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LEAF GROWTH ATTRIBUTES AS COMPARATIVE PHYSIOLOGICAL FACTORS FOR THE GENOTYPES OF GREENGRAM (*Vigna radiata* (L.) WILCZEK) IN RELATION TO YIELD

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Among growth parameters the usefulness of Leaf Area (LA) and Leaf Index (LAI) at peak Vegetative and peak flowering was evident. Specific Leaf weight (SLW) at Vegetative and stray flowering stages appeared to condition the yielding ability.

In comparison to the phenomenal yields possible in cereals, in the case of pulses, inspite of the great efforts made by the plant breeders, yields have been generally low. Most of the pulses are grown as rainfed crop or used in intercropping and thus the production per unit area is naturally less. The vegetative dominance, flower shed, poor filling of pods and other characters also reduce the yield. Although inherently pulses are comparatively low yielders, among the genotypes wide range of variability is seen. Physiological studies in a greater depth will assist the plant breeders in evolving suitable plant type to be employed in breeding programme.

MATERIALS AND METHODS

Investigations outlined in this paper were carried out during 1978-'81 in the Department of Crop Physiology, Tamil Nadu Agrl. University, Coimbatore-3. An attempt was made to bring out the differences in growth attributes in relation to yield among 15 genotypes of greengram.

The 15 genotypes were arbitrarily grouped into high yielders (PIMS 4, Co 3, 11/99, ML 69 and pusa Baisakhi) medium yielders (T 44, 11 395, LAM GG 127, ML 73) and low yielders (KM 1, PH 6, ML 62, DM/2 and MH 1). Plant samples were taken from field at eight stages of crop growth from 15th day harvest at weekly intervals. A total of 30 plants per genotype (10 from each replication) formed a unit. The plants were dried, pooled and seperated into root, stem, leaf, reproductive parts and weighed accordingly for working out the growth attributes Standard and accepted methods were adopted.

RESULTS AND DISCUSSION

(1) *Leaf Area* (LA) (Table 1) The LA in the 15 genotypes at chosen eight stages is presented below. Considering each genotype there was a sequential progressive improvement upto the seventh stage, which coincided with pod development. At

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harvest, except in two genotypes, in the rest a fall in values was observed. Even to start with, the LA suggested that there was some type of association with the three groups. Subsequently upto the fourth stage which corresponded with stray flowering, the high yielders showed relatively lower values. At peak flowering the difference between the group was not much pronounced but at some time most of the genotypes could be associated with the group based on the LA. The values before harvest were rather erratic to make any decision. The data were significant except at fourth, sixth and seventh stages. The LA particularly showed high significant correlation with LAI (0.951** to 0.999**), DMP (0.713** to 0.895**) and to a lesser degree with LAR and SLA.

Table 1. Leaf Area (LA) in 15 genotypes of greengram at chosen stages of growth, expressed in sq. cm.

Genotype	I	II	III	IV	V	VI	VII	VIII stages
	15	22	29	36	43	50	57	64 days
PIMS 4	16.36	62.17	116.43	222.39	352.66	394.94	413.36	365.63
Co.3	16.45	75.69	105.49	235.86	373.87	420.65	519.32	436.66
11/99	22.93	79.11	121.94	235.12	422.63	432.32	589.44	631.05
ML 69	11.91	80.91	113.31	218.88	374.34	409.12	576.66	523.73
Pusa Baisakhi	11.92	81.52	112.20	263.81	314.30	423.68	610.99	361.31
T 44	11.28	69.08	114.29	218.61	488.33	548.12	664.03	517.88
11/395	12.73	56.13	95.40	183.29	263.35	378.97	443.82	429.56
LAM GG127	13.31	63.44	104.31	219.12	285.05	461.14	490.94	609.54
ML 73	10.21	63.99	99.38	177.70	497.32	552.98	557.62	502.17
10/303	10.12	71.54	100.67	205.45	314.58	465.50	522.48	532.11
KM 1	11.92	58.52	93.25	170.69	280.42	332.21	524.53	505.47
PH 6	11.64	53.61	87.93	180.59	310.34	315.23	488.51	360.90
ML 62	9.50	52.35	85.02	210.87	247.03	379.87	393.56	369.45
DM/2	10.86	55.15	74.92	195.08	418.71	428.25	660.94	626.97
MH 1	8.91	58.18	69.05	194.74	340.08	377.24	400.62	307.44
SE	1.21	6.92	9.21	32.94	42.95	52.38	61.36	64.70
CD (P=0.05)	3.50**	20.04*	2.68**	95.41NS	124.41*	151.72NS	177.71NS	187.38*

It was also seen that LA had negative association with SLW (-0.352* to -0.723**) being significant at most of the stages studied. The LA is the assimilatory source, being the combined effect to leaf number and size. Its positive correlation with mentioned parameter is reasonable. Its negative correlation with SLW is mostly due to mutual shading.

Table 2 Leaf Area Index (LAI) in 15 genotypes of greengram at chosen stages of growth

Genotype	I 15	II 22	III 29	IV 36	V 43	VI 50	VII 57	VIII stages 64 days
PIMS 4	0.06	0.21	0.39	0.70	1.18	1.32	1.38	1.22
Co 3	0.06	0.25	0.35	0.79	1.25	1.40	1.73	1.46
11/99	0.06	0.26	0.41	0.78	1.41	1.44	1.97	2.10
ML 69	0.04	0.27	0.38	0.73	1.25	1.36	1.92	1.75
Pusa Baisakhi	0.04	0.27	0.38	0.88	1.05	1.41	2.04	1.21
T. 44	0.04	0.23	0.38	0.73	1.63	1.83	2.21	1.73
11/395	0.04	0.21	0.32	0.61	1.18	1.26	1.48	1.43
LAM GG 127	0.05	0 19	0.35	0.73	0.95	1.54	1.64	2.03
ML 73	0.04	0.21	0.33	0.59	1.66	1.84	1.86	1.68
10/303	0.03	0.24	0.34	0.69	1.05	1.55	1.74	1.77
KMI	0.04	0 20	0.31	0.57	0.94	1.11	1.75	1.69
PH 6	0.04	0.18	0.29	0.60	1.04	1.05	1.63	1.20
ML 62	0.03	0.18	0.28	0.70	0.82	1.27	1.31	1.23
DM/2	0.04	0.19	0.25	0.65	1.40	1.43	2.20	2.09
MHI	0.03	0.20	0.23	0.65	1.13	1 26	1.34	1.03
SE	0.04	0.02	0.03	0.11	0.20	0.17	0.20	0.22
CD (P=0.05)	0.11NS	0.07NS	0.09*	0.32NS	0.58NS	0.50NS	0.59N	0.62*

(2) *Leaf Area Index* (LAI) (Table 2) : The LAI was worked out at the same stages as LA. At the first three stages the data firmly indicated that in the members of high yielders the LAI were more. Similarly there was considerable difference between the LAI of medium and low yielders. At stray flowering, the high yielders maintained their superiority. whereas some members of medium as well as low yielders did not fall within the group. At subsequent stages till harvest, the LAI did not convey probable difference between the groups In most of the genotypes a decline towards harvest was evident. The data were signficant at third and eighth stages only. LAI behaved just like LA in different genotypes regarding association with other factors.

(3) *Leaf Area Duration* (LAD) (Table 3) : The growth factor LAD was observed at seven stages. To strat with, most of the high yielders recorded slightly better LAD than medium and low yielders. At the II-III stage as well the difference between the low and high yielding genotypes in particular, was somewhat contrasting. At subsequent stages, although wide variations did not exist, the members of the high yielding group recorded better LAD than the medium or low yielding group. LAD at harvest showed that there was no consistency with regard to the values with reference to the group. Statistically, high significance was obtained at all stages except later two stages. The contribution of LAD towards NAR was most often negative. Regrding the relationship between LAD and yield, at II-III stage above significant at five per cent level was oberved while at the rest of the stage, the parameter was not significant. Nijhawan and Chandra (1980) strongly felt that high LAD during one or two phases of growth was obligatory for better yield, which was present here.

Table 3 Leaf Area Duration (LAD) of 15 genotypes of greengram at chosen stages of growth, expressed as day.

Genotype	I-II 15-21	II-III 22-28	III-IV 29-35	IV-V 36-42	V-VI 43-49	VI-VII 50-56	VII-VIII stages 57-64 daps
PIMS 4	0.94	2.10	3.96	5.46	8.89	9.25	8.87
Co 3	0.88	1.93	4.08	6.72	9.28	10.97	11.15
11/99	1.12	2.35	3.70	7.65	9.99	11.92	13.90
ML 69	1.08	2.16	4.00	7.14	8.81	11.18	12.85
Pusa Baisakhi	0.96	2.28	3.79	6.03	8.60	12.07	11.34
T 44	1.11	2.25	3.89	8.25	12.09	13.91	13.79
11/395	0.90	1.79	3.37	5.41	7.49	9.60	10.20
LAM GG 127	0.83	2.00	3.90	5.89	7.54	11.08	12.30
ML 73	0.88	1.90	3.23	7.89	12.26	12.97	12.38
10/303	0.74	1.84	3.92	6.06	9.11	11.55	12.31
KM 1	0.84	1.94	3.12	5.06	7.16	10.00	12.03
PH 6	1.05	1.74	3.13	5.73	7.31	9.38	11.15
ML 62	0.96	1.51	3.36	6.13	7.27	11.18	9.13
DM/2	0.78	1.93	3.28	7.21	9.65	12.46	13.89
MHI	0.75	1.48	3.56	6.63	8.58	9.00	11.24
SE	0.09	0.14	0.44	0.80	0.82	1.44	1.41
CD (P=0.05)	0.26*	0.39*	1.26**	2.31NS	2.36**	3.31NS	4.07NS

(4) *Leaf Area Ratio* (LAR) (Table 4) : The peak LAR was recorded at the second stage of the crop, followed by rather a steep fall at subsequent stages till harvest. LAR was proportionately higher in high yielders. Between medium and low yielders the LAR did not suggest much of a difference. A second mild peak at fourth stage corresponding to the stray flowering was seen in all the genotypes except T 44 and DM/5. High statistical significance was noticed except at the seventh stage. LAR actually suggests the active part in photosynthesis and is considered as a useful parameter. Reference can be made here to wallace and Munger (1965) and Buttery and Buzzel (1972) who have reported that high photosynthetic ability is closely related to low LAR and this is clearly shown in the study. The contribution of LAR towards yield was uncertain, with low positive or negative relationship in this particular study.

Table 4: Leaf Area ratio (LAR) in 15 genetypes of greengram at chosen stages of growth, expressed in cm^2g^{-1}

Genotype	I 15	II 22	III 29	IV 36	V 43	VI 50	VII 57	VIII stages 64 days
PIMS 4	203.54	241.90	142.12	135 81	91.51	62.53	48.18	33.35
Co 3	165.67	274.00	115.40	152.22	91.53	64.85	43.62	34.84
11/99	211.92	202.55	125 34	152.83	99.46	53.67	52.67	48.43
ML 69	139.75	230.77	117.14	131.26	77.10	56.56	47.27	39.03
Pusa Baisakhi	141.55	242.45	131.96	154.35	79.77	69.82	52.87	30.27
T 44	150.03	236.80	143.17	138.89	104.36	53.67	52.36	37.10
11/395	142.24	218.77	133.72	124.70	78.00	87.03	52.44	36.02
LAM GG 127	170.56	220.69	118.27	139.99	88.67	69.47	52.95	54.01
ML 73	131.00	222.30	112.11	113.56	122.50	100.40	49.68	38.89
10/303	115.14	244.75	129.24	154.03	113.33	61.12	52.10	40.65
KM 1	146.74	226.58	113 94	141.67	91.56	50.01	50.40	41.59
PH 6	148.81	186.16	124.68	145.79	115.18	54.63	48.89	33.22
ML 62	124.26	187.14	115.73	144.22	95.88	60.12	43.23	37.99
DM/2	135.76	235.92	114.86	102.91	114.40	64.72	57.26	49.23
MH 1	127.27	228.76	108.91	127.26	71.57	63.45	43.19	33.57
SE	1.92	4.49	8.71	2.65	2.27	1.18	3.01	3.60
(P=0.05)	5.55**	13.01**	25.24**	7.67**	6.71**	12.10**	8.73NS	10.43**

(5) *Specific Leaf Area* (SLA) (Table 5) : Among individual genoytpes, except 11/99 which recorded maximum SLA of 332.37 cm^2 g^{-1} on the 15th day, tne rest of the genotypes showed maximum values on the 22nd day. This was the major peak and subsequently there was a reduction towards harvest with mild peaks at stray flowering and pod development. To start with, the low yielders uniformly recorded comparatively lower values. Among medium yielders except T 44 the rest showed lower SLA values. However the data did not show any particular association with the performance of the crop. SLA is considered as an important factor, although in the present study its contribution in greengram genotypes was doubtful. SLA increased during the period of vegetative growth when leaf expansion was rapid and thereafter dropped towards reproductive stage. The inverse relationship between SLA and SLW is well known and workers like Sheehy and peacock (1977) and Usha Rani (1979) have impressed the relationship. In this particular study also high level of negative significance was established between SLA and SLW.

Table 5 Specific Leaf Area (SLA) in 15 genotypes of greengram at chosen stages of growth, expressed in cm^2 g^{-1}

Genotype	I 15	II 22	III 29	IV 36	V 43	VI 50	VII 57	VIII Stages 64 days
PIMS 4	314.69	372.93	228.34	221.46	172.71	183.04	211.73	198.87
Co 3	259.35	423.06	187.28	243.30	185.25	182.40	215.42	159.60
11/99	332 37	308.21	205.08	253.91	204 15	179.51	235.09	214.80
ML 69	220.14	343.22	187.36	235.35	157.22	186.01	221 55	179.08
Pusa Baisakhi	225.65	370.74	217.69	253.99	168.81	207.24	237.59	157.06
T 44	343.67	358.30	225.11	223.00	203.38	195.64	241.88	168.56
11/395	226.19	366.22	215.16	210.28	152.63	253.84	231.25	192.09
LAM GG 127	272.36	362.89	196.14	223.94	168.63	212.00	227.43	245.00
ML 73	219.50	336.48	181.57	184.50	273.24	262.66	236.76	200.72
10/303	186.00	372.26	211.73	253.49	220.83	185.00	245.33	192.58
KMI	229.73	348.10	185.63	232.19	183.03	143.48	200.72	186.54
PH6	234.25	281.26	202.60	237.64	235.64	176.07	242.43	157.81
ML 62	206.44	290.19	187.30	336.99	180.71	188.40	195.81	203.29
DM/2	215.90	332.68	200.07	173.44	219.21	155.13	213.66	184.33
MH 1	203.42	343 01	180.22	207.72	141.83	180.14	294.62	186.03

(6) *Specific Leaf Weight* (SLW) (Table 6) : Taking individual genotypes, high SLW was recorded in the first sample and the high yielders PIMS 4, Co 3 and 11/99 recorded low values and compared to the medium or low yielders. Among medium yielders, LAM GG 127 alone showed lower values At the second stage there was a drop and subsequently, the SLW improved and somewhat maintained. The peak was reached at different stages. In soybean

Buttery and Buzzell (1972) and in mungbean at AVRDC (Anon., 1976), SLW was strongly recommended for screening genotypes for high potentiality. In the present study, its relationship with DMP in the parts of the plant did not convey any useful information as to its importance. Regarding its contribution towards yield the values at the second (0.298*, and fourth (0 395*) stages alone suggested possible application of the data for assessement of the genotype. At the rest of the stages negative values were seen indicating its rather low importance in governing the yield.

Table 6 : Specific Leaf Weight (SLW) in 15 genotypes of greengram at chosen stages of growth, expressed in $mg\ cm^{-2}$

Genotype	I	II	III	IV	V	VI	VII	VIII Stages
	15	22	29	36	43	50	57	64 days
PIMS 4	3.2	2.7	4.4	4.5	5.8	5.5	4.7	5.1
Co 3	3.9	2.4	5.3	4.1	5.4	5.5	4.6	6.3
11/99	3.0	3.2	4.9	3.9	5.0	6.6	4.3	4.7
MI 69	4.5	2.9	5.3	4.3	6.4	5.4	4.5	5.6
Pusa Baisakhi	4.4	2.7	4.6	3.9	5.9	4.8	4.2	6.4
T 44	4.1	2.8	4.4	4.5	4.9	5.1	4.1	5.9
11/395	4.4	3.0	4.7	4.8	6.6	3.9	4.3	5.2
LAM GG 127	3.7	3.0	5.1	4.5	5.9	4.7	4.4	4.1
ML 73	4.6	3.0	5.5	5.4	3.7	3.8	4.2	5.0
10/303	5.4	2.7	4.7	3.9	4.5	5.4	4.1	5.2
KM 1	4.4	2.9	5.4	4.3	5.5	7.0	5.0	5.4
PH 6	4.3	3.6	4.9	4.2	4.3	5.7	4.1	6.3
ML 62	4.8	3.6	5.3	4.2	5.6	5.3	5.1	4.9
DM/2	4.7	2.8	5.0	5.8	4.6	6.5	4.7	5.4
MH 1	4.9	2.9	5.6	4.7	7.1	5.6	5.1	5.4

REFERENCES

ANONYMOUS. 1976. Mungbean AVRDC. Progress report 92-63.

BUTTERY, B. R. and R. I. BUZZELL. 1972. Some differences between soybean cultures observed by growth analysis. *Cam. J. pl. Sci.* 52 : 13-2

NIJHAWAN, D. C. and S. CHANDRA. 1980. The physiology of plant growth with particular reference to the concept of photosynthetic efficiency in mungbean *(Vigna radiata* (L.) Wilczek.) *Inian J. Plant physiol.* 23 : 40-46

SHEEHY, J. E. and J. M. PEACOCK. 1977. Microclimate, canopy structure and photosynthesis in Canopies of three contrasting temperate forage grasses. 1. Canopy structure and growth. *Ann. Bot* 41 : 567-578.

USHA RANI, Y. 1979. Growth attributes of blackgram *(Vigna mungo* L.) in relation to yield. Thesis for M. Sc. degree of the Tamil Nadu Agricultural University (unpublished).

WALLACE, D. H. and MUNGER. 1965 Studies on the physiological basis of yield differences. I. Growth analysis of six dry bean varieties. *Crop Sci.* 5 : 343-348