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Research Article

COMBINING ABILITY ANALYSIS FOR YIELD, YIELD COMPONENTS AND TRAITS RELATED TO KALAHASTI MALADY RESISTANCE

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ABSTRACT

Seven parental lines were crossed in half diallel fashion to identify the best general and specific combiners for further use in development of high yielding kalahasti malady resistant genotype. ICG(FDRS)79 was the best general combiner for yield, yield attributes and kalahasti malady resistance. Kalahasti was the best general combiner for 100-kernel weight and total phenolic compounds while Narayani, Tirupati 4 and Kadiri 6 for earliness. Narayani× ICG(FDRS) 79 followed by Tirupati 4 × ICG(FDRS) 79 and Kadiri 6 × ICG(FDRS) 79 were identified as best cross combinations with high SCA effect for traits viz., pod and kernel yield per plant, number of primary branches per plant and number of kernels per plant. Among these three cross combinations, Tirupati 4 × ICG (FDRS) 79 recorded high negative SCA effect for days to maturity and high positive SCA effect for total phenolic compounds.

Keywords: *Kalahasti, Groundnut, Combining Ability*

INTRODUCTION

Groundnut is an annual legume, important source of edible oil and vegetable protein, cultivated in over a hundred countries in warm temperate, sub-tropical and tropical regions of the world. India ranks first in area (5.64 m.*ha*) and second in production (6.96 m.tonnes). In Andhra Pradesh, the area was 10.42 lakh ha with production of 5.40 lakh tonnes during *kharif* 2012, while the area during *rabi* was 1.16 lakh *ha* and production 2.40 lakh tonnes with a productivity of 2069 kg per *ha* (Directorate of Economics and Statistics 2012-13). However the productivity appears to be low as the crop is often exposed to various biotic stresses, the prominent being the nematode menace caused by *Tylenchorhynchus brevilineatus* Williams. The size of the nematode attacked pods was found to be drastically reduced. Nevertheless, the kernels from such diseased pods appeared apparently healthy except reduced size. Losses in pod yield to a tune of 60 to 70% were not uncommon in severely infected areas (Rao *et al.,* 1986).

Forty eight genotypes were screened for their reaction to nematode infection and NC 2 was found resistant (Rao *et al*., 1986).

A total of 1599 groundnut germplasm accessions and breeding lines were screened during 1985-86 by Mehan *et al.,* (1993). Among these, twenty three genotypes were identified as resistant and they had disease scores of 2.0 or less on a 1-5 scale. Fourteen genotypes were confirmed to be resistant but most of the resistant genotypes had undesirable pod and seed characteristics. One of the resistant Virginia genotypes (TCG 1518) was released as 'Tirupati 3' in 1990, but farmers require a variety with a shorter duration than 'Tirupati 3', that could mature in 105-110 days.

Hybridization programme was taken up using 'Tirupati 3' as donor parent. In 2002, TCGS 320 derived from TCG 1709×TCG 1518 was released as 'Kalahasti'. Later on, moderately susceptible/susceptible line, 'TCGS 341' with rose testa colour was released as 'Prasuna' in 2006. To improve yield level along with resistance, it is necessary to identify parents with good combing ability. With this background information, study of combining ability was carried out utilizing these three varieties with an objective of obtaining information on inheritance pattern.

MATERIALS AND METHODS

Seven parental lines viz., Narayani, Tiruapati4, Kadiri 6, Prasuna, Tirupati 3 and ICG(FDRS)79 were crossed in half diallel fashion. Twenty one cross combinations and their parental genotypes were evaluated in randomized block design with three replications in soil of nematode problem at Regional Research station, Tirupati. Observations were recorded for characters viz., days to 50%.

Table 1: Parental lines used in hybridization

Genotype	Pedigree	Botanical type	Reaction to kalahasti malady
Narayani	JL 24 × Ah 316/S	Spanish bunch	Susceptible
Tiruapati4	JL 24 × Ah 216/S	Spanish bunch	Susceptible
Kalahasti	TCGS 1709 × TCGS 1518	Spanish bunch	Resistant
Kadiri 6	JL 24 × Ah 216/S	Spanish bunch	Susceptible
Prasuna	TCGS 1717 × TCGS1518	Spanish bunch	Moderately resistant
Tirupati 3	Selection from TMV 10	Virginia bunch	Resistant
ICG(FDRS)79	(ICGV 92069 × ICGV 93184) × (ICGV 96246 × 92R/75)	Spanish bunch	Resistant

flowering, days to maturity, number of primary branches per plant, number of secondary branches per plant, number of kernels per plant, 100 kernel weight (g), shelling out-turn (%), kalahasti malady incidence, harvest index (%), SCMR, total phenolic contents (mg/g), kernel yield per plant (g) and pod yield per plant (g). The general combining ability and specific combining ability of the crosses were computed based on Method II (involves parents and F_1s only) and model I (fixed effect) of Griffing (1956).

RESULTS AND DISCUSSION

From the analysis of combining ability, mean squares due to GCA were found to be highly significant for all characters studied (Table2). Variance due to GCA was more than SCA variance for seven characters viz., days to 50% flowering, number of primary branches, number of secondary braches, number of kernels per plant, kernel yield per plant, pod yield per plant and total phenols per plant indicating the predominant role of additive gene action in their inheritance. In contrary to the results of the present study, non- additive gene action for days to flowering was reported by Gibouri *et al.,* (1978) Savitramma *et al.,* (2010) and Vishnuvardan *et al.,* (2011). Additive gene action for kernel number observed in the present study was in agreement with the earlier findings of Garet (1976) and Harward and Wynne (1999). Basu *et al.,* (1987), Hariprasad (1990) and Shoba *et al.,* (2010) also reported the larger role of additive genetic variance in the genetics of pod and kernel yield. Vindhya and Raveendran (1994) reported the involvement of both types of gene action i.e., additive and non- additive gene action in the inheritance of harvest index.

General Combining Ability Effects

The parents Narayani, Tirupati-4 and Kadiri-6 have registered significant desirable negative GCA effects for days to 50% flowering and days to maturity (Table 3). These three parents are good general combiners for exercising selection of earliness. Tirupati-3 and ICG (FDRS) 79 exhibited significant positive GCA effect for number of primary branches and also for number of secondary branches. Kalahasti displayed significant positive GCA effect for number of primary branches. For the traits, kalahasti malady resistance and 100-kernel weight, Kalahasti and ICG (FDRS) 79 were good combiners. For pod yield and number of kernels per plant also, ICG (FDRS) 79 exhibited the highest significant GCA effect and for the traits, harvest index and shelling out-turn, it displayed positive effect. ICG (FDRS) 79 displayed highly significant desirable GCA effect for nine characters and lower positive GCA effect for harvest index and

shelling out-turn. Though the genotype, Tirupati-3 exhibited significant positive GCA effects for days to 50% flowering, days to maturity, number of primary branches, number of secondary branches, SCMR, total phenolic compounds and kalahasti malady incidence the GCA effects for other major yield contributing characters were highly non significant. Hence it is a poor general combiner for yield contributing traits. Kalahasti displayed significant positive GCA effects for number of secondary branches, kalahasti malady incidence, harvest index, 100 kernel weight and total phenols content. Hence these two genotypes, Kalahasti and Tirupati-3 are good general combiners for number of secondary branches, Kalahasti malady incidence and total phenolic compounds content.

Specific Combining Ability Effects

Cross combinations registered mean and SCA in desirable direction are given in Table 4. Among the cross combinations showed significant negative SCA effect for days to 50% flowering and maturity, number of primary and secondary branches were either high × low or low × high GCA combinations. Tirupati-4 × ICG(FDRS)79), Narayani × ICG(FDRS)79 and Kadiri-6 × ICG(FDRS)79 have registered significant positive SCA effect for kernel number and kernel yield per plant., There is scope of getting good transgressive segregants with more number of kernels per plant in these cross combinations.

Table 2: Combining ability analysis of variance for yield and yield traits and kalahasti malady resistance in groundnut during rabi 2010-11

Character	GCA		SCA		Error	Variance (GCA)	Variance (SCA	Variance (GCA/SCA) ratio	Additive variance (σ2A)	Dominant variance (σ2D)
DF	44.412	**	4.197	**	0.283	4.859	3.913	1.241	9.719	3.913
DM	22.147	**	3.332	**	0.248	2.433	3.084	0.788	4.866	3.084
PB	0.872	**	0.121	**	0.032	0.093	0.089	1.047	0.186	0.089
SB	9.0012	**	0.665	**	0.212	0.977	0.453	2.158	1.955	0.453
KN	67.129	**	13.982		8.775	6.483	5.214	1.243	12.967	5.214
KY	13.594	**	2.517		1.53	1.34	0.986	1.358	2.68	0.986
HKW	52.814	**	15.99	**	6.069	5.194	9.921	0.523	10.388	9.921
SOT	51.716	**	35.175	**	14.168	4.172	21.007	0.198	8.344	21.007
KMI	0.373	**	0.16	**	0.045	0.036	0.114	0.316	0.072	0.114
HI	173.149	**	27.566	**	8.88	18.252	18.685	0.976	36.504	18.685
SCMR	15.5	**	4.606	**	0.17	1.703	4.436	0.384	3.406	4.436
TP	13.71	**	1.532	**	0.243	1.496	1.289	1.16	2.992	1.289
PY	36.744	**	7.306		4.709	3.559	2.597	1.37	7.118	2.597

1.DF=Days to 50% flowering; DM=Days to Maturity; =Number of Primary Branches per plant; SB=Number of Secondary Branches per plant; KN=Number of kernels per plant; KY=Kernel Yield per Plant;.SOT=Shelling out-turn;KMI=Kalahasti malady incidence; HI=Harvest Index;SCMR=SPAD Chlorophyll meter reading;TP=Total phenols content ; PY=Pod yield per plant;
*2. *&** significant at 5% and 1% level of respectively*

Table 3: Parents with good general combining ability (GCA) and mean in desirable direction

	Mean	Parents with significant GCA effects	
Time to 50% flowering (days)	27	Narayani	(Negaive)
	28	Tiruapati4	(Negaive)
	27	Kadiri 6	(Negaive)
	31	Prasuna	(Positive)
	41	Tirupati 3	
	35	ICG(FDRS)79	
Time to maturity (days)	105	Narayani	(Negaive)
	105	Tiruapati4	(Negaive)
	105	Kadiri 6	(Negaive)
	115	Tirupati 3	
	106	ICG(FDRS)79	
Number of primary branches per plant	5.97	Tirupati 3	
	4.64	ICG(FDRS)79	
Number of secondary branches per plant	5.47	Tirupati 3	
	3.69	ICG(FDRS)79	
Number of kernels per plant	26.61	ICG(FDRS)79	
Kernel Yield per Plant (g)	9.69	ICG(FDRS)79	
100 kernel weight (g)	44.15	Kalahasti	
	36.73	ICG(FDRS)79	
Shelling out-turn (%)	-	-	
Kalahasti malady incidence	2.15	Kalahasti	(Negaive)
	2.26	ICG(FDRS)79	(Negaive)
Harvest index (%)	46.08	Narayani	
	48.48	Kadiri 6	
SPAD Chlorophyll Meter reading	52.16	Tirupati 3	
Total phenolic compounds (mg/g)	13.6	Kalahasti	
	11.71	Tirupati 3	
Pod yield per plant (g)	14.02	ICG(FDRS)79	

Table 4: Promising cross combinations were identified with high significant SCA effect in desirable direction for different traits

Characters	Mean range	Crosses (Rabi) Parent GCA status
Days to 50% flowering	30.33-40.33	Narayani × Tirupati 4 (negative × negative) Narayani×Kadiri-6 (negative × negative) Narayani ×Tirupati 3 (negative × positive) Tirupati ×Kalahasti (negative × positive) Tirupati 4 ×Kadiri-6 (negative × negative) Tirupati 4× Prasuna (negative × negative) Kalahasti× Kadiri-6 (positive × negative) Kalahasti×Prasuna (positive × negative) Prasuna× ICG(FDRS)79 (positive × negative) Tirupati 3×ICG(FDRS)79 (positive × negative)
Days to maturity	104.33-112.67	Narayani×Kadiri-6 (negative × negative) Narayani ×ICG(FDRS)79 (negative × negative) Tirupati 4 × Kalahasti (negative × negative) Tirupati 4 ×Kadiri-6 (negative × negative) Tirupati 4 × Prasuna (negative × negative) Kalahasti×ICG(FDRS)79 (negative × positive) Kadiri-6×Prasuna (negative × negative) Kadiri-6 × ICG(FDRS)79 (negative × positive) Prasuna × ICG(FDRS)79 (negative × positive) Tirupati 3 × ICG(FDRS)79 (Positive×positive)
Number of primary branches per plant	5.16-5.60	Tirupati 4×Tirupati 3 (negative × positive) Tirupati 4×ICG(FDRS)79 (negative × negative) Kalahasti×Kadiri 6 (positive × negative) Kalahasti× Kadiri 6 (positive × negative) Kadiri-6× ICG(FDRS)79 (negative × positive) Prasuna× ICG(FDRS)79 (negative × positive) Tirupati 3×ICG(FDRS)79 (positive × positive)
Number of secondary branches per plant	2.33-6.07	Tirupati 4× Kadiri 6 (negative × negative) Kalahasti×Prasuna (positive × negative) Kalahasti× Tirupati 3 (positive × positive) Prasuna× ICG(FDRS)79 (positive × negative) Tirupati 3× ICG(FDRS)79 (positive × negative)
Number of kernels per plant	26.96-29.46	Narayani× ICG(FDRS)79 (positive × negative) Tirupati 4× ICG(FDRS)79 (negative × positive) Kadiri-6× ICG(FDRS)79 (negative × positive)
Kernel yield/ plant	10.68-11.38	Narayani× ICG(FDRS)79 (positive × positive) Tirupati 4× ICG(FDRS)79 (negative × positive) Kadiri-6× ICG(FDRS)79 (negative × positive)

100-kernel weight	28.57-37.53	Tirupati 4× Kadiri 6 (positive × positive) Kadiri-6× Prasuna (positive × negative) Prasuna× ICG(FDRS)79 (negative × positive)
Shelling out-turn	56.18-62.44	Narayani× Kadiri 6 (positive × positive) Tirupati 4× Kalahasti (positive × positive) Tirupati 4× Prasuna (positive × negative)
Kalahasti malady incidence	1.67-2.70	Narayani× Kadiri 6 (positive × positive) Narayani× ICG(FDRS)79 (positive × negative) Tirupati 4× Tirupati 3 (positive × negative) Kalahasti× Prasuna (negative × positive) Kalahasti× ICG(FDRS)79 (negative × negative)
Harvest index	39.31-40.32	Tirupati 4× Kalahasti (negative × positive) Kalahasti× ICG(FDRS)79 (positive × positive)
SCMR	42.73-47.5	Narayani× Tirupati 4 (negative × negative) Narayani× Kalahasti (negative × negative) Narayani× Prasuna (negative × negative) Narayani× ICG(FDRS)79 (negative × negative) Tirupati 4× Tirupati 3 (negative × positive) Tirupati 4× ICG(FDRS)79 (negative × negative) Kalahasti× Kadiri 6 (negative × negative) Kalahasti× ICG(FDRS)79 (negative × negative) Kalahasti× Prasuna (negative × negative) Kadiri-6× ICG(FDRS)79 (negative × negative) Prasuna× ICG(FDRS)79 (negative × negative)
Pod yield per plant	12.51-20.62	Narayani× ICG(FDRS)79 (positive × positive) Tirupati 4× ICG(FDRS)79 (negative × positive) Kalahasti× Prasuna (positive × negative) Kadiri-6× ICG(FDRS)79 (negative × positive) Prasuna× ICG(FDRS)79 (negative × positive)
Total phenols	7.62-11.20	Narayani× Prasuna (negative × negative) Tirupati 4× Kalahasti (negative × positive) Tirupati 4× Kadiri 6 (negative × negative) Tirupati 4× Prasuna (negative × negative) Tirupati 4× ICG(FDRS)79 (negative × positive) Kalahasti× Kadiri 6 (positive × negative) Kadiri-6× Prasuna (negative × negative) Tirupati 3× ICG(FDRS)79 (positive × negative)

For Kalahasti malady incidence, five cross combinations viz., Kalahasti × Prasuna (-0.60), Tirupati-4 × Tirupati-3(-0.58),
Narayani × ICG(FDRS)79 (-0.49) Kalahasti × ICG(FDRS)79(-0.30) and Narayani × Kadiri 6 (-0.18) have exhibited desirable SCA effect.
These cross combinations had resistant/moderately resistant varieties as parents. Tirupati-3 × ICG(FDRS)79 (1.97), Narayani × Prasuna (1.78), Kadiri-6 × Prasuna (1.53), Tirupati-3 × ICG(FDRS)79 (1.51), Tirupati-4 × Prasuna (0.90), Kalahasti × Kadiri-6 (0.75), Tirupati-4 × Kadiri-6 (0.57) and Tirupati-4 × Kalahasti (0.48) displayed SCA effects in positive direction for total phenolic compounds.
These cross combinations were either Low × High or High × Low combination indicating the non additive gene action. Among parents Kalahasti, Tirupatii-3 and ICG(FDRS)79 had exhibited significant positive GCA effect.

Narayani x ICG(FDRS)79 (5.20), Tirupati-4 × ICG(FDRS)79 (4.62), Kadiri-6 × ICG(FDRS)79 (3.53), Kalahasti × Prasuna (1.96) and Prasuna × ICG(FDRS)79(1.91) exhibited significant positive SCA effects for pod yield per plant. The GCA status of ICG(FDRS)79 was positive significant.

Conclusion

ICG(FDRS)79 was the best general combiner for number of primary branches per plant, number of secondary branches per plant, pod yield per plant, kernel yield per plant, kernel number per plant, harvest index and kalahasti malady resistance. Kalahasti was the best general combiner for kalahasti malady resistance, 100-kernel weight and total phenolic compounds while Narayani, Tirupati 4 and Kadiri 6 are best combiners for earliness.

Narayani× ICG(FDRS) 79 followed by Tirupati 4 × ICG(FDRS) 79 and Kadiri 6 × ICG(FDRS) 79 were identified as best cross combinations with high SCA effect for traits viz., pod yield per plant, kernel yield per plant, number of primary branches per plant and number of kernels per plant. Among these three cross combinations, Tirupati 4 × ICG (FDRS) 79 recorded high negative SCA effect for days to maturity and high positive SCA effect for total phenolic compounds.

REFERENCES

Baker RJ (1978). Issues in diallel analysis. *Crop Science* **18** 533-536.

Basu MS, Vaddoria MA, Singh NP and Reddy PS (1987). Combining ability for yield and its components in a diallel cross of groundnut. *Indian Journal of Agricultural Sciences* **57** 82-84.

Garet B (1976). Heterosis and combining ability in groundnut (*Arachis hypogaea* L.) *Oleagineux* **31** 435-442.

Griffing B (1956). Concept of general and specific combining ability in relation to diallel crossing system. *Australian Journal of Biological Science* **9** 463-493.

Halward TM and Wynne JC (1991). Generation means analysis for productivity in two diverse peanut crosses. *Theoretical and Applied Genetics* **82** 784-792.

Haripasad AS (1990). Genetic analysis of combining ability, heritability and correlation in of groundnut (*Arachis hypogaea.* L.).M.Sc(Ag.) Thesis submitted to Andhra Pradesh Agricultural University.

Mehan VK, Reddy DDR and mc Donald D (1993). Resistance in groundnut genotypes to Kalahasti malady caused by the stunt nematode, *Tylenchorhynchus brevilineatus.Plant Disease* **68**(8) 526-529.

Rao SDV, Srinivasan S and Raja Reddy C (1986). Reaction of selected groundnut cultivars to nematode infection (*Tylenchorhynchus brevilineatus*) under field conditions. *Tropical Pest Management* **32** 167-170.

Savithramma DL, Rekha L and Sowmya HC (2010). Combining ability studies for growth and yield related traits in groundnut (*Arachis hypogaea.* L.) *Electronic Journal of Plants Breeding* **1**(4) 1010-1015.

Shoba D, Manivannan N and Vindhiyavarman P (2010). Gene effects of pod yield and its components of groundnut (*Arachis hypogaea* L.). *Electronic Journal of Plant Breeding* **1**(6) 1415-1419.

Vishnuvardhan KM, Vasanthi RP and Reddy KH (2011). Combining ability of yield, yield traits and resistanceto late leaf spot and rust in groundnut. *Journal of SAT Agricultural Research* 9.