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Studies on combining ability analysis for quality traits in mungbean (*Vigna radiata* (L.) Wilczek)

J. ANBUMALARMATHI, P. RANGASAMY AND P. YOGAMEENAKSHI
Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai 625 104.

Abstract : A study was conducted in mungbean (*Vigna radiata* (L.) Wilczek) to assess the combining ability of the parents as well as hybrids involving five lines and four testers crossed in line x tester model. The ratio of additive and dominance genetic variance ($\sigma A^2 : \sigma D^2$) indicated that all the characters were found to be predominantly controlled by non additive gene action except solids lost which is governed by both additive and non additive gene action. The parents Vamban 2 and VGG 77 were found to be good general combiners for most of the quality traits and yield. The crosses ML 682 x Vamban 2, VGG 77 x KM 2 and VGG 80 x KM2 were identified as best specific combiners.

Key words: combining ability, additive genetic variance, dominance genetic variance, quality.

Introduction

Mungbean is one of the important grain legumes in many parts of tropics. It is an excellent and cheap source of high quality and easily digestible protein with relatively low trypsin inhibitor content as compared to other pulses. But it is deficient in methionine and tryptophan content. The present investigation was, therefore undertaken in greengram for seed protein content.

Materials and methods

Experimental material consisted of five lines *viz.*, K 851, VGG 77, VGG 80, ML 267 and ML 682 and four testers *viz.*, Co 6, KM 2, Vamban 1 and Vamban 2. The crosses were effected in line x tester mating design and F_1s were evaluated during January 2002, at Agricultural College and Research Institute, Madurai. The 20 F_1s were raised in randomized block design with two replications. Each entry was raised in rows of three meter length with 45 x 15 cm spacing. Parents were raised in adjacent plot with above-mentioned spacing. Observations on five randomly selected plants were recorded for seed protein content (SPC) [Lowry *et al.* (1951)], methionine content (MQ, tryptophan content (TQ [Block *et al.* (1956)], trypsin inhibitor conten. (TIC) [Kakade *et al.* (1974)], cooking time (CT), solids lost (SL) [Chakrabarthy *et al.* (1972)], volume expansion ratio (VER), water absorption ratio (WAR), linear elongation ratio (LER), breadth elongation ratio (BER), [Khan and Ali (1985)] and single plant yield (SPY). Line x tester analysis was done as suggested by Kempthorne (1957).

Results and discussion

The analysis of variance of combining ability revealed significant differences among hybrids, lines, testers and line x tester interaction. The estimates of dominance genetic variance (σ^2_D) was higher than additive genetic variance ($\sigma^2 A$) for all the traits except solids lost, which revealed the predominance of dominance gene action. The trait solids lost was governed by both additive and non additive gene action (Table 1).

The perusal of the mean performance of the parents and their *gca* effects (Table 2) revealed that *per se* performance of the parents was not a clear indication of their *gca* effects. Vamban 2 was the best general combiner for most of the quality traits *viz.* seed protein

Table 1. Analysis of variance for combining ability for quality traits

Source of variance	Degree of freedom	SPC	MC	TC	TIC	CT	VER	WAR	LER	BER	SL	SPY
Hybrids	19	4.39*	0.02*	0.07*	0.04*	47.50*	0.139*	0.15*	0.011*	0.004*	0.081*	14.97*
Lines	4	2.80*	0.02*	0.01*	0.01*	44.30*	0.22*	0.16*	0.010*	0.002*	0.19*	14.70*
Testers	3	1.81*	0.01*	0.13*	0.07*	119.00*	0.23*	0.26*	0.009*	0.005*	0.075*	6.12*
Line x Tester	12	5.57*	0.03*	0.07*	0.04*	30.50*	0.089*	0.14*	0.012*	0.004*	0.046*	17.27*
Error	19	0.01	0.0001	0.0001	0.002	2.06	0.0004	0.001	0.0007	0.0002	0.002	0.01
σ^2_A		-0.72	-0.002	0.002	-0.0002	11.41	0.03	0.02	-0.0006	-0.0001	0.02	-1.53
σ^2_D		2.78	0.01	0.03	0.019	14.24	0.04	0.07	0.01	0.002	0.02	8.63
$\sigma^2_A:\sigma^2_D$		-0.26:1	-0.20:1	0.06:1	-0.01:1	0.80:1	0.75:1	0.29:1	-0.05:1	-0.05:1	1:1	-0.18:1

Significant at 5 % level

content, methionine content, tryptophan content, trypsin inhibitor content, linear elongation ratio, breadth elongation ratio and yield. It was followed by VGG 77 for methionine content, tryptophan content, volume expansion ratio, water absorption ratio, linear elongation ratio and single plant yield. Involvement of these parents in hybridization programme for evolving desirable genotypes was suggested on the basis of present study. Sprague (1960) reported that gca effects were related to additive genetic effects or additive x additive interaction which represents the fixable genetic variance. Similar observations were reported by Tiwari *et al.* (1993), Halkude *et al.* (1996) and Kute *et al.* (1999).

The specific combining ability effects of crosses were given in Table 3. Among the hybrids, ML 682 x Vamban 2 was the best specific combination for most of the quality traits *viz.* seed protein content, methionine content, tryptophan content, trypsin inhibitor content, volume expansion ratio, water absorption ratio, breadth elongation ratio and yield. Similarly the crosses, VGG 77 x KM 2 and VGG 80 x KM 2 were also the best specific combinations for all characters except trypsin inhibitor content, cooking time and breadth elongation ratio in both along with solids lost for the former and linear elongation ratio for the latter hybrid. Hence, these cross combinations should be given due weightage in breeding programme.

Hybrids involving significant *gca* effects and non significant *sca* effects are useful in recombination breeding. K 851 x Vamban 1 and VGG 77 x Vamban 1 recorded significant gca effect and non significant sca effects for cooking time, K 851 x Vamban 1 and ML 682 x Co 6 for water absorption ratio and K 851 x Vamban 2 for breadth elongation ratio. Hence these hybrids can be exploited in recombination breeding.

References

Block, R.J., Weiss, A.B., Almquist, H.A and Diana,

Table 2. Estimates of general combining ability *(gca)* effects of parents for quality traits

Parents	SPC	MC	TC	TIC	CT	VER	WAR	LER	BER	SL	SPY
Lines											
K851	0.90*	-0.08	-0.05*	0.00	3.15	0.16*	0.10*	-0.01	0.03*	-0.09	-0.26*
	(25.48*)	(1.12)	(0.71)	(1.54)	(34.50)	(2.14)	(2.03)	(1.41)	(1.34*)	(1.88*)	(13.52)
VGG77	-0.09*	0.02*	0.03*	-0.04	1.77	0.10*	0.10*	0.04*	-0.01*	0.00	1.90*
	(24.49*)	(1.32)	(0.73*)	(1.44*)	(30.00)	(1.91)	(1.88)	(1.35)	(1-26)	(2.33)	(14.05)
VGG80	-0.64*	0.05*	0.05*	0.01*	-1.85	0.09*	-0.03*	0.05*	-0.02*	0.20	-1.65*
	(23.43*)	(1.43*)	(0.97*)	(1.57)	(29.50)	(2.28*)	(2.18*)	(1.50*)	(1.26)	(2.30)	(12.55)
ML 267	-0.36*	0.01*	-0.03*	0.02*	-0.85*	-0.25*	-0.23*	-0.02*	0.00	-0.20	0.69*
	(23.40)	(1.42*)	(0.96*)	(1.51)	(24.50*)	(2.14)	(2.03)	(1.52*)	(1.24)	(2.36)	(14.54*)
ML 682	0.21*	0.00	0.00	0.02*	-2.23	0.08*	0.07*	0.03*	0.00	0.09	-0.68*
	(24.01)	(1.38*)	(0.85*)	(1.52)	(31.50)	(2.23*)	(2.12*)	(1.45)	(1.16)	(2.23)	(16.55*)
SE	0.04	0.004	0.003	0.02	0.50	0.006	0.01	0.009	0.005	0.016	0.04
Testers											
Co 6	-0.23*	-0.05*	-0.09*	0.04	-0.98	-0.02*	0.02*	-0.03*	-0.01*	0.09	-0.65*
	(22.83)	(1.49*)	(0.97*)	(1.50*)	(23.00)	(2.16)	(2.05)	(1.54*)	(1.39*)	(1.84*)	(16.21*)
KM2	0.30*	-0.01*	-0.07*	0.04	-1.98	0.00	-0.03*	-0.01	-0.02*	0.00	-0.17*
	(24.08*)	(1.17)	(0.85)	(0.51*)	(21.50*)	(20.16)	(2.03)	(1.54*	(1.33)	(2.07)	(13.15)
Vamban 1	0.41*	0.01*	0.00	0.05	5.12	0.19*	0.20*	-0.01	0.00	0.03*	-0.32*
	(22.08)	(1.47*)	(0.98*)	(1.64)	(30.00)	(2.15)	(2.07)	(1.45)	(1.29)	(2.05)	(16.12*)
Vamban2	0.48*	0.04*	0.16*	-0.13*	-2.18	-0.18*	-0.19*	0.06*	0.03*	-0.12	1.13*
	(24.29*)	(1.28)	(0.72)	(1.76)	(23.50*)	(2.12)	(2.00)	(1.37)	(1.28)	(1.87*)	(16.30*)
SE	0.03	0.003	0.003	0.01	0.45	0.006	0.01	0.008	0.005	0.014	0.03

* Significant at 5 per cent level
Note: Parenthesis value indicates mean value.

Table 3. Estimates of specific combining ability *(sca)* effects of crosses for quality traits

Parents	SPC	MC	TC	TIC	CT	VER	WAR	LER	BER	SL	SPY
K 851x Co6	0.28*	-0.07*	-0.06*	-0.18	0.35*	-0.09*	-0.10*	0.05*	0.05*	-0.15	1.50*
K 851x KM2	-1.30*	0.06*	-0.01*	0.06*	1.35*	-0.11*	-0.18*	-0.01	-0.01	-0.09	0.44*
K 851x Vamban 1	0.28*	0.19*	0.38*	0.10	-2.25	0.00	0.03	-0.05*	-0.05*	0.23	-1.70*
K 851x Vamban 2	0.73*	-0.18*	-0.32*	0.02*	0.55*	0.20*	0.26*	0.01	0.00	0.01*	-0.25*
VGG 77x Co 6	0.37*	0.05*	-0.06*	-0.09	-6.27	0.14*	0.14*	-0.06*	0.04*	0.18	0.85*
VGG 77x KM2	1.08*	0.02*	0.03*	0.04*	0.23*	0.08*	0.13*	0.08*	-0.06*	0.03*	0.53*
VGG 77x Vamban 1	1.05*	-0.03*	-0.08*	0.01*	1.13*	0.00	0.05*	-0.07*	0.04*	-0.21	1.02*
VGG 77x Vamban 2	-2.51*	0.05*	0.11*	0.04*	4.93	-0.22*	-0.32*	0.04*	-0.02*	0.00	-2.39*
VGG 80 x Co6	0.43*	0.04*	0.02*	0.05*	2.85	0.22*	0.30*	-0.09*	-0.07*	-0.06*	-1.06*
VGG 80 x KM2	1.94*	0.01*	0.02*	-0.18	-4.15	0.08*	0.14*	-0.08*	0.01	-0.05*	5.39*
VGG 80 x Vamban 1	-0.86*	-0.02*	-0.09*	-0.08	0.25*	-0.29*	-0.38*	0.11*	0.03*	-0.03*	-1.38*
VGG 80 x Vamban 2	-1.51*	-0.03*	0.05*	0.21	1.05*	-0.01	-0.06*	0.06*	0.03*	0.14	-2.95*
ML 267 x Co6	-1.64*	0.13*	0.17*	0.20	-1.65*	-0.33*	-0.36*	0.03	0.00	-0.11	0.76*
ML 267 x KM2	0.72*	-0.16*	-0.10*	-0.01*	-0.15*	-0.02	-0.07*	0.08*	0.05*	0.03*	-4.73*
ML 267 x Vamban 1	-0.29*	-0.01*	-0.04*	0.03*	4.25	0.36*	0.39*	-0.03	-0.01	0.00	1.86*
ML 267 x Vamban 2	1.22*	0.05*	0.03*	-0.22	-2.45	-0.01	0.04	-0.07*	- -0.04*	0.08	2.11*
ML 682 x Co6	0.56*	-0.04*	0.08*	0.02*	4.73	0.07*	0.03	0.07*	-0.03*	0.14	-2.04*
ML 682 x KM2	-2.44*	0.06*	0.06*	0.09	2.73	-0.04*	-0.03	-0.06*	0.01	0.08	-1.63*
ML 682 x Vamban 1	-0.18*	-0.13*	-0.17*	-0.06*	-3.37	-0.07*	-0.08*	0.03	-0.01	0.01*	0.19*
ML 682 x Vamban 2	2.07*	0.11*	0.19*	-0.05*	-4.07	0.04*	0.08*	-0.04*	0.03*	-0.22	3.48*
SE	0.08	0.007	0.006	0.03	1.01	0.013	0.02	0.018	0.01	0.03	0.08

Significant at 5 per cent level