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EFFECT OF BIOFERTILISERS, MACRONUTRIENTS AND MICRONUTRIENTS ON *ABELMOSCHUS ESCULENTUS* (L.)

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ABSTRACT
A field experiment conducted to findout the effect of biofertilisers, micronutrients and macronutrients. Study reveals an increase yield upto 10921.0 kg/ha (10.921t/ha) at 30N: 30P: 30K kg/ha with the combination of dual inoculums of biofertiliser viz, *Pseudomonas striata* and *Azotobacter chroococcum which was* significantaly superior than control. In control, the yield was 4521.4 kg/ha (4.52t/ha), where as in with chemical fertilisers *i.e.* NPK with macro and micronutrients,the yield were 9057.62kg/ha (9.05t/ha) and with 30S:50Ca:20Mg: 5.0Zn: 15.0Fe: 20 Mn: 1.25Cu:2.0Bkg/ha and the yield were 12778.06kg/ha (12.778t/ha). It is evident that the intigration of macro and micronutrients with the application of two strains of biofertilisers viz, *Pseudomonas striata and Azotobacter chroococcum* results into higher yields *i.e.* 12778.06kg/ha (12.778t/ha) in *Ablemoschus esculentus* (L.).

INTRODUCTION

The Vidarbha region mainly consist of ten districts. The soil type varies from black cotton soil to sand stony upto loamy and alluvial type and average rainfall is 90-120 cm per year. The cultivation of *Ablemoschus esculentus* (L.) is limited and its production per unit area is also very low. Sable *et al.,* (2000) reported the influence of seed inoculation with *Rhizobium* and molybdenum on Soyabean roots. It is due to lack of agronomic management practices, including poor fertilization. There is a good scope for increasing the production. Dumal, (1992) reported the effect of *Azotobacter* on germination, growth and yield of some vegetables. Wange and Patil, (1996) reported the response of Pigeon pea cultivars to Rhizobium inoculation under rainfed condition. The present investigation was under taken to study the effect of biofertilisers, macro and micro nutrients on production of *Abelmoschus esculentus* (L.)

MATERIALS AND METHODS

The experiment was conducted in a randomized block design with three replications, there were thirty seven treatments and the details have been listed in Table 1 to 4. The distance between the two rows and two plants was 60 x 45 cm respectively.The experimental soil was black cotton soil, medium in depth (60 to 75cms) and slightly alkaline in reaction (pH 7.5). The macronutrient in soil was high. The available nitrogen (322.4 Kg/ha), was low in P_2O_5 (32.19 Kg/ha), and rich in K_2O (228.9 Kg/ha). 21, 20, 18 kg Ca, Mg, and S/ha was found.The micro nutrients in soil were 15,20,20,18,10 and 10 Kg Zn, Cu, Fe, Mn, B and Mo/ha respectively.

The 8-days old plantlets were treated with 1mL of biofertiliser. The half doses of macro and micro-nutrients was applied as a basal dose at the time of sowing and half dose after three weeks. The seed was sown on 27.6.2002, 29.6.2002, 27.6.2003 and 29.6.2003.

RESULTS

Ablemoschus esculentus (L.):
I.Chemical treatments: *Abelmoschus esculentus* (L.)

N-level	Symbol	P-level	Symbol	K-level	Symbol
0 kg N/ha	N_0	0 kg P/ha	P_0	0 kg K/ha	K_0
10 kg N/ha	N_{10}	10 kg P/ha	P_{10}	10 kg K/ha	K_{10}
20 kg N/ha	N_{20}	20 kg P/ha	P_{20}	20 kg K/ha	K_{20}
30 kg N/ha	N_{30}	30 kg P/ha	P_{30}	30 kg K/ha	K_{30}
40 kg N/ha	N_{40}	40 kg P/ha	P_{40}	40 kg K/ha	K_{40}
50 kg N/ha	N_{50}	50 kg P/ha	P_{50}	50 kg K/ha	K_{50}

II. Biofertiliser treatments (*Abelmoschus esculentus* (L .)
Treatment without chemical and biofertiser (control) T_0
Treatment with *Pseudomonas striata* T_1
Treatment with *Azotobacter chroococcum* T_2
Treatment with *Pseudomonas striata* + *Azotobacter chroococcum* T_3

III. Chemical fertilisers + Biofertiliser treatments (I+ II).
$T3_{select}$ + N10 + P_{10} + K_{10} T_4
$T3_{select}$ + N20 + P_{20} + K_{20} T_5

$T3_{select}$ + N30 + P_{30} + K_{30} T_6
$T3_{select}$ + N40 P_{40} + K_{40} T_7
$T3_{select}$ + N50 + P_{50} + K_{50} T_8
Treatment only with N50 + P_{50} + $K_{50(Only\ chemical\ treatment)}$ T_9

IV. Treatment with major and minor Chemical fertilisers + Bio-fertilisers
(I + II + III) with T9 select

$T_{6\ select}$ + 20 Kg S/ha T_{10}
$T_{6\ select}$ + 30 Kg S/ha T_{11}
$T_{6\ select}$ + 40 Kg S/ha T_{12}
$T_{11\ select}$ + 40 Kg Ca/ha T_{13}
$T_{11\ select}$ + 50 Kg Ca /ha T_{14}
$T_{11\ select}$ + 60 Kg Ca /ha T_{15}
$T_{14\ select}$ + 10 Kg Mg/ha T_{16}
$T_{14\ select}$ + 20 Kg Mg /ha T_{17}
$T_{14\ select}$ + 30 Kg Mg /ha T_{18}
$T_{17\ select}$ + 5.0 Kg Zn/ha T_{19}
$T_{17\ select}$ + 7.5 Kg Zn /ha T_{20}
$T_{17\ select}$ + 10.0 Kg Zn /ha T_{21}
$T_{19\ select}$ + 5.0 Kg Fe/ha T_{22}
$T_{19\ select}$ + 10.0 Kg Fe /ha T_{23}
$T_{19\ select}$ + 15.0 Kg Fe /ha T_{24}
$T_{24\ select}$ + 10 Kg Mn/ha T_{25}
$T_{24\ select}$ + 15Kg Mn /ha T_{26}
$T_{24\ select}$ + 20 Kg Mn /ha T_{27}
$T_{27\ select}$ + 1.25 Kg Cu /ha T_{28}
$T_{27\ select}$ + 1.75 Kg Cu /ha T_{29}
$T_{27\ select}$ + 2.50Kg Cu /ha T_{30}
$T_{28\ select}$ + 1.0 Kg B /ha T_{31}
$T_{28\ select}$ + 1.5Kg B /ha T_{32}
$T_{28\ select}$ + 2.0 Kg B /ha T_{33}
$T_{33\ select}$ + 0.5Kg Mo /ha T_{34}
$T_{33\ select}$ + 1.0 Kg Mo /ha T_{35}
$T_{33\ select}$ + 1.5 Kg Mo /ha T_{36}

V.Treatments with macro and micronutrients only (without biofertilisers)

$T_{9\ select}$ + 30 Kg S + 50 Kg Ca + 20 Kg Mg + 5.0 Kg Zn + 15 Kg Fe + 20 Kg Mn + 1.25 Kg Cu + 2.0 Kg B + 0.5 Kg Mo(All in kg/ha) T_{37}

Table 4: Effects of NPK, some other Macro and Micro-nutrients with *Pseudomonas striata and Azotobacter chroococcum* on the yields of fruits of *Ablemoschus esculentus* (L.)(Bhindi) with T6 select

1	2	3	4
T6 select with S-Level			2.02 t/ha
20	T_{10}	10.935	
30	T_{11}	11.144	
40	T_{12}	11.00	
T11 select with Ca-Level			
40	T_{13}	11.18	
50	T_{14}	11.297	
60	T_{15}	11.237	
T14 select with Mg-Level			
10	T_{16}	11.39	
20	T_{17}	11.41	
30	T_{18}	11.40	
T17 select with Zn-Level			
5	T_{19}	11.72	
7.5	T_{20}	11.70	
10	T_{21}	11.67	
T19 select with Fe-Level			
5	T_{22}	12.22	
10	T_{23}	12.25	
15	T_{24}	12.27	
T24 select with Mn-Level			
10	T_{25}	12.24	
15	T_{26}	12.29	
20	T_{27}	12.31	
T27 select with Cu-Level			
1.25	T_{28}	12.42	
1.75	T_{29}	12.43	
2.5	T_{30}	12.44	
T28 select with B-Level			
1	T_{31}	12.61	
1.5	T_{32}	12.72	
2	T_{33}	12.72	
T33 select with Mo- Level			
0.5	T_{34}	12.75	
1	T_{35}	12.75	
1.5	T_{36}	12.77	
	Only mixed treatment T_{37} = 9.05t/ha		

1 = Application of Nutrients levels kg/ha; 2 = Treatments; 3 = Fruits Yields in gram per plants at 30N: 30P: 30K t/ha with *Pseudomonus striata*. and *A. chroococcum;* 4 = Fruit yields/plant only in chem. fert. 50: 50: 50 NPK t/ha

Table 1: Ablemoschus esculentus (L.) Effect of Pseudomonas striata, Azotobacter chroococcum and chemical fertiliser (NPK) on the plant height per plant (cms) of Ablemoschus esculentus (L)

Treatment	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Year2002-03	81	100	105.5	107.5	126	136	138	148	120	146
Year2003-04	80	100	108.5	107	127	132	134	148	120	145

Table 2: *Ablemoschus esculentus (L.)* Effect of *Pseudomonas striata, Azotobacter chroococcum* and chemical fertiliser (NPK) on the yield of fruits per plant of *Ablemoschus esculentus (L.) t/ha*

Treatments	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Year2002-03	30.52	33.21	34.62	36.12	38.12	38.21	76.7	72.3	72.27	49.63
Year2003-04	32.05	33.34	34.41	37.02	37.61	37.89	77.73	72.61	72.26	48.91
Average of 2-years t/ha)	31.28	33.27	34.51	36.57	37.57	38.05	77.22	72.45	72.26	49.27

Table 3: *Ablemoschus esculentus (L.)* Effect of *Pseudomonas striata, Azotobacter chroococcum* and chemical fertiliser (NPK) on the fruit yield per year in t/ha (2-years data) *Ablemoschus esculentus (L)*

Treatment	T_0	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Year 2002-03	4.52	4.91	5.12	5.35	7.44	10.70	10.91	10.25	9.52	8.92
Year 2003-04	4.74	4.93	5.09	5.48	7.45	10.72	10.92	10.27	9.53	8.94
(Average of 2-years t/ha)	4.63	4.92	5.10	5.41	7.44	10.71	10.91	10.26	9.52	8.93

DISCUSSION

The combined treatments (T_3) of biofertilisers showed significant growth (Table 1and 2) and yields over individual and control treatments. Same type of growth response was reported by Butani *et al.,* (2007). Similarly, it was reported that the application of combined inoculum of *Pseudomonas striata* + *Azotobacter chroococcum* and NPK (T_6) reveals the increase in yields over the control, individual, combined and chemical treatments (NPK) (Table 2 and 3). A similar type of results was reported by Pawar *et al.,* (1996). A individual chemical treatments of NPK (T_9) fails to show much influence over the treatments T_6. These results were co-related with Ilavasi, (2007). Treatments with T_6 and macronutrients treatments (Table 2, 3 and 4) T_{11}, T_{14} and T_{17} reveals an increase in yields over T_0, T_3, T_6 and T_9 treatments. Kalaghatagi *et al.,* (1996); Shrivastava *et al.,* (1998) reported the similar results. Treatments with T_{17} and micronutrient treatments T_{19}, T_{24}, T_{27}, T_{28}, T_{33} and T_{36} reveals the most promising results in increased yields (12.79 t/ha) over the control and integrated chemical treatments $T_{37.}$ These results were in conformity with Dumal, (1992), Agrawal *et al.,* (2008) and Jadhao *et al.,* (1988).

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