https://doi.org/10.29321/MAJ.10.A02099

Madras Agric. J. 75 (3-4): 114-118 March-April 1988

PHOTOSYNTHETIC EFFICIENCY AND RELATED FACTORS ON GREENGRAM (VIGNA RADIATA (L.) WILCZEK) GENOTYPES IN RELATION TO YIELD

V. DHANDAPANI AND J. SAKHARAM RAO

Relationship existed among photosynetehtic efficiency, chlorophyll content, carbohydrate status, nodele number, nodule weight and yiele. The direct relationship of the above characters with yield brought out their participation through photosyntehtic efficiency.

Genotypic variability has been noted in respect of the yield and other yield attributing characters Physiological studies on photosynthetic efficiency and related factors shall assist the plant breeders in evolving desirable plant type in crop improvement programme. With the objective of making a comparative assessment 15 genotypes of greengram were subjected to evaluation. Dornhoff and Shibles (1970) planned a series of experiments by using Infra Red Gas Analyser (IRGA) for providing possible evidence for the natural differences in soybean in relation to photosynthetic efficiency. In mungbean, leaf chlorophyll content at flowering stage had a high concentration associated with enhanced Net Assimilation Rate (Anon., 1977).

The pattern of distribution of assimilates in soyabeans using ^{14}C was elaborated by Stephenson and Wilson (1977) involving movement of current photosythnates directly from leaves to pod. Photosynthetic efficiency has been attempted in relation to Geen gram yield.

MATERIALS AND METHODS

Findings outlined in this article were carried out during 1978-81 in the Department of Crop Physiology, Tamil Nadu Agrl. University, Coimbatore-3. The crop was raised during February-April, 1980 (Summer season) under irrigated condition. The fertilizers applied were 25 kg N as urea and 50 kg P as super phosphate per hectare. To bring out the photosyntehtic efficiency and related factors in 15 genotypes of greengram grouped as high yielders (PIMS 4, CO. 3, 11/99, ML 69 and Pusa Baisakhi), medium yielders (T44, 11/395, LAM GG 127, ML 73 and 10/303) and low yielders (KM1, PH 6, ML 62, DM/2 and MH 1) experiments were planned. For measuring photosynthetic rate third leaf from top was used, sampled at four stages viz., vegetative, stray flowering, peak flowering and harvest and the rate was measured using an Infra Red Gas Analyser (IRGA), model 225-213-SS Gas Analyser, Hoddesdon, England employing differential measurement technique, The contents of chlorophyll a, b and total, were estimated following the method of Yoshida *et al* (1971) at the above stages. Nodules were counted for each plant in each replication at weekly intervals from 15 days after sowing and design as I (15); II and average was worked out. Correspondingly, dry weight of these nodules was estimated and expressed in mg. The yield per plant VIII (64) was also worked out and presented. Carbohydrate was estimated by colorimetric method described by Somogyi (1952).

RESULTS AND DISCUSSION

i. *Photosynthetic rate* : At vegetative stage the rate did not vary much between the genotypes; whereas at stray and peak flowering, high yielding genotypes alone recorded higher rates. At harvest stage, the same tended to decline. In the case of PIMS 4, 11/99 and ML 69, the decline at harvest was

Tamil Nadu Agricultural University, Coimbatore-641 003.

comparatively less than the previous stage. Most of the differences were at vegetative or stray flowering stage indicating significance of photosynthetic rate at vegetative or stray flowering. However, at the vegetative stage the photosynthetic rates were not closely associated with yielding ability The medium yielders like T, 44 and low yielder like KM 1 have also recorded high rates. But, at the stray as well as peak flowering stages most of the high and medium yielders had their rates compared to the low yielders. Net photosynthesis generally increased prior to pod filling irrespective of grain. Dornhoff and shibles (1970). At the final stage, because of the increased senescnce of the leaves, the rates were seen to decline. Tha high yielders mostly maintained a better photosynthetic rate when compared to medium or low yielders. From peak flowering to harvest, however the photosynthetic rate mostly coincided with the amount of carbohydrate (Fig. 1) and its moblization to the seed. This status assures special significance it provides specific information as to the capacity of individual genotype and the groups to which they belong to.

Fig. 1: Photosynthetic rate and amount of carbohydate in 15 Genotypes of greengram

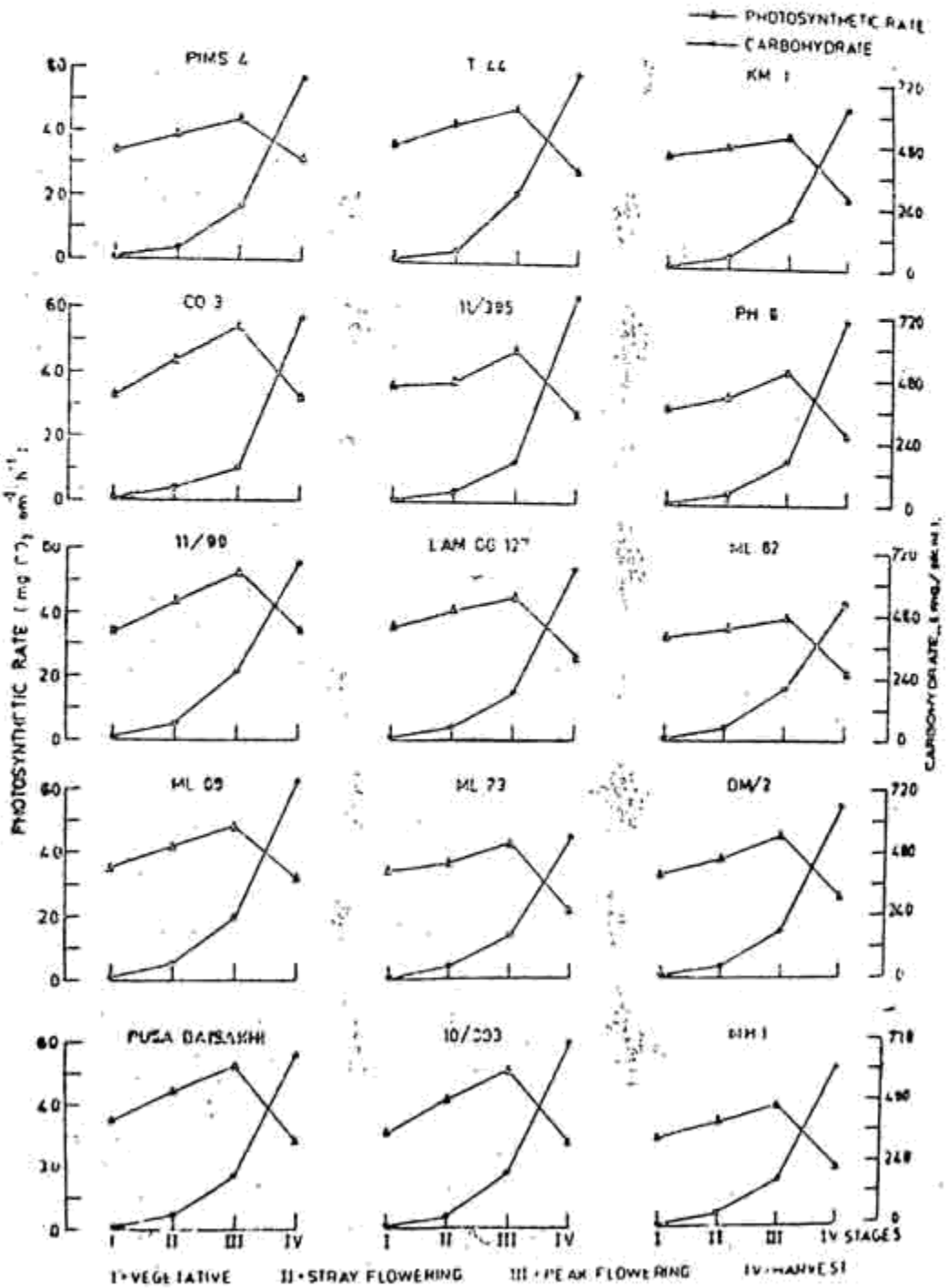

Table-1 Content s of chlorophyll 'h', 'b' and 'total' in leaves of 15 genotypes of greengram.

Geno-type	Chl. 'a' (mg/g)				Chl. 'b' (mg/g)				Total Chl. (mg/g)				Yield/plant (g)
	I	II	III	IV	I	II	III	IV	I	II	III	Iv	
PIMS 4	0.315	0.424	0.721	0.401	0.284	0.424	0.541	0.256	0.599	0.848	1.262	0.657	4.25
CO 3	0.261	0.388	0.586	0.298	0.257	0.381	0.505	0.247	0.518	0.769	1.091	0.545	4.15
11/99	0 319	0.337	0.547	0.358	0.299	0.299	0.507	0.305	0.616	0.636	1.054	0.663	3.80
ML 69	0.399	0.344	0.563	0.332	0.313	0.313	0.493	0.271	0.652	0.657	1.056	0.603	3.58
Pusa Baisakhi	0.258	0.358	0.561	0.362	0.244	0.344	0.469	0 343	0.502	0.692	1.030	0.705	3.56
T 44	0.204	0.304	0.564	0.223	0.197	0.277	0.432	0.260	0.401	0.581	0.996	0.503	3.30
11/395	0.242	0.292	0.519	0.295	0.218	0.268	0.501	0.240	0 460	0.560	1.050	0.535	3.26
LAM GG 127	0.225	0.310	0.452	0.288	0.202	0.304	0.418	0.248	0.427	0.614	0.870	0.536	3.19
ML 73	0.244	0,294	0,540	0,248	0.236	0.286	0.477	0.190	0.480	0.580	1.017	0.438	3.16
10/303	0.264	0.264	0.522	0.258	0.231	0.231	0.446	0.205	0.495	0.496	0.968	0.460	3.09
KM 1	0.227	0.217	0.435	0.268	0.190	0.199	0.423	0.192	0.417	0,416	0.858	0.460	2.68
PH 6	0.204	0.209	0.473	0.188	0.177	0.204	0.425	0.120	0.381	0.413	0.898	0.308	2.56
ML 62	0,233	0.294	0.418	0.189	0.223	0.186	0.366	0.142	0.456	0.480	0.784	0.331	2.42
DM/2	0,220	0.225	0.415	0.250	0.193	0.202	0.408	0.202	0.413	0.427	0.823	0,452	2.38
MH 1	0.229	0.290	0.477	0.198	0.219	0.214	0.391	0.147	0.448	0.504	0.868	0.345	2.15

I = Vegetative ; II = Stray flowering ; III = Peak flowering ; IV = Heryest stage.

Table-2 Number of nodules per plant in 15 genotypes of greengram at chosen stages of growth.

Geaotype	I	II	III	IV	V	VI	VII	VIII stages	Yield/ Plant (g)
PIMS 4	20	20	23	29	37	57	37	18	4.25
CO 3	19	24	25	24	32	45	38	13	4.15
11/99	13	23	24	25	39	41	35	23	3.80
ML 69	23	24	25	28	31	38	30	17	3.58
Pusa Baisakh.I	14	22	24	30	32	36	28	19	3.56
T 44	9	21	23	28	30	37	31	14	3.30
11/395	10	17	21	24	30	34	32	9	3.26
LAM GG 127	8	15	22	25	25	34	29	13	3.19
ML 73	3	21	22	27	30	34	29	12	3.16
10/303	3	15	20	23	24	32	28	11	3.09
KM	2	7	17	19	21	29	27	8	2.83
PH 6	3	16	14	16	25	34	24	6	2.56
ML 62	3	13	18	19	21	26	20	4	2.46
DM/2	2	11	18	20	21	29	24	5	2.38
MH 1	2	12	16	21	24	31	27	8	2.15
CD	—	—	—	—	—	—	—	—	0.73

ii Chlorophyll content (*Table 1*) : Components of chlorophyll were estimated in leaf at four stages and the results showed clear trend. Regarding chlorophyll 'a', it increased gradually from vegetative stage to peak flowering, but subsequently decline to nealy half the value. This was the pattern of distribution in every gonotype. It was evident in that the content of chlorophyll was higher in high yielders, moderate in medium yielders and comparatively low in low yielders. The difference between the genotypes was obvious at stray flowering, being more pronounced at peak flowering. For instance, in high yielders it ranged from 0.547 to 0.721 mg/g, in medium yielders from 0.519 to 0 564 mg/g and in low yielders from 0 415 to 0.477 mg/g. Irrespective of genotypers the content of chlorophyll 'b' was lower than chlorophyll 'a' at all the stages sampled. at stray flowering, it was possible to demarcate the groups with reference to content of chlorophyll 'b'. A Subsequently except for one or two genotypes the rest of the members could be identified to their respective group from the value estimated. Total chlorophyll content showed distinct difference in value among high, medium and low yielders. The estimation of chlorophyll components clearly revealed that chlorophyll 'a', 'b' and ,total' were more in high yielding group. Bansal and Singh(1975) suggested that chlorophyll can be related to yield. The chlorophyll status is supposed to enhance the Net Assimilation Rate(NAR) in mungbean(Anon, 1977) In the present investigation also a relationship existed between the chlorophyll components, photosynthesis, carbohydrate and yield.

iii. *Nodule number* (*Table 2*) *and nodule wight* (*Table* 3)

All the genotypes individually showed increase in nodule number upto the 6th stage or peak flowering and thereafter recorded a steepfall. It was evident in that all the members of the three groups showed appreciable difference in nodule number at all stages. Taking into account the data relating to the peak

Table-3 Dry weight of nodules per plant (mg) in 15 genotypes of greengram at chosen stages of growth

Genotype	I	II	III	IV	V	VI	VII	VIII	Yield/ Plant (g)
PIMS 4	37	43	58	100	91	133	102	53	4.25
CO 3	34	66	80	81	100	180	105	79	4.15
11/99	28	45	97	100	117	160	144	93	3.80
ML 69	37	50	59	78	116	150	125	54	3.58
Pusa Baisakhi	27	54	63	84	98	166	110	82	3.56
T 44	23	53	42	72	92	147	93	38	3.30
11/395	16	40	53	63	83	124	100	35	3.26
LAM GG 127	21	28	54	67	80	109	89	38	3.19
ML 73	20	37	49	70	78	147	94	37	3.16
10/303	15	30	43	65	73	116	101	36	3.09
KM 1	10	13	43	59	62	73	70	30	2.83
PH 6	16	18	19	52	67	100	68	35	2.56
ML 62	15	25	44	53	46	95	49	26	2.42
DM/2	12	37	39	44	57	69	84	30	2.38
MH 1	12	35	44	56	60	71	56	28	2.15
CD	—	—	—	—	—	—	—	—	0.73

nodule number, the high yielders recorded from 36 to 57/ plant, the medium yielders 32 to 37/ plant while low yielders from 26 to 34/ plant. Again, towards harvest the differences were obvions. The genotype 11/99 at harvest gave the highest value of 23 nodules against 5 recorded in DM/2. Considering the nodule weight, the data reflected the same position as the number of nodules. The maximum weight in all the members except DM/2 was recored at 6th dstage which coincided with peak flowering. The subsequent drop towards harvest was rather very steep. Irrespective of the stages, both nodule number and weight were more in high and medium yielders when compared to low yielders. A progressive increase upto sixth stage and subsequent decline towards harvest was the general trend in all the genotypes Lawn and Brown (1974) in soybean also recorded high nodulation at flowering stage and a reduction thereafter.

REFERENCES

ANONYMOUS. 1977 Mungbean, AVRDC progress report 45-53.

BANSAL, K. N. and H. G. SINGH. 1975. Interrelationship between sulphur and iron in the prevention of iron chlorosis in cowpea. *soil sci. 120* : 20-24.

DORNHOFF, G. M. and R. M. SHIBLES. 1970. Varietal differences in net photosynthesis of soybean leaves. *Crop Scl. 10* : 42-45.

LAWN, R. J. and W. A. BRUN 1974. Symbiotic nitrogen fixation in soybeans. I. Effect of photosyntehtic source-sink manipulations *Crop scl. 14* : 11-16

SOMOGYI, M. 1952. Note on sugar deter mination. *J.* Biol. Chem. 2002: 145-154.

STEPHENSON, R. A. and G. L. WILSON. 1977. Patterns of assimilates distribution in soybean at maturity. 2. The time course of changes in ^{14}C distribution in pods and stem sections. *Aust. J. Agric. Res. 28* : 395-400.

YOSHIDA, S. and D. A. FORNO and J. H. COCK. 1971. Laboratory manual for physiological studies of rice. IRRI publication philippines 36-37.