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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON YIELD, QUALITY AND ECONOMICS OF *MOTIHARI* TOBACCO (*NICOTIANA RUSTICA*) IN TERAI REGION OF NORTH BENGAL

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Tobacco is one of the important cash crops grown particularly in northern part of West Bengal. Two cultivated species of tobacco viz., *Nicotiana tabacum* and *Nicotiana rustica* locally known as *Jati* and *Motihari* tobacco, respectively are grown in Cooch Behar and Jalpaiguri districts of West Bengal. Tobacco area in West Bengal is 18,000 ha of which about 14,000 ha is under *Motihari* tobacco which holds traditional reputation for its quality and strong flavour and is used mainly for *hookah* as well as chewing purposes. In *Motihari* tobacco, *Hemti* and *Bitri* types are characterized by late and early maturing genotypes/land-races, respectively. Judicious use of organic manures with inorganic fertilizers not only increases the yield of tobacco but also makes the tobacco farming sustainable under North Bengal conditions (Krishnamurthy *et al.*, 1990). The phosphate solubilizing bacteria play a significant role in dissolving interlocked phosphates in the soil into available form (Sharma, 2003). The role of *Azotobacter* in fixing atmospheric nitrogen by using organic carbon and phosphate has been established (Lehri and Mehrotra, 1972; Shinde *et al.*, 1977; Harishu Kumar *et al.*, 1991). Keeping in view the adverse effect of chemical fertilizers on soil and crop health and also on beneficial effects of microorganisms, the present study was conducted to investigate the role of chemical fertilizers along with promising biofertilizers on yield and quality of *Motihari* tobacco.

Field experiment was conducted during 2003-06 at CTRI RS, Dinhata to study the effect of biofertilizers in combination with organic and inorganic fertilizers on yield, economics and quality of *Motihari* tobacco in *terai* region of North Bengal. Nine treatment combinations viz., T1 - 100 % N +100% P_2O_5+ 100% K_2O + 10 t FYM/ha (RDF),T2 - 75% N+100% P_2O_5+ 100% K_2O, T3 - 75% N + 100% P_2O_5+ 100% K_2O + 2.5 t FYM/ha, T4 - 75% N + 100% P_2O_5+ 100% K_2O + 2.5 t FYM+ 10 kg *Azotobacter*/ha,T5 - 100% N + 75% P_2O_5 + 100% K_2O, T6 - 100% N + 75% P_2O_5 + 100% + 2.5 t FYM/ha, T7 - 100% N + 75% P_2O_5 + 100% K_2O + 2.5 t FYM + 10kg PSB/ha, T8 - 75% N + 100% P_2O_5 + 100% K_2O + 2.5 t FYM + 10 kg *Azotobacter* + 10 kg PSB/ha and T9 - 100% N + 75% P_2O_5 + 100% K_2O + 2.5 t FYM + 10 kg *Azotobacter* + 10 kg PSB/ha were evaluated in randomizied block design with four replications. The soil of experimental field was sandy loam and acidic (pH: 4.6-6.4), low to medium in organic matter, available N and K whereas available P (22.5 kg/ha) was medium. *Motihari* tobacco seedlings of 35 – 40 days old were transplanted during the first week of December with 60 x 45 cm spacing. Recommended dose of fertilizers (RDF) was 125 kg N+ 50 kg P_2O_5 + 75 kg K_2O/ha and recommended dose of FYM was 10 t/ha. Half the dose of nitrogen, full dose of phosphorus and potassium and FYM were applied at the time of transplanting through Plant-Row-Plant-Furrow (PRPF) method. Second dose of nitrogen was applied 30-35 days after transplanting by Dollop method. All the package of practices were followed in raising the crop.The leaf quality parameters (nicotine and reducing sugars) were analyzed as per standard methods.

Results showed that the cured leaf yield (Table1), with recommended dose of fertilizers (RDF) +10 t FYM/ha (T1) was at par with T9. The cured leaf yield data were also comparable in the treatments T6 and T7 with T1 and T9. The treatments T2 and T5 exhibited significantly lower cured leaf yields when compared to the other treatments with the same level of N + FYM @ 2.5 t/ha with or without biofertilizers which indicated that absence of FYM created significant impact in bringing down the productivity of cured as well as first grade leaf in *Motihari* tobacco.

First grade leaf yield (Table 1) was on par among the treatments T1, T4 and T9. Very low first grade leaf yields have been recorded in treatments T2 and T5 indicating the fact that absence of FYM has a deleterious effect on the quality of leaf. Addition of FYM @ 2.5 t/ha along with *Azotobacter* @ 10 kg/ha (T4 and T9) also gave significant increase in the first grade leaf yield over T2 and T5 but not over T3 and T6 on par with T1. The above results clearly indicate that whenever the FYM dose is reduced from 10 to 2.5 t/ha it has to be accompanied by *Azotobacter* @ 10 kg/ha to get comparable first grade leaf yield of the recommended practice. Addition of PSB @ 10 kg/ha did not show significant improvement in cured leaf and first grade leaf yields as seen from the data of treatments T6 and T7.

The highest cured (2315 kg/ha) and first grade (1315 kg /ha) leaf yield of *Motihari* tobacco was obtained in T1 as compared to other combinations of fertilizers. The increase in cured and first grade leaf yield of *Motihari* tobacco in T1 was to the tune of 40.5 and 70%, respectively over T2. Application of 100% N + 75% P_2O_5 + 100% K_2O + 2.5 t FYM + 10 kg *Azotobacter* +10 kg PSB/ha (T9) exhibited more cured and first grade leaf yield to the tune of 31.0 and 50.8 %, respectively over

Table 1: Productivity (kg/ha) and economics of *Motihari* tobacco as influenced by different fertilizer combinations

Treatments	Cured leaf yield (kg/ha)	First grade leaf yield (kg/ha)	First grade leaf (%)	Net return (Rs/ha)	C:B ratio	Nicotine (%)	Reducing sugars (%)	Organic carbon (%)
T1	2315	1315	57	23085	1.83	3.83	0.38	0.50
T2	1648	773	47	11792	1.50	2.17	0.52	0.44
T3	1961	1065	54	19381	1.79	4.14	0.35	0.50
T4	1996	1159	59	20808	1.84	3.99	0.39	0.51
T5	1727	923	53	15462	1.65	3.11	0.40	0.47
T6	2038	1105	54	20033	1.82	3.51	0.42	0.51
T7	2113	1110	52	21885	1.87	4.21	0.34	0.54
T8	1967	1036	53	18699	1.74	3.55	0.39	0.54
T9	2158	1166	54	22348	1.88	4.24	0.37	0.55
SEm ±	**98.1**	**64.0**	-	-	-	**1.19**	**0.03**	**0.02**
CD (P=0.05)	**284.7**	**185.6**	-	-	-	**0.57**	**0.09**	**0.06**

RDF : 125 kg N + 50 kg P_2O_5 +75 kg K_2O + 10 t FYM/ha
Azo : *Azotobacter;* PSB : Phosphorus solubilising bacteria

T1-100% N +100 %P + 100% K +10 t FYM, T2- 75% N+100 %P + 100% K, T3-75% N+100 %P + 100% K+2.5 t FYM/ha, T4-75% N+100 %P + 100% K+2.5 t FYM/ha+10kg Azo/ha, T5-100% N +75 %P + 100% K, T6-100% N +75 %P + 100% K+2.5 t FYM/ha, T7-100% N +75 %P + 100% K+2.5 t FYM + 10kg PSB/ha, T8-75% N+100 %P + 100% K+2.5 t FYM + 10kg Azo +10 kg PSB/ha, T9-100% N +75 %P + 100% K+2.5 t FYM + 10kg Azo + 10kg PSB/ha.

application of 75% N + 100% P_2O_5 +100% K_2O. Application of 100% N + 75% P_2O_5 + 100 % K_2O + 2.5 t FYM + 10 kg *Azotobacter* + 10 kg PSB/ha recorded highest nicotine (4.24%) content in cured leaf as compared to other fertilizer schedules (Table 1). Lowest nicotine content (2.17%) was recorded in 75 % N + 100% P_2O_5+100% K_2O as compared to other treatment combinations. Significantly higher reducing sugars (0.52 %) in the leaves were recorded in 75 % N + 100% P_2O_5+ 100% K_2O as compared to other combinations of organic, inorganic and biofertilizers in the *Motihari* tobacco.The results clearly indicate that net returns were significantly highest under treatment T1 followed by T9 and T7 (Table 1). The highest benefit : cost ratio (1.88) was realized in T9 followed by T7 and T4. The result is clear indicative of the fact that there is enhancement in the benefit: cost ratio of *Motihari* tobacco when inorganic fertilizers are applied in consortium with biofertilizers and FYM at much lower doses compared to recommended dose at field level. Even at 25% (2.5 t/ha) of the recommended dose of FYM (10 t/ha) in *Motihari* tobacco, a sizeable influence on increase in yield and quality of leaves was observed. Highest organic carbon content (0.55%), was restored in the soil with 100% N + 75% P + 100% K_2O +2.5 t FYM +10 kg *Azotobacter* + 10 kg PSB/ha as compared to other combinations of organic, inorganic and biofertilizers (Table 1. Application of 75 % N + 100%P_2O_5+100% K_2O + 2.5 t FYM + 10 kg *Azotobacter* + 10 kg PSB kg/ha ranked second in restoring more organic carbon content (0.54%) in the soil than other combinations. Minimum organic carbon content (0.44%) was in T2. Addition of FYM @ 2.5 t/ha + *Azotobacter* @ 10 kg/ha increased soil organic carbon content significantly over no addition of FYM and *Azotobacter* in a three-year experimentation period. Organic carbaon increased significantly from 0.44% in T2 to 0.51 in T4 and to 0.54% in T8. It also increased significantly from 0.47% in T5 to 0.54% in T7 and to 0.55% in T9. Significant increase in organic carbon content of soil due to application of FYM is not observed in the absence of biofertilizers as seen from the data (Table 1). Application of biofertilizers and FYM along with inorganic fertilizers significantly increased the available P status of the soil over application of inorganic fertilizers alone indicating the importance of biofertilizers in improving soil fertility. Dual inoculation of *Rhizobium* and PSB resulted in increased accumulation of nitrogen and phosphorus uptake in soil (Shinde and Saraf, 1992; Poi *et al.*, 1998). Results of the present investigation clearly indicated that biofertilizers play an important role in improving the soil health in terms of influencing the uptake of different essential elements for the soil system.

From the results, it can be concluded that application of FYM @ 2.5 t/ha along with inorganic fertilizers is essential to get significant increase in yield (cured leaf and first grade leaf) of *Mothihari* tobacco over application of inorganic fertilizers alone. Application of FYM @ 2.5 t/ha along with inorganic fertilizers did not significantly improve soil fertility over application of inorganic fertilizers alone but application of biofertilizers along with FYM and inorganic fertilizers improved soil fertility significantly over application of only inorganic fertilizers at 75 or 100% of recommended level of N and P. Application of biofertilizers (*Azotobacte*r and PSB) along with reduced level of FYM (2.5 t/ha) and inorganic P fertilizers (75 %) at recommended level of N and K gave comparable yield and higher benefit : cost ratio over application of FYM @10 t/ha with recommended N, P and K levels without bio-fertilizers resulting in a saving of 7.5 t FYM + 12.5 kg P_2O_5/ha and it can be an alternative recommendation for *Motihari* tobacco in West Bengal to tide over the scarcity of FYM, if any.

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Table 2: Nicotine and reducing sugar content of leaf lamina and available nutrient status in the soil as influenced by organic inorganic and biofertilizer treatments in *Motihari* tobacco

Treatment	Nicotine (%)	Reducing sugars (%)	Organic carbon (%)	Available P (kg/ha)	Available K (kg/ha)
T1-100% N +100 %P + 100% K +10 t FYM	3.83	0.38	0.50	20.34	106.04
T2- 75% N+100 %P + 100% K	2.17	0.52	0.44	15.79	86.24
T3-75% N+100 %P + 100% K+2.5 t FYM/ha	4.14	0.35	0.50	18.03	91.84
T4-75% N+100 %P + 100% K+2.5 t FYM/ha +10kg Azo/ha	3.99	0.39	0.51	21.22	98.54
T5-100% N +75 %P + 100% K	3.11	0.40	0.47	14.80	97.44
T6-100% N +75 %P + 100% K+2.5 t FYM/ha	3.51	0.42	0.51	16.47	88.48
T7-100% N +75 %P + 100% K+2.5 t FYM + 10kg PSB/ha	4.21	0.34	0.54	21.26	107.52
T8-75% N+100 %P + 100% K+2.5 t FYM + 10kg Azo +10 kg PSB/ha	3.55	0.39	0.54	22.19	112.00
T9-100% N +75 %P + 100% K+2.5 t FYM + 10kg Azo + 10kg PSB/ha	4.24	0.37	0.55	23.49	115.36
SEm±	**1.19**	**0.03**	**0.02**	**0.90**	**2.43**
CD (P=0.05)	**0.57**	**0.09**	**0.06**	**2.71**	**7.27**

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