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FIELD EFFICACY OF DIFFERENT ISOLATES OF *AZOTOBACTER CROOCOCUM* FOR IMPROVING THE YIELD OF FINGER MILLET (*ELEUSINE CORACANA* (L.) GAERTN.

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ABSTRACT

Field experiments for the three years (2009-11) were conducted to see the Field efficacy of different isolates of *Azotobacter croococum* for improving the yield of Finger millet. Native Azotobacter isolates (Azotobacter ABN-1) was isolated and selected on the basis of its performance in *in vitro* as well as pot studies. Other five different isolates were procured from the different sources and named as exotoic-Azoto-1 to 5. Recommended split quantity of chemical fertilizer (40:20:0) were applied in the treatment of Recommended doses of fertilizer as per the standard method of fertilizer application. Significant different in the potentiality of the different isolate were observed. Azotobacter ABN-1 was found best among all with the highest number of productive tillers (22.33), maximum plant height (72.33cm) highest grain yield (2388.67 Kg ha^{-1}) and highest fodder yield (2388.67 Kg ha^{-1}) as compared to the exotoic-Azoto-2 to 5. Exotoic-Azoto-1 was numerically lower, however, were stastically et par with the Azotobacter ABN-1.

1.0 INTRODUCTION

*Azotob*acter *croococum*, commonly reffered as Azotobacter is most important microorganism responsible for the non symbiotically recycling of nitrogen on earth contributing significantly in nitrogen homeostasis in the biosphere. They are widely distributed in different environments, such as soil, water and sediments (Becking et al.,1981; Palleroni, 1984 Tchan and New 1984,). Apart from the fixing nitrogen it also has beneficial effects on plant yields by secretion of growth stimulating hormones viz., gibberellins, auxins and cytokinins (Gonzales-Lopez et al., 1991 Gouri and Jagasnnatathan, 1995; Mishra et al., 1995; Pandey et al., 1998; Radwan, 1998). Therefore, it is one of the most commonly used biofertilizer in the many crop ecosystem viz., cereals, fodder, legumes, vegetables, fruits, flower, etc. Azotobacter can also be used in aquaculture systems and vermicompost preparation due to their ability of fixing nitrogen and solubilizing phosphates (Garg et al., 2001, Kumar and Singh, 2001). Nitrogen fixed by the rhizospheric and endophytic diazotrophs microorganism is most aboundand in the ecosystem and in the heavy feeder crop like sugarcane it contributes 70% of the nitrogen assimilated (Urquiaga, et al., 1992, Baldani, et al., 1997).. Many antagonistic, pathogenic, as well as unapparent microorganisms remain in equilibrium proportion in the soil which predominately determines its characteristics. As long as the equilibrium remains ideal or shifted towards the antagonistic microorganisms by selectively favoring its activities, the soil suppresses the disease and support good crop. However, if the equilibrium shifts towards the pathogenic microorganisms and increases its potentiality, soil becomes conducive for the disease (Mahatma and Mahatma, 2015). High degree of variation in the efficiency of the different isolates of any species is vary common phenomenon in the nature, therefore, it is utmost important to select an excellent strain of the microorganism being used for the artificial introduction in any of the exosystem so that it can selectively dominated over the others and shift the equilibrium of microbes towards the antagonistic microorganisms. During the present investigation attempts were made to evaluate the efficacy of different isolate of *Azotobacter* sp. In the field. Finger millet (*Eleusine coracana* (L.) Gaertn.) is a type of millet grown in the arid parts of Africa and Asia was selected as it is generally grown on the residual nutrients availability, however, shows rapid and visible response to the fertilizers application. It is also known as poor man’s crop, however, has the higher amount of calcium (344 mg%) and potassium (408 mg%). It has higher dietary fiber, minerals, and sulfur containing amino acids compared to white rice, the current major staple in India. It is one of the most nutritious of all the world’s cereal crops, containing high levels of starch, calcium, iron and methionine, an amino acid that is absent from the diets of millions of the poor who live on starchy foods such as cassava and plantain (Shobana et al. 2013). Finger millet is popular crop in dry areas because it can lie dormant for weeks. As soon as the rains come, the grain springs to life and is ready for harvesting in just 45 days. Six different isolates of Azotobacter were used to find out the best isolates for the commercial biofertilizers production.

2.0 MATERIALS AND METHODS

2.1. Site description

The experiments were performed in the Field of Hill Millet Research Station, Navsari Agricultural University, Waghai Dist. Dangs, situated at a cross section of latitude of 20.77' N and longitude of 73.50' E; at an altitude of 107 meters above mean sea level. It comes under South Gujarat Heavy Rainfall Zone-I, Agro Ecological situation-I. Field trials were conducted for three years in 2009-11 during *kharif*. The soil has organic carbon 0.82%, nitrogen 294 kg/ha, phosphorous 24 kg/ha and potash 220 kg/ha in the range of average to good.

2.2 Design and treatments

Finger millet cv GN-5 popularly grown in the south Gujarat zone was used for the experiment. The crop was transplanted in *kharif* every time and was mechanically harvested at maturity. All the standard agronomic practices were followed. For transplanting, one month old seedlings were used. Seedlings were planted at 22.5x7.5 cm row to row and plant to plant distance. Gross and net field size were 2.25 X 1.80 m and 1.65 X 1.35 m respectively. Total 240 seedlings were planted in a plot. The experiments were laid out in randomized block design with three replications. Total eight different treatments as per the table 1 including recommended doses of chemical fertilizers (RDCF 40:20:0 N:P:K Kg/ha) for the variety in the south Gujarat zone were planted. Other standard agronomical practices were followed uniformly in all the treatments.

2.3 Biofertilizers and its application

Uniform quality of fresh Biofertilizers from all the isolates were prepared by Biofertilizers Production Unit, Department of Plant Pathology, N.M. College of Agriculture, NAU, Navsari every year before the treatment. Native Azotobacter isolates was isolated and selected on the basis of its performance in *in vitro* as well as pot studies. Other five different isolates were procured from the different sources and named as exotoic-Azoto-1 to 5. *Jaggery* solution (1 %) was prepared by mixing 200 g jaggery in 20 litres of water. One per cent Biofertilizer solution was prepared by mixing 200 ml Biofertilizer of respective strain (minimum cfu $1x10^8$) in the 20 litres of the above prepared jaggery solution. Biofertilizers @ 200 ml/ha were used for the seedling dip method. Roots of the Finger millet seedlings were dipped for 30 minutes in this Biofertilizer solution prepared in the *jaggery* solution. Liquid Biofertilizer @ 1000 ml/h were applied mixed in the pulverized soil (20 Kg/ha) as spot application at the time of transplanting. Recommended split quantity of chemical fertilizer (40:20:0) were applied in the treatment of Recommended doses of fertilizer as per the standard method of fertilizer application. Number of tillers, plant height and root length was recorded at 50 days after transplanting (DAT). Grain and fodder yield was recorded at hearvesting. To measure the root length, plants were uprooted when the field was sufficient wet alongwith the soil surrounding the root carefully without damaging roots and washed thoroughly.

3.0 RESULTS AND DISCUSSION

3.1 Number of productive tillers per plant

Data on number of productive tillers per plant is presented in Table 1 indicated that different treatments including RDCF were significantly better over absolute control. Highest number of productive tillers (22.33) was obtained where Native Azotobacter ABN-1 and 20-20-0 NPK Kg ha^{-1} was applied. These results are statistically superior over the other isolates of Azotobacter. Minimum number of productive tillers per plant (13.11) was observed in absolute control where neither N nor P nor Azotobacter were applied. The different Azotobacter isolates indicated that there were variation in their efficacy.

3.2 Plant height and Root length

The analysis of variance revealed that different isolates differ significantly from each other. Maximum plant height (72.33cm) was attained in treatment T-1 where Native Azotobacter ABN-1 and 20-20-0 NPK Kg ha^{-1} was appliedagainst minimum plant height was observed from treatment where no fertilizer was applied (47.67) which was stastically at par with 40-20-0 NPK (T7), 20-20-0 NPK + Exotic Azoto-4 (T5) and 20-20-0 NPK + Exotic Azoto-5 (T6) by giving 51cm, 53 cm and 50.67 cm plant height. Treatment 20-20-0 NPK + Exotic Azoto- 1 (T2), 20-20-0 NPK + Exotic Azoto-2 (T3) and 20-20-0 NPK + Exotic Azoto-3 (T4) were stastically significant then absolute control and RDCF with 66 cm, 60 cm and 59 cm plant height respectively. No significant relation was observed in the root length and different treatments.

3.3 Grain yield

Study of the variance that different isolates differ significantly in their capabilities to support the plant growth and yield. The highest grain yield (2388.67 Kg ha^{-1}) was obtained in treatment T1 where Native Azotoacter ABN-1 isolate and 20-20-0 Kg ha^{-1} NPK was applied. This yield was stastically at par with the treatment T2 (yield 2338.33 Kg ha^{-1}) where Exotic-Azoto-1 20-20-0 Kg ha^{-1} NPK was applied. The lowest grain yield (1774.00 Kg ha^{-1}) was obtained from control (with out NPK fertilizer). Remaining isolates gave significantly higher yield then the absolute control, however, were at par with the RCDF (1943.67 Kg ha^{-1}). There are several reports where the use of Azotobacter sp as biofertilizers improves the yield of plants. This may be either by the fixation of atmospheric nitrogen as well as sdue to PGPR activities of the plant Gonzales-Lopez et al., 1991 Gouri and Jagasnnatathan, 1995; Mishra et al., 1995). production of vitamins of the B group (e.g. thiamine, biotin, riboflavine, niacin) has been documented in some Azospirillum, Azotobacter, Pseudomonas fluorescens and Rhizobium strains (Richardson et al., 2009).

3.4 Fodder yield

Study of the data different isolates differ significantly in their capabilities to support the fodder yield. The highest grain yield (2388.67 Kg ha^{-1}) was obtained in treatment T1 where Native Azotoacter ABN-1 isolate and 20-20-0 Kg ha^{-1} NPK was applied. This yield was stastically at par with the treatment T2 (yield 2338.33 Kg ha^{-1}) where Exotic-Azoto-1 20-20-0 Kg ha^{-1} NPK was applied. The lowest grain yield (1774.00 Kg ha^{-1}) was obtained from control (without NPK fertilizer). Remaining isolates gave significantly higher yield then the absolute control, however, were at par with the RCDF (1943.67 Kg ha^{-1}).

Table 1: Effect of different isolates of *Azotobacter croococum* for improving the yield of Finger millet (Three years pool data).

Treatment No.	Azotobacter isolates	No of tillers per Hill	Plant height (CM) 50 DAT	Root length (CM) 50 DAT	Grain yield Kg/ha	Fodder yield Kg/ha
T1	Azotoacter ABN-1	22.33	66.44	22.44	2388.67	7432.67
T2	Exotic Azoto-1	20.00	61.67	21.00	2338.33	7241.33
T3	Exotic Azoto-2	18.78	57.00	21.56	2015.67	5951.00
T4	Exotic Azoto-3	18.22	55.67	21.33	1788.67	6543.67
T5	Exotic Azoto-4	18.00	53.33	24.44	2024.67	7149.00
T6	Exotic Azoto-5	16.67	50.89	21.78	1903.67	6946.33
T7	RDCF (40:20:0)	17.00	48.00	22.44	1943.67	5681.67
T8	Absolute control	13.11	31.24	23.89	1774.00	5689.00
S.Em ±		0.67	4.91	NS	41.67	111.94
C.D. 5%		1.96	14.34	NS	121.88	327.44
C.V. %		6.44	16.04	NS	3.54	2.94

4.0 CONCLUSION

Analysis of the data revealed the significance difference among the differen isolates in their efficacy to enhance the growth parameters and yield of finger millets. The most efficient isolate of *A. croococum* was found to be Native Azotoacter ABN-1 isolate which was stastically at par with the Exotic-Azoto-1. These not only enhance the genetic potential of the crop but also save fifty per cent chemical nitrogen. Other isolates of the Azotobacter were also capable to save fifty per cent chemical nitrogen. 3.

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