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Prediction and postdiction of heterosis in Safflower (*Carthmus tinctorius* L.)

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Selected lines of safflower (*Carthamus tinctorius* L) were used to predict the heterosis for yield and yield components and to assess the reliability of prediction methods. The highest magnitude of useful heterosis was observed in respect of number of seeds per capitula (53.78%), seed yield per plant (27.23%), 100 seed weight (2.58%) and days to maturity (-2.87%). Only one cross, AKMS 1 x JLSF 228 recorded significant useful heterosis over the check variety Bhima for seed yield per plant (27.23%).The parents JLSF 228, A_1 and Bhima were good general combiners for seed yield per plant. The predictive model was effective for describing hybrid. There was, however, the positive relationship between mid parent and hybrid yield indicating that mid parent may still be a useful guide for the selection of parents for testing hybrid combinations. The effectiveness of predictive and postdiction model differed for different characters except for number of seeds per capitulum and days to maturity for which both models were equally effective in predicting hybrid yield.

Key Words : *Carthamus tinctorius* L. Postdiction of heterosis, Prediction of heterosis.

INTRODUCTION

The significant breakthrough in yield advances n safflower (*Carthamus tinctorius* L) could be made through exploitation of heterosis at commercial level. (Knowles,1989). The comprehensive reviews of heterosis in safflower indicate that there is a significant amount of heterosis over commercial cultivars indicating the possibility of exploiting heterosis at commercial level in safflower. In absence of cytoplasmic genetic male sterility, genetic male sterility offers a vast scope in safflower hybrid development programme. (Chitanvis *et al. 1999*)

The retrospective analysis of factors which led to the development of hybrid varieties in different crop plants does not pin point conclusive variable that can serve as a guide in the identification of commercially accepted hybrid. Production and testing of a relatively large number of cross combinations is the only way to trace a desirable hybrid. This indeed is true for all the crop plants as very little direct information is available on hybrid breeding through the application of recent procedures of statistical genetics. There is however; some indirect information which can help us in rationalizing the hybrid breeding. Therefore, at an initial stage of hybrid breeding undertaken to predict the heterosis for yield and yield components and to assess the reliability of prediction methods and to assess the performance of hybrid.

MATERIALS AND METHODS

The present study was conducted during winter 2000 at the Farm of Department of Agricultural Botany, College of Agriculture, Nagpur,(India).The experimental material comprised of eleven lines selected for high yield, earliness and wider adaptability viz., JLSF 228,N 7,CTV 209, JLSF 88,Sharda, BLY 652, AKS 65, AKS 68, HUS 305,A_1 Bhima and ten exotic lines viz., S 541, W6-872, PI 401470,PI307029A,PI307029B, PI537601A, PI537601B, PI401473, PI401479A,PI401479B. Each line was crossed with a common tester i.e. AKSMS 1, a genetic male sterile line, during winter 1999 to obtain 21 crosses.

Thus, complete set of material; under study consisting of one tester, 21 lines and 21 crosses, among them were raised in randomised complete block design with two replications. The plants were spaced 45 cm between rows and 30 cm between plants. Fifteen plants per genotype per row were grown. Border plants were grown on all sides of the block to avoid border effect. Recommended package of practices was followed to raise a good crop. Data were recorded for ten competitive plants of each

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genotype for the following characters viz., plant height (cm), number of primary branches per plant, number of capitula per plant, number of seeds per capitulum, 100 seed weight (g), seed yield per plant (g), oil content (%) and days to maturity.

Statistical methods :

Expected hybrid performance was estimated from observed parental performance using a predictive method and a postdictive method. The predictive method was based on calculation of mid parent values (Panter and Allen, 1995) as follows:

$$H_{ij} = (P_i + P_j)/ 2$$

Where,

H_{ij} is the expected performance of progenies from parent i and j with respective phenotypic values of Pi and Pj.

The postdictive method was based on parental GCA values (Brandle and McVetty, 1989) and expected hybrid performance was calculated as follows.

$$H'_{ij} = H.. + GCA_i + GCA_j$$

Where,

H'_{ij} is the expected performance of hybrid derived from the i^{th} and j^{th} parents.

H.. is the population mean.

GCA_i and GCAj are the GCA values of the i^{th} and j^{th} parents.

Pearson's simple correlation coefficients were calculated between expected and observed hybrid phenotypes to assess the relative effectiveness of the two methods as descriptors of hybrid performance.

RESULTS AND DISCUSSION

Heterosis :

The phenomenon of heterosis was of general occurrence for most of the characters under study except number of capitula per plant and oil content. The magnitude of heterosis and useful heterosis was low and differed for different characters. The commercial value of hybrid will depend on whether it is more profitable than the best available commercial cultivar. In this study, the highest magnitude of useful heterosis was observed in respect of number of seeds per capitulum (53.78% AKMS 1X JLSF 228), seed yield per plant (27.33% AKMS 1X JLSF 228), 100 seed weight (2.58% AKMS 1 X CTV 209) and days to maturity (-2.87% AKMS 1X PI307029A) over the check variety, Bhima.

Evaluation of parental lines for general combining ability :

In the present study, JLSF 228, A_1 and Bhima recorded significant general combining ability for seed yield per plant. This indicates that the rest of the lines are not useful for the development of hybrid variety in safflower particularly with reference to genetic male sterile line, AKMS 1. None of the line showed significant general combining ability with AKMS 1for number of primary branches per plant and number of capitula per plant.

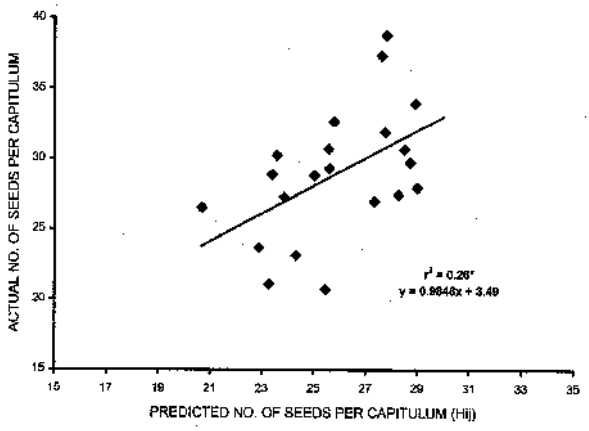
Prediction of heterosis :

The simple correlation between actual and predicted means of twenty-one crosses (Prediction method, Panter and Allen (1995)) indicated that significant correlation for plant height (0.56**), number of seeds per capitulum (0.51*), seed yield per plant (0.74**), and days to maturity (0.74**). The regression of expected hybrid yield on observed hybrid yield resulted in significant regression and coefficient of determination (r^2) for plant height (r^2 = 0.34**) Fig. 1, number of seeds per capitulum (r^2 = 0.26**) Fig. 2, seed yield per plant (r^2 = 0.55**, Fig.3) and days to maturity (r^2 = 0.55**, Fig.4).

Therefore, this study indicates that the hybrid performance can be predicted on the basis of *per se* yield and mid parental value. Thus, those combinations of lines that resulted in very low mid parent yield could be discarded without a great deal of loosing potential useful material. Therefore, mid parent yield may be used as a cost effective guide for selection of parents for evaluation in hybrid combination. These results are in confirmity with results of Brandle and McVetty (1989).

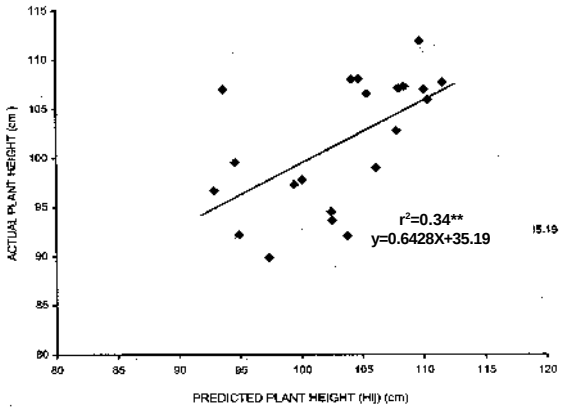
The simple correlation between actual and predicted heterosis based on additive model (Brandle and McVetty, 1989) exhibited significant correlation and coefficient of determination respectively for number of capitulum per plant (0.52* and 0.27*), number of seeds per capitulum (0.81** and 0.65**), oil content (0.78** and 0.60**) and days to maturity (0.74** and 0.55**). The additive model based on general combining ability was effective in describing hybrid yield. Brandle and McVetty (1989) indicated general combining ability was more effective than mid parent for describing hybrid yield.

The effectiveness of predictive and postdictive model differed for different characters except for number of seeds per capitulum and days to maturity for which both models were equally effective in predicting hybrid yield.



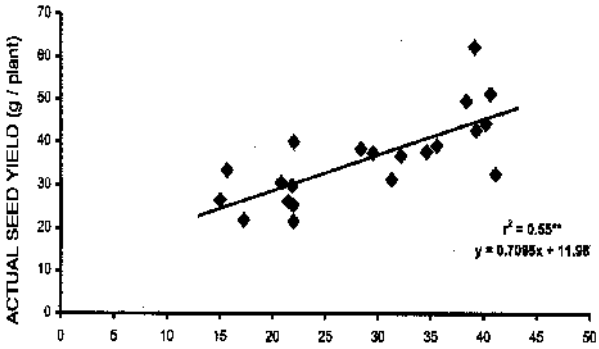
PREDICTED PLANT HEIGHT (Hij) (cm)

Figure 1. Actual vs. predicted plant height of hybrid. ** indicates significance of regression at P=0.01 level.



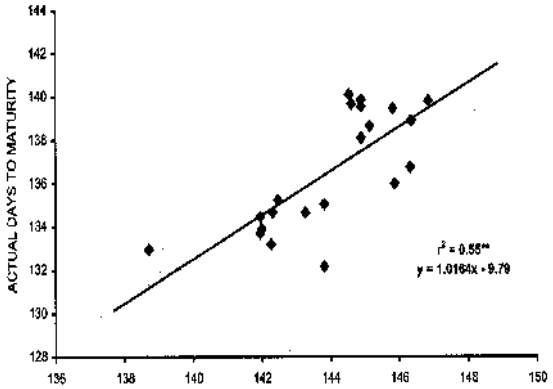
PREDICTED NO. OF SEEDS PERCAPITULUM (Hij)

Figure 2. Actual vs. predicted number of seeds per capitulum of hybrid. ** indicates significance of regression at P=0.05 level.



PREDICTED SEED YIELD (Hij) (g/plant)

Figure 3. Actual vs. predicted seed yield per plant of hybrids. ** indicates significance of regression model at P=0.01 level.



PREDICTED DAYS TO MATURITY(Hij)

Figure 4. Actual vs. predicted days to maturity of hybrids. ** indicates significance of regression at P=0.01 level.

REFERENCES

Brandle, J.E. and McVetty, P.B.E. (1989). Heterosis and combining ability in hybrids derived from oilseed rape cultivars and inbred lines. *Crop Sci.*, **29**: 1191-1195.

Chitanvis, A.G., Peshettiwar, P.D., Ghorpade, P.B. and Pande, M.K. (1999). Inheritance of AKSMS-1 male sterility in safflower. *Journal of Soils and Crops*, **9** (2): 271-272.

Falconer, DS and Mackay, T.F.C. (1996). Introduction to Quantitative Genetics. 4th Ed, Longman, pp. 480.

Hallauer, AR and Miranda, J.B. (1988). Quantitative Genetics in Maize Breeding. Iowa State University Press, Ames USA.

Knowles, P.F. (1989). Global perspectives of safflower. Proceeding of Second International Safflower Conference, Hyderabad, India.pp.13-16.

Panter, D. M. and Allen, F.L. (1995). Using best linear unbiased prediction to enhance breeding for yield in soybean. II. Selection of superior crosses from a limited number of yield trials. *Crop Sci.*, **35**: 405-410.