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Effect of Various Organic Manures and *Azotobacter chroococcum* on the Growth and Yield of Paddy

By

M. Rangarajan[1] and P. Muthukrishnan[2]

ABSTRACT

Seed, seedling and soil inoculation of *A. chroococcum* applied alone or in combination with various organic manures viz., farmyard manure, compost and pig manure enhanced the growth and yield of paddy over control during all stages of crop growth. Growth and yield were more in combined applications of organic manures and *A. chroococcum*. Pig manure in combination with *A. chroococcum* increased drymatter production during the panicle initiation stage by 13.8 per cent and grain yield by 10.7 per cent over the application of full dose of nitrogen.

INTRODUCTION

Azotobacter chroococcum is reported to be efficient in fixation of molecular nitrogen when sufficient amount of organic substrates are available in soil (Alexander, 1961). Seed, seedling and soil inoculations of *Azotobacter* were reported to increase the growth and yield of many crops viz., paddy, wheat, maize, sorghum, cotton, tobacco, tomato and mustard (Brown *et al.*, 1962, 1964; Rovira, 1963; Mehrotra and Lehri, 1971; Jain *et al.*, 1973; Muthukrishnan *et al.*, 1975).

Thompson (1974) obtained significantly increased yields from wheat and barley, and the yield components were highly influenced by inoculation of *Azotobacter*. Monib *et al.* (1974) reported that additions of organic matter greatly influenced *Azotobacter* and other soil microflora. In the present studies, the effect of *Azotobacter chroococcum* applied along with the organic manures viz., farmyard manure, compost and pig manure on growth and yield components of Kannaki variety of paddy was investigated.

MATERIALS AND METHODS

The field trial was laid out in randomized block design with one cent plot for each treatment. The experiment included ten treatments viz., *A. chroococcum*, farmyard manure, compost, pig manure, farmyard manure + *A. chroococcum*, compost manure + *A. chroococcum*, pig manure + *A. chroococcum*, nitrogen full dose (120 kg N/ha), nitrogen half dose (60 kg N/ha) and control. The organic manures were applied at the rate of 10 tons/hectare. All the treatments involving *A. chroococcum* and various

1-2: Department of Biology, Agricultural College and Research Institute, Madurai

organic manures alone and in combination received half the dose of nitrogen. Phosphorus and potash were applied uniformly in all the treatments at the recommended dose viz., 60 kg P_2O_5 and 60 kg K_2O/ha.

A. chroococcum (peat soil based culture) was applied as seed, seedling and soil inoculant. Kannaki variety of paddy was used for the studies. Seedlings were raised with and without *Azotobacter* seed treatment. The seedlings raised without *Azotobacter* seed treatment were transplanted in the following treatments viz., control, farmyard manure, compost, pig manure, nitrogen full dose and half dose. The plots of all other treatments were transplanted with seedlings raised from seeds treated with *Azotobacter*. The roots of seedlings were also dipped in *Azotobacter* suspension and transplanted in the plots which were already applied with *Azotobacter* as basal dressing.

In the nursery stage both treated and untreated seedlings were studied for the influence of *Azotobacter* applied as seed treatment. The growth parameters viz., shoot length, root length, number of roots per plant, and dry matter production per 100 seedlings were investigated. The growth characters were recorded periodically during tillering, stage, panicle initiation stage and at the time of harvest. In the transplanted field, the growth characters viz., height of the plant, number of tillers and dry weight of the clump were studied. The yield components viz., number of productive tillers, length of the panicle, number of grains per panicle, weight of 1000 grains and grain yield per hectare were recorded.

RESULTS AND DISCUSSION

Earlier reports indicated that the yield of paddy was increased by the application of *A. chroococcum* (Ranga rajan and Muthukrishnan, 1975). In continuation with these findings, the present study was undertaken to find out the influence of various organic manures such as farm yard manure, compost manure and pig manure along with *A.chroococcum* applied as seed, seedling and soil inoculants.

Growth characters : In the nursery stage, *A. chroococcum* significantly increased the shoot length and dry matter production of the Kannaki seedlings (Table I). The seedlings raised from the seeds treated with *A. chroococcum* were strong and healthy. *Azotobacter* increased the height of the seedlings, numbers of leaves, length of leaf and width of leaf by 7.5, 16.5, 8.8 and 8.3 per cent, respectively over the control.

Azotobacter in combination with farm yard manure increased the height of the plant by 4.2 and 0.7 per cent over the application of farm yard manure alone during the tillering and panicle initiation stage, respectively. Similarly, combined application of *Azotobacter* and compost increased the height of the plant by 0.9 and 3.0 per cent, respectively over the application of compost alone. Application of *Azotobacter* combined with pig manure signifi-

TABLE I. Effect of the seed treatment of *Azotobacter* on the growth of seedlings of Kannaki variety of paddy.

Treatment	Shoot length per plant (cm)	Root length per plant (cm)	No. of roots per plant	No. of Leaves per plant	Length of leaf (cm)	Width of leaf (cm)	Dry matter production per 100 seedlings (g)
Treated	26.5	13.5	52.0	6.0	17.0	6.0	13.568
Control	24.5	12.0	39.0	5.0	15.5	5.5	11.235

cantly increased the height of the plant by 1.2 and 13.3 per cent, respectively over the application of pig manure alone. During these two growth stages, the increase in height of the plant due to the application of *Azotobacter* combined with pig manure was greater by 25.5 and 15.7 per cent, respectively over the application of full dose of nitrogen.

Combined application of *Azotobacter* and organic manures increased the dry matter production during all the stages of crop growth. Particularly, *Azotobacter* applied with pig manure significantly increased the dry matter production by 11.5 per cent over the application of farm yard manure alone, by 10.3 per cent over the application of compost alone, by 4.2 per cent over the application of pig manure alone and by 13.8 per cent over the application of full dose of nitrogen (Table II).

Yield Components: The increases in yield components namely, productive tillers, length of the panicle, number of grains per panicle and weight of 1000 grains were in the order

TABLE II. Effect of *Azotobacter* and organic manures on the growth of Kannaki variety of paddy during different stages of crop growth.

Treatment	Height of the plant (cm)		Number of tillers per clump		Dry matter production (g)	
	A	B	A	B	A	B
Control	44.4	73.7	5.0	7.6	15.250	32.638
Azotobacter	44.6	74.9	6.0	7.9	20.150	35.719
Farm yard manure	49.9	80.1	7.0	8.4	22.990	45.990
Compost	52.4	80.2	7.0	8.9	22.999	46.638
Pig manure	66.0	89.9	10.0	19.0	26.980	49.765
Azotobacter + Farm yard manure	52.1	80.9	8.0	9.4	22.999	47.989
—Do— + compost	52.9	82.7	8.0	9.9	23.990	48.867
—Do— + pig manure	66.9	103.7	11.0	19.9	35.150	51.980
Nitrogen Half dose	44.7	84.3	6.0	9.0	19.100	37.989
Nitrogen Full dose	49.7	87.4	6.0	11.9	34.630	44.756

A—Tillering stage; B—Panicle initiation stage

of *Azotobacter*+pig manure>*Azotobacter* + compost > *Azotobacter* + farmyard manure > pig manure > farmyard manure = Nitrogen full dose > *Azotobacter* alone > Nitrogen half dose > control. Application of *Azotobacter* alone significantly increased yield over the control. (Table III.) Organic manures alone increased grain yield over the control and *Azotobacter* treatment. Combined application of *A. chroococcum* and organic manures enhanced the grain yield over the application of organic manure alone. Among all the organic manures tried pig manure was found to be the best for increasing the grain yield. *Azotobacter* applied in combination with pig manure increased the grain yield over all other treatments; including the application of full dose of nitrogen. Combined application of *A. chroococcum* and pig manure increased the grain yield by 49.9 per cent over the control, 34.3 per cent over the application of *A. chroococcum* alone, 27.9, 9.7 and 4.4 per cent over the applications of farm yard manure, compost and pig manure alone, respectively. Application of *Azotobacter* in combination with the pig manure also increased the grain yield by 22.1 per cent over the combined applications of *Azotobacter* and farmyard manure and also with compost and by 10.7 per cent over the application of full dose of nitrogen (Table III).

The present studies indicated that the application of *Azotobacter* with the basal dressing of pig manure maximised grain yield of Kannaki variety of paddy. These results on the influence of *Azotobacter* in combination with organic manures are in conformity with the earlier report of Monib *et al.* (1974) who observed that additions of organic matter to soil greatly influnced the multiplication of

TABLE III. Effect of *Azotobacter* and organic manures on yield components of Kannaki variety of paddy.

Treatment	No. of productive tillers	Length of the panicle (cm)	No. of grains per panicle	Weight of 1000 grains (g)	Grain yield per plot (kg)	Grain yield per hectare (Kg)
Control	6.0	23.0	153	22.100	17.02	4086
Azotobacter	7.8	24.5	164	22.700	22.30	5352
Farm yard manure	8.2	25.5	167	25.000	24.50	5880
Compost	8.8	26.0	169	25.390	30.69	7366
Pig manure	17.0	26.3	172	25.300	32.50	7800
A. chroococcum+ Farmyard manure	11.4	26.5	169	25.000	26.48	6356
A. chroococcum + Compost	11.8	26.9	121	25.780	26.48	6356
—Do— +Pig manure	18.9	26.9	174	25.990	33.99	8157
Nitrogen Half dose	6.8	22.0	160	22.380	28.83	6919
Nitrogen Full dose	8.6	24.8	169	22.700	29.95	7188

Azotobacter. The present report is also in accordance with the findings of Jain *et al*. (1973) and Thompson (1974) who reported that application of organic manures and *A. chroococcum* increased crop yields.

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