Comparative studies on the chlorophyll content, growth, N uptake and yield of groundnut varieties of different habit groups

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Abstract. — The field experiments conducted on the comparative physiological studies of the erect (Spanish) and runner (Virginia) habit group groundnut varieties showed that, the runner cultivars showed higher chlorophyll contents in leaves, showed higher crop growth, produced more leaf, stem and nodule biomass, gave higher pod and haulm yield and accumulated more nitrogen in different parts of plant, than that of erect type groundnut varieties. The chlorophyll content in leaves was lowest at 4 weeks after emergence (WAE) which increased to highest at 8 WAE. Similarly the crop growth rate was low till 6 WAE, which increased sharply afterward and was maximum in between 7-13 WAE. The groundnut crop showed highest dry matter accumulation in their leaves and stems at 14 and 15 WAE, during dry season and 11 and 12 WAE during wet season, in erect and runner varieties, respectively. The root nodulation started after 3 WAE and showed its maximum biomass at 11 and 12 WAE during dry season and 9 and 10 WAE during wet season in erect and runner varieties, respectively. The N uptake by leaves and stems however was maximum at 13 and 10 WAE during dry and wet seasons, respectively. Among the erect type JL 24 and GG 2 and among the runners GAUG 10 showed more chlorophyll contents in their leaves, produced higher biomass in leaf, stem, root and nodule, showed higher pod and haulm yields and N uptake than other varieties. The dry season crop took more time for its maturity, accumulated more nitrogen and produced higher pod and haulm yields than wet season crop. The crop growth rate ($g/m^2/day$) of groundnut varieties from 7-13 WAE, however, was more during wet season than that during dry season, but, the cumulative per day dry matter production ($g/m^2/day$) in groundnut was similar during both the seasons.

Key words. — Groundnut, erect and runner, chlorophyll, crop growth rate, dry matter production, nodulation, nitrogen uptake, yields

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important grain legume crop of the world. In India, it is grown in about 8 m ha of land and accounts for more than 50% of total oil seed production of the country. There are nearly 80 released groundnut varieties of different habit groups in India for their general cultivation with pod yield varying from 1 to 3.0 t/ha (Basu and Reddy, 1987, Personal Communication, P.C.). But the cultivation of most of these varieties is localised to certain areas. The process of photosynthesis and the subsequent partitioning of its products are the most crucial to the yield potential of this crop. However, there is a stark contrast that humankind has not improved on nature with respect to photosynthesis but has profoundly changed the partitioning of assimilates in crop plants in the course of their domestication and improvement (Evan, 1983). The groundnut has the potential for high yield. (Dwivedi *et al.*, 1985). The photosynthetic sink is adequate for an increase in yield of nearly 50% to a total yield realised (Mc Cloud, 1973). Moreover, in the groundnut the nitrogen fixation is related to photosynthesis (Nambiar and Dart, 1980).

The growth, N uptake and yield of current groundnut cultivars has not been adequately evaluated in comparative experiment. The objective of this field experiment was to compare the growth of leaf, stem, root and nodule, uptake and distribution of nitrogen in different plant parts and yields of Virginia (runner) and Spanish (erect) cultivars and their seasonal performances.

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MATERIALS AND METHODS

Field experiment was conducted at the Research Farm of the National Research Centre for Groundnut, Junagadh, India during dry and wet seasons of 1985. The soil of the experimental field was clayey (30% sand, and 43% clay), medium black calcareous (15% $CaCO_3$) with 0.65% organic carbon, 0.60% total nitrogen, 5 ppm available phosphorus, 7.5 pH and 0.31 EC (mmh). The experiment was laid out in a randomised-block-design with 6 replications (3 for samplying during the crop growth period and 3 for recording yield data).

Eight groundnut varieties being cultivated in various parts of the country belonging to two habit groups i.e. erect (Spanish bunch) and Virginia runner (Spreading) were grown in the field at 30 × 10 and 60 × 10 cm spacings respectively. The groundnut varieties GAUG 1(V1), Kisan (V2), TMV 2(V3), JL 24(V4) and GG 2(V5) were erect type and Robut 33-1(V6), Punjab 1(V7) and GAUG 10(V8) were runner type.

The field was prepared, levelled and 10 cm deep furrows were opened at 30 cm spacing. The field was then divided into 48 small plots of 35 m^2 (7 × 5 m^2) by raising bunds. The single superphosphate at 40 kg P_2O_5/ha, muriate and potash at 40 kg K_2O/ha and urea at 20 kg N/ha was applied in the field as basal. The erect and runner groundnut varieties were sown in the furrows spaced at 30 and 60 cm distance, respectively at a space of 10 cm. During dry season the sowing was done on 2nd February which germinated on 11th February and during wet season the sowing and germination was on 1st and 8th July respectively. The harvesting of these crops were attended on 10th and 17th June during dry season and 21st and 28th October during wet season for erect and runner

varieties, respectively. The field was irrigated with water after sowing and at 10 days intervals during dry season. During wet season since the rain was not distributed properly during cropping seasons (Fig. 1) protective irrigations were given whenever required.

The crop was protected from weed, insect pest and diseases during the cropping seasons. The meteorological data were recorded (Fig. 1).

The groundnut plants of 1 m^2 area were sampled at weekly intervals from the date of germination. A 20 cm gap within the row and 30 cm from row to row was left as border during each sampling. The plants were digged from 30 cm depth, washed, separated into leaf, stem, roots and nodules, dried in an oven at 40 °C for seven days and weighed. The chlorophyll a, b and the total chlorophyll content of the leaves were measured at 1, 4, 8 and 12 (WAE) by Arnon (1949) method. The weekly crop growth rate (g/m^2/day) was calculated by the formula:

$$CGR = \frac{W_2 - W_1}{T_2 - T_1}$$

where W_1 and W_2 are the total dry matter of 1 m^2 area at T_1 and T_2 times. The cumulative dry matter production rate (g/m^2/day) was calculated by dividing the total biomass of an unit area by total days to maturity.

After maturity the groundnut crop was harvested leaving border row, dried in sun for 7 days and pod and haulm yields were determined. The samples of 1 m^2 area were harvested separately and the pod number, pod and haulm weight, total dry matter and nodule weight was determined.

The dry plant samples were ground in an electric Wiley mill passing through 0.25 mm sieve and analysed for total nitrogen by Kjeltec Auto Analyser. The N accumulation (uptake) in the various parts of the groundnut was calculated by multiplying their dry matters to the per cent nitrogen. All these data were analysed statistically.

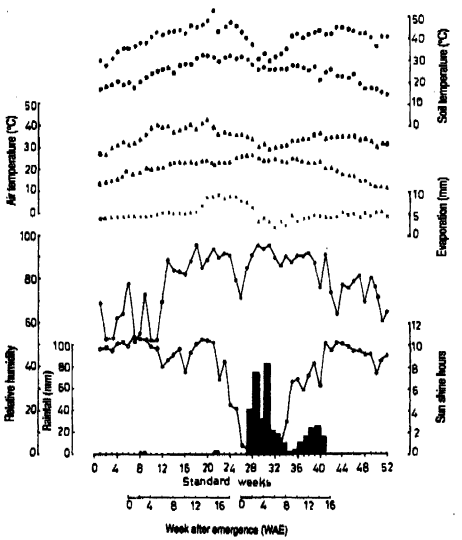

FIG. 1. — Weekly record of meteorological data showing rainfall (▮) in mm, sunshine hours (O ——— O) relative humidity (●——— ●) evaporation (X X) in mm, minimum (△△△) and maximum (▲ ▲ ▲) temperature of air and minimum (O O O O O) and maximum (● ● ● ● ●) temperature of soil at 5 cm depth

RESULTS

Chlorophyll content

The chlorophyll a, b and total chlorophyll contents of groundnut leaves were more at one week after emergence (WAE) of seedling which decreased afterward and was lowest at 4 WAE. The increase in the chlorophyll content of leaves after 4 WAE was noticed and reached to a maximum at 8 WAE and retained similar amount till 12 WAE. In general, the runner cultivars (GAUG 10 and Punjab-1) showed dark green leaves containing higher chlorophyll than the erect types (Fig. 2 and table I). Among the erect type GG 2 showed highest chlorophyll content at 8 WAE and GAUG 1 lowest chlorophyll at 4 WAE. The chla was higher than chlb and accounted for 2/3rd of the total chlorophyll content. The chlorophyll of both runner and erect type groundnut was higher during dry season than that during wet season (Table I, Fig. 2).

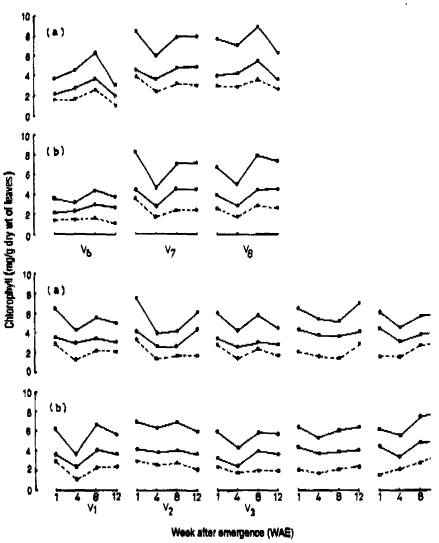

FIG. 2. — Leaf chla (O———O), chlb (O------O) and total chlorophyll (●———●) contents (mg/g dry wt. of leaves) of different groundnut varieties at 1,4,8 and 12 WAE (week after emergence of seedling during dry (a) and wet (b) season. The V1, V2.....V8 are the respective groundnut varieties as mentioned in the materials and methods

Crop growth rate and dry matter production

The varietal differences in the crop growth rates and dry biomass of leaves, stems and roots recorded at weekly intervals were observed during both the seasons. Among the erect type JL 24 showed highest dry matter accumulation in their leaves up to 14 and 11 WAE during dry and wet seasons, and highest dry matter in stem up to 15 WAE during dry season and throughout the crop period during wet season. The variety GG 2 showed lowest dry matter in both leaves and stems till 10 to 7 WAE, during dry and wet seasons, but the accumulation increased afterward and showed highest dry matter in leaves at 15 and 14 WAE during those seasons and in stem at 16 WAE during dry season. Among the spreading GAUG 10 showed highest and Robut 33-1 showed lowest dry matter in their both leaves and stems during the entire crop period in both the seasons. The varieties GAUG 1,

Kisan and TMV 2 showed higher dry matter accumulation than GG 2 in the early stages of crop growth, but lesser during the later part of their growth period. The dry matter accumulation in the leaves and stems of both erect and runner groundnut varieties increased with the growth stages and was highest at 14 and 15 WAE, respectively during dry season and 11 and 12 WAE during wet season. In general, most of the plant contained maximum foliage in between 14 to 15 WAE during dry season and 11 to 12 WAE, during wet season though slight variation occured. The total dry matter accumulated in the leaves and stems at maximum foliage (MF) was higher than at harvest (Table II). Among the erect types JL 24 showed highest dry matter in their leaves and stems at MF and total dry matter production at harvest during both the seasons, and among runner GAUG 10 showed highest leaves and stem weight and total dry matter, both at MF and also at harvest during both the seasons (Table II).

The crop growth rates (CGR) of groundnut varieties were very slow till 6 WAE but increased sharply afterwards. The peak growth of groundnut was noticed in between 7 to 13 WAE (Table III). During dry season GAUG 1, Kisan and TMV 2 showed their highest CGR at 10 WAE and JL 24, GG 2, Robut 33-1, Punjab 1 and GAUG 10 showed their highest CGR at 9 WAE. However, during wet season all these varieties showed their highest CGR at 9 WAE. Except TMV 2 which showed highest CGR at 8 WAE (Table III). It was

TABLE I. — Leaf chlorophyll contents (mg/g dry wt. of leaves) of different groundnut varieties at 8 WAE (Week after emergence of seedlings)

Groundnut varieties	Dry 1985			Wet 1985		
	Chla.	Chlb.	Total ± SE	Chla.	Chlb.	Total ± SE
GAUG 1	4.2	2.4	6.6 ± 0.2	3.4	2.2	5.6 ± 0.3
Kisan	4.0	2.8	6.8 ± 0.3	2.6	1.6	4.2 ± 0.2
TMV 2	3.9	2.0	5.9 ± 0.3	3.1	2.5	5.6 ± 0.3
JL 24	4.0	2.2	6.2 ± 0.2	3.6	1.6	5.2 ± 0.4
GG 2	4.8	2.8	7.6 ± 0.2	3.8	2.8	6.6 ± 0.3
Robut 33-1	3.8	2.6	6.4 ± 0.3	3.0	1.6	4.6 ± 0.3
Punjab 1	4.8	3.2	8.0 ± 0.2	4.6	2.4	7.0 ± 0.3
GAUG 10	5.4	3.6	9.0 ± 0.3	5.4	2.6	7.0 ± 0.4
Mean	4.4	2.7	7.1	3.6	2.2	5.8

TABLE II. — Dry matter production (g/m^2) by different groundnut varieties at a growth stage having maximum foliage (MF) and at harvest (AH) of crop

Groundnut varieties	Dry season				Wet season			
	Dry wt. of leaf and stem		Total dry matter	Rate of dry matter production	Dry wt. of leaf and stem		Total dry matter	Rate of dry matter production
	MF.	AH	AH	(g/m^2/day)	MF	AH	AH	(g/m^2/day)
GAUG 1	360	270	449	3.77	325	255	402	3.83
Kisan	350	300	413	3.47	310	238	365	3.48
TMV 2	365	320	383	3.22	320	215	330	3.14
JL 24	415	335	471	3.96	345	275	425	4.05
GG 2	400	335	455	3.82	320	270	403	3.84
Robut 33-1	385	300	433	3.44	281	235	396	3.54
Punjab 1	440	330	494	3.92	300	245	435	3.88
GAUG 10	475	360	548	4.35	320	280	460	4.11
S.E.	18.6	14.0	17.7	0.25	11.7	13.1	16.9	0.31

TABLE III. — Crop growth rate (g/m^2/day dry matter production) of different groundnut varieties at weekly intervals

Weeks after emergence	Dry, 1985 Varieties								Wet, 1985 Varieties							
	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8
1.	0.26	0.26	0.30	0.43	0.2	0.28	0.43	0.57	0.14	0.10	0.12	0.43	0.14	0.29	0.29	0.43
2.	0.86	0.86	0.57	0.57	0.61	0.71	0.86	0.86	0.57	0.61	0.64	0.57	0.29	0.57	0.57	0.57
3.	0.92	0.90	0.71	0.86	0.71	0.71	1.00	0.86	0.71	0.71	0.79	0.71	0.43	0.71	0.71	0.57
4.	1.43	1.18	1.14	1.14	1.14	1.14	1.0	1.43	0.86	0.71	0.88	0.86	0.57	0.86	1.00	1.00
5.	1.36	1.71	1.43	1.57	1.29	1.57	1.71	1.73	1.14	0.86	1.00	0.86	0.86	1.10	1.00	1.14
6.	1.36	1.71	1.71	1.71	1.57	1.60	1.81	2.10	1.41	0.86	1.14	1.29	1.14	1.42	1.57	1.57
7.	3.71	2.14	4.00	6.00	3.29	5.29	6.00	6.12	3.40	4.14	5.00	5.29	3.43	3.00	3.89	4.29
8.	7.00	4.20	6.14	10.10	8.57	10.7	10.57	10.71	6.71	10.14	10.47	8.57	3.57	5.00	6.71	8.86
9.	7.57	5.09	8.14	10.50	9.57	10.8	11.00	11.80	11.43	11.86	8.40	13.71	11.86	10.00	11.86	12.86
10.	8.86	8.14	8.29	9.50	8.29	7.57	8.57	8.43	10.71	8.86	5.10	9.71	9.42	8.51	8.61	9.41
11.	5.14	9.00	6.86	4.71	6.43	5.62	6.10	6.71	5.12	5.86	5.00	5.92	8.71	6.81	8.10	8.10
12.	4.80	5.42	4.00	4.57	6.14	4.10	5.00	6.12	5.10	3.57	4.75	5.14	5.86	6.43	6.81	6.10
13.	4.57	4.28	3.83	3.80	4.14	3.67	4.12	5.00	3.90	2.43	3.70	4.80	4.03	6.40	5.13	5.25
14.	4.34	3.42	2.46	3.20	3.86	3.60	4.10	4.83	3.92	2.40	3.10	3.57	4.29	4.42	5.10	5.10
15.	4.30	3.43	1.85	2.96	3.12	3.57	3.42	4.83	3.12	2.30	2.10	2.85	4.20	3.12	4.33	4.12
16.	3.30	3.25	1.50	2.15	2.57	2.43	3.10	3.14						3.13	3.12	3.00
17.	2.80	2.90	1.10	2.14	2.43	2.14	2.12	2.86								
18.						1.01	1.89	2.10								
S.E.	0.51	0.43	0.54	0.62	0.65	0.71	0.68	0.72	0.63	0.58	0.52	0.61	0.72	0.63	0.68	0.75

For details of V_1..... V_8 see materials and methods

interesting to note that the crop growth rate of groundnut varieties from 7-13 WAE was higher during wet season than that during dry season. The root biomass recorded weekly showed that it increased up to a certain period and decreased slightly later on (Fig. 3). The highest root biomass of erect and runner type groundnut was observed at 15 and 16 WAE during dry season and 12 and 14 WAE during wet season. Among the erect type JL 24 and TMV 2 showed higher root biomass than other varieties and among runners GAUG 10 showed highest root biomass during both the seasons. The root biomass of erect type groundnut reached to its highest only one week before harvest during dry season, but during wet seasons, it was highest 3 weeks before harvest. The runner cultivar however, showed their highest biomass in root at 2 weeks before harvest of crop during both the seasons. The groundnut crop during dry season showed higher root biomass than during wet season.

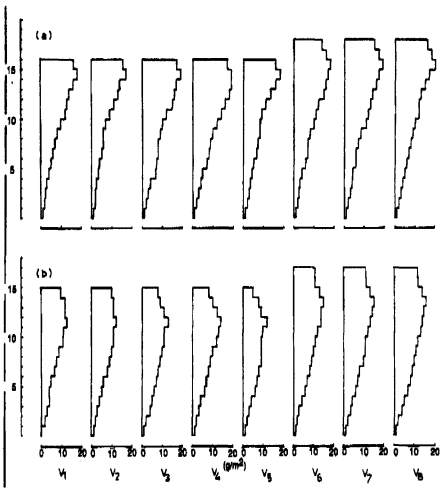

FIG. 3. — Root biomass (g/m²) of groundnut varieties observed at weekly intervals during dry (a) and wet (b) seasons

Nodule weight and nitrogen uptake

The groundnut varieties did not show any nodules on the roots till 3 WAE. The nodulation started in the 4th week of seedling emergence and increased afterwards (Fig. 4). The highest nodule weight was observed at 11 and 12 WAE in erect and runner groundnut, respectively during dry season and 9 and 10 WAE, respectively during wet season. The nodules after attaining highest biomass started decomposing and later on the nodule weight recorded was lower than its highest weight. Among the erect type JL 24 and GG 2 and among runner GAUG 10 showed higher nodule biomass than other varieties at maximum foliage (Table IV and Fig. 4). The nodule weight of groundnut varieties at MF was higher than that at harvest (Table IV). Among the two habit groups the runner showed bigger nodule and more nodule biomass than the erect type groundnut.

The nitrogen uptake by different plant parts showed that leaves accumulated highest amount of nitrogen during the crop growth period, but at harvest it was more in pod (Fig. 5 and 6). The nitrogen accumulation in the leaves and stems increased with the increase in crop growth and was maximum at 13 and 10 WAE during dry and wet seasons, respectively. Later on the nitrogen from the leaves and stems was translocated to pod and the amount declined. The pod initiation in groundnut started 9 and 8 WAE during dry and wet seasons, respectively in erect type and 9 WAE in runner type during both the seasons. Soon after the initiation of kernel

TABLE IV. — **Nodule biomass (dry weight) and nitrogen uptake by groundnut varieties at growth stage having maximum foliage (MF) and at harvest (AH) of crop**

Groundnut varieties	Nodule wt (g/m²)				Nitrogen uptake (kg/ha)			
	Dry		Wet		Dry		Wet	
	MF	AH	MF	AH	MF	AH	MF	AH
GAUG 1	12.1	7.2	11.0	8.0	140	164	98	108
Kisan	11.1	6.0	12.9	7.8	150	158	90	100
TMV 2	12.0	7.0	12.8	6.1	144	150	104	110
JL 24	13.2	6.9	13.0	7.1	165	170	110	130
GG 2	13.1	7.1	12.2	5.0	128	165	88	112
Robut 33-1	11.0	7.2	10.0	5.9	116	150	105	126
Punjab 1	14.9	10.2	13.0	7.4	126	176	120	130
GAUG 10	15.8	10.8	13.8	8.8	140	192	126	130
S.E.	0.51	1.31	0.84	0.60	4.7	5.6	2.8	5.1

The maximum foliage was observed at 15 and 11 WAE during dry and wet season, respectively

TABLE V. — **Pod number and pod and haulm yields of groundnut varieties grown during dry and wet seasons**

Groundnut varieties	Pod				Haulm	
	Number/m²		Yield (kg/ha)		yield (kg/ha)	
	Dry	Wet	Dry	Wet	Dry	Wet
GAUG 1	152	142	1853	1400	2640	2617
Kisan	143	145	1733	1250	2398	2400
TMV 2	150	148	1700	1283	2125	2020
JL 24	170	160	2047	1550	2663	2700
GG 2	172	158	2000	1500	2548	2530
Robut 33-1	163	153	1887	1527	2440	2430
Punjab 1	168	158	2140	1530	2800	2820
GAUG 10	181	168	2350	1600	3125	3000
S.E.	8.4	7.5	88.6	93	147	112

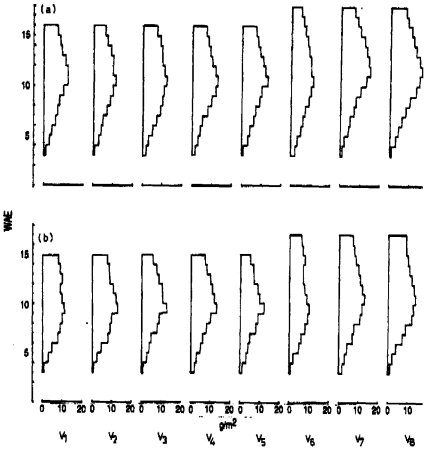

FIG. 4. — Nodule wt (g/m^2) of groundnut varieties observed at weekly intervals during dry (a) and wet (b) seasons

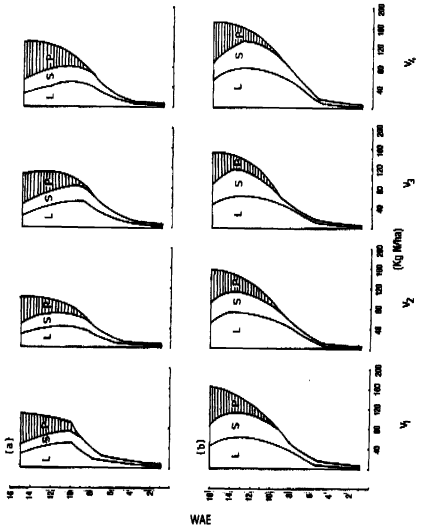

FIG. 5a. — Nitrogen accumulation (kg N/ha) in leaf (L), stem (S) and pod (P) of different groundnut varieties observed at weekly intervals during dry (a) and wet (b) seasons (V_1.....V_4)

formation in pod the major amount of nitrogen was translocated to pod and at harvest the pod accumulated maximum amount of nitrogen. The variation in the N uptake pattern of leaf, stem and pod was noticed with the varieties. In general runner varieties showed higher N uptake than erect type. Among the erect type JL 24 and GG 2 and among runner GAUG 10 showed higher N uptake than other varieties (Table IV, Fig. 5a and 5b). The comparison of N uptake by

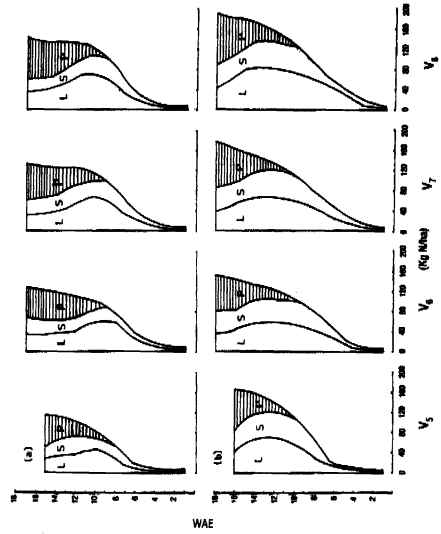

FIG. 5b. — Nitrogen accumulation (kg N/ha) in leaf (L), stem (S) and pod (P) of different groundnut varieties observed at weekly intervals during dry (a) and wet (b) seasons (V_5.....V_8)

groundnut at maximum foliage (15 and 12 WAE during dry and wet seasons, respectively) and at harvest showed that most of the nitrogen uptake in plant occured till 15 and 12 WAE during dry and wet seasons when plant contained maximum foliage.

Pod number, pod and haulm yields

The variation in the number of pods, and pod and haulm yields were observed with varieties (Table V). The runner showed higher yields than erect type. Among the erect type JL 24 and GG 2 showed higher number of pods and pod yield than other varieties during both the seasons. The haulm yield however, of JL 24 and GAUG 1 was at par and higher than other varieties during dry season, and during wet season the JL 24 showed highest haulm yield. In runner group GAUG 10 showed highest number of pods and pod and haulm yields (Table V). The pod number, pod and haulm yields of groundnut varieties during dry season were higher than that of during wet season. But, the per day dry matter production(g/m^2/day) of both wet and dry season crop was similar. It was interesting to note that groundnut varieties grown during dry season took 10 to 14 days more time than that grown during wet season for their maturity.

DISCUSSION

The varietal differences in the chlorophyll content of groundnut leave and growth of plant was observed. The plant showed higher chlorophyll content in their leaves soon after their emergence which decreased later on and was lowest at 4 WAE. This was because of lesser nitrogen availability to crop due to no nodule development during the first 3 WAE. After 3 weeks of seedling emergence the plant developed nodule and started fixing nitrogen and caused increase in chlorophyll contents of the leaves. The runner cultivar contained higher chlorophyll in their leaves than the erect one. This was also due to accumulation of more nitrogen in the leaves

TABLE VI. — **Comparative studies on the chlorophyll contents, nodulation, nitrogen uptake dry matter production and yield of erect and runner groundnut**

Habit group	Chlorophyll contents mg/g dry weight of leaves	Dry matter in leaves and stems (g/m^2)		Total dry matter at harvest (g/m^2)	Rate of dry matter production g/m^2/day	Nodule Wt. (g/m^2)		N uptake (kg ha^{-1})		Yield (kg/ha)	
		MF	AH			MF	AH	MF	AH	Pod	Haulm
	Dry season										
Erect	6.6	378	312	434	3.65	12.3	6.8	145	161	1867	2475
Runner	7.8	433	330	492	3.90	13.9	9.4	127	173	2126	2788
	Wet season										
Erect	5.4	324	251	385	3.67	12.4	6.8	98	112	1397	2453
Runner	6.2	300	253	430	3.84	12.3	7.4	117	132	1552	2750

of runner varieties than the spanish one. The high acetylene reduction activity in Virginia runners than Spanish have also been reported by Tonn and Wearer (1981). The chlorophyll contents of groundnut leaves increased after the plant started fixing nitrogen and was maximum at 8 WAE.

The crop growth rate (CGR) and dry matter accumulation in leaves and stems were slow till 6 WAE, which sharply increased and was at peak between 7-13 WAE. The dry matter recorded was highest at 14 and 15 WAE during dry season and 11 and 12 WAE during wet season in erect and runner groundnut varieties. Choudhari *et al.*, (1985) observed that the total dry matter accumulation in groundnut was low up to 30 days after sowing and increased linearly up to 86th day in the kharif season and up to harvest during summer season.

The variety JL 24 maintained higher dry matter in their leaves and stems than other erect varieties up to 14 WAE during dry season and up to 11 WAE during wet season. The GG 2 however, showed the lowest dry matter in leaves and stem till 7 WAE which increased afterwards and accumulated highest dry matter at 15 WAE. However, these two varieties showed similar pod yield at the harvest of crop. The higher chlorophyll contents and more nodule biomass in JL 24 were the main reason for higher dry matter production during early growth stages. Among the two habit groups Virginia runner showed bigger nodules and more nodule weight than Spanish (erect) type. These studies corraborated with Wynne *et al.*, (1980), Tenn and Weaver (1981) and Nambiar (1982). Nambiar and Dart (1980) reported that N_2-fixation started at around 25-30 days after planting and significant genotypic differences were observed at 30 days onwards. However, in this study the nodulation was observed after 3 weeks of emergence. Among the erect type JL 24 and GG 2 and among runner GAUG 10 showed higher nodule biomass and nitrogen accumulations than other varieties. Kulkarni *et al.*, (1987) also reported that JL 24 showed more nitrogen uptake than other varieties of Spanish group. The host plant plays a major role in symbiotic N_2-fixation and supply of carbohydrates to the nodules may be a limiting factor for N_2-fixation in other varieties, however it was probably adequate in JL 24 in this study.

The leaf accumulated highest amount of nitrogen during the crop growth stages but, at harvest the N uptake was maximum in pod. It was interesting to note that most of the nitrogen accumulation in the crop occured till crop produced maximum foliage (15 and 12 WAE during dry and wet seasons, respectively). The nitrogen content of the leaf and stem decreased soon after as the kernel growth in pod started. Williams (1979) reported that the crop accumulated 2.39 kg N/ha/day during its vegetative growth and 3.77 kg N/ha during the first half of the productive growth after which the N accumulation ceased. He further reported that the cessation of N accumulation coincided with the cessation of vegetative growth. Similar observation were also noticed in this study. Here the varieties showing highest dry biomass also showed highest N uptake. Thus, we can say that the varieties showing higher biomass production fixed more nitrogen. Nambiar *et al.* (1982) reported that total N uptake or total dry matter production may be an useful index ranking cultivars for their N_2 fixing abilities. Since the N_2 fixation is closely related to photosynthesis the maximum uptake was recorded in runner cultivars (Table VI).

The Virginia runner cultivar showed higher pod number, pod and haulm yields than the Spanish (erect) type due to more dry matter and N accumulation and higher crop growth rate in runner than Spanish, during the crop growth stages. Moreover, the runner maintained more leaf area (higher active assimilation surface) and higher percentage of nitrogen in their leaves throughout the season than erect one. Tonn and Weaver (1981) reported that the runner accumulated N in fruit at a faster rate than the Spanish. Wynne *et al.* (1980) reported that among the 12 growth analysis traits, leaf area duration accounted for more than 70% at the variability in N_2-fixation which demonstrate the importance of photosynthetic assimilation apparatus to N_2-fixation. However, Choudhari *et al.* (1985) reported that the number of fruting points per plant were the most important yield determining components.

The pod yield and total dry matter production was more during the dry season than that of wet season. This was due to the longer duration of crop and more sunshine hours during dry season than that of wet season. Moreover, the dry season crop took 10-14 days more time for its maturity than that during wet season. This was supported by Choudhari *et al.* (1985). However, Dwivedi and Saha (1983) reported that the energy harvesting capacity of groundnut did not differ significantly during kharif and rabi-summer season, but inspite of low solar irradiation, PI and PAR the total dry matter production and leaf area index were significantly higher during kharif season than rabi-summer season due to high RH, relatively low temperature and slow photorespiration during kharif season. Here in this study also comparatively high crop growth rate was observed for 7-13 WAE during wet season than that of during dry season. But, the per day dry matter production rate was similar during both wet and dry season. Choudhari *et al.*, (1985) reported that the higher dry matter and pod yield during dry season was attributed to the high leaf area duration during the later stage of crop growth.

Thus it is concluded from the study that the varieties (like JL 24 and GAUG 10 for Spanish and runner groups, respectively) having higher chlorophyll content in their leaves, faster growth, higher nodulation, nitrogen fixation and its partitioning should be used for obtaining higher productivity.

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RESUME

Etudes comparatives de la teneur en chlorophylle, de la croissance végétative, de l'absorption de N et du rendement chez des variétés d'arachide regroupées en fonction de leur port végétatif

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Les essais au champ conduits dans le cadre d'une étude physiologique comparative de variétés d'arachide érigées (Spanish) ou rampantes (Virginia) a montré que les variétés rampantes ont une teneur foliaire en chlorophylle plus élevée et une croissance plus rapide, produisent une biomasse foliaire, caulinaire et nodulaire plus importante, donnent des rendements plus élevés en gousses et en fanes et accumulent plus d'azote dans les différents organes de la plante que les variétés à port érigé. La teneur foliaire en chlorophylle est à son niveau minimal à 4 semaines après la levée (SAL) et maximal à 8 SAL. De même, le taux de croissance est faible jusqu'à 6 SAL et augmente brusquement par la suite, pour atteindre sa valeur maximale entre 7 et 13 SAL. Les variétés rampantes et érigées ont présenté le taux maximal d'accumulation de matière sèche dans les feuilles et dans la tige à 14 et 15 SAL respectivement pendant la saison sèche et à 11 et 12 SAL respectivement pendant la saison des pluies. La nodulation des racines chez ces mêmes variétés commence à 3 SAL pour atteindre une biomasse maximale à 11 et 12 SAL respectivement pendant la saison sèche et à 9 et 10 SAL respectivement pendant la saison des pluies. Par contre, l'absorption de N par les feuilles et les tiges est maximale à 13 et 10 SAL respectivement pendant et la saison sèche et la saison des pluies. Les variétés JL 24 et GG 2 parmi les érigées et GAUG 10 parmi les rampantes ont une teneur foliaire en chlorophylle plus élevée, produisent plus de biomasse foliaire, caulinaire, racinaire et nodulaire, donnent des rendements plus élevés en gousses et en fanes et accumulent plus de N que les autres variétés. La culture de la saison sèche mûrit plus lentement, accumule plus d'azote et donne des rendements plus élevés en gousses et en fanes que celle de la saison des pluies. Le taux de croissance végétative (g/m/jour) des variétés d'arachide de 7 à 13 SAL est pourtant plus élevé pendant la saison des pluies que pendant la saison sèche, mais la production cumulée de matière sèche (g/m/jour) chez l'arachide est similaire pendant les deux saisons.

Mots clés. — Arachide, variétés érigées et rampantes, chlorophylle, taux de croissance végétative, production de matière sèche, nodulation, absorption d'azote, rendements