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SUMMER GROUNDNUT AS A COMPONENT OF RICE BASED CROPPING SYSTEM

M. Ramakrishnan and V. Gopinathan Nair
College of Agriculture, Vellayani 695 522, Trivandrum, India

Abstract: Realizing the difficulty in determining the time of optimum maturity in groundnut, a maturity index was formulated. Recombination breeding with high productive and extra early types was undertaken. Combining ability was estimated by the line \ tester method. Among lines, Chico was the best combiner for earliness. Among testers, TMV 2 was the best for productivity. High yielding extra early recombinants were selected from the F_2 populations for further testing and selection.

Key words: Groundnut breeding, cropping system, combining ability, rice-groundnut system

INTRODUCTION

There is scope for cultivating groundnut in the rice-rice fallow area in Kerala. The major constraint in extending the groundnut crop to the summer rice fallows is the lack of an extra early variety maturing in 80-90 days with synchronized pod maturity and moderate yield potential. A study was therefore undertaken with the main objective of providing basic information to overcome the above constraint through development of extra early groundnut types suitable as a summer crop in the rice fallows.

MATERIALS AND METHODS

The genetic material consisted of 63 bunch types of groundnut maintained under the oil-seeds project of the Department of Plant Breeding, College of Agriculture, Vellayani. These types were evaluated in rice fallows during summer 1989 (January to April) at the Rice Research Station, Kayamkulam. The experiment was laid out in a split plot design with three stages of maturity as the main plot and the 63 types in the subplot, with three replications. Each subplot comprised of a single 3 m row with plants spaced at 20 cm. Staggered harvesting of the main plots was done at 80, 95 and 110 days after sowing. Data on the maturity related traits such as number of immature pods per plant, number of mature pods per plant, pod yield per plant, 100 pod weight, shelling percentage, 100 kernel weight and oil content were recorded taking all the 14 plants, except the border plants of a variety in each replication as the sample.

Maturity index

The mean values for the different traits in each type at the three different stages of harvest from the above split plot experiment were taken into consideration. Based on the critical difference values of the treatment combinations, the 63 types were scored for the maturity traits in 1-3 scale. For each type, the total score was calculated by adding the scores obtained for the six different traits. On the basis of the standard error (SE) values, the 63 types were classified into three groups namely, extra early (> mean + SE), early (mean +/- SE) and medium (< mean - SE).

Choice of parents and hybridization

Six extra early types [Chico, ISKN 8827, 1CGS 35-1, Dh(E) 20, Dh(E) 32 and IES 883] as ovule parents were crossed in the line x tester model with three high productive types (TC 3, TMV 2 and JL 24) as the male parents. They were grown at the College of Agriculture, Vellayani during kharif 1989 (May to October) and crossed following the technique suggested by Reddy *et al.* (1970). At harvest, the mature pods were collected cross wise, dried and stored.

Combining ability

The six lines, three testers and their eighteen hybrids were raised adopting a randomized block design with three replications in the rice fallows during summer 1990 at the Rice Research Station, Kayamkulam. Each plot comprised of a single 4 m row with plants spaced at 20 cm. Data on the following traits such as days to first flowering, spread of flowering, days to maturity, number of immature pods per plant, number of mature pods per plant, haulm yield per plant, pod yield per plant, 100 pod weight, shelling percentage, 100 kernel weight and oil content (NMR method) were recorded from five plants selected at random in each treatment per replication. Combining ability was estimated following the line x tester method proposed by Kempthorne (1957).

Study of F_2 generation

The eighteen F_2 populations (families) were raised in three randomized blocks. The plants were harvested at 80 days after sowing. Ten high yielding extra early recombinants with high mature to immature pod ratio were selected from each family in every replication. Observations were recorded on traits such as number of immature pods per plant, number of mature pods per plant, pod yield per plant, kernel yield per plant and shelling percentage.

RESULTS AND DISCUSSION

The mean values for the different traits in the extra early group are presented

Table 1. Mean values for the different traits in the extra early group

Type	Ratio of No. of mature to immature	Pod yield / plant	100 pod weight (g)	Shelling %	100 kernel weight (g)	Oil content (%)
Chico	23.0	76.69	32.96	55.37	21.50	47.17
ICGS 35-1	14.89	10.81	64.46	59.89	30.60	47.25
ICGSE 21	16.37	8.38	53.33	55.28	26.17	45.28
ICGSE 121	11.15	7.00	46.92	58.35	30.13	45.20
ICGV 86012	13.83	11.27	56.74	44.29	26.29	45.17
ICGV 86013	19.08	9.77	58.47	41.56	27.20	45.28
IES 883	16.11	10.30	54.89	58.63	26.30	48.93
ISKN 8827	13.00	12.30	56.05	55.43	36.21	49.18
ISKN 8836	11.02	9.10	59.01	33.45	21.17	43.30
ISKN 8837	15.41	7.82	45.48	55.63	29.53	45.13
ISKN 8839	12.83	8.97	49.39	48.93	26.42	44.35
ISKO 8805	13.97	9.40	47.83	42.48	27.73	45.22
ISKO 8821	12.43	9.34	56.44	39.88	23.37	44.78
TG 3	15.92	11.17	53.72	52.62	20.12	47.17
BPG 521	12.77	9.82	54.18	58.24	26.10	45.05
Dh(E) 20	12.58	9.46	72.51	51.77	29.13	48.13
Dh(E) 32	14.72	8.47	52.98	59.92	31.25	48.19

Mean pod yield/plant in the extra early group, early group and medium group were 9.4 g, 12.2 g and 14.8 g respectively.

Table 2. Gca effects and mean performances of superior parents for different traits

Trait	Lines/testers	gca effect	Mean performance
Days to first flowering	Chico	-0.98*	23.0
	TG3	-0.04	25.0
Spread of flowering (days)	Dh(E) 32	0.41	45.0
	TMV 2	-0.15	48.3
Days to maturity	Chico	-4.30*	77.3
	ISKN 8827	-5.17*	94.8
	TMV 2	-1.76*	94.3
No. of immature pods/plant	Chico	-0.27*	1.4
	ISKN 8827	-0.81*	2.3
	DlI(E) 32	-0.19*	2.8
	TMV 2	-0.44	3.5
No. of mature pods/plant	Dh(E) 20	1.26*	11.3
	Dh(E) 32	0.76*	12.8
	ICGS 35-1	0.70*	11.4
	JL 24	0.74*	8.5
Haulm yield/plant (g)	ICGS 35-1	8.74*	34.6
	IES 883	11.81*	71.8
	TG 3	-0.66*	66.6
Pod yield/plant (g)	ISKN 8827	0.80*	15.3
	Dh(E) 20	0.76*	19.0
	Dh(E) 32	2.63*	16.7
	IES 883	2.71*	14.9
	TMV 2	0.65*	16.6
	TG 3	-0.28	16.3
100 pod weight (g)	Dh(E) 20	14.94*	69.3
	Dh(E) 32	0.28	99.0
	IES 883	20.82*	62.9
	JL 24	1.30	111.1
Shelling %	Chico	6.36*	60.4
	ISKN 8827	4.11*	71.6
	ICGS 35-1	-2.33	74.7
	TG 3	-2.15*	67.9
	TMV 2	1.97*	65.9
100 kernel weight (g)	Dh(E) 20	6.00*	38.3
	Dh(E) 32	4.57*	46.1
	IES 883	10.36*	38.1
	TMV 2	1.02*	38.5
	JL 24	0.16*	55.5
Oil content (%)	ICGS 35-1	0.72	48.2
	IES 883	0.08	49.3
	TMV 2	-0.10	49.1

* Significant at 5% level

Table 3. Sca effects and mean performance of superior cross combinations for diffferent traits

Trait	Cross combination	sca effect	Mean performance
Days to first flowering	Chico x TG 3	0.04	23.7
	Chico x TMV 2	0.09	23.7
	Chico x JL 24	-0.13	23.7
Spread of flowering (days)	Chico x TG 3	-0.85	48.3
	IES 883 x JL 24	-0.63	48.3
Days to maturity	ISKN 8827 x TG 3	-3.33*	81.2
	IES 883 x TMV 2	-4.52*	83.3
No. of immature pods/plant	Dh(E) 32 x TM 2	-0.42*	1.5
	IES 883 x TG 3	-0.61*	2.4
No.of mature pods/plant	Dh(E) 20 x JL 24	1.46*	16.3
	ICGS 35-1 x TMV 2	2.87*	15.2
Haulm yield/plant (g)	ICGS 35-1 x TMV 2	10.6	61.6
Pod yield/plant (g)	ISKN 8827 x TG 3	3.5*	18.3
	Dh(E) 32 x JL 24	2.1*	18.9
100 pod weight (g)	Dh(E) 20 x TMV 2	13.3*	104.1
Shelling %	Chico x TG 3	6.9*	79.0
100 kernel weight (g)	ISKN 8827 x TG 3	4.8*	25.8
	IES 883 x TMV	0.8*	46.5
Oil content (%)	IES 883 x TG 3	1.7*	50.8

*Significant at 5% level

in Table 1. The mean pod yield per plant in the extra early group (9.4 g) is comparatively low than that in the early (12.2 g) and in the medium (14.8 g) groups. Thus, in order to improve the low yielding extra early types, recombination breeding with high productive types was undertaken.

In the combining ability study, the variance due to lines was significant for traits such as days to first flowering, days to maturity, haulm yield per plant, pod yield per plant, 100 pod weight and 100 kernel weight. But the variance due to testers was not significant for any of the traits. However, the variance due to line x tester interaction was significant for number of immature pods per plant, number of mature pods per plant, haulm yield per plant, pod yield per plant, 100 pod weight, shelling percentage, 1(X) kernel weight and oil content which indicated that both additive and non-additive gene actions might be involved in their inheritance. The predominance of sca variance over gca variance for all these traits indicated the preponderance of non-additive genes over additive genes in the control of the traits. This is in tune with the findings of Raju *el al.* (1979). However, Manoharan *et al.* (1985) reported prponderance of additive gene action for pod yield and shelling percentage. The preponderance of additive gene action for days to maturity, number of mature pods, pod yield, shelling percentage and 100 kernel weight was reported by Basu *et al.* (1987).

The nature of gca effects and their -mean performance were considered for the evaluation of parents. The gca effects and mean performances of superior parents for different traits are presented in Table 2. Among lines, Chico was found to be the best general combiner for earliness. Among testers, TMV 2 was the best general combinerforproductivity.

In the evaluation of cross combinations the nature of sca effects and their mean performances were considered. The sca effects and mean performances of superior cross combinations are presented in Table 3. With regard to days to maturity, the most important attribute governing earliness, the best performance was by the cross combination, ISKN 8827 x TG 3. This could be attributed to the high significant negative gca effect of one of the parents involved namely, ISKN 8827 for the trait and comparatively desirable negative significant sca effect produced in the combination. In the case of pod yield per plant also, the combination Dh(E) 32 x JL 24 which gave the highest mean pod yield per plant had one of the parents, Dh(E) 32 with highly significant positive gca effect and a comparativelyhighpositivesignificantsca effect. Such superior cross combinations involving high performing and low performing parents are expected to segregate for desirable transgressive segregants, as the desirable additive gene effect of the high performing parent and the complementary epistatic effects of the cross are coupled in the direction to maximize the expression of the character under consideration (Singh *et al.,* 1990). This supports the importance of both additive and non-additive gene effects in controlling earliness and productivity. Basu *et al.* (1987) however, reported preponderance of additive gene action fordays to maturity and pod yield. The gca/sca variance ratio which is less than unity for all the traits except spread of flowering indicated the predominance of non-additive gene action in the inheritance of these characters. This may be due to the fact that the parental materials included in the study were highly selected for yield and maturity related traits (Nanda *et al.,* 1983).

In the F_2 study, the highest range in case of pod yield per plant was recorded by the family Dh(E) 20 x JL 24 (9.14 - 29.19 g) and the lowest range by ISKN 8827 x JL 24 (12.70 - 23.35 g). The highest mean pod yield per plant was also registered by the family Dh(E) 20 x JL 24 (20.17 g) and the lowest was by Chico x TG 3 (12.34 g).

The promising high yielding extra early recombinants have been advanced through different stages of selection and it is expected that a few promising extra early types with high productivity would be identified very soon from the progenies.

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