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VARIATION IN THE PHYSIOLOGICAL PARAMETERS OF POPULAR GROUNDNUT VARIETIES

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A field experiment was conducted at National Agricultural Research Project, Tirupati, during Kharif, 1981 to study the variation in the physiological parameters of popular groundnut varieties belonging to different habitat groups, under adequate water availability. Crop canopy expansion as reflected in LAI was maximum at 90 DAS (Virginia runner) and 75 DAS (Valencia, Spanish and Virginia bunch). The leaf senescence started from 75 DAS onwards in all the groups except in virginia runner in which it was observed from 90 DAS onwards. CGR and NAR were maximum between 45 to 60 DAS in Valencia, Spanish and Virginia bunch while two peaks were observed in CGR (31-75 & 61-75 DAS) in the spreading type. Leaf and stem contribution towards total dry matter production was equal upto 60 DAS in all the groups and from 60th day stem contribution was more. The reproductive effeciency and translocation efficiency were higher in valincia and spanish bunch groups compared to the spreading and semi-spreading groups.

Groundnut, the popular oilseed crop grown in India, shows large variations in growth depending on the habitat group to which it belongs. The growth analysis (of the groundnut varieties belonging to different habit) technique helps in understanding the growth pattern and also contribution of various plant components to economic yield. It also aids in finding out the growth and yield characters directly relevant to the productivity of crop and thus forms the basis for manipulation of productivity. In the present study, an attempt has been made to assess the physiological parameters responsible for the yield variations in the different habitat groups viz., Valencia bunch, Spanish bunch, Virginia bunch and Virginia runner.

MATERIAL AND METHODS

A field trial was laidout in alfisols during kharif, 1981 at the S. V. Agricultural College dryland farm, Tirupati with 13 varieties belonging to different habitat groups (as given below) replicated thrice in a randomized block design.

Habitat groups		Varieties
1) Valencia bunch	—	EC 21137-1, JL-24, Gangapuri
2) Spanish bunch	—	TMV$_2$, J$_{11}$, DH$_2$-30
3) Virginia bunch	—	Kadiri-2, C 501, Local Reddagutti
4) Virginia runner	—	M$_{13}$, Kadiri-3 Kadiri-1

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The plot size was 5 × 4 m², with a spacing of 30 × 10 cm between rows and plants, respectively, for Valencia and Spanish bunch varieties and 30 × 15 cm for Virginia varieties. A fertilizer schedule of 20 N + 10 P+50 K Kg/ha was applied in the forms of urea, single super phosphate and muriate of potash, respectively. Plant protection measures were taken as and when needed and the crop was maintained pest free. Though the crop was grown under rainfed conditions, the rainfall (529.5 mm and 41 rainy days) was favourably distributed throughout the season and hence, the crop did not suffer due to moisture stress during any growth stage.

Observations on growth parameters viz., leaf area and bio-mass production were recorded at fortnightly intervals on ten plants from each replication, starting from seedling to maturity. Leaf area was measured with an automatic electronic digital leaf area meter (Licor-model 3000) and bio-mass production (of aerial ground parts) was measured by recording the dry weights of plant samples kept in an electric oven at 80°C for 24 hours. Data on yield and yield components Crop Growth Rate (CGR), Net Assimilation Rate (NAR), dry matter partitioning, Leaf Area Index (LAI), Leaf Area Duration (LAD) and Leaf Area Duration from pod filling to maturity (LADP) were computed from bio-mass production and leaf area as per watson (1952). Reproductive efficiency was estimated as the ratio of flowers produced to filled pods formed expressed as percentage. Harvest index was calculated as the ratio of pod yield and total biological yield.

RESULTS AND DISCUSSION

The crop canopy expansion in terms of leaf area index increased with the age of the crop from 15 to 75 DAS in Valencia bunch, Spanish bunch and semi-spreading groups which showed declining trend thereafter upto maturity. In the spreading (Virginia runner) group crop expansion continued upto 90 DAS and declined thereafter (Table-1). The crop did not suffer shortage of water because of uniform distribution of rainfall during the season. Varietal differences in the pattern and enlargement of coverage of canopy in different plant types was reported by Maeda (1972), Sastry *et al* (1979). The data indicate that leaf senescence started from 75 DAS onwards in all the groups except in Virginia runner in which leaf drop was observed from 90 DAS afterwords. Mc Cloud (1974) recorded higher LAI at flowering which declined rapidly thereafter. as also observed in the present investigation. LAD and LADP were maximum in spreading group followed by semi-spreading, Spanish bunch EC-21137-1 (Valencia bunch), TMV_2 (Spanish bunch), K_{12} (Virginia bunch), M_{13} (Virginia runner) recorded highest leaf area duration. The increased LAD in these varieties allowed the plant to establish more mature pods and a larger proportion of potential fruits resulting in higher yield. The highest LAD and LADP in the Virginia Group can be attributed to the longer duration of the crop in the field.

The results indicate (Table-2) that crop Growth Rate (CGR) was maximum at 46-60 DAS in Valencia, Spanish bunch and semi spreading varieties and declined thereafter till the matarity. In the spreading type two peaks were observed in the CGR one between 31-45 DAS and another between 61-75 DAS. Suraj Bhen (1973) reported that in erect bunch varieties, growth rate was faster than spreading which reached a higher dry matter production earlier, but growth rate continued for a longer period in the spreading types. This is in confirmation of the growth pettern of groundnut in which, depending on the cultivar, vegetative growth may cease midway to the crop's life and continue till the crop maturity (Williams, 1981). The rate of biomass production varied in the different groups Net Assimilation Rate (NAR) also showed similar trend as above in Valencia, Spanish and Virginia bunch, whereas, in runner group, it was maximum at 31-45 DAS. No significant differences were found in the CGR and NAR among the different varieties at 46-60 DAS as has also been observed by Duncan *et al* (1978).

The leaf and stem contributed almost equally upto 60 DAS, while the stem contribution was more (60% and above) towards the biomass production, later on till maturity (Table-3) has also been observed by Sastry *et al.* (1979). However, no marked differences were observed among the different varieties of groups and in general they followed the same trend as described above.

The data on yield components (Table-4) revealed that flower to pod atio (13.2-18.8) and 100 pod weight 98-108) were higher in Valencia bunch group in which plants had more number of three seeded pods.

The haulm yield was also higher in Valencia (1726-1807) and Spanish bunch (1694-1823) groups compared to spreading and semi-spreading groups Though the number of flowers per plant were higher in spreading group and lowest in Valencia bunch group the flower to pod ratio was less in these groups. Bhan and Mishra (1972) reported that Virginia produced maximum number of flowers. The reproductive efficiency as evident from flower to pod ratio was higher in Valencia bunch group followed by Spanish bunch group. Though Virginia recorded higher photosynthesis, productivity in terms of higher dry matter production, the translocation of photosynthates into the pod was lower than Valencia and Spanish bunch.

The Harvest Index (HI) was also higher in Valencia and Spanish bunch group indicating that partitioning of the dry matter towards the production of economic yield was better in these groups No marked changes were observed in the shelling % of the varieties. Per day production of economic yield was highest in Valencia bunch (12.3 kg/ha/day), while the other two groups recorded lowest per day production(6 42—7.8) evidently due to the lowest duration of the crop in Valencai

and Spanish bunch group compared to other two groups. The source capacity which is most active upto 75 DAS in Spanish bunch and Virginia group might have resulted in the production of photosynthates sufficient to cater to the demand of the sinks (pods) most effectively, while in spreading group the leaf senescence which started from 75 DAS resulted in lower source (leaf) activity and was unable to compensate the demand for the photosynthates resulting in the production of lower number of filled pods in proportion to the large number of flowers. Though the number of filled pods was less in Valencia bunch, most of the pods were 3 to 4 seeded and the 100 pod weight also was higher. Significant and positive correlation were found between LAI at 60 DAS and pod yield (+0.78) and filled pods and pod yield (+0.58) in all the habitat groups. The leaf area duration (LAD) and leaf area duration from pod filling to maturity (LADP) were found to be significantly associated (+0.70, +0.68, respectively) with pod yield in the Valencia and Spanish bunch groups.

The present findings reveal that Valencia and Spanish bunch groups are characterised by higher reproductive efficiency and higher translocation rate, while Virginia group possess the capacity to produce higher dry matter under conditions of adequate water availability.

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TABLE 1 : Leaf Area Index (LAI) and Leaf Area Duration (LAD) in popular groundnut varieties

Varieties	LAI									LAD	LADP
	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	120 DAS	135 DAS		
Valencia bunch											
EC-21137-1	0.40	0.72	1.6	1.7	2.4	1.9	—	—	—	130.60	90.00
JL-24	0.38	0 74	1.0	1.6	2.2	2.0	—	—	—	118.60	87 00
Gangapuri	0.29	0.54	1.0	1.4	2.1	2.0	—	—	—	109.95	82.50
Spanish bunch											
DH_3-30	0.26	0.55	1.2	1.4	2.2	1.7	1.2	—	—	116.65	86 50
J_{11}	0.28	0.64	1.1	1.6	2.4	2.2	1.6	—	—	123.30	93·00
TMV_8	0.34	0.71	1.2	1.9	2.5	2.4	1.4	—	—	135.75	92.25
Semi-spreading											
K_9	0.34	0.69	1.1	2.0	2.9	2.7	1.8	1.4	—	184.95	129.6
Local Peddagutti	0.29	0.70	1.1	1.5	2.2	2 1	1.6	1 0	—	157.35	100.8
C-501	0.33	0.66	1.1	1.3	2 5	2 0	1.5	0.8	—	153.15	97.2
TMV_{13}	0.25	0.69	1.2	1.7	2.4	2.0	1.8	1,1	—	165.60	108.00
Spreading											
M_{16}	0.54	0.71	1.6	2.4	2.5	3.0	2.4	1.5	1.0	239.25	165.1
K_5	0.40	0.60	1 4	2.2	3.0	3.0	2.2	1.6	0 8	228.00	161.3
K_1	0.33	0.73	1.4	2.1	2.3	2.9	2.1	1.1	0 8	236 40	142.4
CDCP=0.05	0.10	0.11	0 34	0.60	0.34	0.29	0.30	0.10	—	19 0	15.2

LADP : Leaf area duration from pod filling to maturity

TABLE 2 : Crop growth rate and Net Assimilation Rate in popular groundnut varieties

Varieties	0-15 CGR	0-15 NAR	16-30 CGR	16-30 NAR	31-45 CGR	31-45 NAR	46-60 CGR	46-60 NAR	61-75 CGR	61-75 NAR	76-90 CCR	76-90 NAR	91-105 CGR	91-105 NAR	106-120 CGR	106-120 NAR	121-135 CGR	121-135 NAR
Valencia bunch																		
EC-21137-1	0.89	—2.04	2 47	4.53	7.67	6.96	9.20	5.58	6.27	0.62	4.33	—2.02	—	—	—	—	—	—
JL-24	1.00	—2.55	2.20	4.07	5.73	6.64	9 13	7.15	5.33	2 83	2 00	—0.95	—	—	—	—	—	—
Gangapur	0.53	—2.26	2.73	6.80	4.67	6.25	11.13	9.36	8.27	4.79	1.20	-0.59	—	—	—	—	—	—
Spanish bunch																		
DH_3-30	0.87	—4.51	1.93	4.99	7.07	8.48	8.93	6 91	2.60	1.55	2.67	—1.44	1.67	—1.22	—	—	—	—
J_{11}	0 53	—2 41	2.40	5.51	2.53	2.29	7.93	5 94	8.27	1.21	1.33	—0.58	0.88	—0.48	—	—	—	—
TMV_2	0 47	—1.49	2 80	5.57	6.07	6 50	8.67	5.86	8.87	3.50	4.53	—1.85	2.54	—1.45	—	—	—	—
Semi-spreading																		
K_2	0 60	—1.90	2.20	4.45	3.40	3.87	7.87	5 23	6.13	3.53	4.20	—0.30	3.20	—1.00	2.20	—0 84	1.10	—0.52
Local Poddagutti	1 07	—4 57	2.40	4.75	4.13	4.67	9.53	7.39	4 47	2.44	3.13	—1.46	2.10	—0.90	1 50	—0.54	0.80	—0 26
C—501	0.60	—2.02	2.87	5.92	3.80	4.35	8.33	6.96	10.00	5.52	5.47	—2.44	4'0	—2.10	2.60	—0.82	0.07	—0 14
TMV_{13}	0.80	—4.44	2.39	7.41	5.33	6.20	4.40	3.07	7.87	3.88	7.13	+2.85	4.30	—2.30	1.20	—0 32	—	—
Spreading																		
M_{13}	0.60	—0.68	3.33	5.37	7.00	6.39	4.33	2.20	6.60	2.69	5.33	+1.94	4 20	—2.40	2.10	—0.90	0.60	—0.08
K_3	0.80	—1.83	2.40	4.87	7.87	8.33	5.67	3.20	7.73	3.00	5.53	1.87	3.00	—1.50	1.20	—0.24	—	—
K_1	0 53	—1.78	2.33	4.63	7.67	7.39	7.33	4.25	6.53	4.34	4.87	+1.87	2.40	—1.00	0.89	—0 86	8.50	—
CD at P=0—05	0.06	—0.20	0.24	061	1.36	0.83	1.46	0.82	1.13	1.11	1.40	1.13	0.82	—0.40	0 76	—0.24	0.24	—0 01

TABLE 3. Relative contribution (%) of leaf and stem to the total dry matter production in popular groundnut varieties

Varieties	15		30		45		60		75		90		105		120		135	
	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem
Valencia bunch																		
EC-21137-1	46	54	58	42	55	45	51	49	55	45	38	62	—	—	—	—	—	—
JL-24	40	60	48	52	46	54	46	54	48	52	41	59	—	—	—	—	—	—
Gangapuri	50	50	53	47	47	53	43	57	48	52	42	38	—	—	—	—	—	—
Spanish bunch																		
DH_8-30	54	46	55	45	49	51	48	52	49	51	41	59	—	—	—	—	—	—
J_{11}	50	50	54	46	46	54	47	53	48	52	42	58	—	—	—	—	—	—
TMV_4	43	57	43	57	49	51	47	53	43	57	34	66	—	—	—	—	—	—
Semi-spreading																		
K_1	56	44	55	45	45	55	46	54	50	50	42	58	32	68	28	72	20	80
Local	50	50	62	38	45	55	46	54	56	44	47	53	34	64	26	74	22	78
Peddaguttı																		
C-501	56	44	62	38	42	58	53	47	51	49	44	56	34	66	30	70	21	79
TMV_{13}	62	38	60	40	46	54	51	49	51	49	37	63	37	63	25	75	—	—
Spreading																		
M_{13}	56	44	54	46	53	47	58	42	59	41	50	50	45	55	35	65	24	76
K_5	33	67	56	44	53	47	43	57	49	51	41	59	38	62	30	70	—	—
K_1	75	25	56	44	49	51	46	59	50	50	45	55	39	61	28	72	20	80

TABLE 4: Yield and yield components in popular groundnut varieties

Varieties	No. flowers per plant	No. filled pods/ plant	Flowers to pod rate(%)	100 pod wt.(g)	100 kernel wt.(g)	Shelling %	Podyield kg/ha	Haulers yield kg/ha	Harvest index	Production per field day(kg/ha)
Valencia bunch										
EC-21137-1	60	12	16.7	92	31	68	1250	1726	0.42	13.0
JL-24	68	13	13.2	108	43	74	1420	1807	0.40	13.5
Gangapuri	64	12	18.8	105	36	68	1164	1746	0.44	12.3
Spanish bunch										
DH_8-30	78	12	15.4	94	38	74	1220	1756	0.41	11.6
J_{11}	80	14	17.5	83	32	74	1320	1823	0.42	12.6
TMV_8	84	11	13.1	84	34	72	1227	1694	0.42	11.7
Semi-spreading										
K_2	120	14	11.7	89	38	68	880	1498	0.37	8.5
Local Paddagutti	80	10	12.5	90	36	66	920	1636	0.36	7.1
C-501	78	10	12.8	92	38	66	860	1527	0.36	6.4
TMV_{10}	80	10	12.5	92	36	68	980	1533	0.39	7.8
Spreading										
M_{13}	120	14	11.7	105	44	68	1020	1664	0.38	7.8
K_5	120	13	10.8	98	39	68	900	1600	0.36	7.8
K_1	114	12	10.5	75	30	69	860	1464	0.37	6.4
CDCP=0.05	7.0	3.0	1.3	10.0	3.4	N.S	71.2	70.6	0.03	1.3