.*, **53 (1):** 1-3.

Gyanendra Singh and Majorsingh. (1995). Genetic analysis of maize in Sikkim. *Indian J. Agri. Sci.*, **65(4):** 293-294.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. (1955). Estimation of genetic variability and environmental variability in soybean. *Agron. J.*, **47:** 314-318.

Kabdal, M. K., Verma, S.S., Ahmad, N. and Panwar, U. B. S. (2003). Genetic variability and correlation studies of yield and its attributing characters in maize *(Zea mays* L.). *Agric. Sci. Digest*, **23(2):** 137-139.

Lush, J.L. (1940). Intra - sire correlation and regression of offspring on dams as a method of estimating heritability of characters. *Proc. Amer. Soc. Animal Production.*, **33:** 293-301.

Saraswathi, R., Juliet Hepziba, S. Theradi Mani, M., Palanisamy, S. and. Fazlullah Khan, A.K. (1995). Variability in pearl millet. *Madras Agric. J.*, **82 (12):** 665-666.

Madras Agric. J., 94 (1-6) : 120-124 January-June 2007

https://doi.org/10.29321/MAJ.10.100646

Research Notes

Correlation and path analysis in sunflower *(Helianthus annuus* L.)

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Yield is a complex character and influenced by several other yield component characters. The knowledge on association of several characters with yield and among themselves will be very essential for planning a successful breeding programme. Path analysis splits the correlation coefficient into measures of direct and indirect effects and determines the direct and indirect contribution of various characters towards yield. The present study was undertaken to assess the association between yield and yield components and also path analysis of

oil yield per plant in sunflower *(Helianthus annuus* L.)

Twenty three genotypes of sunflower were evaluated in randomized block design with two replications with a plot size of $8m^2$ during *kharif* 2006 at the Cotton and Oilseeds farm, Tamil Nadu Agricultural University, Coimbatore. Normal cultural practices were followed through out the crop growth. Biometrical observations were taken on randomly selected five plants in each genotype for the following eight characters *viz*., days to 50% flowering, plant height (cm), head diameter (cm), volume weight per 100 ml (g), 100-seed weight (g), oil content (%), seed yield per plant (g) and oil yield per plant (g). Oil content was estimated using Oxford 4000 NMR oil analyzer. Simple correlation among yield and yield components were worked out as per the standard method. The direct and indirect effects of seven characters on oil yield per plant were estimated by path coefficient analysis (Dewey and Lu, 1957).

Simple correlation coefficients were presented in table. 1. Oil yield per plant had significant positive correlation with yield per plant (0.93), oil content (0.47), volume weight (0.43). head diameter (0.39) and 100-seed weight (0.30). Chikkadevaiah *et al.* (2002) and Loganathan and Gopalan (2006) reported positive correlation of oil yield per plant with oil content and head diameter.

The information on inter-association among the yield components showed the nature and extent of relationship with each other. In the present study, head diameter had positive correlation with oil content (0.53) and volume weight (0.34). Chikkadevaiah *et al.* (2002) reported positive correlation between head diameter with oil content. Vidhyavathi *et al.* (2005) observed that head diameter had significant correlation with seed yield per plant. Hundred seed weight had significant positive correlation with seed yield per plant (0.41). Ashok *et al.* (2000), Ramasubrahmanyam *et al.* (2002) and Chikkadevaiah *et al.* (2002) reported that hundred seed weight had significant positive correlation with oil content. Lakshminarayana *et al.* (2004) and Manivannan *et al.* (2005) observed that hundred seed weight had significant positive correlation with seed yield per plant and volume weight respectively.

Volume weight had significant positive correlation with oil content (0.79). Chikkadevaiah *et al.* (2002) and Manivannan *et al.* (2005) reported that volume weight had significant positive correlation with oil content. Jhagirdhar (1986), Abdelgawad *et al.* (1987) and Mogali and Virupakshappa (1994) observed that oil content was positively associated with plant height. Amenla (1996) and Chikkadevaiah *et al.* (2002) observed significant positive correlation between oil content and yield. However Vanishree *et al.* (1988) observed negative correlation between oil content and plant height. Non significant correlation between oil content and seed yield per plant was recorded by Chidambaram and Sundaresan (1990).

The simple correlation coefficients were partitioned into direct and indirect effects using path analysis on oil yield per plant (Table 2). In the present study, the estimated residual effect (0.12) had indicated that the characters chosen for path analysis were appropriate. The path analysis on oil yield per plant revealed that seed yield per plant (0.89) and oil content (0.36) recorded high positive direct effect on oil yield per plant. Lakshminarayana *et al.* (2004) and Moorthy (2004) reported that plant height and head diameter had high positive direct effect on seed yield per plant. Gouri

Table 1. Simple correlation coefficients of yield and yield components in sunflower.

Character	Days to 50% flowering	Plant height (cm)	Head diameter (cm)	100-seed weight (g)	Volume weight/ 100ml (g)	Oil Content (%)	Yield/ plant (g)
Plant height (cm)	0.27						
Head diameter (cm)	-0.25	-0.22					
100-seed weight (g)	0.01	-0.13	0.10				
Volume weight/ 100 ml (g)	-0.11	0.01	0.34*	0.06			
Oil content (%)	-0.15	-0.16	0.53**	-0.12	0.79**		
Yield/plant (g)	0.03	-0.05	0.24	0.40*	0.18	0.14	
Oil yield/plant (g)	0.00	-0.09	0.39**	0.29*	0.43**	0.47**	0.93**

*, ** Significant at 5% and 1% level respectively

Table 2. Direct and indirect effects of the oil yield components in sunflower.

Character	Days to 50% flowering	Plant height (cm)	Head diameter (cm)	100-seed weight (g)	Volume weight/ 100ml (g)	Oil Content (%)	Yield/ plant (g)	Simple correlation co-efficient with oil yield per plant
Days to 50% flowering	**0.02**	0.00	0.00	-0.00	0.00	-0.05	0.02	0.00
Plant height (cm)	0.01	**0.01**	0.00	0.00	-0.00	-0.06	-0.05	-0.09
Head diameter (cm)	-0.01	-0.00	**-0.01**	-0.00	-0.00	0.19	0.22	0.39**
100-seed weight (g)	0.00	-0.00	-0.00	**-0.02**	-0.00	-0.04	0-.36	0.29*
Volume weight / 100 ml (g)	-0.00	0.00	-0.00	-0.00	**-0.00**	0.28	0.16	0.43**
Oil Content (%)	-0.00	-0.00	-0.00	0.00	-0.00	**0.36**	0.13	0.47**
Yield/ plant(g)	0.00	-0.00	-0.00	-0.01	-0.01	0.05	**0.89**	0.93**

Diagonal values are direct effects
Residual effect = 0.12

shankar *et al. (2006)* observed 100-seed weight had high positive direct effects on seed yield per plant.

Considering the indirect effect, head diameter and volume weight recorded low and medium level of indirect effects respectively on oil yield per plant *via* oil content. Head diameter and 100-seed weight had medium and high indirect effects respectively *via* seed yield per plant. The character volume weight per 100ml and oil content showed low level of indirect effect *via* seed yield per plant.

From the foregoing discussion, it may be concluded that head diameter, 100-seed weight, volume weight, oil content and seed yield are important indices for oil yield improvement in sunflower breeding programmes. Moreover, the present study revealed that the plant height and days to 50% flowering had no association with oil yield. Hence development of genotypes with high oil yield is possible irrespective of plant height and duration.

Reference

Amenla, I. (1996). Evaluation of new inbred lines for *per se* performance and combining ability in sunflower.Msc. (Agri) Thesis, Univ. Agric. Sci., Bangalore, pp.l-14.

Abdelgawad, A.A., Salch, S.A., Kohab, M.A. and Gazzer, M.M. (1987). Correlation studies between leaf surface, head characteristics and yield of sunflower in Egypt. *Ann. Agri. Sci.,* **32:** 1213-1227.

Ashok, S., Mohamed Sheriff, N. and Lakshmi Narayanan, S. (2000). Character association and path coefficient analysis in sunflower *(Helianthus annuus* L.) *Crop Res.,* **20:** 453-456.

Chidambaram, S. and Sundaresan, N. (1990). Correlation between yield components in sunflower. *Madras Agric .J.,* **77:** 406-407.

Chikkadevaiah, Sujatha, H.L. and Nandini. (2002). Correlation and path analysis in sunflower. *Helia,* **25:** 109-118.

Dewey, D.R. and Lu, K.H. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.,* **51:** 515-518.

Gouri Shanker, V., Ganesh, M., Ranganatha, A.R.G. and Bhave, M.H.V. (2006). A study on correlation and path analysis of seed yield and yield components in sunflower *(Helianthus annuus* L). *Agric. Sci. Digest,* **26(2):** 87-90.

Jhagirdhar, N.L. (1986). Genetic analysis of some quantitative traits in sunflower *(Helianthus annuus* L.) hybrids. M.Sc. (Agri.) Thesis, Univ. Agric, Sci, Bangalore pp. 124

Loganathan, P. and Gopalan, A. (2006b). Association analysis in sunflower *(Helianthus annuus* L). *Res. on crops,* **7(l):** 202-203.

Lakshminarayana, N.N., Sreedhar, N. and Prabbakar, A.J. (2004). Correlation and path analysis in sunflower *(Helianthus annuus* L.) *The Andhra Agric. J.,* **51** (3 and 4): 342-344.

Manivannan, N., Muralidharan, V. and Subbalakshmi, B. (2005). Correlation analysis in sunflower. *Legume Res.,* **28(1):** 71-73.

Mogali, S.C. and Virupakshappa, K. (1994). Intercharacter association and path coefficient analysis in sunflower. *Indian J. Genet.,* **54:** 366-370.

Moorthy, J. (2004). Combining ability, heterosis and association studies in confectionery sunflower *(Helianthus annuus* L.). M.Sc. (Ag.) Thesis, Tamil Nadu Agric. Univ., Coimbatore.

Rama Subrahmanyam, S.V., Ranganatha, A.R.G. and Sudeer Kumar, S. (2002). Genetic variability for seed yield and seed parameters in sunflower. *J. Oilseeds Res.,* **19:** 171-174.

Vanisree, G., Ananthasayana, K., Nagabushanam, G.V.S. and Jagadish, C.A. (1988). Correlation and path coefficient analysis in sunflower *(Helianthus annuus* L.). *J. Oilseeds Res.,* **5:** 46-51.

Vidhyavathi, R., Mahalakshmi, P., Manivannan, N. and Muralidharan, V. (2005). Correlation and Path analysis in sunflower *(Helianthus annuus* L). *Agric. Sci. Digest,* **25 (1):** 6-10.

Madras Agric. J., 94 (1-6) : 124-126 January-June 2007

Research Notes

Influence of *Rhizobium* strains on nodulation and grain yield in chickpea (*Cicer arietinum* L.)

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Chickpea (*Cicer arietinum* L.) is an important pulse crop of Maharashtra state and occupied an area of 7.56 lakh ha (2001-2002) with a annual production of 4.51 lakh tones with an average productivity of 596 kg/ha (Anonymous, 2002). Studies under All India Co-ordinated Pulses Improvement Project (AICPIP) in different parts of the country has shown that seed inoculation with efficient strain of *Rhizobium* increases the grain yield of legumes (Rewari, 1985). Effectiveness of the symbiotic nitrogen fixation depends upon the proper establishment of inter-relationship between a particular legume and a specific strain of *Rhizobium* (Dart *et al.,* 1976). Variability among *Rhizobium* strains of the same species exists for biological nitrogen fixation (Khurana and Dudeja, 1981). Choice of the strain is very critical task for the success of bio-inoculant. Therefore, efficiency of *Rhizobium* strains received from AICPIP, Kanpur was evaluated at Mahatma Phule Krishi Vidyapeeth, Rahuri (India) during *Rabi* 2000-'01 and 2001-'02.

A field trial with Randomized Block Design replicated thrice was laid out in medium black soil. The treatments consisted 22 *Rhizobium* strains, one un-inoculated control and two treatments consistent of 20 and 40 kg N/ ha respectively without *Rhizobium* inoculation. The seeds of chickpea cultivar Vishal were inoculated with carrier based rhizobial inoculant @ 250 g /10 kg seed and sown at 30x10 cm spacing in the plots (4 x 1.8 m net plot size). Basal dose of 40 kg $P_2 O_5$/ha was applied at the time of sowing uniformly. The vigour of the plants was maintained throughout the season by adopting proper agronomic management and plant protection