

EFFECT OF BIOFERTILIZERS AND NITROGEN LEVELS ON YIELD AND NITROGEN ECONOMY IN PEARLMILLET UNDER DRYLAND CONDITIONS

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ABSTRACT

An experiment on biofertilizers alongwith different nitrogen (N) levels in pearl millet was conducted during *kharif* seasons of 2 years at the Dry Farming Research Station, Solapur. The data pooled over two seasons indicated that the seed inoculation with *Azotobacter*, *Azospirillum* and their mixture increased grain and stover yield irrespective of N levels over no biofertilizer inoculation and no N application. Dual inoculation of *Azotobacter* and *Azospirillum* + 50 kg N/ha produced the highest grain yield (14.91 g/ha), however, it was at par with the grain yield (13.13 g/ha) obtained with dual inoculation of *Azotobacter* and *Azospirillum* + 37.5 kg N/ha. This indicates the possibility of N economy in pearl millet by the use of biofertilizers.

KEY WORDS : Biofertilizer, N level, yield, N economics, Bajara dry land.

An increase in native N through biofertilization offers considerable potential to soil, making it more fertile for getting higher yields. Identification of *Azospirillum* and *Azotobacter* as N fixing bacteria for cereal crops proved to be beneficial in N fixation in soil and increased pearl millet production (Reddi and Reddy, 1981 ; Jadhav *et al.*, 1987). Joshi and Singh (1981) explored the possibility of the use of *Azospirillum* as biological source of N for increasing pearl millet production, especially when the application of chemical fertilizer is considered risky and expensive. The present investigation was, therefore, undertaken to study the effect of biofertilizers alongwith N levels on the yield of pearl millet and to see the possibility of economising the fertilizer N under dryland conditions.

MATERIALS AND METHODS

The trial was conducted during *kharif* season of 2 years at the Dry Farming Research Station, Solapur, on medium deep soils having pH-7.8, EC-0.1 dsm^{-1} , available nutrient (kg/ha) N-143, P-12.5 & K-633, in factorial randomised block design with three replications with gross and net plot size of 4.5 x 3.6 m^2 and 3.6 x 2.7 m^2 respectively. The main treatments consisted of biofertilizers *viz.*, no culture (B₀), *Azotobacter* (B₁), *Azospirillum* (B₂) and equal quantity of *Azotobacter* and *Azospirillum* were mixed and used (B₃) and sub-treatments consisted of three levels of N fertilizers *viz.*, 0 kg N/ha (N₀), 37.5 kg N/ha (N₁) and recommended N dose *i.e.* 50 kg N/ha (N₂). The

seed of variety WCC-75 was treated with biofertilizer as per main treatment @ 250 g/10 kg of seed at the time of sowing. Recommended dose of FYM @ 6 t/ha was applied to the soil as a basal dose before sowing. A full dose of 25 kg P₂O₅/ha through single super phosphate and N through urea was applied as per treatments at the time of sowing. Necessary control measures were followed to keep the crop free from pests and diseases. Observations on grain yield, stover yield and yield components were recorded at harvest and subjected to statistical analysis.

RESULTS AND DISCUSSION

The variances due to biofertilizers inoculation and N levels were statistically significant in respect of all the characters studied *viz.*, grain and stover yield, plant height, cob length, 1000 grain weight and N uptake (Table 1). The pooled data indicated that individual as well as dual inoculation of biofertilizers significantly increased grain and stover yield of pearl millet over uninoculated control. Significantly higher grain (13.29 q/ha) and stover (42.12 q/ha) yield were obtained in dual inoculation treatment (B₃), indicating that the inoculation of *Azotobacter* and *Azospirillum* together supplied extra nutrients to the crop as compared to their individual inoculation, which is evident from its significantly higher response in respect of plant height (182.33 cm), length of cob (21.60 cm), 1000 grain weight (6.36 g) and nutrient uptake (55.52 kg/ha) over the individual

Table 1. Yield and growth parameters as influenced by biofertilizer and nitrogen fertilizer levels in pearl millet

Treatment	Yield (Q/ha)						Plant Height (cm)		
	Grain			Stover			I Year	II Year	Pooled
	I Year	II Year	Pooled	I Year	II Year	Pooled			
I	2	3	4	5	6	7	8	9	10
B ₀	9.72	8.23	8.97	23.44	37.61	30.52	166.8	182.1	174.43
B ₁	10.86	9.63	10.30	28.00	41.04	34.52	165.1	186.1	175.60
B ₂	11.68	10.93	11.30	29.72	46.44	37.51	172.0	189.1	180.50
B ₃	12.69	13.86	13.29	34.29	49.95	42.12	174.3	190.3	182.33
SE ±	0.37	0.29	0.34	0.63	0.70	0.62	6.51	3.76	5.31
CD at 5%	1.48	0.86	0.97	1.85	2.07	1.75	NS	NS	NS
N ₀	10.83	9.96	10.40	27.43	42.18	34.79	157.8	176.9	167.4
N ₁	11.12	10.70	10.92	27.86	43.23	35.13	172.6	187.8	180.2
N ₂	11.76	11.31	11.58	31.29	45.87	38.58	178.2	195.9	187.0
SE ±	0.32	0.25	0.24	0.54	0.61	0.57	5.63	3.26	4.60
CD at 5%	NS	0.77	0.84	1.60	1.79	1.62	16.10	9.53	13.15
Interaction									
SE ±	0.64	0.51	0.59	1.09	1.22	1.07	11.27	6.57	9.20
CD at 5%	NS	NS	NS	NS	NS	3.07	NS	NS	NS

Length of cob (cm)			1000 grain wt. (g)			Nitrogen uptake /kg/ha		
I Year	II Year	Pooled	I Year	II Year	Pooled	I Year	II Year	Pooled
11	12	13	14	15	16	17	18	19
18.50	20.8	97.70	5.98	4.77	5.40	42.78	45.67	44.22
19.40	21.3	20.4	6.2	5.60	5.92	49.36	53.77	51.56
19.80	21.9	20.8	6.4	5.80	6.13	50.58	56.02	53.29
20.80	20.7	21.6	6.6	6.13	6.36	53.74	57.30	55.52
0.77	0.56	0.68	0.11	0.62	0.45	1.21	1.50	1.36
NS	NS	NS	0.25	NS	1.28	3.54	4.39	3.89
18.00	20.27	19.20	5.35	4.57	4.97	40.15	43.92	42.04
19.80	21.20	20.50	6.51	5.67	6.09	50.94	55.19	53.06
21.10	22.00	21.10	7.11	6.47	6.78	56.25	60.45	58.35
0.67	0.49	0.58	0.05	0.54	0.39	1.05	1.30	1.18
1.96	1.43	1.67	0.25	1.58	1.11	3.06	3.80	3.97
1.34	0.98	1.17	0.17	1.08	1.29	2.09	2.60	2.36
3.82	NS	3.92	NS	NS	NS	6.13	7.60	6.74

inoculation and uninoculated control. Similar trend was observed in each year study.

As regards the effect of different levels of N, significant increase in grain and stover yield with increase in N levels was observed (Table 1). The highest grain (11.58 q/ha) and stover (38.58 q/ha) yield was obtained with the highest dose of N i.e. 50 kg/ha which was significantly higher than N₀ i.e. 0 kg N/ha (grain 10.40 q/ha, stover 34.79 q/ha). Further, the treatments viz., N₂ and N₁ were found at par in respect of grain yield, suggesting the possibility of minimising the cost of N. Bharvaga *et al.*, (1981) and Jadhav *et al.*, (1994) reported similar findings. The plant height (187.0 cm), length of cob (21.10 cm), 1000 grain weight (6.78 g) and N uptake (58.35 kg/ha) were more in

treatment N₂ and it was found on par with N₁ except N uptake.

The interaction effects between biofertilizers and N levels were found significant for stover yield, length of cob and N uptake. However, the interaction effect between biofertilizers and N for grain yield, plant height and 1000 grain weight was not significant. Though, the interaction effects were not significant in respect of grain yield, dual inoculation of *Azotobacter* and *Azospirillum* produced higher grain yield in combination at all levels of N, indicating its importance for obtaining higher grain yields. Similar results were reported by Reddi and Reddy (1981), Joshi and Singh (1981), Jadhav *et al.*, (1987, 1990) in pearl millet.

Table 2. Cost Benefit ratio of various treatment in pearl millet

Treatment	Yield (Q/ha)		Monitory returns (Rs/ha)			Additional monitory returns over control (Rs/ha)	Cost of treatment (Rs/ha)	C : B ratio
	Grain	Stover	Grain	Stover	Total			
N ₀ B ₀	8.29	28.47	2487	854	3341	-	-	-
N ₀ B ₁	9.97	33.60	2991	1008	3999	658	34.00	1:19.35
N ₀ B ₂	10.92	38.00	3276	1140	4416	1075	34.00	1:31.61
N ₀ B ₃	12.50	39.09	3750	1173	4923	1582	39.00	1:40.56
N ₁ B ₀	9.21	30.52	2763	916	3679	338	154.25	1:02.19
N ₁ B ₁	10.24	34.29	3072	1029	4101	760	159.75	1:04.79
N ₁ B ₂	11.07	34.56	3321	1037	4358	1017	159.25	1:06.39
N ₁ B ₃	13.13	41.15	3939	1234	5173	1832	164.25	1:11.15
N ₂ B ₀	9.52	32.58	2856	917	3833	492	196.00	1:02.50
N ₂ B ₁	10.69	35.67	3207	1070	4277	936	201.00	1:04.66
N ₂ B ₂	11.91	39.95	3573	1198	4771	1430	201.00	1:07.11
N ₂ B ₃	14.91	40.12	4257	1204	5461	2120	206.00	1:10.29

1) Rate of pearl millet grain Rs. 300/Q

2) Rate of pearl millet stover Rs. 30/Q

3) Rate of *Azotobacter* and *Azospirillum* Rs. 5/250 g

4) Rate of Urea - Rs. 167/50 kg.

5) Man power required for culture seed treatment one unit hence cost Rs. 29/Unit/day.

Further, it is interesting to note that (Table 2) no inoculation (B₀) produced consistently less grain yield irrespective of N levels than inoculated one, indicating the importance and utility of biofertilizers in crop production.

The cost benefit ratios (Table 2) indicated that the dual inoculation of biofertilizer is beneficial over their individual inoculation at all N levels. Even though the highest cost benefit ratio was observed in N₀B₃, the maximum additional monitory returns per hectare were obtained in N₂B₃ (Rs. 2120/-) followed by N₁B₃ (Rs. 1832/-). Amongst these two treatments, the maximum cost benefit ratio was noted in N₁B₃ (1:11.15).

Considering the maximum additional monitory returns and cost benefit ratio, it can be concluded that the application of N @ 37.50 kg/ha with dual inoculation of *Azotobacter* and *Azospirillum* is economical and thereby saving 12.50 kg N/ha (25% N saving over recommended dose) without

sacrificing grain and stover yield of pearl millet under dryland conditions.

REFERENCES

- BHARGAVA, S.S., RATHORE, K.S., SINGH, P.K. and LAL, M. (1981). Response of *Azotobacter* under varying levels of nitrogen in bajra under unirrigated conditions. *Agric. Sci. Digest* 1(3): 133-134.
- JADHAV, A.S., SHAIKH, A.A., NIMBALKAR, C.A. and HARINARAYANA, G. (1987). Synergistic effects of bacterial fertilizers in economising nitrogen use in pearl millet. *Millet Newsl.*, 6: 14-15.
- JADHAV, A.S., SHAIKH, A.A., and HARINARAYANA, G. (1990). Response of rainfed pearl millet to bio-fertilization. Paper presented in VIIIth Southern Regional Conference on Microbial Inoculants, Pune. 5-6th Feb. 90. pp 36-38.
- JADHAV, A.S., SHAIKH, A.A. and DUKRE, N.S. (1994). Response of rainfed pearl millet to fertilizer and biofertilizers. *J. Maharashtra agric. Univ.*, 19: 485-486.
- JOSHI, N.L. and SINGH P. (1981). Towards higher bajra yields in arid Rajasthan. *Indian Fmg.*, 3(7): 17.
- REDDI, M.R. and REDDY, G.B. (1981). Effect of *Azotobacter* inoculation and nitrogen application on the yield of pearl millet (HB-3). *Indian J. Agron.*, 26: 408-412.

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