Table 1. Lodging per cent of soybean genotypes grown in understorey of coconut plantations

/Environments Genotypes	Eight year old coconut plantation	Eighteen year old coconut plantation
Bragg	96.5	95.5
CO 1	97.8	98.6
DS 74 - 37	96.6	98.1
Hardee	9.6	83.2
Hill	94.0	97.8
JS 422	96.4	97.9
JS 72 - 185	98.0	98.6
KHSB 2	87.8	97.5
KHSB 5	93.4	97.6
KHSB 6	97.0	98.2
Monetta	8.6	87.2
Nimsoy 7	96.9	98.1
PB 1	95.0	97.8
UGM 21	95.4	85.3
UGM 24	95.6	98.3
Mean	83.9	95.3
SEd	1.1	0.8
CD (P=0.05)	2.2	1.7

and eighteen year old coconut plantations respectively and however, it ranged from 8.6 to 98.0 per cent under eight year old coconut plantation and from 83.2 to 98.6 per cent under eighteen year old coconut plantation. Hardee and Monetta recorded very low (less than 10 per cent)lodging percentages, all others recording upwards of 87.8 per cent under eight years old coconut plantation. Although all the fifteen genotypes recorded lodging per cent of above 83.2 the genotypes viz., Hardee, UGM 21 and Monetta recorded low lodging per cent of the overall mean in understorey of eighteen year old coconut plantation. The genotypes Co.1, JS 72-185 and KHSB 6 were consistently recorded higher lodging per cent in both the coconut stands. The genotypes Co.1 and JS 72-185 recorded the highest and second highest lodging percentages in understorey of eighteen year old coconut plantation and second highest and highest and highest lodging percentages under eight year old coconut plantation.

Soybean plants lodged severely in understorey of coconut plantations due to shade effect. Low lodging percentages of Hardee and Monetta in both coconut stands showed their shade tolerance. The genotypes Co.1, JS 72-185 and KHSB 6 appeared to be particularly prone to lodging. Appropriate cultivars should be fitted in cropping systems for achieving maximum production potential in the specified environment.

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GENETIC ANALYSIS OF YIELD COMPONENTS IN SHORT DURATION RICE (*Oryza sativa* L.) VARIETIES

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ABSTRACT

The genetic analysis for yield and its components was attempted using 4x4 diallel. The diallel analysis showed the importance of both additive as well as non-additive gene action for all the traits studied. Except for ear bearing tillers, SCA variances were higher than GCA variances for all the traits suggesting the predominance of non-additive gene action. In the case of ear bearing tillers, the GCA variance was greater than SCA variance indicating more of additive gene action. Parents with high combining ability have been identified.

Breeding for higher grain yield has been the main objective of crop improvement among the breeders. A knowledge of the genetic architecture of the genotypes and the nature of gene action for the traits is a pre-requisite for improvement in any crop plant. Many biometrical techniques help the breeder to choose appropriate parents. Among them diallel analysis is the one which enables the breeder to make predictions from the information collected from the F1s. In this paper, an attempt has been made to study the nature of gene action and the degree of combining ability for yield and its components in short duration rice varieties.

MATERIALS AND METHODS

The experimental material for this study consisted of four short duration rice varieties, viz.,

Table 1. Analysis of variance for combining ability

Source	df	Plant height	Ear bearing tillers per plant	Ear length	Grain number per ear	100-grain weight	Grain yield
GCA	3	1114.29**	635.41**	3.82**	667.04**	0.22**	8.52**
SCA	6	2874.10**	30.30**	154.55**	4127.90**	1.19**	81.89**
RCA	6	6.32**	0.13	0.81**	37.52**	0.0025	4.43**
Error	30	0.70	0.16	0.08	5.92	0.0011	0.08
GCA : SCA		0.39:1	20.98:1	0.02:1	0.16:1	0.18:1	0.10:1

** Significant at 1% level

ADT 37, Co 41, IR 50 and ADT 36 and which were crossed in all possible combinations. All the twelve F1s along with the parents were raised in Randomised Block Design with three replications during June-September, 1989 at Rice Research Station, Ambasamudram. A spacing of 20 cm between rows and 15 cm between plants was adopted. Observations were recorded for six characters on ten randomly chosen plants from each replication and the mean values were used for statistical analysis. The combining ability analysis was carried out as per Griffing (1956) Method I, model I.

RESULTS AND DISCUSSION

The estimates of variances due to general and specific combining ability were significant for all the characters (Table 1). The estimates of SCA variance were higher than the GCA variance and the ratio of GCA/SCA was less than unity for all the characters except ear bearing tillers per plant. The estimates of *gca* effects revealed that the parents ADT 37 and IR 50 showed significant *gca* effects for all the characters studied (Table 2). However, ADT 37 had positive and significant *gca* effects for grain number per ear, 100 grain weight and grain yield while IR 50 for ear bearing tillers per plant, ear length and grain yield. Mean values of F1 hybrids and the respective *sca* effects for different characters are presented in Table 3.

For plant height, the highest mean value was recorded by the combination Co 41 X IR 50(131.48 cm) and the lowest value by ADT 37 X IR 50 (87.32 cm). The highest and the positive *sca* effect for plant height was recorded by Co 41 X IR 50 (18.04). The *sca* effects were positive and significant in four crosses but in two crosses the *sca* effects were negatively significant. The mean values of hybrids for ear bearing tillers per plant ranged from 10.34 (ADT 37 X Co 41) to 13.90 (Co 41 X ADT 36). The cross Co 41 X ADT 36 (2.14) recorded the highest positive and significant *sca* effect. The range of mean for ear length in respect of the hybrids varied from 22.94 cm (ADT 37 X Co 41) to 25.61 cm (Co 41 X IR 50). The cross Co 41 X IR 50 (1.52) gave the highest positive and significant *sca* effect. Three combinations had significant positive *sca* effects and the remaining other three combinations had positive but non-significant effects. For grain number per ear, the maximum number was noticed in the hybrid ADT 37 X ADT 36 (151.24) and the minimum in Co 41 X IR 50 (117.93). The highest positive and significant *sca* effect was recorded in the Cross Co 41 X ADT 36 (15.09). Significantly negative *sca*

Table 2. Mean and general combining ability effects of parents

Parents		Plant height	Ear bearing tillers per plant	Ear length	Grain number per ear	100 - grain weight	Grain yield
ADT 37	Mean	86.72	7.39	20.75	138.75	2.23	13.05
	gca	-5.25**	-1.18**	-0.91**	13.19**	0.23**	0.77**
Co 41	Mean	108.39	8.78	23.31	98.07	1.60	10.67
	gca	17.49**	-0.01	0.74**	-4.77**	-0.15**	-1.12**
IR 50	Mean	72.85	10.52	22.02	96.17	1.79	12.41
	gca	-8.31**	1.01	0.24*	-7.22**	-0.07**	0.99**
ADT 36	Mean	91.42	9.16	21.94	88.71	1.93	12.23
	gca	-3.93**	0.20	-0.05	-1.20	-0.02	-0.64**

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

Table 3. Estimates of mean and sca effects of hybrids for six characters

Parents		Plant height	Ear bearing tillers per plant	Ear length	Grain number per ear	100 - grain weight	Grain yield
ADT 37 x Co 41	Mean	121.00	10.34	22.94	126.71	2.14	19.47
	sca	7.67**	0.05	0.01	-6.07**	0.08**	1.71**
ADT 37 x IR 50	Mean	87.32	13.06	23.03	134.35	2.24	21.54
	sca	-1.84**	1.79**	0.05	2.96*	0.12**	2.53**
ADT 37 x ADT 36	Mean	96.78	10.48	23.91	151.24	2.16	20.53
	sca	1.22*	-0.16	0.90**	16.32**	0.03	1.13**
Co 41 x IR 50	Mean	131.48	12.31	25.61	117.93	1.69	20.63
	sca	18.04**	0.44	1.52**	8.96**	-0.02	1.96**
Co 41 x ADT 36	Mean	125.37	13.90	24.44	136.80	1.87	17.08
	sca	5.16**	2.14**	0.17	15.09**	0.03	0.32
IR 50 x ADT 36	Mean	89.95	13.36	24.34	129.09	1.87	19.07
	sca	-1.38**	0.70**	0.42*	3.07*	-0.04	1.95**

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

effects was noticed in the combination ADT 37 X Co 41. The mean of 100-grain weight ranged from 1.69 g (Co 41 X IR 50) to 2.24 g (ADT 37 X IR 50). Two combinations, viz., ADT 37 X Co 41 and ADT 37 X IR 50 had significantly positive *sca* effects while the remaining combinations had non-significant effects. For grain yield per plant the mean values in respect of hybrids ranged from 17.08 g (Co 41 X ADT 36) to 21.54 g (ADT 37 X IR 50). Five combinations recorded significantly positive *sca* effects while remaining one recorded positive but non-significant effect.

In the present investigation, GCA and SCA variances were highly significant for all the characters, revealing the importance of both additive and non-additive gene action. Except for ear bearing tillers per plant, SCA variances were higher than GCA variances and the ratio of GCA/SCA was less than unity in all other traits indicating the preponderance of dominant gene action. Ear bearing tillers per plant showed more than one as GCA/SCA ratio and its additive genetic variance was higher than dominant genetic variance which revealed that this character is governed more by additive gene action.However, Singh (1980) indicated the important role of both general and specific combining ability variance for expression of characters like grain yield, grain number per ear, ear bearing tillers per plant, plant height and 100-grain weight. According to Pethani and Kapoor (1984), the nature of gene action varied with the materials, the analytical procedure used and the environment under which the test was carried out.

The parent Co 41 for plant height and ear length, IR 50 for ear bearing tillers per plant and the grain yield and ADT 37 for grain number per ear, 100-grain weight and grain yield had high *per se* performance as well as high *gca* effects. This indicated that the *per se* performance of parents may be a good indicator of their combining ability. Among the parents, ADT 37 possessed favourable *gca* effects for grain number per year, 100-grain weight and grain yield. So, it could be used as the base parent and crossed with other parents to improve yield components. Parent Co 41 could be used to improve plant height and ear length while IR 50 for improving the ear bearing tillers per plant besides grain grain yield itself.

In the present study, the parents involved in the crosses ADT 37 X IR 50 for grain yield and Co 41 X IR 50 for ear length had high gca effects and sca effects. This is in confirmity with the results of Bhandari (1978) who reported that when the parents with high *gca* effects were crossed, they produced hybrids with high *sca* effects. These two crosses, therefore, have good potentiality for use in future breeding programmes. If both the parents of a specific cross combination showed high *gca* effect, it reveals the additive X additive gene action, since, the additive gene action is fixable in nature, high yielding segregants could be isolated from the segregating generation of these crosses.

It was observed that none of the hybrids obtained by crossing two parents with low *gca* effects showed high *sca* effects. But, the other combinations, like high X low or low X high for *gca* effects showed high *sca* effects. The crosses ADT 37 X Co 41 (plant height, 100-grain weight and grain yield), ADT 37 X IR 50 (ear bearing tillers per plant, grain number per ear and 100-grain weight), ADT 37 X ADT 36 (grain number per ear and grain yield), Co 41 X IR 50 and Co 41 X ADT 36 (plant height) and IR 50 X ADT 36 (ear bearing tillers per plant, ear length and grain yield) showed significant and positive *sca* effects though one of the parents involved had low *gca* effects. These crosses can throw transgressive segregation in the segregating generation for effective selection.

Both additive as well as non-additive genetic components have been found to be important in governing the yield and its component in this study. So, biparental mating in the early generation among the selected lines or diallel selective mating as suggested by Jensen(1970) exploiting the available genetic male-sterile lines would be appropriate in our breeding programmes for the improvement of characters studied.

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ENERGY MANAGEMENT IN SORGHUM BASED CROPPING SYSTEMS WITH BIO-DIGESTED SLURRY AND AZOSPIRILLUM

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Abstract

The results of the experiment conducted during 1982-1983 revealed that in the cropping systems, the maximum amount of energy flow was through irrigation (55%) followed by fertilizer (28.5%). The high intensity cropping system viz., sorghum-sorghum ratoon-maize-sunflower with itercrops gave the highest energy input, output and energy efficiency than conventional system. Energy efficiency improved by incorporation of biodigested slurry and inoculation of Azospirillum, under moderate level of N. Irrespective of the cropping systems, application of biodigested slurry at 10 t/ha with 75% recommended N + Azospirillum to each crop needed less specific energy.

At present, the crop production is highly correlated with inputs of fertilizer. The high intensive cropping systems have been reported to remove 500 to 700 kg of nutrients per ha per year. Hence increasing energy input-output ratio is important from the point of view of increasing costs of high energy inputs like fertilizers. Hence there is a need to lay more emphasis on the use of renewable source of energy i.e. recycling the Agricultural wastes and biofertilizers. With this view, a study was undertaken to assess the energy flow into the different sorghum based intensive cropping systems and to workout energy efficiency and specific energy.

MATERIALS AND METHODS

A field experiment was conducted at TNAU, Coimbatore, in clay loam soil with three different cropping systems viz; (C_1) - Sorghum - Finger millet - Cotton, (C_2) - Sorghum + Cowpea - Finger millet + Sunflower as border crop - Cotton + Blackgram, (C_3) - Sorghum + lab-lab-Sorghum ratoon + Blackgram - Maize + Soybean - sunflower. In the cropping systems three levels of organic manures and four fertiliser levels were tried in split plot design with the cropping system and manurial levels in main plot and fertiliser levels in sub plot with three replications. The energy used for different field operations, yield