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NODULATION AND NITROGEN FIXATION IN SOME IMPROVED VARIETIES OF GROUNDNUT (Arachis hypogaea.L.)

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ABSTRACT

Important commercially cultivated varieties representing three habit groups of groundnut were evaluated during rainy season for plant growth, nodulation and nitrogen fixation. Varieties of virginia runner, virginia bunch (spp. **hypogaea** var. **hypogaea**) were found to be superior bunch (spp. **festigiate** var. **vulgaria**) and valencia (spp. **fastigiata** var. **fastigiata**) in all the parameters studied. An early bunch variety, JL 24 among the spanish varieties, M 145 and TMV 10 of virginia bunch and S 230, M 37 and GAUG 10 of virgina runner were found to have higher nitrogen fixation and plant growth. Significant and positive relationship was observed between nitrogen fixation traits, plant biomass and leaf area. No correlation between the nitrogen fixation traits and pod yield was evidenced. However, the study indicated that JL 24, M 145 and GAUG 10 were found to have higher yield potential besides good nitrogen fixation.

Realizing the increasing demand of vegetable oil in the country nearly 40 improved groundnut varieties have been released for commercial cultivation (from 1969 to 1984) by the Indian Council of Agricultural Research and State Agricultural Universities (Reddy, 1985). All the varieties are fairly well adopted to the local conditions of major groundnut production areas and carry many desired traits like higher yield potentials, disease resistance or tolerance besides good market acceptability. All the cultivated groundnuts, have been classified into three major groups as ssp. **hypogaea** var. **hypogaea** (virginia runner; VR and Virginia bunch; VB); spp. **fastigiata** var. **fastigiata** (valencia; VA) and ssp. **fastigiata** var. **vulgaris** (spanish; SB). Although difference between the growth habit groups in groundnut is well known; systematic evaluation of major groundnut varieties has not been done except a general study done by Bhagat *et al.* (1985), which comprised of many quantitative and qualititative attributes including nodulation. However, no detailed study on nodulation, nitrogen fixation and its relation to growth and yield has been made so far. Therefore, an attempt was made to study the performance of some improved varieties of groundnut, released till 1984, for growth nodulation and nitrogen fixation under field condition.

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MATERIALS AND METHODS

The experiment was conducted on a medium black calcarious soil (pH 8.2, Total N 0.03% and Organic Matter 0.6%) for two years during the rainy season (June to Nov. of 1985 and 1986). There were 25 and 34 varietal entries during 1985 and 1986 respectively. The varieties were planted in a randomised block design with each entry comprising three rows of two metre length at an uniform spacing of 60 x 10cm. There were three replications in each variety. The basal dose of N and P_2O_5 @ 12.5 Kg/h were applied as urea and super-phosphate, respectively. No inoculation with **Rhizobium** was done as native **Rhizobium** were enough to incite normal nodulation. Moreover, response of groundnut to **Rhizobium** inoculation is also observed to be variable (Kulkarni *et al.* 1984). The crop was grown entirely under rainfed situation though there was no adequate and well distributed rainfall during both the years.

Ten plants from each treatment were sampled at 45 and 70 days after sowing and recorded plant growth, nodulation and acetylene reduction assay. The acetylene reduction assay was carried out as described by Dart *et al.* (1972). Nitrogen content of the shoot was established by Micro-Kjeldahl method using auto analyser 'Kjeltec 1030'. Data on plant biomass and leaf area (Wynne *et al.* 1982) were also recorded at both stages of crop growth. Acetylene reduction and leaf area were recorded only during the year, 1986. At maturity 10 plants from each entry were harvested and pod yield was recorded after sun drying.

Statistical analysis of the data (mean of observations on 45 and 70 days growth) were performed, to compare the varieties for plant growth, nodulation, nitrogen fixation and pod yield; and to determine the extent of their relationship, following standard procedure.

RESULTS AND DISCUSSION

Large variation in nodulation, nitrogen fixation and other growth traits of groundnut was observed between three morphologically distinct habit groups and also within the habit groups. Varieties of ssp. **hypogaea** var. **hypogaea** (virginia) were found to possess higher mean values for nitrogen fixation traits (Table 1) compared with ssp. **fastigiata** var. **fastiqiata** and var. **vulgaris** (valencia and spanish, respectively). Within the virginia group again virginia runner (spreading) varieties possessed higher values for nitrogen fixation traits. The above observations support the earlier reports by Wynne *et al.* (1982, Nambiar *et al.* (1982). According to Kulkarni *et al.* (1988), such differences among the habit groups was due to sustained leaf area duration and leaf area index. Similarly, in the present study it was observed that leaf area of virginia types was found to be almost double than the spanish and valencia types besides possessing dark, green leaves. Thus, it is evident that varieties which produce more active photo-synthetic area are able to nodulate well presumably due to availability of adequate photosynthates. Nitrogen uptake and plant biomass were

TABLE 1. Mean values for growth, nodulation, nitrogen fixation and yield in different habit groups of groundnut

Growth habit	Nodule		N_2 fixation*	Plant dry weight (g/pl.)	N-uptake (mg/pl.)	Leaf area (cm^2)	Pod Yield (g/pl.)
	Number	Weight (mg/pl.)					
Spanish	59	44	6.0	7.2	203	497	4.2
Valencia	53	34	3.0	5.6	160	417	3.9
Virginia bunch	82	69	6.4	10.0	304	940	5.7
Virginia Runner	130	89	9.0	11.3	331	1005	9.5
C.B.	23	22	2.1	3.4	91	391	3.2

* moles of ethylene/plant/hr.

also significantly higher in virginia bunch and runner than the valencia and spanish groups.

Though there was distinct differences in mean values for nodulation and nitrogen fixation among the habit groups certain varieties within the group exhibited a good capacity to bear nodules or fix fairly good amount of nitrogen.

Among the spanish group, JL 24, an early high yielding variety released during 1982 from Jalgaon (Maharashtra) possessed higher nodulation, nodule dry mass, N-uptake during both the years (viz., 1985 and 1986) and also higher nitrogen fixation during 1986 (Table 2). Plant biomass and nitrogen uptake in this variety were fairly high, though a few varieties were superior to it. As a result of better growth, coupled with higher nitrogen fixation this variety could also produce relatively higher pod yield among the spanish varieties except Kisan and Co1 in 1985 and S 206 in 1986. Variety JL 24 has also been reported to respond well to **Rhizobium** inoculation as compared with J 11 and GAUG 1 (Joshi and Kulkarani, 1984). Other spanish varieties viz. GAUG 1, TMV 2, TMV 9 and Co 1 although not consistent were found to be promising with respect of nodulation and nitrogen fixation. Among the less known valencia types Gangapuri was found to be superior to MH 2. However, nitrogen fixation traits of this group was low as compared with spanish group.

Superiority of M 145 and TMV 10 among the virginia bunch varieties (Table 3) was evident with respect of nodulation, nitrogen fixation, plant biomass. N - uptake in M 145 was higher during 1985 while during 1986 it was lower than Kadiri 3, RSB 87 and TG 1 varieties, but its nitrogen fixation was highest among all the virginia bunch varieties. The results indicated that major portion of nitrogen in M 145 was perhaps derived from N2 fixation. TMV 10, a high oil yielding variety with 55% oil (Sreedharan et al., 1972) was found to

TABLE 2 : Growth, nodulation, nitrogen fixation and pod yield of spanish and valencia groundnuts

Variety	1985					1986						
	Nodule		Plant dry weight (g/pl.)	N-uptake (mg/pl.)	Pod yield (g/pl.)	Nodule		Plant dry weight (g/pl.)	N-uptake (mg/pl.)	Nitrogen fixation*	Leaf area (cm^2	Pod yield (g/pl.)
	Number	weight (mg/pl.)				Number	Weight (mg/pl.)					
Spanish												
AK 12-24	30	19	4.6	120	3.7	106	87	11.7	325	5.8	623	5.8
Co 1	13	9	4.6	102	5.1	86	79	7.6	229	6.7	514	5.3
Co 2	15	9	5.1	118	3.9	73	54	5.5	146	5.6	409	7.7
Dh 3-30	34	21	3.7	114	3.3	84	54	12.9	330	4.6	557	6.9
GAUG 1	29	21	5.1	140	3.1	86	62	10.1	292	8.1	390	6.3
GG 2	24	30	5.1	133	3.9	50	45	7.3	200	6.5	547	
J 11	35	27	5.1	145	3.9	110	57	13.1	396	4.3	581	6.6
Jawan	-	-	-	-	-	67	82	6.5	169	3.0	473	6.3
JL 24	57	37	5.1	165	4.2	114	91	11.8	365	9.9	644	8.8
Jyoti	41	23	5.1	125	3.8	78	53	11.0	357	5.2	532	5.9
Kisan	28	22	4.5	108	5.2	64	86	11.0	340	3.9	623	5.4
KRG 1	25	16	5.7	164	3.8	95	72	7.7	200	6.6	526	6.7
S 206	31	16	5.0	123	3.8	112	77	7.8	196	5.7	588	9.2
SB XI	33	23	4.8	118	3.8	-	-	-	-	-	-	-
TMV 2	34	24	5.7	159	3.5	108	63	7.7	231	7.2	475	6.5
TMV 7	23	14	3.9	142	3.3	76	56	9.3	239	4.6	492	5.4
TMV 9	-	-	-	-	-	71	82	9.1	310	7.2	-	-
TMV 12	23	9	3.8	105	3.2	106	54	10.1	306	6.1	494	7.1
Valencia Gangapuri	38	26	5.1	105	3.3	93	55	8.0	230	4.1	526	4.7
MH 2	24	12	3.9	121	2.6	55	44	4.1	136	0.8	309	3.8
CD (5%)	11	7	2.1	53	NS	18	16	2.4	81	3.4	96	NS

* Data presented are mean of two observations at 45 and 75 days after sowing. More moles of ethylenes/plant/hr.

be superior in all respect except its poor yield. In our previous studies also variety TMV 10 was capable of possessing good nodulation and nitrogen fixation as result of higher leaf area and good root biomas (Kulkarani and Ravindra, 1987).

The virginia runner varieties by the virtue of good phtosynthetic activity as evidenced by their higher leaf area and dark green foliage (Table 3) were able to support good nitrogen fixation except in varieties RS 1 and Chitra. During both the years of testing variety S 230 was found to be superior however, during 1986, variety M 37 showed a high amount of nitrogen fixation. Though it possessed less-nodules/plant the nodule mass was higher perhaps due to bigger nodule size. Variety GAUG-10, a popular spreading variety among the farmers in Saurashtra region was fairly good in terms of N-uptake, plant biomass and pod yield. Nodulation and nitrogen fixation in this variety were next best to M 37 and S-230, yet begin a locally adapted variety the pod yield was much superior to all the other varieties.

Correlation coefficients of various plant parameters of the data (1986) indicated that there was a significant positive correlation between nitrogen fixation with plant biomass and leaf area (Table 4). N-uptake was significantly correlated with nodule number, nodule weight, acetylene reduction activity and plant biomass. Both these correlations indicated that, groundnut being a legume is able to meet its major nitrogen requirement through symbiosis and while doing so depends on photosynthates. These results however, are not surprising as previous studies in legumes have indicated a close relationship between N2 fixation and photosynthesis (Wynne et al., 1982).

Comparison of data (Table 2 and 3) between two years with respect of nodulation, plant biomass and pod yield indicated that the values of the year 1985 rainy season were drastically lower than the year 1986. This was perhaps due to prolonged water stress in 1985 as compared with that of 1986. Though crop suffered due to water stress in 1986 was not severe on nodulation and nitrogen fixation as it occurred at the later stage of the crop which perhaps affected pod filling. Kulkarni et al. (1988 a and b) observed that nitrogen fixation in groundnut was sensitive to water stress during flowering and pod formation stages when the N2-fixation is supposed to be highest.

The relationship between N2 - fixation and pod yield, plant biomass and pod yield although were positive but non-significant (Table 4). These results indicated that yield and nitrogen fixation traits are independent characters and therefore, it may be feasible to combine varieties with high N2 - fixation ability and pod yield. Simultaneous selection for nitrogen fixation and yield characters seem to be a viable breeding technique. Such selection among the commercial varieties, in the present investigation resulted in identification of JL 24 (spanish), M 145 (virginia bunch) and GAUG 10 (virginia runner). However, resorting to the study of nitrogen

TABLE 3. Growth nodulation, nitrogen fixation and pod yield of Virgins bunch and runner groundnuts.

Variety	1985					1986						
	Nodule		Plant dry weight (g/pl.)	N-uptake (mg/pl.)	Pod yield (g/pl.)	Nodule		Plant dry weight (mg/pl.)	N-uptake (mg/pl.)	N_2 fixation	Leaf area (cm^2	Pod yield (g/pl.)
	Number	Weight (mg/pl.)				Number	Weight (mg/pl.)					
Virginia Bunch												
BG 2	-	-	-	-	-	77	64	8.4	277	6.1	1019	7.5
Kadiri 2	-	-	-	-	-	92	62	9.4	287	7.8	927	-
Kadiri 3	40	22	7.7	240	5.2	100	90	12.9	397	7.6	947	7.2
Kopergaon 1	-	-	-	-	-	101	82	9.1	234	6.5	830	4.8
M 145	76	42	8.5	248	7.2	136	83	11.5	311	10.3	871	9.3
RSB 87	-	-	-	-	-	73	61	10.0	341	4.7	854	6.4
TG 1	22	20	5.2	143	3.4	115	90	10.4	322	3.3	983	-
TMV 10	61	47	10.4	319	5.7	148	144	15.5	387	8.7	1025	5.7
Virginia runner Chitra	-	-	-	-	-	124	99	8.9	313	5.0	987	10.4
GAUG 10	84	50	11.4	319	13.4	156	149	12.6	356	9.7	1103	13.5
M 13	127	47	10.9	320	11.0	138	69	5.5	305	7.0	971	7.2
M 37	-	-	-	-	-	146	152	13.3	289	13.8	1050	7.9
Punjap 1	89	50	11.5	370	9.5	116	132	10.5	327	8.5	1064	10.4
RS 1	-	-	-	-	-	127	95	12.7	95	12.7	384	3.8
RS 138	-	-	-	-	-	160	76	9.6	292	8.9	958	6.2
S 230	163	67	14.4	424	11.2	175	145	13.3	378	12.9	1090	10.2
CD (5%)	15	20	2.9	56	4.4	32	14	4.2	91	4.1	78	5.7

Data presented are mean of two observations at 45 and 75 days after sowing

* r moles of ethylene/plant/hr.

TABLE 4. Crrelation co-efficients (r) between nodulation, nitrogen fixation, plant biomass, leaf area and pod yield in groundnut

	Nodule Dry wt.	A.R. activity	Plant biomas	N-Uptake	Pod Yield	Leaf area
Nodule Number	0.769*	0.661	0.179 NS	0.494	0.17BNS	0.595*
Nodule Dry weight		0.666*	0.660	0.508*	0.146NS	0.450*
A.R. Activity			0.486*	0.328	0.112NS	0.393*
Plant Biomas				0.899*	0.237NS	0.532*
N-uptake					0.036 NS	0.279 NS

* Means-significant at 5% level of significance NS - not significant

fixation characters across the seasons and locations for stability will further strengthen our knowledge on the symbiotic association and environmental interaction.

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EFEECTS OF FERTILIZER AND SPACING ON SEED YIELD AND QUALITY IN SNAKEGOURD cv.PKM.1

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ABSTRACT

An experiment was conducted to find out optimum fertilizer and spacing requirements for the seed crop of snakegourd cv.PKM.1. The three fertilizer treatments were : 6:12:6, 9:15:9 and 12:24:12 g of the NPK/pit and three spacings were : 2 x 2.5m, 3 x 1m and 4 x 0.6m. The results revealed that application of 12:24:12g. of NPK/pit and sowing at a spacing of 2 x 2.5m were optimum for getting higher seed yield (119.87g/pl.). The treatments also recorded high recovery of large size seeds (61.5%), high, 100-seed weight (32.095g), germination (98%), root length (18.6 cm), shoot length (39.6 cm) and vigour index (5692).

Cucurbits are an important group of vegetable crops cultivated extensively in this country. Of these, snake gourd is a popular vegetable particularly in

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