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Growth, yield and economics of groundnut (*Arachis hypogaea*) as influenced by intercrops and sulphur application

DAYANAND[1] AND N.L. MEENA[2]

SKN College of Agriculture, Rajasthan Agriculture University, Jobner, Rajasthan 303 329

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ABSTRACT

A study was undertaken by introducing castor (*Ricinus communis* L.) and sesame (*Sesamum indicum* L.) as intercrops in groundnut (*Arachis hypogaea* L.) fertilized with 0, 20, 40 and 60 kg S/ha at SKN College of Agriculture, Jobner (Jaipur), during the rainy (*kharif*) season of 1999 and 2000, to study the growth and yield behaviour of groundnut. Inclusion of oilseeds as intercrops (castor and sesame) reduced the dry-matter accumulation, dry weight of root nodules, chlorophyll content and branches/plant of groundnut compared to sole crops. The yield attributes, viz. pods/plant, kernels/pod and test weight were also decreased by intercropping of oilseeds. Similarly, the pod yield, kernel yield and biological yield were also decreased by inclusion of intercrops. The intercropping of groundnut with castor in 4 : 1 row ratio gave the highest groundnut pod-equivalent yield, net return and benefit : cost ratio. Groundnut responded to sulphur application up to 40 kg S/ha, whereas higher groundnut pod-equivalent yield, net return and benefit : cost ratio were obtained with 60 kg S/ha.

Key words : Groundnut, Intercropping, Pod yield, Kernel yield, Groundnut equivalent

Temporal and spatial intensification of cropping is the need of the day to keep the pace between oil production and demand of the burgeoning population in a densely populated country like India. Though intercropping is an age-old practice, it has attracted world-wide attention owing to yield advantages (Willey, 1979). Groundnut, a premier oilseed crop of India is generally grown as mono- or mixed, crop with cereals and legumes in arid and semi-arid regions. The intercropping of oilseeds in oilseeds is a recent concept which has become feasible after development of new early-maturing and short-statured cultivars. The castor and sesame are the important

Present address : [1]Lecturer (Agronomy), PND college of Agriculture, Gajsinghpur 335 024; [2]Director (Agric. Ext.), Directorate of Agriculture Extension, RAV, Bikaner 334 006.

rainy (*kharif*)-season oilseed crops which are compatible with groundnut and are ideally suited for rainfed conditions in arid and semi-arid areas.

Groundnut is a legume oilseed energy-rich crop but mostly it is grown under energy-starved condition. As the crop yields pods rich in oil and protein, it has relatively high requirement for sulphur. Hence, the present investigation was undertaken to investigate the influence of intercrops and sulphur nutrition on groundnut.

MATERIALS AND METHODS

A field experiment was conducted at SKN College of Agriculture, Jobner, (Rajasthan) during *kharif* seasons of 1999 and 2000. The soil of the experimental site was loamy sand in texture with pH 8.1, low in organic carbon (0.22 per cent), available N (129.27 kg/ha), P (16.57 kg/ha), K (146.30 kg/ha) and low in available SO_4^{-2}-S (18.55 kg/ha). The experiment comprising 28 treatment combinations of 7 intercropping systems (sole groundnut, groundnut + castor and groundnut + sesame both in 2:1, 3:1 and 4:1 row ratios) as main plot treatment and four levels of sulphur (0, 20, 40 and 60 kg S/ha) through elemental sulphur as subplot treatments was laid out in split-plot design with four replications. The groundnut 'Chandra', castor 'GCH 4' and sesame 'RT 46' varieties were sown using seed rate of 80 kg, 12 kg and 5 kg/ha, respectively. The seed rates of groundnut, castor and sesame were different in different intercropping treatments depending on row ratios. Sole groundnut was planted at a uniform row distance of 40 cm. In groundnut + castor, one row of castor was adjusted in inter-row space with 20 cm extra space after every two, three and four rows of groundnut in 2:1, 3:1 and 4:1 row ratios, respectively, whereas in groundnut + sesame intercropping, one row of sesame was adjusted in inter-row space after every two, three and four rows of groundnut, respectively by keeping the plot size of 5.0 × 4.4 m. A uniform basal dose of 25 kg N + 40 kg P_2O_5/ha through urea and diammonium phosphate was drilled in rows. Rainfall received during crop period of 1999 and 2000 was 180.3 and 298.1 mm respectively. Market price prevailing during crop period was used for computing groundnut equivalent. The groundnut pod-equivalent yield was calculated by converting the intercrop yield into groundnut yield by using prevailing market price of groundnut, castor and sesame as:

$$\text{Equivalent yield (q/ha)} = \text{Seed yield of main crop} + \text{Grain yield of intercrop} \times \frac{\text{Price of intercrop}}{\text{Price of main crop}}$$

RESULTS AND DISCUSSION

Growth of groundnut

Intercropping of other oilseeds decreased growth characteristics of groundnut, viz. dry matter, branches/plant, dry weight of root nodules and chlorophyll content (Table 1). Though significantly higher values for growth parameters were recorded under sole groundnut, it remained at par with its intercropping with sesame in 4:1 row ratio for dry matter, dry weight of root nodules and chlorophyll content of leaves. The improvement in growth para-

meters of sole groundnut might have occurred because the crop enjoyed a competition - free environment for light, water and nutrients which is also clear from the growth parameters of groundnut under wider row ratio compared with narrower row ratio later recording lowest values. These results confirm the findings of Venkateswarlu (1984).

All the growth parameters showed an increasing trend with increasing levels of S up to 60 kg/ha, though the increase in dry weight of root nodules beyond 40 kg S/ha was not significant. It might have been owing to better utilization of resources under improved S supply, as it plays multiple role in plant metabolism being an essential constituent of S-containing amino acids and as such of proteins, vitamins, acetyl CO-A, ferrodoxin and glutathione.

Yield attributes and yield of groundnut

Groundnut as sole crop recorded significantly higher yield attributes, viz. pods/plant, kernels/pod, test weight and pod, kernel and biological yields, compared to its intercropping with oilseeds under different row ratios (Tables 1 , 2). However, the kernels/pod, kernel and biological yields remained at par with intercropping with sesame in 4:1 row ratio and test weight remained at par with intercropping with castor in 4:1 row ratio and with sesame in 3:1 and 4:1 row ratios. It might be because of the fact that sole crop enjoyed a competition-free environment which resulted in better development of growth parameters and more photosynthetically active leaf area. It in turn led to greater translocation of assimilates from source to sink which ultimately increased the yield attributes and yield of groundnut. The results confirm the findings of Singh (1980).

Pods/plant significantly increased with increasing levels of S up to 60 kg/ha, whereas increase in kernels/pod, test weight, pod, kernel and biological yields was recorded only up to 40 kg S/ha. Improvement in vegetative structures for nutrient absorption and photosynthesis, strong sink strength through development of reproductive structures and production of assimilates under the influence of applied S maintained balanced source–sink might have resulted in increased yield attributes and yield. The results are in close conformity with the findings of Sachidanand *et al.* (1980).

Groundnut pod-equivalent yield

An intercropping of groundnut with castor in 4:1 row ratio remaining at par with 3:1 row ratio gave significantly higher groundnut pod-equivalent yield, being 7.43% more than sole groundnut (Table 2). This may be because of the fact that groundnut yield was reduced due to lower plant population compared with sole groundnut in intercropping, but this was compensated by the yield of castor intercrop. The groundnut pod-equivalent yield in narrow row ratio with castor was low due to more competition for light, water and nutrients. Groundnut pod-equivalent yield exhibited an increasing trend with increasing levels of S up to 60 kg/ha.

Economics

An intercropping of groundnut + castor

Table 1. Effect of intercropping and sulphur on growth and yield attributes of groundnut (pooled means of 1999 and 2000)

Treatment	Dry matter (g/m row length)	Branches/ plant	Dry wieght of root nodules (mg/plant)	Chrolophyll content (mg/g weight of leaves)	Pods/ plant	Kernels/ pod	Test weight (g)
Intercropping							
Sole groundnut	547.06	10.85	107.20	2.79	30.18	1.62	403.8
G + C (2:1)	478.37	7.69	91.94	2.39	22.31	1.28	367.0
G + C (3:1)	501.18	8.37	95.18	2.55	24.99	1.41	380.5
G + C (4:1)	524.09	9.56	100.90	2.68	27.51	1.54	394.7
G + S (2:1)	491.38	8.34	93.25	2.47	24.37	1.32	372.2
G + S (3:1)	522.65	9.61	100.79	2.62	26.99	1.43	393.3
G + S (4:1)	538.29	10.08	102.26	2.71	28.16	1.57	398.7
CD (P=0.05)	14.82	0.56	5.59	0.10	1.52	0.06	14.0
Sulphur (kg/ha)							
0	500.56	8.36	94.48	2.31	24.27	1.23	376.0
20	507.02	8.78	97.43	2.52	25.52	1.32	383.4
40	518.79	9.58	101.03	2.71	26.96	1.61	391.0
60	532.49	10.15	102.22	2.86	28.68	1.64	398.2
CD (P=0.05)	10.02	0.37	3.47	0.06	1.09	0.04	10.0

Table 2. Effect of intercropping and sulphur on groundnut yield, net return and benefit: cost ratio (pooled means of 1999 and 2000)

Treatment	Pod yield (q/ha)	Kernel yield (q/ha)	Biological yield (q/ha)	Equivalent pod yield	Net return (Rs/ha)	Benefit : cost ratio
Intercropping						
Sole groundnut	18.70	12.40	61.68	18.70	17,353	2.08
G + C (2:1)	13.83	8.56	46.92	18.43	16,405	2.04
G + C (3:1)	15.64	9.90	52.10	19.56	18,573	2.19
G + C (4:1)	17.33	11.22	57.44	20.09	19,473	2.23
G + S (2:1)	14.62	9.10	49.29	18.81	16,692	2.03
G + S (3:1)	16.15	10.44	53.58	18.83	17,014	2.06
G + S (4:1)	17.60	11.66	58.32	19.20	17,911	2.11
CD (P=0.05)	1.15	0.76	3.50	0.82	830	0.05
Sulphur (kg/ha)						
0	14.63	9.23	49.36	16.50	13,666	1.89
20	16.06	10.20	53.59	18.61	16,970	2.08
40	17.04	11.05	56.42	20.22	19,407	2.21
60	17.34	11.38	57.38	21.03	20,483	2.26
CD (P=0.05)	0.72	0.50	2.45	0.58	608	0.04

was found highly profitable when compared to all other intercropping systems. Groundnut + castor in 4:1 row ratio gave significantly higher net return (Rs 19,473/ha) and benefit : cost ratio (2.23) compared with all other treatments. It is obvious because of the fact that in 4:1 row ratio, all the component crops enjoyed comparatively better nutrient availability and ultimately attained full growth.

The maximum net return (Rs 20,483/ha) and benefit : cost ratio (2.26) were obtained under 60 kg S/ha. It might be owing to increased yield of all component crops under application of 60 kg S/ha with comparatively less-added cost of sulphur fertilizer under this treatment.

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