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Combining Ability Analysis of Yield and Its Components in Lentil (*Lens culinaris.* Medic)

S. N. Goyal[1], P. Joshi and H. N. Mehrotra

Agril. Research Station, University of Udaipur, Vallabhnagar, Udaipur (Raj.)

ABSTRACT

A diallet set of seven varieties of lentil was studied for combining ability. Importance of both, general as well as specific combining ability was observed for yield and yield components except plant height, number of primary branches and test weight, where only additive type of gene action was considerable. Parent T 8 and local which were good general combiners were also involved in best specific combinations indicating the validity of general combining ability for the prediction of yield of hybrids. Specific combinations like earliness and high yield (NP 47 × Local and T 8 × Local) were recognised.

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INTRODUCTION

IN RECENT years studies have been initiated on genetic aspects of pulse crops, like cowpea (Singh and Jain, 1972), Mungbean (Singh and Singh, 1972), black gram (Singh and Dhaliwal, 1972) and pigeon pea (Sharma *et al.*, 1973), but very little work has been done so far in lentil. An attempt is, therefore, made to study the combining ability for yield and its components with some promising varieties of lentil.

MATERIAL AND METHODS

A complete diallel set (excluding reciprocals) of 7 × 7 promising parents of lentil namely 'B 77', 'BR 25', 'C-31', 'Hyb. 1-1', 'NP 47', 'T 8' and local was made in 1970. Twenty-one crosses and their seven parents were grown in complete randomised block design with three replications in the *rabi* of 1971 at the Agricultural Research Station, Vallabhnagar (Udaipur). The material was planted in single row with ten plants per plot at a spacing of 40 × 15 cm.

Observations were recorded on five randomly selected plants for eight characters, viz. plant height, days to flower, number of primary branches, number of secondary branches, pod number, number of seeds per pod, seed yield per plant and test weight. Combining ability effects were calculated according to method two, model one of Griffing (1956).

RESULTS

The mean performance of parents and their hybrids is given in Table 1. There was considerable variability among the parents. T 8 proved to be comparatively better parent with respect to

1. Present address: Plant Breeder, A.I.C.O.R.P.O., Umrala (Bhavnagar), Gujarat.

TABLE 1

Mean performance of parents and F_1 hybrids for 8 characters in lentil.

Parent or cross	*Plant height*	*Days to flower*	*Primary branches(No.)*	*Secondary branches(No.)*
B 77	25·00	57·33	5·00	45·00
BR 25	23·00	59·33	4·33	34·67
C 31	19·33	56·33	6·00	36·00
Hyb 1—1	22·33	57·33	6·00	37·33
N P 47	22·00	62·67	5·00	39·33
T 8	38·67	62·67	9·67	50·00
Local	35·66	66·67	4·33	37·33
B 77 × BR 25	25·00	59·67	5·33	42·00
B 77 × C 31	24·66	57·00	5·67	35·33
B 77 × Hyb 1-1	24·33	59·00	7·00	38·33
B 77 × N P 47	25·66	57·33	6·00	44·67
B 77 × T 8	28·66	67·33	8·00	59·00
B 77 × Local	33·33	67·00	6·67	51·33
BR 25 × C 31	25·00	60·33	6·33	40·67
BR 25 × Hyb 1—1	24·33	60·67	5·67	43·67
BR 25 × N P 47	25·33	62·33	5·67	44·00
BR 25 × T 8	33·33	64·33	8·33	50·33
BR 25 × Local	29·00	68·33	7·33	61·00
C 31 × Hyb 1—1	23·00	59·33	6·00	38·67
C 31 × N P 47	24·66	65·67	5·67	39·67
C 31 × T 8	29·66	68·00	8·00	57·33
C 31 × Local	29·66	56·00	6·00	45·00
Hyb 1—1 × N P 47	24·00	62·00	6·00	39·67
Hyb 1—1 × T 8	32·33	66·00	10·67	74·00
Hyb 1—1 × Local	29·66	65·67	6·67	48·33
N P 47 × T 8	32·33	68·33	6·00	41·33
N P 47 × Local	32·66	64·33	7·00	46·67
T 8 × Local	39·66	65·67	11·67	52·00
CD at 5%	5·827	3·386	1·683	15·041
CD at 1%	6·761	4·572	2·272	20·311

pod number	*Seeds per pod (No.)*	*Grain yield (gm)*	*Test weight (gm)*	*pod number*	*Seeds per pod (No.)*	*Grain yield (gm)*	*Test weight (gm)*
260·33	1·600	7·73	1·208	452·00	1·530	10·07	1·579
326·00	1·593	10·90	1·764	397·33	1·427	11·27	1·489
159·00	1·207	4·40	1·438	379·00	1·440	15·33	2·732
289·00	1·337	11·37	1·964	309·00	1·553	9·00	1·726
273·00	1·800	7·63	1·775	323·33	1·440	8·17	1·521
318·00	1·383	11·60	2·397	369·33	1·507	13·97	2·289
215·00	1·423	10·00	2·793	298·00	1·373	10·60	2·446
348·33	1·543	10·97	1·645	406·33	1·603	9·43	1·559
331·67	1·575	8·97	1·559	739·00	1·603	19·77	2·589
302·67	1·667	9·80	1·694	541·00	1·420	17·10	2·674
380·00	1·647	10·40	1·577	443·00	1·697	15·53	2·547
369·33	1·530	12·40	1.565	727·67	1·573	24·60	2·396
416·67	1·300	18·67	2·656	740·67	1·310	26·97	2·789
414·67	1·557	11·73	1·924	116·615	0·090	0·903	0·554
371·67	1·560	11·10	1·794	157·476	0·122	1·219	0·748

majority of the characters, though it was late. No hybrid was found to be significantly earlier in flowering. With respect to grain yield ten hybrids superseded even the best yielding parent.

The analysis of variance of combining ability (Table 2) revealed that the variance due to general combining ability was highly significant for all the characters. Variance due to specific combining ability was not significant for plant height, number of primary branches and test weight. However, it was highly significant for rest of the characters. GCA/SCA ratio was quite high in all the characters which indicated that additive type of gene action was predominant in the expression of these traits.

Estimates of general and specific combining ability effects are presented in Table 3 and Table 4, respectively. T 8 and local were found to be the best general combiners for almost all the characters, whereas, B 77, BR 25 and C-31 were poor combiners for all the characters. C-31 and NP 47 were best general combiners for earliness and number of seeds per pod, respectively. However, none of the parents was good general combiner for test weight. Considering the specific

TABLE 2

Analysis of variance for combining ability in lentil.

Source	*df.*	*Plant height*	*Days to flower*	*Number of primary branches*	*Number of secondary branches*	*Number of pods/plant*	*Number of seeds/pod*	*Seed yield per plant*	*Weight of 100 seeds*
GCA	6	112·47**	37·21**	8·70**	138·33**	24585·88**	0·0435**	50·9127**	0·8614**
SGA	21	2·73	10·64**	0·44	65·86**	19522·59**	0·0108**	18·3357**	0·0729
Error	54	4·04	1·37	0·34	26·87	1781·64	0·002	0·0967	0·0400
GCA/SCA		41·19	3·49	19·77	2·11	1·26	4·207	2·776	11·816

** Significant at 1% level of probability.

TABLE 3

Estimates of general combining ability effects of parents in lentil.

Parents	*Plant height*	*Days to flower*	*Number of primary branches*	*Number of secondary branches*	*Number of pods/plant*	*Number of seeds/pod*	*Seed yield per plant*	*Weight of 100 seeds*
1. B 77	—1·31	—1·89**	—0·50	—0·33	—49·47*	—0·0172	—1·46**	—0·323
2. BR 25	—1·72	—0·52	—0·65**	—1·40	—11·06	—0·0413*	—0·844**	—0·148
3. C 31	—3·13**	—2·23**	—0·38	—3·88	—83·39**	—0·1330**	—3·18**	—0·187
4. Hyb. 1—1	—2·35*	—1·30*	0·09	—0·69	14·79	—0·0571**	0·10	—0·007
5. N P 47	—1·65	0·69	—0·75	—3·21	18·19	0·5284**	—0·71**	—0·144
6. T 8	5·53**	2·88**	2·24**	7·82**	64·45**	—0·0838**	2·58**	0·226
7. Local	4·64	2·37**	0·09	1·71	46·48*	—0·1503**	3·71**	0·584
SE	1·07	0·62	0·36	2·758	22·561	0·0173	0·1661	0·3162

* Significant at 5% level of probability

** Significant at 1% level of probability

TABLE 4

Estimates of specific combining ability effects in lentil.

Crosses	*Plant height*	*Days to flower*	*Number of primary branches*	*Number of secondary branches*	*Number of pods/plant*	*Number of seeds/pod*	*Seed yield per plant*	*Weight of 100 seeds*
B 77×BR 25	0·10	—0·29	—0·17	—1·94	19·54	0·0057	0·77	0·113
B 77 × C 31	1·17	—1·26	—0·09	—5·91	75·22	0·1482**	1·11*	0·066
B 77 × Hyb 1—1	0·06	—0·19	0·76	—6·11	—51·97	0·1664**	—1·14*	0·051
B 77×N P 47	0·69	—3·86	0·61	2·77	21·95	0·0364	0·07	0·041
B 77 × T 8	—0·38	3·96*	—0·39	6·06	—34·98	0·0560	—1·22*	—0·341
B 77 × Local	0·22	4·17*	0·43	4·50	30·33	—0·1075*	3·92**	0·392
BR 25 × C 31	0·21	0·70	0·72	0·50	119·81	0·1564**	3·25**	0·256
BR 25×Hyb 1—1	0·05	0·11	—0·42	0·32	—21·38	0·0835	—0·46	—0·054
BR 25×N P 47	0·08	—0·23	0·43	3·17	55·55	—0·0565	—0·88	—0·132
BR 25×T 8	0·17	—0·41	0·19	—1·54	—45·38	—0·0229	—2·98**	—0·592
BR 25×Local	—0·20	2·77	1·24	15·24	—45·75	0·0566	—0·05	0·293
C 31×Hyb 1—1	—0·60	0·48	—0·36	—1·18	—11·71	0·1682**	—0·22	—0·083
C 31×N P 47	0·16	4·82*	0·17	1·32	—0·79	—0·0548	—0·45	—0·152
C 31×T 8	—0·07	4·96*	—0·50	7·94	—1·05	0·1489**	—2·06**	0·247
C 31 × Local	0·02	—6·52**	—0·35	1·73	—54·42	0·0814	—2·44**	0·046
Hyb 1—1×N P 47	0·01	0·22	0·01	—1·86	—15·98	0·0324	—2·26**	—0·293
Hyb 1—1×T 8	0·13	2·03	1·69	21·43*	270·43**	0·1890**	4·78**	0·361
Hyb 1—1×Local	—0·06	2·22	—0·17	1·87	90·40	0·0525	0·98*	0·094
N P 47×T 8	0·05	1·36	2·13*	8·72	28·97	0·1530**	1·15*	0·462
N P 47×Local	0·19	—1·12	1·02	2·73	273·66**	0·0955	9·09**	—0·047
T 8×Local	0·17	—1·96	2·69**	—2·98	240·40**	—0·0309	8·17**	—0·024
SE	3·12	1·95	0·90	8·058	65·62	0·0490	0·48	0·30

* Significant at 5% level of probability   ** Significant at 1% level of probability

combining ability T 8 and local appeared to show high specific combining ability effects for grain yield. Almost all the crosses which gave high yield involved either T 8 or local parent (NP 47 × local, T 8 × local and Hyb. 1-1 × T 8). A low × low combination gave low yield while high × low and high × high resulted in to higher yield. Only one cross BR 25 × C-31 has shown high specific combining ability effects though its both the parents were poor general combiners, may be due to complementary gene action. No cross showed high specific combining ability effects for plant height and test weight. Only one cross C-31 × local was significantly earlier, while none of the early × early specific combinations could give significant earliness. It seemed that genetic constitution of the parents for this character was more or less similar and required more diversity. Only three specific combinations Hyb. 1-1 × T 8, NP 47 × local and T 8 × local were found superior for number of pods per plant. Number of primary and secondary branches were significantly more in crosses T 8 × local, and Hyb. 1-1×T 8, respectively. Specific combinations for earliness and high yield like NP 47 × local and T 8 × local may be of some interest.

DISCUSSION

It is generally believed that the best parent is also the best general combiner for the particular character. In the present study also this concept has been proved for almost all the characters except number of pods per plant. Therefore, a due consideration should always be given to the mean performance of the varieties while making crossing programme.

The study further indicated the importance of both general combining ability and specific combining ability effects for all the characters except plant height, number of primary branches and test weight. Therefore, yield and its components, days to flower, secondary branches, pod number and seeds per pod are under the control of both additive and non-additive gene actions. Further, it was observed that variance due to general combining ability was larger than due to specific combining ability. Effects indicated that general combining ability are pre-dominant for yield components. Since general combining ability is attributable to additive gene action and additive × additive epistasis, it appears that conventional breeding methods would be much more rewarding in the improvement of this crop also as they are in other pulse crops like cowpea (Singh and Jain, 1972), mungbean (Singh and Singh, 1972) and pigeon pea (Sharma *et al.*, 1973). An examination of GCA and SCA effects revealed that the parents T 8 and local in general exhibited good GCA effects for grain yield and most of the characters. Inspite of their good general combining ability effects, a number of crosses involving either of these parents were not high yielding. This suggests epistatic inter-actions resulting in the internal cancellations of the components of heterosis as suggested by Murty (1965). The possibilities of involving other factors also can not be ruled out. Even then these two parents (T 8 and local) appear to be worthy of exploitation. Normally, in a self pollinating crop, specific combining ability alone does not contribute tangibly in its improvement, except where the commercial exploitation of heterosis is feasible. However, the crosses showing high specific combining ability effects involving either both the parents or atleast one parent with good general combining ability could be exploited for practical breeding.

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REFERENCES

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Australian J. Biol. Sci.* **9:** 463-93.

Murty, B. R. 1965. Heterosis and combining ability in relation to general divergence in flu cured tobacco. *Indian J. Genet.* **25:** 43-56.

Sharma, H. K., Laxman Singh and D. Sharma. 1973. Combining ability in diallel crosses of pigeon pea. *Indian J. Agric. Sci.* **43:** 25-29.

Singh, K. B. and H. S. Dhaliwal. 1972. Combining ability for seed yield in black gram. *Indian J. Genet.* **32:** 99-102.

Singh, K. B. and R. P. Jain. 1972. Heterosis and combining ability in Cowpea. *Indian J. Genet.* **32:** 62-66.

Singh, Tejinder P. and K. B. Singh. 1972. Combining ability in Mung bean. *Indian J. Genet.* **32:** 66-72.