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Research Article

Assessment of combining ability for various quantitative traits in summer urdbean

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Abstract
Line x tester analysis was carried out involving four lines and three testers in summer urdbean for assessing combining ability for grain yield and its component traits. The relative estimates of variance due to specific combining ability (sca) were higher than variance due to general combing ability (gca) for plant height, number of pods per plant and grain yield per plant indicating the pre-dominance of non-additive gene action for these traits. The parents Mash 391, Mash 1008 and Mash 218 were good general combiners for number of primary branches, number of pods per plant and grain yield per plant and hence can be used in urdbean yield improvement programme through pedigree selection method. The hybrid combination; KUG 391 x Mash 1008 recorded highly significant sca effects as well as high *per se* performance for plant height, number of branches per plant, number of pods per plant and grain yield per plant suggesting that this cross could be further exploited to obtain transgressive segregants in the breeding programme.

Key words
Urdbean, *Vigna mungo*, combining ability and gene action

Introduction:

Urdbean (*Vigna mungo* (L.) Hepper) is an important pulse crop of India cultivated over a wide range of agro-climatic zones of the country. Apart from an excellent source of high quality dietary protein, it also has good digestibility. It contributes a major portion of lysine in vegetarian diet and fairly a good quantity of vitamins and much needed iron and phosphorus (Solh,2009). Hence, there is a strong need to improve the productivity of urdbean. This could be achieved by studying the genetic architecture of this crop. Genetic information on major yield attributes is a pre-requisite for any crop improvement programme. However, success depends primarily upon identification of best parental lines which may produce desirable gene combinations. In general, the *per se* performance of parents is not always a true indicator of its potential in hybrid combinations. Combining ability is the relative ability of a genotype to transmit its desirable performance to its crosses. It is not only the quickest method of understanding the genetic nature of quantitatively inherited traits but also gives essential information about the selection of parents which in turn produces better segregants. The knowledge of the type of gene action involved in the expression of yield and component traits is essential to choose an appropriate breeding strategy to isolate desirable segregants in later generations. The present study was therefore, carried out to know the type of gene action governing yield and yield contributing traits and to identify the parents and crosses which could be exploited for future breeding programme.

Materials and method

The experimental material for the study consisted of four lines *viz*., Mash 391, KUG 665, KUG 719 and KUG 397 and three diverse testers *viz*., Mash 1008, Mash 218 and Pant U-19. The genotypes Mash 391, Mash 1008, Mash 218 and PU-19 are commercial cultivars whereas, rest are high yielding advanced breeding lines. The parents were crossed in line x tester mating fashion to synthesize 12 F_1 hybrids at Punjab Agricultural University(PAU) , Ludhiana during summer 2013. Individual cross combinations along with their parents were raised in randomized block design with two replications in four meter row with spacing of 30 x 10 cm at pulses farm area, PAU, Ludhiana during *kharif* 2013. Observations were recorded on five random plants from each F_1 and parent on nine quantitative traits; days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, number of pods per plant , number of seeds per pod , pod length (cm),100- seed weight(g) and grain yield per plant (g). The mean values were subjected to line x tester analysis as suggested by Kempthorne (1957)

Result and discussion

The variance due to parents and hybrids was highly significant for days to 50% flowering, days to maturity, plant height, pods per plant and grain yield indicating sufficient amount of genetic variability among the parents and the hybrids (Table 1). The variance due to lines x testers was also significant for days to 50% flowering, days to maturity, plant height, number of pods per plant and grain yield. Similar results have also been reported by Singh Mohar (2008), Baradhan and Thangavel (2011) and Gill *et al.* (2014). The relative estimates of variance due to specific combining ability (sca) were higher than variance due to general combining ability (gca) for plant height, pods per plant and grain yield indicating the pre- dominance of non-additive gene action for these traits and suggesting that selection in early segregating generations will be desirable for exploiting non-additive gene action. These results are in accordance with Baradhan and Thangavel (2011), Parveen and Shekhar (2013) and Gill *et al.* (2014). However, Barad *et al* (2008) reported additive gene action for the control of days to 50% flowering, days to maturity and grain yield per plant in mungbean. Whereas, plant height, pods per plant, 100-seed weight and protein content were under the control of non-additive gene action. Singh *et al.* (2003) reported the importance of both additive and non-additive components for plant height and grain yield per plant in urdbean. Whereas, Waldia and Lal (1991) observed non-additive gene action was more prominent in the expression of yield and its components.

The estimates of gca and *per se* performance of parents are given in Table 2. The parents with high *per se* performance and significant gca effects are considered as good general combiners for deriving desirable transgressive segregants in self-pollinated crops. The line KUG 665 and testers Mash 1008 and Mash 218 recorded significant negative *gca* effects for days to 50% flowering, suggesting that these parents are good general combiners for breeding for earliness. The line Mash 391 and tester Mash 1008 are good general combiners for breeding for early maturing as they showed high negative *gca* effects. For plant height, line KUG 719 and testers Mash 1008, Mash 218 showed significantly high gca effects indicating that they are good general combiners for plant height in urdbean during summer season. For number of branches per plant line; Mash391 and tester Mash 1008 were good general combiners as they showed significant gca effects and their mean values were also high. The lines KUG 391, KUG 719 and testers Mash 1008 , Mash 218 recorded highly significant, positive *gca* effects and high *per se* performance for pods per plant indicating that these are good general combiners for this important grain yield component. For grain yield, the lines KUG 391, KUG 665 and testers Mash 1008 and Mash 218 recorded high *per se* performance as well as significant positive gca effects suggesting that these are good general combiners for this trait. The high gca effects are associated with additive and additive x additive interaction effects (Griffing 1956) hence, these parents could be used in breeding programme of summer urdbean for yield improvement through pedigree method

The sca effect is an important criterion for the evaluation of hybrids. The cross combinations with significant desirable sca effects along with mean performances and *gca* effects of parents are listed in Table3. The cross KUG 391 x Mash 1008 and KUG 397 x Mash 218 recorded lowest mean values for days to 50% flowering and high mean values for number of branches per plant, number of pods per plant and grain yield per plant suggesting that they can be exploited for transgressive segregation for these traits. The cross KUG 386 x Mash 1008 recorded significant sca effects for days to maturity and number of branches per plant. The cross KUG 665 x Mash 218 also recorded high mean value for grain yield per plant. It was observed that the desirable cross combinations included high x high, high x low, high x medium and medium x medium type of general combiners . The high x low or high x medium type of cross combination could be due to additive and additive x additive type of gene action. Hence, the present study described the importance of both additive and non-additive components of variance for yield and its component traits. Therefore, breeding strategies like simple selection can be useful where particular cross-combinations show additive component of variance. But, where the dominance component play a vital role, breeding procedures like repeated crossing and recurrent selection will be more effective in bringing out improvement in grain yield .

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Table 1. Analysis of variance for various characters in summer urdbean

Source	df	Days to 50% flower ing	Days to matur- ity	Plant height (cm)	Number of branches per plant	Number of pods per plant	Number of seeds per pod	Pod length (cm)	Grain yield per plant (g)	100-seed wt. (g)
Parents	6	14.23**	9.11**	12.04**	1.58	375.30**	0.56	0.39	368.07**	0.32
Hybrids	11	13.28**	54.93**	30.81**	2.31	498.40**	0.95	0.41	465.95**	0.20
F_1 vs Parents	1	2.71	143.16	147.25	-2.16	-97.65	-3.72	-91.40	56.58	0.97
Lines	3	26.93*	19.66*	43.08*	1.51	52.27**	0.87	0.40	313.48**	-4.61
Testers	2	14.00	244.66**	30.96*	4.60	1371.12**	2.66	1.01	1297.16**	0.48
Lines x Testers(LxT)	6	6.22*	9.33**	24.64**	1.92	430.56**	0.42	0.21	265.11**	0.19
Error (Me)	18	0.49	1.38	3.04	0.354	27.12	0.33	0.40	16.60	-0.12
δ^2 gca	-	2.03	17.55	1.76	0.168	40.16	0.19	-9.29	77.17	-1.03
δ^2 sca	-	2.86	3.97	10.79	0.784	201.7	-4.57	-6.94	124.3	-9.01
δ^2 gca/δ^2 sca	-	0.71	4.42	0.16	0.214	0.19	0.04	1.34	0.62	0.11

* , **Significant at P= 0.05 and 0.01 respectively

Table 2. Estimates of gca effects of parents for various characters in summer urdbean

Sr. No.	Parent	Days to 50% flowering	Days to matur- ity	Plant height (cm)	Number of branches per plant	Number of pods per plant	Number of seeds per pod	Pod length (cm)	Grain yield per plant (g)	100-seed wt. (g)
I	Lines									
1	Mash391	2.85* (44.0)	-6.43** (69.50)	0.85 (8.25)	5.71** (30.50)	14.02** (62.50)	0.78 (6.05)	-0.133 (4.60)	61.66** (52.50)	-0.002 (3.55)
2	KUG 665	-11.88** (39.0)	2.00 (68.50)	-1.76 (7.25)	-0.64 (28.50)	-6.79** (39.00)	0.68 (4.70)	1.51 (4.25)	15.34** (37.50)	0.005 (4.35)
3	KUG 719	8.19** (44.50)	1.20 (70.00)	3.00* (6.75)	-0.19 (31.65)	12.22** (34.00)	2.10 (5.15)	-1.28 (3.95)	-21.73** (29.0)	0.025 (4.40)
4	KUG 397	0.84 (42.00)	3.20** (71.50)	-2.09* (7.15)	-4.87** (28.50)	-19.45** (33.50)	-2.20* (4.65)	-0.133 (3.80)	-55.27** (31.50)	-0.02 (4.20)
	S.E.(±)	0.249	0.415	0.210	0.616	0.184	0.204	0.225	0.144	3.93
II	Testers									
1	Mash 1008	-2.45* (45.0)	-15.25** (69.50)	2.80* (7.75)	4.05** (28.0)	70.86** (61.50)	2.53* (5.25)	1.47 (4.85)	76.23** (60.0)	0.04 (3.85)
2	Mash 218	-4.90** (40.50)	-1.97 (70.50)	2.33* (6.50)	-0.31 (33.0)	26.66** (40.50)	1.44 (5.00)	0.65 (3.90)	48.46** (46.50)	0.04 (4.15)
3	Pant U19	7.35** (46.50)	17.19** (75.00)	-5.14** (5.50)	-3.73** (25.75)	-97.53** (28.50)	-3.97 (4.45)	-2.18 (3.65)	-124.61** (22.50)	-0.08 (3.35)
	S.E. (±)	0.204	0.339	0.171	0.503	0.150	0.166	0.183	0.117	3.21

* , **Significant at P= 0.05 and 0.01 respectively . Mean performance given in parentheses.

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Table 3. Specific combining ability effects, mean performance and general combining ability effects of parents and promising crosses in summer urdbean

Sr. No.	Character	Cross with high *per se* performance and significant sca effects	sca effects	*Per se* performance	gca effects of parents
1	Days to 50% flowering	Mash 391 x Mash 1008	-1.33**	42.5	M x M
		KUG 719 x Pant U 19	-2.26**	45.0	H x H
		KUG 397 x Mash 218	-1.33**	41.5	L x H
2	Days to maturity	Mash 391 x Mash 218	-2.83**	68.5	H x L
		KUG 719 x Mash 1008	-1.50*	68.5	L x H
3	Number of branches per plant	Mash 391 x Mash 1008	0.78*	9.50	H x H
		KUG 719 x Mash 1008	0.67*	8.80	M x H
		KUG 397 x Mash 218	0.86*	7.90	M x M
4	Plant height	Mash 391 x Mash 1008	5.60**	36.5	H x H
5	Number of pods per plant	KUG 391 x Mash 1008	17.06**	73.0	H x H
		KUG 397 x Mash 218	10.83**	58.0	L x H
6	Grain yield (g)	Mash 391 x Mash 1008	12.25**	72.0	H x H
		KUG 665 x Mash 218	8.91**	62.5	H x H
		KUG 397 x Mash 218	11.83**	52.0	L x H

M - Medium, L – Low, H – High . * , **Significant at P= 0.05 and 0.01 respectively