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GENETICS OF SEED SIZE AND SEED YIELD IN LENTIL (*LENS CULINARIS* MEDIK)

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ABSTRACT

One bold- and five small seeded varieties/lines of lentil were crossed to make a half-diallel. Combining abilities were calculated and both additive and nonadditive gene actions were found to be important in the expression of 100-seed weight and seed yield/plant in lentil. The per se performance of parents gave fair indication of their gca effects for 100-seed weight. One bold- and two small seeded parents had high seed weight besides being good general combiners for this trait. Only one parent KL 86-2, was found to be a good general combiner for seed yield/plant and also having significant positive gca effects for both the traits. Significant sca effects for 100-seed weight were recorded in the crosses involving one parent with high and the other with low gca effects.

Key words: Lentil, *Lens culinaris*, genetics, combining ability, gca, sca.

The combining ability analysis helps in selection of superior parents (general combining ability) as well as crosses (specific combining ability) when considered along with the mean performances. It also tells about the nature of gene action involved and thus helps in framing a suitable breeding scheme for the improvement of the characters under consideration. The combining ability analysis in lentil is frequently used by breeders [1–4] to fulfill the above mentioned objectives. The present investigation was therefore undertaken to gather information on these aspects for seed size and seed yield in lentil.

MATERIALS AND METHODS

Six varieties/lines, one bold-(Precoz) and five small seeded (KL 86-2, Lens 4136, Pant L 406, Pant L 639 and HUL 12) were crossed in a half-diallel fashion. Fifteen F_1s along with the six parents were evaluated in randomized block design with three replications with plant-to-plant and row-to-row distance 10 and 23 cm, respectively. Observations were

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recorded on seed yield/plant and 100-seed weight on five random competitive plants in each population. Combining ability analysis was carried out following Model I, Method 2 of Griffing [5].

RESULTS AND DISCUSSION

The analysis of variance (Table 1) for combining ability revealed that variances due to both general combining as well as specific combining abilities (gca, sca) were highly significant for both 100-seed weight and seed yield/plant. This indicated that both additive and non-additive gene actions were involved in the inheritance of the traits studied. However, for 100-seed weight the gca variance was much higher in magnitude than for sca variance, indicating predominant role of additive genetic system in the inheritance of this trait whereas, nonadditive gene action played an important role in the inheritance of seed yield/plant due to its higher sca variance than the corresponding gca variance. Predominance of additive genetic variance for 100-seed weight has also been reported by [1]. Singh and Jain [2] also reported greater importance of nonadditive genetic variance for seed yield/plant in lentil.

Table 1. ANOVA for combining ability for 100-seed weight and seed yield in lentil

Source	d.f.	100-seed weight	Yield per plant
Gca	5	2.622**	0.130**
Sca	15	0.196**	0.470**
Error	40	0.003	0.028

**Significant at 1% level.

Table 2. Performance and gca effects of parents for 100-seed weight and seed yield per plant in lentil

Parent	100-seed weight		Seed yield/plant	
	seed weight	gca	yield	gca
Precoz	4.16	0.80**	2.41	-0.02
KL 86-2	3.46	0.25**	3.18	0.19**
Lens 4136	3.30	0.34**	3.69	-0.10
Pant L 406	1.90	-0.58**	3.36	-0.02
Pant L 639	1.70	-0.36**	3.00	0.09
HUL 12	1.92	-0.43**	2.84	-0.14**
SE (gi)		0.01		0.05
SE (gi–gj)		0.02		0.08

**Significant at 1% level.

The estimates of gca effects (Table 2) revealed that Precoz—a bold seeded parent, and two small seeded parents—KL 86-2 and Lens 4136, had significant positive gca effects for 100-seed weight. Only one parent (KL 86-2) exhibited significant positive gca effect for seed yield/plant. Besides, it was the only parent exhibiting significant positive gca effects simultaneously for both 100-seed weight and seed yield/plant. KL 86-2 was found to be the best and HUL 12 poorest general combiner for both characters. Perusal of the mean performance of the parents and their gca effects revealed that for 100-seed weight, parental mean was a good indicator of the gca effect, whereas no such relationship was found for seed yield/plant.

The sca effects for 100-seed weight and seed yield/plant are presented in Table 3. Nine crosses viz., Lens 4136 x HUL 12, Lens 4136 x Pant L 639, Precoz x Pant L 406, KL 86-2 x Pant L 639, KL 86-2 x Pant L 406, Precoz x Pant L 639, Precoz x HUL 12, KL 86-2 x HUL 12 and Lens 4136 x Pant L 406, showed high sca effects for 100-seed weight. High sca for 100-seed weight was recorded in the crosses involving one parent with high and the other with low gca effects. Similar findings have also been reported by [1]. It was interesting to note that whenever both parents either with high or low gca were involved in a cross it resulted into significant negative sca effects for 100-seed weight. Six crosses viz. Precoz x KL 86-2, Precoz x HUL 12, Pant L 406 x Pant L 639, Lens 4136 x Pant L 639, Pant L 639 x HUL 12 and KL 86-2 x HUL 12 showed significant positive sca effects for seed yield/plant. Of these, two crosses (Precoz x KL 86-2 and KL 86-2 x HUL 12) involved one parent with high gca, and three other crosses (Pant L 406 x Pant L 639, Lens 4136 x Pant L 639 and Pant L 639 x HUL 12) with one parent having average gca effects. Such crosses could produce promising segregates only if additive gene effects are important in the good general combiners and complementary epistatic effects in the F_1s and both act in the same direction to maximize the expression of the trait under study. Three crosses (Precoz x HUL 12, Lens 4136 x Pant L 639 and KL 86-2 x HUL 12) showed significant positive sca effects for both 100-seed weight and seed yield/plant, indicating the possibility of producing transgressive segregates with high seed size and seed yield/plant in F_2 generation.

Table 3. Estimates of specific combining ability effects for 100-seed weight and seed yield/plant in crosses of lentil

Cross	100-seed weight	Seed yield
Precoz x KL 86-2	- 0.46**	1.37**
Precoz x Lens 4136	- 1.13**	- 0.42**
Precoz x Pant L 406	0.74**	0.19
Precoz x Pant L 639	0.40**	- 0.51**
Precoz x HUL 12	0.33**	1.00**
KL 86-2 x Lens 4136	- 0.57**	- 0.42**
KL 86-2 x Pant L 406	0.56**	- 0.58**
KL 86-2 x Pant L 639	0.62**	0.17
KL 86-2 x HUL 12	0.30**	0.26**
Lens 4136 x Pant L 406	0.20**	- 0.12
Lens 4136 x Pant L 639	0.81**	0.49**
Lens 4136 x HUL 12	0.99**	- 0.95**
Pant L 406 x Pant L 639	- 0.32**	0.53**
Pant 406 x HUL 12	- 0.29**	- 0.27*
Pant L 639 x HUL 12	- 0.36**	0.27*
SE (Sij)	0.04	0.12
SE (Sij-sik)	0.07	0.22
SE (sij-skl)	0.06	0.20

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

The development of pure lines by following pedigree method of breeding is most common in lentil, like in other autogamous pulse crops. The present investigation as well as earlier reports by [1–4] have indicated the presence of both additive and nonadditive components of genetic variance for 100-seed weight and seed yield. Therefore, breeding techniques involving some sort of intermating in segregating generations may be useful in isolating high yielding pure lines in the later generations.

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