recorded only 3.04 g. Foliar application of N and P through DAP may be effective in extending the maturity period by delaying senescence *ie.*, increased leaf area duration, which ultimately reflected in number of seeds and test weight through translocation of more quantity of metabolites as reported by Patel *et al.* (1984).

Yield

Dibbling in rice stubbles with stubble mulch (M_4) produced higher grain yield of 593 kg ha^{-1} which was 28 per cent more than relay sowing. Optimal plant population evenly distributed over the land surface resulted in greater LAI which inturn produced increase in yield under dibbling (Kumar *et al.* 1992). Application of basal and foliar nutrient increased the grain yield by 37.5, 20.7 and 22.5 per cent over control, basal N and P fertilizer only and DAP spray respectively. Foliar application of DAP might have created a positive source - sink gradient of photosynthates translocation resulting in increased yield attributes and yield of green gram under rice fallow condition.

Economics

Higher grain yield of green gram under rice fallow condition was noticed in dibbling with stubble mulching combined with basal application of N and P fertilizers and two per cent DAP spray twice (M_4S_4) led to increased net return as compared to other treatments. But the net return per rupee invested was higher under dibbling and stubble mulched with two per cent DAP alone sprayed plots (M_4S_3) since the involvement of higher cost towards basal N and P fertilizer to the former treatment.

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(Received:September 2000; Revised: August 2001)

Madras Agric. J. 88(7-9): 409-413 July-September 2001
https://doi.org/10.29321/MAJ.10.A00356

Stability of yield and its components in black gram

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Abstract : Sixty five genotypes of black gram consisting of fifteen parents and their fifty hybrids were evaluated for stability in four environments differentiated by locations. Both linear and non-linear components of G x E interaction were significant for clusters/plant and pods/plant, while only non-linear component was significant for grain yield. The study of stability parameters revealed that the parent T9 and hybrids ADT 3 x TAU 5 were found to be stable over the environments with desirable high mean yield. *(Key words : Black gram, Yield stability)*

Seed yield is quantitatively inherited character and there is considerable interaction between genotypes and environments. Some of the crop varieties are widely adapted, whereas others are not so. Multilocation / multi-environtnent testing of genotypes provides an opportunity to the plant breeders to study the adaptability of a genotype to a particular environment and also the stability of the genotype over different environments. The genotypes x environment interaction is of major importance to the plant breeder in developing improved varieties. In the present study 65 genotypes have been evaluated for identifying stable genotypes in blackgram.

Materials and Methods

Sixty five genotypes comprising of 15 parents and their resultant 50 hybrids obtained through L x T mating design were evaluated during *kharif* 1996 under four environments differentiated by locations *viz.*, Millet Breeding Station, Coimbatore (E1), National Pulses Research Centre, Vamban (E2), Agricultural Research Station, Pattukkottai (E3) and Coconut Research Station, Veppankulam (E4). The trials were conducted in randomised block design replicated thrice in each environment. Each genotype was sown in single row of 1.5 meter length with a spacing of 30 X 10 cm. Observations were recorded on five randomly selected plants per replication in each hybrid and parents in all locations for three characters *viz.* clusters/plant, pods/plant, and seed yield / plant. The data were analysed for stability as per the method suggested by Eberhart and Russell (1966).

Results and Discussion

Pooled analysis of variance (Table 1) revealed significant differences among the genotypes and environments used in this study. Significant mean square due to environment + genotype x environment interaction showed differential response of genotypes to the changing environment. Singh *et al.* (1994), Kandaswami (1995) and Manivannan *et al.* (1997) reported similar findings in black gram. Both linear and non-linear components of G X E interaction were significant for cluster/plant and pods/plant indicating that the genotypes responded linearly to environmental changes in respect of these characters. The non-linear components were significant for all the characters studied.

Table 1. Analysis of variance for stability

Source	df	Mean squares		
		Clusters/plant	Pods/plant	Seed yield/plant
Genotypes	64	45.57**	232.29**	23.64**
Environment + (Genotype x Environment)	195	23.54	116.35	5.36
Environment (linear)	1	3148.75**	16219.01**	433.51**
Genotype x Environment (linear)	64	9.89*	48.99**	2.64
Pooled deviation	130	6.22**	25.64**	3.41**
Non linear : linear		1:0.63	1:0.52	1:1.29

* Signfiicant at 5% level ** Significant at 1% level

Table 2. Environmental index for three characters

Characters	Environments			
	E_1	E_2	E_3	E_4
Clusters/plant	-2.54	5.64	0.08	-3.18
Pods/plant	-2.76	13.32	-322	-7.36
Seed yield/plant	0.20	1.51	0.36	-2.06

Table 3. Stability parameters for different characters

Genotypes	Clusters/plant			Pods/plant			Seed yield/plant		
	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
Co 5	12.67	0.40	6.65**	27.56	0.55	77.89**	6.25	0.96**	5.94**
ADT 3	13.78	0.51	0.92*	31.34	0.70	-0.33	7.51	0.99	0.19
ADT 4	12.32	0.52	2.02**	28.77	0.39	7.49**	6.87	0.65	0.75**
ADT 5	12.92	0.11	10.04**	29.26	0.13	3.54**	7.79	0.38	3.31**
Vamban 1	14.82	0.90	-0.05	32.79	1.00	13.99**	8.55	1.49	0.03
Pant U 30	15.06	0.69	3.31 **	33.41	0.83	1.41	8.31	1.08	1.46**
T 9	15.34	0.38	3.85**	41.48	0.67	0.82	10.42	0.61	-0.10
PDU 10	11.40	1.18	0.61	29.45	1.12	-0.74	6.74	0.98	0.23
PDU 104	12.28	0.73	0.13	29.73	0.98	-0.74	6.22	0.87	1.16**
TMV 1	15.08	0.70	0.73	34.45	0.91	1.90	8.68	0.87	0.32**
TAU 5	15.97	0.83	1.82**	35.01	0.78	12.15**	8.86	0.69	2.31 **
TAU 12	13.31	1.03	10.15**	28.54	1.08	42.23**	6.77	1.50	2.04*
WBG 57	13.68	0.78	0.14	33.80	0.84	4.08**	7.42	0.85	0.39**
VB 3	11.21	0.40	3.80**	27.41	0.46	20.47**	7.28	1.02	1.20*
VB 20	16.04	0.65	0.44	36.11	0.75	1.19	8.81	1.28	0.41**
Co 5 x TAU 5	14.52	1.18	13.10**	34.23	1.55	10.72**	8.29	2.67	12.28**
Co 5 x TAU 12	12.94	1.20	18.31 **	29.64	1.36	85.79**	7.30	1.86*	13.44**
Co 5 x WBG 57	16.95	1.15	3.90	32.26	1.50	72.07**	9.67	2.26**	7.44**
Co 5 x VB3	12.30	0.61	9.69**	28.25	0.94	88.71 **	7.38	1.03*	8.94**
Co 5 xVB 20	15.74	1.22	1.39*	36.10	1.44	10.40**	9.77	1.69	0.14
ADT 3 x TAU 5	19.06	0.95	3.76**	44.27	1.06	38.33**	11.55	0.64	0.14
ADT 3 x TAU 12	13.01	1.55	5.54**	32.03	1.27	12.13**	7.37	1.43	0.51*
ADT 3 x WBG 57	17.74	1.29	0.62	38.33	1.01	4.80**	8.44	1.23	0.12
ADT 3 x VB 3	13.16	1.80	7.27**	29.72	1.56	5.33**	6.59	1.30*	0.61**
ADT 3 x VB 20	16.91	1.59	2.13**	40.52	1.93	14.78**	9.53	2.16	11.81**
ADT 4 x TAU 5	14.33	0.62	2.41 **	32.27	0.59	4.08**	6.71	0.79	0.50*
ADT 4 x TAU 12	13.97	0.44	1.27**	29.50	0.73	19.00**	5.82	-0.05	0.65**
ADT 4 X WBG 67	14.51	1.34	6.90**	33.51	1.01	19.12**	7.29	0.72	2.20**
ADT 4 x VB 3	16.63	0.26	30.43**	33.95	0.14	2.36**	7.12	-0.11	6.33**
ADT 4 X VB 20	16.12	0.74	3.97**	36.88	0.74	47.10**	8.16	0.10	2.48**
ADT 5 x TAU 5	12.30	1.62	6.28**	27.39	1.44	4.36**	5.66	0.65	1.46**
ADT 5 x TAU 12	13.29	1.06	5.29**	28.62	1.08	15.87**	5.85	1.10	2.67**
ADT 5 x WBG 67	13.25	1.02	1.66**	31.09	0.86	4.90**	6.45	0.48	2.13**
ADT 5 x V13 3	17.72	0.02	24.04**	39.66	-0.26	6.45**	8.71	-01.62**	7.05**
ADT 5 x VB 20,	13.29	1.52	4.82**	31.57	1.61	4.60**	76.76	0.46	-0.03

Contd...

Vamban 1 x TAU 5	15.49	1.25	4.71**	35.22	1.41	6.31**	8.52	0.69	1.86**
Vamban I x TAU 12	15.82	1.57	2.18**	34.99	1.57	3.90**	8.06	1.67**	4.75**
Vamban 1 x WBG 57	13.39	1.11	8.03*-	36.38	1.20	22.24**	9.34	0.72	1.02**
Vamhan 1 x VB 3	15.34	0.49	11.38**	34.48	0.27	58.39**	8.35	-0.13	9.98**
Vamban I x VB 20	17.63	0.99	22.00**	40.77	0.64	138.33**	9.37	0.62	14.48**
Pant U 30 x TAU 5	18.29	1.47	1.44**	43.26	1.10	69.34**	11.03	1.70	14.44**
Pant U 30 x TAU 12	12.54	0.76	0.10	29.67	0.88	9.54**	6.39	0.44	0.00
Pant U 30 x WBG 57	14.58	0.71	-0.20	34.14	0.89	0.75	7.16	0.34	1.99**
Pant U 30 x VB 33	14.49	1.20	4.13**	30.30	1.16	2.17	6.58	0.73	0.25**
Pant U 30 x VB 20	15.05	0.90	-0.20	36.17	0.95	21.85	9.51	1.29*	4.21**
T9 x TAU 5	18.99	0.28	21.16**	46.28	0.65	0.06	12.9	0.82	0.07
T9 x TAU 12	15.27	1.00	3.96**	31.99	1.74	22.44**	6.88	1.51*	3.39**
T 9 x WBG 57	15.16	1.24	1.77**	34.29	1.40	23.42**	7.83	1.22	4.35**
T 9 x VB3	13.72	0.92	28.85**	31.69	0.96	191.63**	7.99	1.46	13.02**
T 9 x VB 20	13.38	1.18	7.62**	32.74	1.62	2.11	7.49	0.79	0.71 **
PDU 10 x TAU5	12.32	0.50	4.16**	30.39	0.55	22.66**	6.35	0.38	3.09**
PDU 10 x TAU12	15.18	1.48	4.48**	31.63	1.23	16.81 **	6.64	1.10	2.15**
PDU 10 x WBG 57	15.48	0.91	0.53	34.64	0.85	5.27**	7.36	0.63	3.44**
PDU 10 x VB3	17.07	2.14	2.76**	33.52	1.60	1.88	7.98	1.82	1.10**
PDU 10 x VB 20	17.99	1.56	3.36**	38.83	0.67	23.79**	8.86	1.02	0.58**
PDU 104 x TAU 5	18.83	1.14	4.18**	39.6	0.65	0.03	11.08	1.70	9.40**
PDU 104 x TAU 12	14.52	0.74	3.17**	31.7	0.80	0.29	7.00	0.67	1.60**
PDU 104 x WBG 57	14.91	1.13	2.34**	34.88	1.03	41.93**	7.42	0.93	1.29**
PDU 104 x VB 3	17.04	1.59	-0.11	34.85	1.72	11.06**	8.37	1.67	1.90**
PDU 104 x VB 20	15.51	1.01	4.71**	33.52	1.02	15.41**	8.03	1.15	1.38**
TMV 1 x TAU 5	17.67	0.97	23.27**	39.06	0.44	59.47**	10.25	0.69	6.94**
TMV 1 x TAU 12	13.62	1.22	2.82**	29.84	0.82	6.37**	6.92	0.55	0.04
TMV 1 x WBG 57	13.44	1.40	7.24**	31.11	1.35	3.39**	7.84	1.47	1.92**
TMV 1 x VB3	12.88	2.11	7.33**	28.05	1.76	1.99	7.13	1.84	1.98**
TMV 1 x VB 20	14.10	1.31	1.90**	30.97	1.28	32.45**	8.39	1.13	0.32**
G M	14.82			33.66			7.98		
SE	1.44			2.92			1.01		

* Significant at 5% level ; ** Significant at 1% level

The environmental index (Table 2) calculated as deviation of the mean of all genotypes at particular environment from the grand mean over the environments revealed, E_2 (National Pulses Research Centre, Vamban) recorded the substantial increase in the value of environmental index for seed yield and other characters, so the location E_2 proved to be the best environment to realise increased seed yield.

Estimates of mean performance (x), regression coefficents (b_i) and deviation from regression (S^2di) of sixty five genotypes for clusters per plant, pods/plant and seed yield are presented in Table 3.

In considering the stability of genotypes, the three stability parameters *viz.*, the grand mean over the environments, the regression coefficient and squared deviation from the regression were considered to be important. The regression coefficient around unity and the deviation from regression around zero indicate that the genotype possessing these attributes are stable over the environments.

Simultaneous consideration of these three parameters the parent T9, hybrids ADT 3 x TAU 5 and T9 x TAU 5 possessed higher mean performance than the population mean plus 2 SE (10.218/plant) coupled with non-significant unit regression and least deviation from regression for seed yield. Similarly the ADT 3 x TAU 5 for clusters/plant, and the parent T9 and T9 x TAU 5 for pods per plant showed desired stability parameters with high mean for respective characters.

Among the stability parameters, the potentiality of a genotype to express greater mean over environments is the most important parameter, since the regression coefficient and deviation mean squares may not be of any practical utility if the genotype is potentially weak. In the present study, T9, ADT 3 x TAU 5 and T9 x TAU 5 possessed stable performance over the environments with desirable mean above the confident limit of 2SE. Similarly ADT 3 x WBG 57 for clusters/plant and T9 and T9 x TAU 5 for pods/plant were stable with high mean.

As a whole, when all the three parameters were considered, the parent T9 and the hybrids ADT 3 x TAU 5 and T9 x TAU 5 recorded stable performance over the environments with high seed yield which are worthy for exploitation. However, there is no direct exploitation of the hybrid for general cultivation. In blackgram the high mean yield and phenotypic stability of the adaptable hybrids are expected to be inherited to their progenies (Malhotra *et al.* 1971).

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(Received: December 1998; Revised: September, 2001)