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THE EFFECT OF IRRIGATION AND MANURING ON N, P, K UPTAKE AND SOIL NUTRIENT STATUS IN GROUNDNUT

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ABSTRACT

Field experiments were conducted at Agricultural Research Station, Aliyarnagar, Tamil Nadu, India during summer 1994 and 1995 on groundnut. Results revealed that irrigation scheduled at 0.75 IW/CPE ratio registered higher uptake of macro nutrients and higher soil available N, P and K compared to 0.60 IW/CPE. Uptake of nutrients by groundnut and post harvest soil available nutrients were higher at higher level of fertilisation and organic amendments application. Though irrigation and fertiliser levels did not influence organic carbon content, application of organic amendments significantly increased the organic carbon content of the soil.

KEY WORDS : Groundnut, Nutrient uptake, Soil nutrient status

Groundnut (*Arachis hypogaea* L.) is the most important oilseed crop of India. The average pod yield of groundnut in India ranged between 700 and 900 kg ha^{-1} during the past decade. These yields are low compared to world's average yield of about 1100 kg ha^{-1} (ISOR, 1993). In irrigated groundnut, higher productivity would result by optimum irrigation and nutrient management.

An average crop of groundnut yielding 1.9 t ha^{-1} removed 170 kg N, 30 kg P_2O_5 and 100 kg K_2O ha^{-1} (Aulakh *et al.*, 1985). Hence regular and adequate fertilisation is a must for groundnut to increase the productivity. Sustainability of higher yields of groundnut could be achieved through conjuctive use of plant nutrients combing organic and inorganics fertilisers (Singh *et al.*, 1990). Uptake and accumulation behaviour of major nutrients is conditioned by irrigation and fertiliser regimes (Reddy *et al.*, 1982). Hence the present study was undertaken to study the influence of irrigation regimes, fertiliser levels and organic amendments application on the nutrient (N,P,K) uptake by groundnut and soil nutrient status.

MATERIALS AND METHODS

Field experiments were conducted during summer 1994 and 1995 at Agricultural Research Station, Aliyar Nagar. The station is geographically situated at 10°39'5" N latitude and 77°0'15" longitude, Tamil Nadu, India. During 1994, 328 mm of rainfall was received in 25 rainy days during the crop period while in 1995, 171 mm of rainfall was received in 13 rainy days.

The soil of the experimental field was sandy loam, low in available nitrogen (230 kg ha^{-1}), medium in available phosphorus (12.5 kg ha^{-1}) and potassium (250 kg ha^{-1}). The pH of the experimental field was 7.3 with bulk density 1.3 g cc^{-1}. Mechanical analysis showed that the experimental field had 14% clay, 7.85%, silt, 46.43% fine sand and 30.66% coarse sand. Field capacity and per manent wilting point were 20.4 per cent and 10.4 per cent respectively. The experimetnal field was irrigated by well water with pH of 7.9 and EC of 0.6 dSm^{-1}. R.S.C. of irrigation water was 0.1 meq^{-1} and S.A.R. value was 2.4. Groundnut variety VRI 2. with a field duration of 105 days was the test variety

Ther experiment was laid out in split plot desigr with three replications. The gross plot size was 4.8 m x 4. 2 m and net plot size was 3.8 m x 3.6 m Treatment details are given below.

Main plots (Irrigation levels)

I_1 - Irrigation at IW/CPE ratio of 0.60

I_2 - Irrigation at IW/CPE ratio of 0.75
(Depth of irrigation = 4 cm)

Sub plot (Organic amendments and fertilisers)

T_1 - 100 % NPK alone

T_2 - 100 % NPK alone + Farm Yard Manure (FYM)

T_3 - 100 % NPK alone + Coir Pith (CP)

T_4 - 100 % NPK alone + Composted Coir Pith (CCP)

T_5 - 125 % NPK alone

T_6 - 125 % NPK alone + FYM

T_7 - 125 % NPK alone + CP

T_8 - 125 % NPK alone + CCP

T_9 - 150 % NPK alone

T_{10} - 150 % NPK alone + FYM

T_{11} - 150 % NPK alone + CP

T_{12} - 150 % NPK alone + CCP

The recommended dose of fertilisers viz., 17-34-54 kg NPK ha^{-1} was taken as 100% dose. All the organic amendments were applied at the rate of 12.5 t ha^{-1}.

The experimental field was ploughed twice, harrowed, levelled, and individual plots were formed. Within each plot ridges and furrows were formed at 60 cm spacing. Amendments were applied and incorporated well before forming ridges and furrows. FYM and coir pith were obtained locally and composted coir pith was prepared adopting the methodology given by Nagarajan *et al.*, (1987). FYM, coir pith and composted coir pith were analysed for their nutrient contents and the results are presented in Table 1.

The recommended dose of NPK were applied in the form of urea (46% N), single superphosphate (16% P_2O_5) and muriate of potash (60% K_2O) basally at the time of sowing. VRI 2 seeds were sown on both sides of the ridges at 10 cm plant to plant spacing, so that a constant population of 33 plants m^{-1} was maintained in all the plots. Irrigation was given to all the plots immediately after sowing and life irrigation was given on the third day after sowing. Subsequent irrigations were given as per the treatments.

Table 1. Chemical analysis of organic manures (Moisture free basis)

Particulars	Farm yard manure	Raw coir pith	Composted coir pith
N content (%)	0.55	0.26	0.97
P content (%)	0.30	0.03	0.06
K content (%)	0.60	0.78	1.00
Organic carbon (%)	12.80	29.00	25.10
pH (1:2 water extract)	7.50	6.50	6.70
EC (dSm^{-1})	0.30	0.40	0.38

Chemicals Analysis

a. Plant Analysis

The plants collected for dry matter estimation were analyzed for the total N, P and K contents.

i) Nitrogen (N) uptake

The N content was estimated using micro kjeldahl method (Humphries, 1956).

ii) Phosphorus (P) uptake

The total P content was estimated by triple acid wet digestion method (Jackson, 1973) using photoelectric calorimeter.

iii) Potassium (K) uptake

The K content was estimated using triple acid wet digestion method suggested by Piper (1966) using flame photometer.

b. Soil Nutrient Analysis

Composite soil samples at pre-sowing stage and at harvest stage collected upto 30 cm depth.

i) Soil available nitrogen (N)

Available soil N was estimated by the method described by Iruthayaraj *et al.*, (1972).

ii) Soil available phosphorus (P)

This was determined as described by Olsen *et al.*, (1954).

iii) Soil available potassium (K)

Neutral normal ammonium acetate method was adopted using flame photometer (Stanford and English. (1949).

C. Soil Organic Carbon

Organic carbon was estimated by the method described by Walkley and Black (1934).

The experimental data were statistically analysed and presented in Table 2.

RESULTS AND DISCUSSION

Nutrient (N,P,K) Uptake

During 1994 and 1995 irrigation level of 0.75 IW/CPE (I_2) registered higher uptake of N,P and K compared to 0.60 IW/CPE (I_1). This might be due to the favourable soil water content which increased the solubility of nutrients (Russel and Barbar, 1960) and availability of nutrients through mass flow, diffusion and root interception. Increased nutrient uptake in higher irrigation

Table 2. Effect of treatments on nutrient uptake and soil nutrient status

Treat ments	N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		K uptake (kg ha^{-1})		Soil available nitrogen (kg ha^{-1})		Soil available phosphorus (kg ha^{-1})		Soil available potassium (kg ha^{-1})		Soil available carbon (per cent)	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
I_1	157.9	158.3	27.6	28.0	78.0	78.8	218.2	204.9	11.8	11.8	227.5	224.6	0.45	0.44
I_2	164.3	164.3	28.8	29.2	80.9	81.9	221.5	208.4	12.2	12.2	229.7	226.9	0.44	0.44
SE_m	0.81	0.78	0.16	0.23	0.38	0.29	0.51	0.20	0.06	0.07	0.50	0.73	0.001	0.002
CD	3.48	3.36	0.69	0.97	1.63	1.26	2.21	0.87	0.26	0.31	2.15	NS	NS	NS
T_1	144.9	146.0	24.0	23.3	70.8	71.2	202.0	192.9	10.5	10.5	219.2	215.8	0.41	0.41
T_2	160.6	160.5	27.9	28.0	78.9	79.9	224.0	211.3	11.8	12.0	224.2	220.8	0.45	0.45
T_3	158.9	160.2	27.6	28.0	78.9	80.3	221.2	208.8	11.7	11.7	226.7	223.3	0.46	0.45
T_4	162.7	161.6	27.8	28.7	79.7	80.4	223.0	210.0	12.0	11.7	227.5	224.2	0.45	0.45
T_5	151.5	150.4	26.3	26.4	74.5	75.0	204.9	195.0	11.3	11.3	223.3	220.0	0.41	0.41
T_6	165.7	165.0	29.4	29.4	82.0	82.4	225.0	213.4	12.3	12.3	229.2	225.8	0.46	0.46
T_7	164.6	165.3	29.7	29.4	81.5	82.9	223.5	212.0	12.0	12.1	233.3	229.2	0.46	0.46
T_8	165.7	166.8	29.5	30.1	82.0	83.0	224.9	212.8	12.2	21.2	233.3	230.0	0.46	0.46
T_9	154.6	153.0	26.4	27.4	75.5	76.0	207.7	198.4	12.3	12.3	226.7	225.0	0.41	0.41
T_{10}	168.3	168.7	30.2	30.7	83.6	84.2	227.5	215.2	12.9	12.9	231.7	230.0	0.46	0.46
T_{11}	167.2	168.9	29.7	30.9	82.8	84.6	227.0	214.2	12.8	12.8	234.2	232.5	0.46	0.46
T_{12}	168.2	169.3	30.2	30.7	83.5	84.8	227.2	215.5	12.8	12.6	234.2	232.5	0.46	0.46
SE_T	1.62	1.11	0.74	0.94	0.54	0.55	1.96	1.27	0.15	0.16	1.42	1.41	0.004	0.003
CD (P=0.05)	2.67	2.24	1.49	1.90	1.09	1.10	3.95	2.55	0.31	0.32	2.86	2.83	0.008	0.006

I_1 - Irrigation at IW/CPE ratio of 0.60
T_1 - 100% NPK alone
T_2 - 100% NPK + Farm Yard Manure (FYM)
T_3 - 100% NPK + Coir Pith (CP)
T_4 - 100% NPK + Composted Coir Pith (CCP)
T_5 - 125% NPK alone
T_6 - 125% NPK + FYM

I_2 - Irrigation at IW/CPE ratio of 0.75
T_7 - 125% NPK + CP
T_8 - 125% NPK + CCP
T_9 - 150% NPK alone
T_{10} - 150% NPK + FYM
T_{11} - 150% NPK + CP
T_{12} - 150% NPK + CCP

regimes was reported by Rangaraj (1991) in groundnut.

Uptake of major nutrients increased with higher levels of fertiliser application and organic amendments application. Similar results were reported by Sammi Reddy *et al.*, (1992). Nutrient uptake was significantly lower when inorganic fertilizers alone were applied (T_1, T_5 and T_9) compared to combined application of organic amendments along with inorganic fertilisers. Nutrient uptake did not differ significantly among farm yard manure, coir pith and composted coir pith. Higher uptake was recorded at 150% NPK + organic amendments, followed by 125% NPK + organic amendments. Application of organic amendments improved plant growth and accumulation of greater biomass which led to increased uptake. Higher uptake of nutrients in organic amendments applied plots might also be due to greater availability of nutrients contributed by the organic amendments. Added organic matter in the soil not only acted as a source of nutrients, but also influenced their availability (Flaig, 1982).

Soil Available Nutrients

Higher values of soil available nitrogen, phosphorus and potassium were recorded at IW/CPE 0.75 (I_2) compared to IW/CPE 0.60. Under high moisture regime, the mineralization of nutrients might have been positively increased resulting in higher soil available nutrients.

Soil available nutrients were higher at higher level of fertilisation and organic amendments application. Available N content of the soil was found to increase with the application of organic manure (Venkateswar Rao, 1985). Ramaswami and Kothandaraman (1985) have also reported that coir pith application increased the build up of soil nitrogen. Addition of organic manure increased the soil available P and exchangeable K (Singh *et al.*, 1990).

Soil Organic Carbon

Irrigation regimes and fertilizer levels did not influence the soil organic carbon content.

Organic carbon content was higher with the application of organic amendments. Gupta *et al.*, (1992) reported similar findings. As these sources are of high carbon containing materials, their addition resulted in higher organic carbon content in the soil.

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HETEROSIS FOR YIELD AND ITS COMPONENTS OVER ENVIRONMENTS IN CASTOR (*Ricinus communis* L.)**

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ABSTRACT

Investigation with 19 parents (4 cent per cent pistillate lines and 15 inbreds) and their 60 hybrids of castor produced through L x T was taken up over four environments (two seasons and two locations) to determine the extent of heterosis for seed yield and seven related traits and to identify the best heterotic crosses for commercial cultivation. The relative heterosis, heterobeltiosis and standard heterosis for seed yield per plant over environments ranged from 1.23 to 148.76, -9.29 to 118.93 and -23.94 to 84.75 per cent respectively. The hybrids LRES 17 x RC 1226, 240 X USSR 2 and JP 65 X JH 120 exhibited maximum seed yield (183.2 g, 162.7 g and 158.7 g per plant respectively) with maximum heterosis. The heterosis for seed yield appeared to be due to high manifestation of heterosis for length of primary raceme, racemes per plant, capsules per plant and 100 seed weight. Selection of crosses on the basis of per se performance with considerable per cent of heterosis would be more desirable.

KEY WORDS : Castor, *Ricinus communis*, Heterosis, Environment

Castor being a cross pollinated crop endowed with the pistillate mechanism, has lent itself amenable for crop improvement through heterosis breeding. This had led to the evolution of quite a few commercial castor hybrids that are popular among the farmers. The degree of expression of exploitable heterosis for seed yield and homogeneity as well as stability of resulting F1 hybrids are factors contributing to the evaluation of commercial hybrids in castor. Hence the present study was undertaken to study the extent of heterosis for yield and related traits and to identify the best heterotic cross for commercial exploitation. Singh and Narayanan (1995) opined that in order to obtain accurate results the crosses have to be evaluated over multilocation for two or three years. Hence, the study was taken up under two locations and two seasons.

MATERIALS AND METHODS

The materials consisted of four cent percent pistillate lines and 15 inbreds of castor and their 60 hybrids produced in line x tester mating design. The parents and their hybrids were evaluated in RBD with three replications at two locations, viz., Oilseeds Research Station, Tindivanam (11.°46 N,

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