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GENETIC VARIABILITY IN NITRATE REDUCTASE ACTIVITY AND ITS RELATIONSHIP WITH YIELD IN SIX FRENCH BEAN (*PHASELOUS VULGARIS* L.) VARIETIES

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Abstract

In addition to nutrient use efficiency the nitrate reductase activity of the variety/ genotype is also an important criterion for selection of a variety for achieving higher yields. The experiment conducted with six French bean (*Phaselous vulgaris* L.) varieties showed that nitrate reductase (NR) activity among the varieties were found to be significant at 20 days and were non-significant at 40 and 60 days. Higher NR activity rates were positively related to dry matter accumulation and pod yield. The higher NR activity was observed in the varieties, which were recorded higher yields. Significant differences in fresh pod yield were observed amongst different varieties of French bean. Among the varieties tested, Arka Komal and IIHR-909 recorded higher yield besides higher nitrate reductase activity.

Key words : Genetic variability, yield, French bean (*Phaselous vulgaris* L.).

Introduction

Nitrate is one of the major sources of nitrogen in soil available to plants. The enzyme nitrate reductase catalyzes the reduction of nitrate leading to the availability of ammoniacal form of nitrogen for incorporation in to amino acids and proteins (Beevers *et al*., 1965) in addition to nutrient use efficiency, the nitrate reductase activity of the crop is also an important criterion for selection of variety for achieving higher yields.

Considerable work has been done in cereals and legumes to screen the genotypes in breeding programmes for nitrate reductase activity, which influences the yield potential. Hence the studies have been carried out to assess the ability of different varieties of French bean in nitrate reductase activity and its relationship with yield. (Eilrich and Hageman, 1973). A variety with better nutrient use efficiency would enable us in effecting considerable saving of fertilizers and achieving ecological balance. The present study was under taken to monitor the nitrate reductase activity in different French bean cultivars at different stages of growth and its impact on yield levels.

Materials and Methods

A pot culture study was conducted to assess the utilization efficiency of different varieties of Frenchbean. The experiment was carried out in the greenhouse of College of Agriculture, University of Agricultural Sciences., Gandhi Krishi Vigyan Kendra, Bangalore (Karnataka), India. The experiment was laid out in a randomized block design with 12 treatments and three replications. Six varieties (V_1 to V_6) of French bean were selected for the study. Among them two notified varieties *viz*., Arka Komal and contender served as standard checks (control). The remaining four varieties *viz*., IIHR-220, IIHR-909, Tweed Wonder and Pant Anupama were pre released varieties which were undergoing multi location trials for their performance all over the country. The fertilizer levels imposed were: F_1–100% recommended dose of NPK (@ 62.5 kg N:100KgP_2O_5:75 kg K_2O/ha) without FYM. F_2–50% recommended dose of NPK (@ 31.25 kg N: 50 Kg P_2O_5:37.5 kg K_2O/ha) + FYM @ 25 tones/ha.). Two plants plot^{-1} were maintained, adequate irrigation was given to maintain the pots at field capacity. Nitrogen was applied at two split doses whereas Phosphorous and Potassium were applied as basal dose. Recommended plant protection measures were adopted to control pests and diseases. Both soil and plant samples were collected at three stages of crop growth *viz*., 20th, 40th, 60th day of crop growth. Fresh pods were harvested twice.

Table 1 : Effect of fertilizer levels with and without FYM on the nitrate reductase activity (micro moles NO_2 hr^{-1} gm^{-1} fresh weight) of different French bean varieties.

Treatments	Varieties	Nitrate reductase activity		
		20 days	40 days	60 days
T_1	Arka Komal	2.00	1.08	1.09
T_2	IIHR-220	1.30	1.01	0.75
T_3	IIHR-909	1.77	1.02	0.81
T_4	Tweed wonder	1.98	1.24	1.02
T_5	Pant Anupama	1.80	1.64	1.06
T_6	Contender	1.42	1.39	0.99
50% NPK + FYM (F_2)				
T_7	Arka Komal	1.29	1.44	0.99
T_8	IIHR-220	1.92	1.01	0.77
T_9	IIHR-909	1.26	0.89	0.98
T_{10}	Tweed wonder	2.11	0.98	0.87
T_{11}	Pant Anupama	1.86	1.20	0.83
T_{12}	Contender	2.01	1.18	0.96
S. Em±		0.23	0.18	0.09
CD at 5%		0.67	NS	NS

Table 2 : Effect of fertilizer levels with or without FYM on fresh pod yield and total plant biomass of different French bean varieties.

Treatments	Varieties	Total plant biomass (g/pot)	Fresh pod yield (gm pot^{-1})		
			I Harvest	II Harvest	Total
100% NPK (F_1)					
T_1	Arka Komal	20.4	148.34	84.81	233.16
T_2	IIHR-220	19.2	37.49	74.76	112.25
T_3	IIHR-909	18.8	107.49	34.07	141.56
T_4	Tweed Wonder	27.7	10.15	85.17	95.32
T_5	Pant Anupama	21.8	94.50	63.03	157.53
T_6	Contender	21.9	91.55	60.77	152.32
50% NPK + FYM (F_2)					
T_7	Arka Komal	23.1	100.41	81.24	181.65
T_8	IIHR-220	18.9	61.34	65.46	126.80
T_9	IIHR-909	21.5	134.50	43.72	178.22
T_{10}	Tweed Wonder	19.4	13.26	68.65	81.91
T_{11}	Pant Anupama	23.9	77.73	44.58	122.30
T_{12}	Contender	15.5	54.48	41.91	96.40
S.Em±		NS	6.51	3.07	6.37
CD at 5%		7.4	17.21	10.13	17.27

Nitrate reductase activity was determined for 3 times during different growth period of crop by taking composite samples. Nitrate reductase activity was estimated as per the leaf diese method reported by Nicolas *et al*. (1976).

Results and Discussion

Nitrate reductase activity

The data on nitrate reductase activity are presented in table 1. The results showed significant differences among varieties at 20 days. On the other hand, the data on 40 and 60 days was not significant. At 20 days, the nitrate reductase activity micro NO_2/hr/gm. fresh weight was lower (1.26 mm) in IIIHR-909 variety at F_2 level but higher in the variety contender (2.31mm). At 40 days, Pant Anupama variety showed highest NR activity of 1.64 (F_1 level), on the other hand lowest nitrate reductase activity was observed in the variety IIHR-909 (0.89) at F_2 level. At 60 days nitrate reductase activity ranged from

0.75 to 1.06 mm NO_2/hr/gm fresh weight. Similar results were observed in wheat, ragi and jute genotypes (Singh and Singh, 1985; Nataraj *et al*., 1980 and Singh *et al*., 1984). The enzyme nitrate reductase catalyses the reduction of nitrate leading to availability of ammonical nitrogen for incorporation into amino acids and proteins (Beevers *et al*., 1965). The highest nitrate reductase activity was observed in the varieties Arka Komal followed by IIHR 909 which also recorded higher yields. Thus the yield was positively correlated with higher nitrate reductase activity. Many studies showed that higher yield were always positively correlated with higher nitrate reductase activity (Singh and Singh, 1985 and Singh *et al*., 1984). It was also observed that the NR activity was higher in all the varieties at 20 days and decreased gradually at 40 and 60 days suggesting that nitrate reductase activity decreases on the ontogeny of the plants. Similar results was observed in French bean (Peirson and Elliott, 1988).

Yield and biomass production

Fresh pod yield was found significantly different among the varieties at both the fertilizer levels (table 2). Highest total fresh pod yields were recorded in the varieties, Arka Komal (F_1 level) and IIHR-909 (F_2 level) whereas, the variety Tweed wonder recorded the lowest pod yield both at F_1 and F_2 levels.

In total fresh pod yield, Arka Komal recorded higher values both at F_1 and F_2 level than other varieties. On the other hand the variety Tweed wonder recorded the lowest pod yield both at F_1 and F_2 level. It was observed from the data that at F_2 level with 50% NPK and farm yard manure, the variety Arka Komal performed better and produced second highest pod yield. It was observed from the results that the efficient varieties like Arka Komal and IIHR-909 have produced almost equal yields both at higher (F_1) and lower (F_2) fertility conditions. Similar results were observed in French bean by Haag *et al.* (1978) among 124 genotypes under low and high fertility conditions.

Non-significant results were observed in total biomass of plants. However it was observed that in general the varieties, which yielded higher correlated with higher biomass accumulation. The similar results were observed in wheat wherein, the dry matter accumulation is positively correlated with corresponding NR activity by Bowerman and Godman (1971).

Conclusion

This study clearly indicated lot of diversity amongst the different varieties in nitrate reductase activity. This was also highly correlated with higher yields. Hence, that nitrate reductase activity ought to be considered as one of the important criteria for judging the varieties/genotype selection for obtaining higher economic yields.

References

Beevers, L., L. E. Schrader, D. Fresche and R. H. Hagemom (1965). The role of nitrate on the induction of nitrate reductase in radish cotyledons and maize seedlings. *Plant Physiol*., **40** : 691-698.

Bowerman, A. and P. J. Godman (1971). Variance in nitrate reductase activity in Lolium. *Ann. Bot*., **35** : 353-366.

Eilrich, G. L. and R. H. Hageman (1973). Nitrate reductase activity and its relationship to accumulation of vegetation N and grain N in wheat (*T. aestivum* L.). *Crop Sci*., **13** : 59-66.

Haag, W. L., M. W. Adams and J. V. Wiersma (1978). Differential responses of dry bean genotypes to N and P fertilization of a Central American Soil. *Agron. J*., **70** : 565-568.

Nicholas, J. C., J. E. Harper and Hageman (1976). Nitrate reductase activity in soybeans (*Glycine max* L.). Effect of light and temperature. *Plant Physio*., **58** : 731-735.

Pierson, D. R. and J. R. Elliott (1988). Effect of nitrate and bicarbonate on nitrate utilization in leaf tissue of bush bean (*Phaseolus vulgaris*). *J. Plant Physiol*., **133** : 425-429.

Singh, V. P. and Mahendra Singh (1985). Nitrate reductase activity and its relationship with grain protein and grain yield of wheat. *Indian J. Plant Physio*., **28** : 235-242.

Singh, V. K., P. Palit and P. P. Yadav (1994). Nitrate reductase activity and its relationship with yield characters in jute. *Indian J. Plant Physiol*., **37** : 195-197.