Indian J. Genet., **61**(2): 185-186 (2001)

Short Communication

Detection of epistasis in opium poppy (*Papaver somniferum* L.)

H. P. Singh, S. P. Singh, A. K. Singh and N. K. Patra

Central Institute of Medicinal and Aromatic Plants, Lucknow 226 015

(Received: September 1999; Revised: September 2000; Accepted: February 2001)

The knowledge of genic interactions in populations, being an utmost concern for any crop improvement programme, has two folds i.e., one their direct contribution to the development of superior populations and the other on the predicted response to the selection. At present, the various biometrical approaches applied for genetical analysis to predict the response to selection, either ignore the contribution of epistasis or often postulate its absence, which in fact is contrary [1-3]. Kearsey and Jinks [4] extended the North Carolina Design III to provide a suitable test for the epistasis and it was further extended by Jinks et. al. [5] and Ketata *et. al.* [6] for its application to the inbred lines. So far the genetic anayses carried out in opium poppy either ignored or assumed the absence of epistasis, which does not seem plausible. Hence, the present study was undertaken in opium poppy with the objectives - to have the information about the presence or absence of epistasis for morpho-metrical traits and devise the appropriate breeding strategies.

Two genotypes, Shweta (Standard cultivar) and T-12 (a strain) which showed marked differences for days to flower, plant height, number of capsules per plant, capsule diameter and average capsule weight, were crossed during the 1992-93 season. In 1993-94, three testers namely Shweta, T-12 and F_1 (Shweta × T-12), hereafter referred to as L_1, L_2 and L_3, respectively, were crossed with 15 inbred lines drawn from two different gene pools randomly. These tested

Table 1. Test of epistasis and sums and differences and estimates of genetic components of variances and degree and direction of dominance for rive traits in opium poppy

Source	df	Days to flowering	Plant height	Capsule/plant	Capsule diameter	Average capsule weight
Epistasis						
(L_1+L_2+L_3)	15	30.03**	139.84**	0.45	0.90	2.72
Epistasis i type	1	269.74**	1492.39**	1.82	0.87	30.01**
Epistasis j+l type	14	12.90**	43.23	0.04	0.06	0.77**
Within families	540	3.12	13.01	0.07	0.24	0.11
Replications	2	1.15	1.38	0.36	0.005	0.51
Sums (L_1+L_2)	14	128.56	627.64	2.52	0.02	1.91
Error	28	0.97	1.42	0.61	0.003	0.001
Replications	2	0.06	2.11	0.09	0.005	0.01
Differences						
(L_1–L_2)	14	90.25	191.67	1.24	0.18	1.34
Error	28	0.45	0.80	0.004	–0.0004	0.006
Parameters						
D		170.12	817.8	2.55	0.26	2.55
H		119.76	241.92	1.65	0.24	1.78
$(H/D)^{1/2}$		0.70	0.30	0.65	0.96	0.84
F		543.29**	2143.58	–8.08**	0.15	–17.59**
γ (sums-differences)		0.79**	-0.09	–0.91**	–0.07	–0.73**

lines are AP-1, AP-2, AP-5, AP-6, AP-9, AP-11, AP-13, AP-15, BP-2, BP-3, BP-5, BP-6, BP-8, BP-10 and BP-16. Fresh L_3 (F_1) seeds of Shweta × T-12 were also obtained. Thus the experimental material comprised 63 entries, including 3 testers, 15 lines and 45 TTC progenies (30 single crosses + 15 three way crosses). These entries were grown in single row plots of 3 m length in randomized complete block design with three replications during the season of 1994-95 at the research farm of Central Institute of Medicinal and Aromatic Plants, Lucknow (26.5° N latitude and 80.5° E longitude). The soil is sandy loam with pH 8.0 and moderate fertility. Standard cultural practices were followed during the crop. Data were recorded on five randomly chosen plants for plant height (cm) and number of capsules per plant at the time of maturity in each treatment and replicate. Observations for days to flower were recorded in days since the date of sowing to 80% flowering of plants in each entry. Data on capsule diameter (cm) and average weight of capsules (g) were recorded on five capsules randomly harvested from the plants that were studied for plant height and number of capsule per plant. The method for detecting epistasis, as described by Ketata *et. al.* [6], was used.

The presence of epistasis was recorded for days to flowering, plant height and average weight of capsules (Table 1). A further partitioning of epistasis in l (add. × add.) and j and i (add. × dom. and dom. × dom.) type showed the significance of both in respect of all the three traits. However, the magnitude of i type was invariably manifold and much larger than j and l type. Though, the analyses for sums ($L_1 + L_2$) and difference ($L_1 - L_2$) were carried out for all the traits (Table 1), it would be applicable to only number of capsule per plant and capsule diameter. The estimates of additive variances (Table 1) were higher than dominance for these characters and hence expressed partial dominance.

For remaining traits too, the estimates of D components were higher than H and $(H/D)^{1/2}$ excepting for capsule diameter for $(H/D)^{1/2}$. The directional element F was estimated from the co-variance of sums and differences and its significance was tested indirectly as the correlation (γ) of sums and differences. The positive estimate of directional element F observed for days to flower and negative for capsules per plant and average weight of capsules, revealed the iso-directional nature of dominance for days to the flowering suggesting that the genes with increasing effects were most predominant, while the reverse was the true for number of capsule per plant and average weight of the capsule.

Thus, the results of the present study revealed the presence of epistasis for all the traits studied except capsule per plant and capsule diameter, which means unless it is accounted suitably the estimates of genetic components especially for dominance would be misleading and ultimately would be affecting the prediction of variance of the recombinant inbred populations [7]. Presence of additive, dominance as well as epistatic components for all the traits except capsule per plant and capsule diameter, suggests simple selection procedures in the immediate progenies may not help much in achieving improvement in these traits. Therefore, epistasis cannot be ignored. Highly significant larger magnitude of D component indicates the operation of exploitable additive gene action in later generations. The presence of epistasis for the different traits can be exploited by recurrent selection techniques [8].

References

1. **Malhotra R. S. and Singh K. B.** 1989. Detection of epistasis in chickpea. Euphytica, **40**: 169-172.
2. **Sprague G. F., Russel W. A., Penny L. H., Horner T. W. and Hanson W. D.** 1962. Effects of epistasis on grain yield in maize. Crop Sci., **2**: 205-208.
3. **Stuber G. W. and Moll R. H.** 1969. Epistasis in maize (*Zea mays* L.). I. F_1 hybrids and their S_1 progeny. Crop Sci., **9**: 124-127.
4. **Kearsey M. J. and Jinks J. L.** 1968. A general method of detecting additive, dominance and epistatic variation for metrical traits 1. Theory. Heredity, **23**: 403-409.
5. **Jinks J. L., Perkins J. M. and Breese E. L.** 1969. A general method for detecting additive, dominance and epistatic variation for metrical traits II. Application to inbred lines. Heredity, **24**: 45-57.
6. **Ketata H., Smith E. L., Edwards L. H. and McNew R. W.** 1976. Detection of epistatic, additive and dominance variations in winter wheat (*Triticum aestivum* L. cm Thall.). Crop Sci., **16**: 1-4.
7. **Jinks J. L.** 1981. The genetic frame work of plant breeding. Phil. Trans. R. Soc. (London), B. **292**: 407-419.
8. **Subbaraman N. and Sree Rangasamy S. R.** 1989. Triple test cross analysis in rice. Euphytica, **42**: 35-40.