Economization of Nitrogen Requirement of Summer Irrigated Cotton through Use of Biofertilizers

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ABSTRACT

An experiment was conducted on G. hirsutum variety LRA 5166 under summer irrigated conditions in Western Maharashtra to assess the possibility of reducing rates of N fertilizer through the use of bio-fertilizers. The experiment was on a medium deep, black soil, low in N, medium in P_2O_5 and high in K_2O. Experiments were repeated over three years from 1995 to 1887 in split plots with three replications Sixteen treatment combinations consisted of the use of bio-fertilizers Azotobacter and Azospirillium through seed treatment and soil application with four levels of N, 0kg, 40kg, 60kg and 80kg per hectare. P_2O_5 and K_2O were applied as basal dressings of 40 kg/ha. Pooled data indicated no significant differences between Azotobacter and Azospitillium or the method of application. However, bio-fertilizer seed treatment reduced inorganic N requirements by about 25%.

Introduction

Despite the greater abundance of nitrogen around the earth in the atmosphere to the tune of 37 x 1014 metric tonnes, it is completely unavailable for the living systems except for a few microorganisms fortunate enough to possess the mechanism for fixing the atmospheric nitrogen. *Azotobacter* is the most important and well known free living heterotrophic bacterium which plays the beneficial role in agriculture (Allison, 1965; Brown, 1974).

In the present context of the escalating prices of nitrogenous fertilizers and their periodic shortages, there is need for exploitation of microorganisms for the benefit of agricultural production. Goswami (1996) conducted field experiment on various crops viz., wheat, oat, barley, maize, sugarbeet and potato and reported 28 to 40 per cent increase in yield of field crops treated with Azotabacter along with nitrogenous fertilizers.

In Deccan Canal tract of Western Maharashtra, cotton is grown under irrigation during the summer season (April-September). The nitrogen requirement is quite high because the nitrogen status of soils is low and fertilizers contribute about 35 % to the yields of summer cotton (Suryawanshi *et al.* 1993). The experiment was, therefore, planned to assess whether bio-fertilizers can be used for minimizing the requirement of nitrogen for cotton under summer irrigated conditions.

Material and Methods

Field experiments were conducted for three consecutive years (1995-1997) during summer season in split plot design with three replications. The soil was medium deep black, low in nitrogen, medium in phosphorus and high in potassium. Total sixteen treatment combinations included use of bio-fertilizers (*Azotobacter* and *Azopririllium*) their methods of application (to seed and through soil) and four levels of nitrogen. The seed of *G. hirsutum* variety LRA-5166 was treated with *Azotobacter* and *Azospirillium* at 25 gm per kg by slurry method. *Azotobacter* and *Azospirillium* were thoroughly mixed in 50 kg well decomposed sieved farmyard manure for easy spot application. The biofertilizers were placed below the seed and well mixed in the soil at the time of sowing. The levels of nitrogen were 0, 40, 60 and 80 kg per hectare applied in three splits viz., 20% at the time of sowing and 40% each at 30 and 60 days after sowing. The 40 kg each of phosphorus and potassium were applied at the time of sowing. The seed were hand dibbled during the second fortnight of April every year at a row spacing of 90 cm keeping distance of 60 cm in between the seed hills. Inorganic fertilizer were applied as per the treatments making ring 5 cm away from the seed and covered with soil. All the recommended agronomic practices and plant protection measures were followed to raise a normal crop. Five randomly selected plants were used from the net plot of 4.80 x 3.60 m2 for recording plant height and yield contributing parameters.

Results and Discussion

Seed cotton yields were not influenced significantly by the bio-fertilizers or the method of application (Table 1). This conforms with the findings of Avaiya *et al.* (1996). Seed cotton yields were significantly influenced by inorganic N fertilizer rates. The highest seed cotton yield (1,584 kg/ha) was with 100%

recommended dose of N (80 kg/ha) but this was not significantly different to 75% recommended N dose (60 kg/ha) (1,550 kg/ha). The lowest yield (1,117 kg/ha) was zero N. Similar trends were observed by Chawdappan *et al.* (1977). Plant height was not affected significantly by the treatments (Table 1). The yield attributes viz., number of good bolls/plant, average boll weight and yield/plant shows significant response to N as inorganic fertilizers and were increased with increased levels of N.

The cost benefit ratio (Table 2) was highest (2:38) with 100% of the recommended dose of N and almost equal (2:36) with 75. The yield with bio-fertilizers as seed treatment or soil applications with 75% of the N dose gave comparable seed cotton yields to 100% N dose without bio-fertilizer. Similar results were reported by Chawdappan *et al.* (1977) and Goswami *et al.* (1976) with *Azotobacter* on paddy crop applied in combination with 75 per cent dose. The application of bio-fertilizers to seed or soil reduced N fertilizer needs by 25%.

References

Allison, F.E. (1965): Evaluation of incoming and outgoing process that after soil nitrogen. In Soil Nitrogen. W.V. Bartholomeo and F.E. Clark. (Ed.) Amer. Soc. Agron. Wisconsin, Pp.573-603.

Avaiya, Y.V., R.G. Vashi, M.L. Patel and U.G. Patel. (1996): Use of biofertilizer for cotton G. Cot Hy. 8 (Poster) National Seminar on Century of Cotton in India. December 21, 1996 at Surat (A.1).

Brown, M.E. (1974): Seed and root bacterization. Ann. Rev. Phytopath, 12:181-197.

Chowdappan, S.R., N. Balasubramanian and T.N. Balasubramanian. (1977): Effect of *Azotobacter* in summer Irrigated cotton. Madras Agric. J. 64(11):704-706.

Goswami, K.P. (1976): Worth of *Azotobacter* as a bacterial fertilizer. Fert. News 21:32-34 and 45.

Suryawanshi, G.B., A.V. Tendulkar,. M.R. Khetmals and S.K Ransingh. (1993): Studies on effect of different production factors on yield of seed cotton of G. hirsutum (RHV-1) under summer conditions. J. Cotton R. and D. 7(2):259-264.

Table 1. Yearwise and pooled averages of seed cotton yields as affected by different treatments.

1)	Treatments	Seed Cotton Yield(kg/ha)			
		94-95	95-96	96-97	Pooled mean
	Cultures				
a)	Azotobacter	1108	1490	1671	1421
b)	Azospirillim	1148	1535	1599	1428
	S.E.±	46.59	60.75	40.02	55.32
2)	Methods of application				
a)	Seed treatment	1118	1490	1666	1425
b)	Soil application	1134	1535	1604	1424
	S.E.±	46.59	60.75	40.02	55.10
	C.D. at 5%	NS	NS	NS	NS
3)	Nitrogen Doses				
a)	0.00 kg	812	1206	1535	1117
b)	40 kg	1128	1478	1539	1381
c)	60 kg	1258	1661	1731	1550
d)	80 kg	1306	1706	1740	1584
	S.E.±	65.88	85.92	56.61	30.63
	C.D. at 5%	228.03	297.38	195.93	90.96

Table 2. The cost benefit ratio.

Sr. No.	Nitrogen doses kg/ha	Yield of seed cotton	Cross monetary returns	Cost of cultivation	Net monetary returns	Cost Benefit Ratio
	(pooled)	(kg/ha)	Rs./ha	Rs./ha	Rs./ha	
1.	00	1117	22353	8788	13565	1:1.54
2.	40	1381	27620	9081	18539	1:2.04
3.	60	1550	31011	9227	21774	1:2.36
4.	80	1584	31682	9374	22308	1.2.38