REFERENCES

ABDUL-BAKI, A.A. and ANDERSON, J.D. (1973). Vigour determination in soybean seed by multiple criteria. **Crop Sci., 13:** 630 - 633.

ALIKHAN, S.T. and YOUNGS, C.G. (1973). Variation in protein content of field pea. **Can.J.Pl.Sci., 53:** 37 - 41.

ANONYMOUS (1985). Internaional rules for seed testing, **Seed Sci. & Technol., 13:** 307 - 355.

ASIF, M.J. and GREIG, J.K. (1972). Effect of N, P and K on fruit yield, macro and micro nutrient level and nitrate accumulation in Okra. **J.Amer.Soc.Hort.Sci., 97 :** 440 - 442.

CHAKRABARTI, A.K., SINHA, S.N. and SINGH, D. (1979). Produce quality seeds of radish. **Indian Hort., 24(2) :** 11 - 14.

MALIK, B.S. (1973). Quality of carrot seed in relation to row spacing and nitrogen, phosphorus and potash fertilisation. **Indian J. Hort., 30:** 413 - 417.

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STANDARDIZATION OF LOAD OF BIOINOCULANT IN PEARLMILLET UNDER DRYLAND CONDITIONS

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ABSTRACT

Field trial was conducted to study the response of pearlmillet to differnt loads of bioinoculants on vertisol for six years in dryland conditions. Dual inoculation of *Azospirillum lipoferum* and *Azotobacter chroococcum* at optimum load of inoculum i.e. 60 g/kg seed performed economically well in respect of plant height, 1000 grain weight, Nitrogen uptake besides grain and stover yields over their individual inoculaiton at recommended dose i.e. 30 g/kg seed. More cost benefit ratio and additional net income was recorded by 60 g/kg seed treatment as compared to recommended dose of bioinoculant.

KEY WORDS : Load of bioinoculant, pearlmillet, dryland

Pearlmillet seed inoculation with bio-inoculant is now a days included in package of practice, because, bioinoculants have an important role to play in improviong the nutrient supplies and their crop availability in dryland crop production. Increase in pearlmillet production due to use of bioinoculant in dryland have been reported by many research workers viz., Jadhav, et.al. (1994) Laura, et.al, (1994), Subba Rao (1986), Wani, et.al. (1988) and Wani (1990). Farmers from the drought prone area of Maharashtra says that, some time, no increase in pearlmillet production was observed even after treating seed with bioinoculant as per recommendation i.e. 30 g/kg seed. This may happen due to dry spells, normally experienced during late July and August which is a characteristic feature of drought prone area of Maharashtra (Patil, et.al. 1981)

Katyal, et.al. (1994) reported that in dryland response to biofertilizer varied with crops, host cultivars, locations, seasons, agronomic practices, bacterial strains, soil fertility and interaction with native soil microflora. Mulder et.al. (1977) reported that biological nitrogen fixation is often influenced by soil moisture, organic matter content, soil air, and soil temperature. It was, therefore, thought necessary to increase the load of inoculum on seed, so that, some active Nitrogen fixing bacteria will remain in the rhizosphere of the pearlmillet even under adverse soil conditions. Hence, it was decided to determine the amount of inoculum required to derive the maximum benefit and thereby increase in pearlmillet production in drought prone area of Maharashtra

MATERIALS AND METHODS

The trial was conducted during *kharif* seasons continuously for six years from 1989 to 1994 at Dry Farming Research Station, Solapur in vertisol having pH - 7.7, Organic carbon - 0.34 %, Available N - 139, P_2O_5 - 11.6 and K_2O - 628 kg/ha. Three replication for each treatment were arranged in a factorial randomised block design with gross and net plot size of 4.50 x 3.60 m^2 and 4.10 x 2.79 m^2 respectively. The main treatments of bioinoculants included seed treatment with *Azospirillum lipoferum* (B_1), *Azotobactor chroococcum* (B_2), and *Azospirillum* + *Azotobactor*

Table 1. Yield, plant height, 1000 grain weight and nitrogen uptake as influenced by biofertilizers and various loads of bioinoculant in pearlmillet (Pooled mean)

Treatments		Yield (q/ha)		Plant height (cm)	1000 grain weight (g)	Nitrogen uptake (kg/ha)
		Grain	Stove			
Azoapirillum	(B_1)	12.46	34.44	158.08	6.24	79.49
Azotobacter	(B_1)	12.61	32.69	163.63	6.52	69.39
Azospirillum *Azotobacter*	(B_1)	12.83	32.58	165.82	6.80	90.39
	S.E. +/-	0.5050	1.2697	2.7172	0.1562	1.2496
	C.D. at 5%	N.S.	N.S.	7.5317	0.4331	3.4638
30 g/kg seed	(L_1)	11.41	30.58	157.40	6.17	60.77
60 g/kg seed	(L_1)	12.51	32.91	161.98	6.30	75.48
90 g/kg seed	(L_1)	12.73	34.12	164.51	6.46	83.05
120 g/kg seed	(L_1)	13.88	35.34	166.15	6.68	99.74
	S.E. +/-	0.5832	1.4662	3.1376	0.1804	1.4429
	C.D. at 5%	1.6165	4.0640	8.6969	0.5001	3.9996
Interaction						
	S.E. +/-	1.0101	2.5395	5.4345	0.3125	2.4993
	C.D. at 5%	N.S.	N.S.	N.S.	N.S.	6.9275

(B_3) and sub-treatments consisted four levels of loads of inoculum viz., Recommended dose 30 g/kg seed (L_1), 60 g/kg seed (L_2), 90 g/kg seed (L_3) and 120 g/kg seed (L_4). The seeds of pearlmillet (WCC-75) were treated with the bioinoculant as per the treatments prior to sowing. Recommended dose of N and P @ 50:25: kg/ha was applied at the time of sowing with recommended dose of FYM @ 6 t/ha applied once in three years as a basal dose i.e. during kharif seasons of 1989 and 1992. Observations on growth parameters and chemical analysis were taken at monthly interval and yield was recorded at maturity and subjected to statistical analysis.

RESULTS AND DISCUSSION

Pooled data presented in Table 1 indicated that the variances due to bioinoculant treatment and load of inoculum were found to be significant for grain and stover yield as well as for plant height, 1000 grain weight and N uptake. whereas interaction effect was observed in case of N uptake only.

Bioinoculants :

Significantly maximum plant height (165.82 cm), 1000 grain weight (6.80 g) and N uptake (90.39 kg/ha) was observed in B_3 besides grain yield (12.83 g/ha) over B_1 and B_2. This indicated that dual inoculation of *Azospirillum* and *Azotobactor* is more effective in increasing crop production in dryland than their individual seed inoculation. Jadhav, *et.al.* (1994) reported that the seed inoculation with combination of *Azotobactor* and *Azospirillum* increased the grain yield of pearlmillet by 21.4 per cent over uninoculated control under rainfed conditions.

Loads of inoculum :

It was observed that the crop production was increased with the increasing loads of inoculum. The seed inoculated with 4 times (L_4) the recommended dose (30 g/kg seed) was able to increase grain (13.88 g/ha) and stover (35.54 q/ha) yield significantly besides plant height (166.15 cm), 1000 grain weight indicating that the increase in loads of inoculum was effective to the extent of double the recommended dose only. Prabakaran and Rangarajan (1986) reported that the inoculum load beyond optimum doses failed to increase the nodulation and crop yield. From the study it can be understood that in drought prone area of Maharashtra the seed inoculation with bioinoculant @ 60 g/kg seed is sufficient to introduce optimum viable and effective cells in the area where seed gets germinated and for higher crop production.

C : B Ratio :

The information on cost benefit ratio (C:B ratio) with regards to the economy of the pearlmillet production is presented in Table 2. It is revealed that the increase in C:B ratio was directly related with increase in loads of inoculum. The C:B ratio was high at maximum load of inoculum (L_4).

Table 2. Cost benefit ratio of various treatments in Pearlmillet

Treatments	Grain yield (q/ha)	Addl. yield over recommended dose (q/ha)	Addl. monetary returns (Rs)	Fodder yield (q/ha)	Increased over recommended dose (q/ha)	Addl. monetary returns (Rs)	Total addl. monetary returns (Rs)	Total monetary returns (Rs)	Cost of cultivation + cost of treatment (Rs/ha)	Cost benefit ratio
Azospirillum										
30 g/kg seed	11.53	-	-	31.74	-	-	-	4328.04	2355.40	1.84
60 g/kg seed	12.61	1.36	407.4	33.67	1.93	57.99	465.39	4793.43	2357.20	2.03
90 g/kg seed	12.67	1.42	426.0	35.59	3.85	115.44	542.04	4870.08	2359.00	2.06
120 g/kg seed	13.40	2.14	643.5	36.76	5.01	150.45	793.95	5122.11	2360.80	2.17
Azotobacter										
30 g/kg seed	11.58	-	-	30.58	-	-	-	4390.74	2355.40	1.86
60 g/kg seed	12.26	0.68	205.2	32.93	2.35	70.50	275.7	4666.44	2357.20	1.98
90 g/kg seed	12.64	0.78	235.5	33.39	2.81	84.24	319.74	4792.68	2359.00	2.03
120 g/kg seed	13.96	2.38	713.4	33.87	3.29	98.85	812.25	5202.99	2360.80	2.20
Azospirillum + *Azotobacter*										
30 g/kg seed	11.41	-	-	29.42	-	-	-	4305.06	2355.40	1.83
60 g/kg seed	12.65	1.25	373.8	32.13	2.71	81.27	455.07	4760.13	2357.20	2.02
90 g/kg seed	12.98	1.57	470.4	33.40	3.98	119.46	589.86	4894.92	2359.00	2.07
120 g/kg seed	14.28	2.87	862.2	35.39	5.96	178.92	1041.12	5346.18	2360.80	2.26

(1) Rate of pearlmillet grain Rs. 300/q (2) Rate of pearlmillet stover Rs. 30/q

(3) Rate of biofertilizer i.e. *Azospirillum* and *Azotobacter* Rs. 5/250 g

(4) Man power required for biofertilizer seed treatment i.e. 0.1. unit, hence cost is Rs. 3.60, @ Rs. 29/unit/day for 8 hours.

However, it was on par with the inoculum load of 60 g/kg seed (L_2) indicating that the seed inoculation with bioinoculants was economical upto the single fold of recommended dose only.

From the above discussion and based on six years field data, it can be concluded that for better production and more monetary returns in the pearlmillet seed should be treated with combination of *Azospirillum lipoferum* and *Azotobacter chroococcum* @ 60 g/kg seed before sowing under rainfed condition in medium black soils of drought prone area of Maharashtra.

REFERENCES

JADHAV, A.S., SHAIKH, A.A. and DUKRE, N.S. (1994). Response of rainfed pearlmillet to fertilizer and biofertilizers. **J.Maharashtra agric. Univ. 19**(3) : 485-486.

KATYAL, J.C., VENKATESWARLU, B. and DAS, S.K. (1994). Biofertilizers for nutrient supplementation in dryland agriculture. **Fert. News, 39(4)** : 27-32.

LAURA, R.D., RAJ, M., SANGWAN, P.S. and BAGGA, R.K. (1994). Effect of inorganic, organic and biofertilizer on pearlmillet yields in dryland areas., **Crop Research, Hissar. 8(3)**: 499 - 503.

MULDER, E.G., LIE, T.A. and HOUWERS, A. (1977). Biological nitrogen fixation as influenced by soil environment. In : **A Treatise on Dinitrogen Fixation, Sec. IV** Hardy. R.W.F. and Gibson. A.H. Eds. John Wiley and Sons. New York 221 pp.

PATIL, N.D., UMRANI, N.K., SHENDE, S.A., MANKE, B.S., KALE, S.P. and SHINGTE, A.K. (1981). Improved crop production technology for drought prone areas of Maharashtra, **Technical bulletin** published by Mahatma Phule Agricultural University, M.S. pp 3-6.

PRABAKARAN, J. and RANGARAJAN, M. (1986). Effect of inoculum load of *Rhizobium* on the nodulation pattern in green gram. **Abst. Natl. Semi on Microbial Ecol.** Tamil Nadu Agril. Uni. Jan. 23-24. Coimbatore, pp. 3-4.

SUBBA RAO, N.S. (1986). Cereal nitrogen fixation research under the BNF coordinated Project of the ICAR. In cereal Nitrogen fixation (ed, S.P. Wani). **Proceedings of the Working Group Meeting held at ICRISAT Centre**, India, 9-12 October, 1984. International Crops Research Institute for the Semi Arid Tropics Patancheru, India pp 23-30.

WANI, S.P., CHANDRAPALAIAH.S., ZAMBRE, M.A. and LEE, K.K. (1988). Association between N2 fixing bacteria and pearlmillet plants. Responses, mechanisms and persistence. **Plant and Soil, 110** : 289- 302.

WANI, S.P. (1990). Inoculation with associative nitrogen fixing bacteria. Role in cereal grain production improvement. **Indian of Microbiol, 30:** 363-393.

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