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Research Note

Heterosis and Combining ability studies in intra-specific derivatives of Wal (*Lablab purpureus* (L.) Sweet)

T.D. Jadhav and S.S. Desai*
Department of Agricultural Botany, College of Agriculture,
Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli. Dist: Ratnagiri 415712.
Email: desaiss2008@rediffmail.com

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Abstract
Eight genotypes of Wal *viz.*, DPLW-46, DPLW-61, DPLW-10, DPLW-31, DPLW-15, DPLW-48, DPLW-51, DPLW-29 and their crosses made in half diallel fashion were evaluated to estimate the combining ability and heterosis effects for yield and yield component characters. The proportion of δ^2g/δ^2s revealed preponderance of non additive gene action for inheritance of all the characters. All the parents exhibit significant estimates for combining ability for one or more characters. The parents *viz.*, DPLW-29, DPLW-15 and DPLW-51 were good combiner for most of the characters. Among the crosses DPLW -46 X DPLW-29, DPLW-51 X DPLW-29, DPLW-46 X DPLW-61, DPLW-15 X DPLW-51 and DPLW-46 X DPLW-10 were identified as promising cross combinations and recorded highest significant positive heterosis over mid and better-parents for seed yield per plant. These heterotic cross combinations could be exploited to get superior segregants.

Keywords
Wal, GCA, SCA, heterosis and Gene action

Wal (*Lablab purpureus* (L.) Sweet) is one of the important pulse crop cultivated in Konkan region of Maharashtra predominantly grown on residual moisture after rice crop during *rabi* season. It is popularly recognized as 'Wal' in Maharashtra. Though the crop is having a considerable diversity and the improvement through selection is possible, the productivity of this crop is very low. Development of new variety with high yield and early maturity is prime objective of breeder. The first step in a successful breeding programme is to select appropriate parents. Diallel analysis provides systematic approach for selection of appropriate parents and crosses superior in terms of traits. Exploitation of heterosis is primarily dependent on screening and selection of available germplasm that could produce better cross combinations. Breeding strategies based on selection of hybrids require expected level of heterosis as well as the specific combining ability (*sca*). In breeding high yielding varieties of crop plant, the breeders often face the problem of selecting parents and crosses. Combining ability analysis is one of the powerful tool available to estimate the combining ability effects and aids in selecting the desirable parents and crosses for the exploitation of heterosis. The ultimate objective of any crop improvement programme is to improve yield which is a complex character and is dependent on a number of agro-morphological traits. The degree of heterosis depends on the degree to which parental lines are related. With this background information, the present investigation was taken up to assess combining ability and heterosis in wal.

The experimental material consisted of eight genetically diverse genotypes of wal *viz.*, DPLW-46, DPLW-61, DPLW-10, DPLW-31, DPLW-15, DPLW-48, DPLW-51 and DPLW-29 were crossed in half diallel fashion (excluding reciprocals) as suggested by Griffing (1956) in Method –I, Model –II. The resulting 28 F_1's and 8 parents were grown in randomized block design with three replications during *rabi* 2012. The experiment was conducted at research farm of the Department of Agricultural Botany, College of Agriculture, Dapoli, Dist-Ratnagiri, (M.S). The seeds were sown on 60 x 45 cm distance between rows and plants. Observations were recorded on five randomly selected plants of each genotype per replication for six quantitative characters *viz.*, days to maturity, plant height (cm), number of pods per plant, pod length (cm), number of seeds per pod and seed yield per plant (g). The analysis of variance was computed as suggested by Panse and Sukhatme (1985). The combining ability analysis was carried out as per Kempthorne (1969) and the magnitude of heterosis was estimated in relation to better and mid parent as per the standard method.

The analysis of variance for combining ability was highly significant for all the characters except for number of seeds per pod while *sca* variance was highly significant for plant height, pod length, number of seeds per pod and seed yield per plant and it was non-significant for the character days to maturity and number of pods per plant (Table 1). The ratio of δ^2g/δ^2s revealed preponderance of non additive gene action for inheritance of all the characters. Gawali *et al*., (2011) has also reported similar non additive gene action of high magnitude for various characters. The general combining ability (*gca*) effects of the parents are presented in Table 2. The results revealed that none of the parent was good general combiner for all the characters. The parent DPLW-51 was found to be the good general combiner with *gca* effect (-0.72) for days to maturity. The Parent DPLW-29 showed desirable general combining ability effect for the characters *viz.,* plant height, number of pods per plant & yield per plant. The parent DPLW-15 was the good general combiner for pod length. All the parents showed non-significant *gca* effect for number of seeds per pod in both directions. Sawant *et al.,* (2006) and Viraj *et al.,* (2006) have also reported such negative as well as positive *gca* effects exhibited by parents for one or more yield contributing characters.

The specific combining ability (*sca*) effects of hybrids are presented in Table-3. The highest yielding cross DPLW -46 x DPLW -29 recorded significantly highest positive *sca* effect for seed yield per plant (9.96). While the cross DPLW-46 X DPLW-61 showed significant *sca* for number of pods per plant, number of seeds per pod but the character plant height (-4.90) showed negative non-significant *sca* effect. The cross DPLW-15 X DPLW -51 showed significant *sca* effect for plant height (-2.84) and number of pods per plant (10.99). While the cross DPLW-46 x DPLW-48 found to be the best combiner for days to maturity (-1.33). The cross DPLW-10 x DPLW-48 found to be the best combiner for pod length (0.46). Such varying specific combining ability effects exhibited by different crosses has also been reported by Jayarani and Manju (1996) and Jyothula and Guttala (2001). Present investigation revealed that on the basis of *gca* estimates none of the parent was good combiner for all the characters. The parents DPLW-29, DPLW-15 and DPLW-51 were good general combiner for most of the characters in Wal. The *sca* estimates revealed that no cross combination was good for all the characters. However, the crosses DPLW-49 xDPLW-29, DPLW-51 x DPLW-29, DPLW-46 x DPLW-61 and DPLW-15 x DPLW-51 were exhibiting high *sca* effects for important yield contributing characters.

In conventional breeding considerable attention has been paid to increase the yield potential by exploiting the heterosis from intervarietal hybrids of wal by identification of potential cross combinations with respect to grain yield and its related traits. Heterosis over mid and better parent for growth and yield characters are presented in Table-4. For days to maturity negative heterosis was considered as desirable, showed moderate variation from -1.88 per cent to 1.26 per cent over mid parent and -1.57 per cent to 2.56 per cent over better parent. Hybrid DPLW-31 x DPLW-29 showed maximum heterotic performance in negative direction over mid parent (-1.88 %) and better parent (-1.57 %) for this character proved to be desirable for selection. Vashi *et al.* (1999) reported the similar result for the character days to maturity in lablab bean. For the character plant height heterosis ranged from -15.02 per cent to 9.85 per cent over mid parent and -10.86 per cent to 28.08 per cent over better parent. The heterosis was worked out for dwarfness. The heterotic effect for plant height was highly significant for the cross DPLW-61 x DPLW-51 showed (-15.02 %) over mid parent and DPLW-10 x DPLW-51 (-10.86 %) over better parent followed by DPLW-61 x DPLW-51 (-10.47 %) in case of better parent. For the character pod length heterotic values for mid and better parent ranged from 0.91 per cent to 21.70 per cent and 0.38 per cent to 21.31 per cent respectively. Hybrid DPLW-10 x DPLW-48 showed maximum positive heterosis over mid parent (21.70%) and (21.31%) over better parent. Relative heterosis and heterobeltiosis for number of pods per plant ranged from -4.55 to 35.56 per cent and -13.35 to 27.02 per cent respectively. The hybrid DPLW-46 x DPLW-29 showed highest relative heterosis (35.56%).. The hybrids having relatively higher heterosis for this character were found performing well for the yield. Similar findings were reported by Virja *et al.* (2006) for pod length and Valu *et al.* (2006) for number of pods per plant. For number of seeds per pod heterotic value of hybrid ranged from 2.40 per cent to 21.10 per cent over mid parent and -3.88 per cent to 20.08 per cent over better parent. Hybrid DPLW-46 x DPLW-61 proved to be the best by showing higher heterosis over mid parent (21.10%) and better parent (20.08%). To obtain higher seed yield plant which produced more number of pods is desirable. For the character yield per plant relative heterosis and heterobeltiosis ranged from -0.67 per cent to 50.76 per cent and -1.81 per cent to 41.54 per cent. Hybrid DPLW-46 x DPLW-29 has showed maximum relative heterosis (50.76%) and heterobeltiosis (41.54%) followed by hybrid DPLW-46 x DPLW-61 and DPLW-51 x DPLW-29. Similar finding were earlier reported by Bendale *et al.* (2005).

The hybrids DPLW-46 x DPLW-29 and Hybrid DPLW-46 x DPLW-61 were reported significant heterosis for number of pods per plant, pod length, number of seeds per pod and seed yield per plant followed by DPLW-51 x DPLW-29 for number of seeds per pod and seed yield per plant. These two cross combinations can be successfully utilized in the exploiting hybrid vigour as well as development of superior populations in the lablab bean. Further the segregating progenies of these cross combination may provide the opportunity to select the desirable individual plants having high grain yield and also high intensity of expression of yield contributing characters.

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Table 1. Analysis of variance for combining ability for six characters in 8× 8 half diallel of Wal (*Lablab purpureus*L. Sweet)

Sr. No	Characters	Mean sum of squares			σ^2g	σ^2s	σ^2g/σ^2s
		g.c.a (d.f.= 7)	s.c.a (d.f.= 27)	Error (d.f.=70)			
1.	Days to Maturity	1.860*	0.523	0.669	0.119	-0.146	-0.815
2.	Plant Height (cm)	50.451**	9.935**	1.737	4.871	8.197	0.594
3.	Number of pods per plant	168.824**	47.915	32.697	13.613	15.218	0.895
4.	Pod length (cm)	0.099**	0.082**	0.0093	0.009	0.072	0.125
5.	Number of seeds per pod	0.0074	0.0521**	0.0062	0.0001	0.046	0.00261
6.	Seed yield per plant(g)	26.861*	15.823*	9.378	1.748	6.445	0.2712

*Significant at 5% level **Significant at 1% level

Table 2. Estimates of general combining ability effects of parents for six characters in Wal (*Lablab purpureus*L. Sweet)

Sr. No.	Parents	Days to Maturity	Plant height (cm)	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Seed yield per plant (g)
1.	DPLW -46	0.55*	-2.18**	1.68	-0.13**	0.00	-0.47
2.	DPLW -61	-0.22	-0.78	-1.88	0.00	-0.03	-0.94
3.	DPLW -10	0.08	1.88**	0.26	0.08**	0.04	1.07
4.	DPLW -31	-0.05	2.52**	0.52	0.12**	0.02	0.64
5.	DPLW -15	-0.22	0.20	1.89	0.13**	0.02	1.32
6.	DPLW -48	0.628	0.38	-7.57**	-0.06	-0.04	-3.15**
7.	DPLW -51	-0.72**	1.98**	-1.80	-0.05	-0.02	-0.53
8.	DPLW -29	-0.05	-4.00**	6.89**	-0.10**	-0.01	2.05*
	SE(gi)	0.242	0.390	1.691	0.028	0.023	0.906
	SE(gi-gj)	0.366	0.589	2.557	0.043	0.035	1.370
	CD @ 5%	0.57	0.92	4.00	0.07	0.05	2.14
	CD @ 1%	0.85	1.36	5.92	0.10	0.08	3.17

*Significant at 5% level **Significant at 1% level

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Table 3: Estimation of specific combing ability effects of crosses for 6 characters in Wal (*Lablab purpureus*L. Sweet)

Sr. No	Hybrids	Days to Maturity	Plant height (cm)	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Seed yield per plant (g)
1.	DPLW-46 X DPLW-61	0.50	-4.90	11.45*	-0.03	0.22**	4.69
2.	DPLW-46 X DPLW-10	0.20	3.65**	5.02	0.22*	0.09	4.01
3.	DPLW-46 X DPLW-31	-0.33	-3.59**	0.69	-0.01	0.06	2.24
4.	DPLW-46 X DPLW-15	0.50	2.06	-8.42	0.44**	0.18*	-3.04
5.	DPLW-46 X DPLW-48	-1.33	-0.18	-4.29	0.13	0.13	-1.11
6.	DPLW-46 X DPLW-51	-0.33	2.08	-8.86	0.02	0.17*	-2.39
7.	DPLW-46 X DPLW-29	-0.67	1.06	21.06	0.02	0.06	9.96**
8.	DPLW -61X DPLW-10	-0.37	-2.69*	3.57	0.20*	0.19*	1.52
9.	DPLW-61 X DPLW-31	-0.57	-2.06	-5.16	0.21*	0.21**	-2.49
10.	DPLW -61X DPLW-15	-0.07	1.18	1.54	0.18	0.12	1.34
11.	DPLW -61X DPLW-48	0.77	3.34**	-1.27	-0.10	0.08	0.47
12.	DPLW -61X DPLW-51	-0.23	-4.73	4.30	0.12	0.11	0.69
13.	DPLW -61X DPLW-29	0.10	1.12	-3.06	0.26**	-0.03	3.24
14.	DPLW-10 X DPLW-31	-0.53	-0.52	-0.96	0.03	0.09	2.60
15.	DPLW-10 X DPLW-15	-0.37	-0.40	3.40	0.26**	0.10	2.42
16.	DPLW-10 X DPLW-48	0.13	0.76	-2.94	0.46**	0.16*	-2.58
17.	DPLW-10 X DPLW-51	0.47	-4.58	-3.11	0.18	0.09	-1.76
18.	DPLW-10 X DPLW-29	1.13	-1.14	-0.79	-0.27**	0.20**	-2.11
19.	DPLW-31 X DPLW-15	0.77	5.42	1.14	-0.30**	-0.29**	-0.08
20.	DPLW-31 X DPLW-48	0.27	-2.62*	-0.73	0.37**	0.13	-0.68
21.	DPLW-31 X DPLW-51	0.27	-2.22	3.10	0.06	0.18*	1.44

*Significant at 5% level **Significant at 1% level

Table 4. Heterosis (MP) and Heterobeltosis(BP) for six characters in wal

Sr. No.	Hybrids	Days to maturity		Plant height		No. of pods per plant		Pod length (cm)		No. of seeds per pod		Seed yield per plant	
		MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
1	DPLW-46 X DPLW-61	0.16	1.27	-12.38**	-6.39	24.92*	21.27	9.67**	6.60	21.10**	20.08**	32.42**	29.46*
2	DPLW-46 X DPLW-10	0.00	0.95	4.21	14.66**	13.11	10.70	17.47**	13.63**	17.08**	15.88**	23.85*	11.25
3	DPLW-46 X DPLW-31	-0.94	-0.31	-7.85**	2.26	4.47	-0.79	9.05**	2.30	12.73**	8.98**	17.93	6.05
4	DPLW-46 X DPLW-15	0.47	1.92	6.78*	8.52*	-1.71	-3.53	19.46**	11.51**	14.51**	9.09**	7.39	-1.81
5	DPLW-46 X DPLW-48	-1.71	-1.56	0.18	4.64	-0.84	-6.81	12.28**	8.96**	14.05**	11.11**	6.82	3.30
6	DPLW-46 X DPLW-51	-0.94	0.32	-0.89	11.90**	-1.94	-5.24	7.51*	2.37	16.39**	14.06**	10.00	5.64
7	DPLW-46 X DPLW-29	-1.56	-1.25	5.84	14.04**	35.56**	27.02**	8.26**	5.10	13.11**	10.84**	50.76**	41.54**
8	DPLW -61X DPLW-10	-0.16	0.00	-9.81**	-7.28*	9.85	4.43	16.82**	16.24**	20.25**	18.03**	13.31	3.89
9	DPLW-61 X DPLW-31	-0.79	-0.32	-8.51**	-5.18	-4.55	-11.86	14.21**	10.10**	17.31**	12.50**	1.45	-6.88
10	DPLW -61X DPLW-15	0.32	0.64	0.98	6.07	9.66	4.54	13.10**	8.48**	12.63**	6.44	15.94	8.26
11	DPLW -61X DPLW-48	0.63	1.59	2.36	4.60	1.58	-1.76	6.34*	6.16	12.53**	8.73*	7.70	6.50
12	DPLW -61X DPLW-51	-0.48	-0.32	-15.02**	-10.47**	14.54	14.01	9.96**	7.66*	14.46**	11.24**	15.19	13.10
13	DPLW -61X DPLW-29	-0.47	0.32	1.38	17.22**	4.61	-4.66	14.29**	14.14**	10.33**	7.23*	27.02*	21.86
14	DPLW-10 X DPLW-31	-0.63	-0.32	-4.40	-3.65	-1.42	-4.40	11.37**	7.88*	13.60**	10.94**	10.64	10.50
15	DPLW-10 X DPLW-15	0.16	0.64	-0.11	8.01*	9.27	8.95	16.42**	12.19**	12.20**	7.95*	13.96	11.75
16	DPLW-10 X DPLW-48	0.16	0.95	-0.38	4.72	-3.22	-10.87	21.70**	21.31**	14.92**	13.10**	-4.73	-11.75
17	DPLW-10 X DPLW-51	0.32	0.64	-12.95**	-10.86**	1.59	-3.85	12.65**	10.82**	14.00**	12.85**	3.77	-3.23
18	DPLW-10 X DPLW-29	0.63	1.27	-1.03	18.09**	4.95	0.38	2.58	2.20	17.65**	16.47**	7.28	2.32
19	DPLW-31 X DPLW-15	0.79	1.60	9.85**	19.78**	3.41	0.00	0.91	0.38	-2.40	-3.88	6.67	4.73
20	DPLW-31 X DPLW-48	-0.16	0.31	-5.65*	0.00	-3.25	-13.35	16.72**	12.70**	10.63**	9.77**	-0.67	-7.88
21	DPLW-31 X DPLW-51	-0.32	0.32	-9.05**	-7.61*	6.54	-2.04	7.35**	5.66	13.27**	11.72**	11.28	3.90
22	DPLW-31 X DPLW-29	-1.88	-1.57	3.49	24.60**	-0.58	-1.98	15.10**	11.09**	11.68**	10.16**	10.72	5.72
23	DPLW-15 X DPLW-48	1.26	2.56*	3.72	6.55	11.93	3.36	6.23*	2.04	5.43	3.03	12.90	6.54
24	DPLW-15 X DPLW-51	-0.16	0.00	-6.46*	3.76	22.82*	16.57	5.30	3.10	6.43*	3.41	23.91*	17.73
25	DPLW-15 X DPLW-29	-0.47	0.64	7.72*	18.09**	4.20	-0.61	9.97**	5.60	11.89**	8.71**	16.15	12.91
26	DPLW-48 X DPLW-51	-0.79	0.32	-6.57*	0.69	6.12	3.09	3.10	1.11	4.59	3.97	7.66	6.88
27	DPLW-48 X DPLW-29	-1.72	-1.56	5.90	19.54**	3.84	-8.17	3.74	3.70	6.39*	5.75	8.64	5.36
28	DPLW-51 X DPLW-29	-1.58	-0.64	4.42	28.08**	15.48	4.81	5.48	3.40	10.84**	10.84**	31.58**	28.51*
	S.E±	1.002	1.157	1.614	1.864	7.003	8.087	0.118	0.136	0.096	0.111	3.751	4.331
	C.D@5%	2.055	2.373	3.312	3.825	14.369	16.592	0.242	0.279	0.197	0.228	7.696	8.886
	C.D@1%	2.652	3.062	4.275	4.936	18.54	21.413	0.312	0.361	0.255	0.294	9.931	11.468

*Significant at 5% level **Significant at 1% level