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https://doi.org/10.29321/MAJ.10.A02348

Madras Agric. J. 72. (2) 71-77 February 1985.

SEED AND SEEDLING PHYSIOLOGY OF GREENGRAM GENOTYPES (*Vigna radiata* (L.) Wilczek) IN RELATION TO YIELD

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The comparative assessment of seed and seedling physiology, water absorption rate, coefficient of velocity of germination (CVG), vigour index (VI), shoot and root characters showed high significance and reliability in the evaluation of greengram genotypes. Study of seed leachates showed that members of the low yielding group, leached more of total sugars, total amino acids and potassium as compared to medium or high yielders. Leaching out of useful substances, beyond a level as noted in low yielders is not desirable.

The object of the present study was to have a reasonable assessment of the differences in seed and seedling physiology of genotypes chosen for the study. In comparative seed and seedling physiology, 16 parameters were considered in this study. Although pulses are comparatively low yielders, among the genotypes wide range of variability is seen, not only in respect of the yield, but in the case of other characters also. Physiological studies if undertaken in a greater depth in seed and seedling will assist the plant breeders in isolating desirable material to be employed in breeding programme. Germination and attendant characters have been considered important in pulses like greengram in view of the hard seed coat characters as well as protein content. Leaching out of essential substances from the seed during soaking is another disadvantage. With the object of working a comparative assessment and evaluation, 15 genotypes of greengram were chosen for the present study and arbi-

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trarily grouped into three units namely high, medium and low yielders. Being almost of same duration, the wide differences in yield can be explained mainly on the physiological basis. Hence comparative laboratory observations were planned to achieve the above objective.

MATERIALS AND METHODS

The laboratory work was carried out during 1978-81 in the Department of crop physiology, Tamil Nadu Agricultural University, Coimbatore-3. In the present study an attempt was made to bring out the differences in seed and seedling physiology of 15 genotypes of greengram which were arbitrarily grouped into 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 (KMI, PH 6, ML 62, DM/2, and MH 1). The seed and seedling characteristics were studied in the laboratory except the field emergence which was recorded in the field. For the quantitative analysis, replicated samples were taken and analysed. Standard and accepted procedures were adopted both quantitative and qualitative aspects.

RESULTS AND DISCUSSION

Sixteen important characters of seed have been chosen and for matter of convenience except water absorption rate others are presented

Table-1 Water absorption rates in seeds of 15 genotypes of greengram as fresh weight and percentage increase.

Genotype	Increase in fresh weight and percentage at								
	0	4		8		12		16 hours	
	Wt (g)	Wt (g)	% over control	Wt (g)	% over control	Wt (g)	% over control	Wt (g)	% over control
PIEMS 4	0.59	1.24	110.6	1.99	240	2.79	326	3.60	514
Co 3	0.64	1.22	90.9	1.92	199	2.67	316	3.47	441
11/99	1.13	1.65	46.1	2.79	148	4.08	261	5.47	385
ML 69	0.95	1.43	50.7	2.14	126	3.09	226	4.28	351
Pusa Baisakhi	0.98	1.41	45.4	2.21	127	3.20	229	4.37	349
T 44	1.01	1.29	27.5	2.15	112	3.14	210	4 21	317
11/395	0.89	1.35	50.1	2 03	125	2.87	219	3.78	321
LAM GG 127	0.90	1.07	18.4	1.56	72	2.22	146	3.03	236
ML 73	0.96	1.31	36.7	2.13	121	3.14	227	4.27	344
10/303	0.85	1.12	32.1	1.57	85	2.26	167	3.05	260
KM 1	0.91	1.23	35.9	1.77	94	2.38	162	3.05	236
PH 6	0.90	1.21	34.2	1.65	82	2.23	146	2.93	224
ML 62	0.84	1.06	25.3	1.51	79	2.18	159	2.89	243
DM/2	0.88	1.09	24.4	1.68	90	2.39	172	3.13	256
MH 1	1.06	1.36	28.8	1.99	88	2.75	161	3.59	240

Table 2. Germination and seedling characters in 15 genotypes of greengram

Genotype Name	Germination (%)	Field emergene (%)	CVG	VI	Shoot length (cm)	Root length (cm)	Shoot Wt (mg)	Root Wf	S/R	DMP (mg)
PIMS 4	98.0	98.7	33.62	2192	17.7	7.6	19.3	3.0	6.45	22.4
Co 3	98.7	98.3	33 32	2286	17.3	8.0	20.0	3.2	6.21	23.2
11/99	99.7	98.8	33.66	2574	17.3	7.0	22.5	3 0	7.47	25.5
ML 69	98 3	98,0	33.60	2229	17 7	7.7	19.5	3.2	6.17	22.7
Pusa Baisakhi	99.3	98.3	33.29	2271	18.0	7.4	20.2	2.7	7.62	22.9
T 44	97.3	97.3	32.17	1947	16.9	5 8	17.3	2.7	6.53	20.0
11/395	98.7	96.3	32.03	2058	16.2	5.0	18.2	2.7	7.17	20.9
LAM GG 127	97.7	97 0	32.07	2026	16.4	5.9	18 0	2.7	6 79	20 7
ML 73	96.0	96.3	32.00	1969	17.1	5.8	17.8	2.7	6.70	20.5
10/303	97.0	96.7	32.49	2025	15.9	5.4	18,3	2.6	7.09	20.9
KM 1	93.3	96.0	31.70	1679	16.0	5.3	15.5	2.5	6.20	18 0
PH 6	94.3	95.3	31 35	1744	16.9	5.2	16.3	2.4	6.98	18 5
ML 62	93.3	96.0	31.29	1726	16.1	5.4	16.0	2.5	6.07	18.5
DM/2	90.0	95,7	31.31	1740	16.4	5.6	16.5	2.8	5.87	19.3
MH 3	95.7	95.3	31.00	1817	16.2	5.5	16.7	2,3	7.22	19.0
SE	0.82	0.9	0.22	54.38	0.4	0.44	0.49	0.15	0.37	2.73
CD (P = 0.05)	2.38**	* 2.62 NS	0.64**	157.50**	1.15**	1.29**	1.42**	0.44**	1.08*	7.90 NS

together to have a better idea of the similarities and differences.

Water absorption rate (Table 1): It was studied for a duration of 16 hours at four intervals. In all genotypes water absorption rate progressively increased from soaking time till the final sampling.

In considering the percentage of increase at the end of four hours, PIEMS 4 and Co 3 recorded maximum absorption rates of 110 6 and 90.6 per cent over the control. In respect of medium yielders except LAM GG 127, others maintained moderate range generally. Among low yielders except KM 1 others recorded low values. At the end of 8 hour the high as well as medium yielders improved the rate of absorption sufficiently except LAM GG 127. At the end of 12 hours there was considerable increase in rates in all the genotypes which showed maximum rates at 16 hours. In grain legumes like greengram water absorption rates are known to be more than in cereals, the nature of protein being largely responsible for this physical property as reported by Mayer and Maber (1966). With adequate hydration, the subsequent processes naturally reflect the initial capacity and three groups could be identified with some amount of certainty.

Ten seedling characters (Table 2) were considered for the study and the data reported. The genotypes G 1 to G 5 recorded rather close and high *germination*. Among the medium yielders, genotype 11/395 recorded 98.7 percent. The data were significant at one percent level indicating that the genotypic performance was according to the ranking. Perry (1973) concluded that low germination generally resulted in poor yield. The values relating to *field emergence* were similar to germination percentage perticularly in high and medium yielders. However between genotypes the results were not significant. The *coefficient of velocity of Germination* (CVG) was lowest in MH 1, a low yielder and highest CVG was in genotype 11/99 although it ranked third in the first group. The genotype differences were significant at one percent level. The Vigour Index (VI) with range of difference between 2192 and 2574, from 1947 to 2058 and from 1679 to 1817 was noted in the high, medium and low yielders respectively. The results were highly significant. The shoot length of five numbers of the high yielding group were better than the rest. At the same time between medium and low yielders there was not much of difference. Between genotypes the significance was very high. On the other hand root length indicated some clear so advantage in high yielding group and was significant at one percent level among genotypes. Regarding shcot weight among high yielders, 11/99 recorded a maximum of 22.5 mg while the lowest value of 15.5 mg was in KM 1, a low yielder. The medium yielders registered intermediate values and statistically the data were highly significant. Regarding root weight, high yielders showed ranging value of 3.0 to 3.2 mg The medium yielders uniformly recorded 2.7 mg except genotype 10/303. While DM/2 recorded 2.8 mg in this group. For this factor too high level of significance was established. The data on S/R ratio was significant at

five percent level and slight variation among the genotypes and group was evident The dry matter production (DMP) was high in high yielders and low in poor yielders but statistically the data were not significant. Among the seedling characters as well as ratio, the CVG, VI, shoot and root weight were highly significant among the genotypes thereby suggesting that these characters can be used in any comparative physiological study of greengram, seed leachate (Table 3). At the end of 16 hours soaking, the pH as well as a few characters of the leachate were studied and reported. The pH of the seed leachate ranged from 5.75 to 5.85, 5.80 to 6.00 and 6.10 to 6.20 in low, medium and high yielders respectively. The low yielding group showed more acidic nature. The seed extracts appeared to show somewhat narrow variations to pH level but possible association of these pH values with suggested group was indicated. Regarding electrical conductivity (EC) the data amply showed that there was in general an inverse trend between yielding ability and EC. Genotype PIMS 4 recorded a value of 0.225 mmhos/cm whereas the

Table 3. pH, Electrical Conductivity, total sugars, total aminoacids and potassium content in the seed leachates of 15 genotypes of greengram.

Genotype Name	pH	E. C. (mmhos/cm)	Total sugars (μg/g)	Total amino acids (μg/g)	K (μg)
PIMS 4	6.20	0.225	600	397	8.3
Co 3	6.15	0.255	500	352	8.2
11/99	6.10	0.250	620	391	8.8
ML 69	6.15	0.245	540	364	8.4
Pusa Baisakhi	6.10	0.235	360	301	7.6
T 44	6.00	0.250	650	406	11.4
11/395	6.00	0.355	740	428	10.5
LAM GG 127	5.90	0.345	790	404	11.4
ML 73	5.80	0.340	880	407	11.5
10/303	5.80	0.335	900	416	11.0
KM 1	5.85	0.345	1090	437	12.4
PH 6	5.75	0.345	1130	619	12.5
ML 62	5.80	0.360	1110	504	12.9
DM/2	5 80	0.355	1190	644	13.6
MH 1	5.85	0.365	1160	410	12.8

lowest yielder MH 1 recorded a high EC of 0.365 mmhos/cm. Hegarty (1977) opined that for identifying better sample in seed stock counductivity test was dependable. It was not desirable to have higher EC in the leachate which only showed that much of useful soluble substances

are lost from the seed. The values of EC in the 15 genotypes clearly showed that this factor was related to the initial performance of the seed, like germination, VI to CVG As suggested by Abdul-Baki and Anderson (1970, 1972) and Edje and Burris (1970) the high conductivity and free leaching are primarily related to disorganisation of cellular memberanes and loss of control of permeability. The total sugars in the leachate suggested strongly that the low yielders leached out more of sugars as compared to medium or high yielders. The distribution of total amino acids was somewhat specific atleast in the high and medium yielding groups. For, instance the range of total amino acids was 301 to 397 μg/g among high yielders and from 406 to 428μg g among medium yielders. On the other hand the range of variation was from 410 to 644 μg/g among low yielders. The values relating to potassium content in the leachate were more specific to suggest that higher content in leachate was not very desirable. However, between the members of each group the values were not generally associated with the ranking indicated. The progressive increase in potassium content between the genotypes was characteristic Proportionately larger quantities of total sugar, total amino acids and potassium in the leachates were not desirable. It was also observed that desirable seedling behaviour like germination, VI and CVG were related to the leachate values of these substances.

Five characters relating to seed and seedling physiology namely germination, field emergence, CVG VI and DMP were framed in a correlation matrix with yield and results are presented in table 4. It is not proper to correlate that factors with yield since many matabolic change occur during crop growth due to enzyme relationship, metabolic activities, translocation and other phenomena. However the matrix showed high positive correlation between these factors and yield. Atleast it could be understood that in greengram genotypes these characters may serve as useful indices in selection of genotypes. Further these characters should be considered as efficient participants atlease in the establishment and growth of seedling influence being mostly indirect.

Table 4. Correlation matrix of seed and seedling characters in 15 genotypes of greengram with reference to yield.

Characters	Germination (%)	Field emergence (%)	CVG	VI	DMP (mg)
Yield per plant (G)	0.610**	0.670**	0.762**	0.665**	0.649**
Germination	—	0.451**	0.661**	0.770**	0.669**
Field emergence	—	—	0.650**	0.582**	0.578**
CVG	—	—	—	0.823**	0.807**
VI	—	—	—	—	0.988**

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Madras Agric. J. 72. (2) 77-81 February 1985.

EFFECT OF METHODS OF PHOSPHORUS APPLICATION ON THE YIELD, CONTENT AND UPTAKE OF PHOSPHORUS AT DIFFERENT STAGES OF CROP GROWTH BY RICE I. R. 20.

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A field experiment was conducted on red sandy clay loam (Typic Haplustalfs) with rice IR. 20 as test crop to find out the efficacy of different methods of phosphorus on the yield, content and uptake of P at different stages of crop growth. The treatments consisted of full basal application, half basal + foliar and foliar application, alone and in combination with slurry dipping of roots. The results revealed that slurry dipping with half basal and foliar application of 2% DAP recorded an yield of 5312 kg/ha of rice grain and it was on par with treatment, slurry dipping alone (5240 kg/ha). The content and uptake of P were increased at all the stages of crop growth due to slurry dipping. The P recovery was also the highest (18.7%) in slurry dipping alone.

Phosphorus is an essential input and its deficiency is a major constraint for successful crop production in India. Thus there is a need for the application of phosphorus for achieving higher yields of crop. Judicious management of P should take into account of the soil factors, fertilizers and their time and method of application. Crop recovery of added 'P' seldom exceeds 20% and there is a need to increase the efficiency of P utilization Ramasamy *et al* (1974) observed slurry dipping gave yield comparable to that of basal application. However, Gopal Rao (1974) reported that entire dose of P applied as basal gave the highest yield. Gupta (1971) indicated that foliar application not only increased the yield but also the

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