

## Nutrient Management in Tobacco Based Intercropping Systems in North Bihar

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### Abstract

A field experiment was conducted during three consecutive years of 2000-01 to 2002-03 to study the nutrient management on yield, quality and fertility status in tobacco based intercropping system in North Bihar. Results revealed that significantly highest cured and first grade leaf yield of tobacco was obtained in tobacco + garlic than other intercropping systems. Highest net and gross return and cost : benefit ratio were realized in tobacco + garlic followed by tobacco + rajmash and tobacco + potato intercropping systems. Application of 100% recommended dose of fertilizers (RDF) produced significantly highest cured and first grade leaf yield of tobacco as compared to rest of the fertility levels. Application of 100% RDF registered more gross and net returns and cost : benefit ratio. The physical parameters of maturity score was recorded more in tobacco + garlic intercropping and application of 100% RDF. Physical and chemical compositions of soil after harvest of tobacco was restored more in 100% RDF along with tobacco + garlic intercropping.

**Key words :** Nutrient management, Intercrop, Tobacco, Yield.

Chewing tobacco (*Nicotiana tabacum* L.) is a remunerative and profitable *rabi* crop grown in northern part of Bihar comprising mainly in Vaishali, Samastipur, Muzaffarpur, Sitamani, Begusarai and Darbhanga districts. It occupies an area of 23,000 hectare producing about 29,000 tonnes of cured leaves per year. About 80% of tobacco farmers of this region fall under small and marginal category with average land holding size less than one hectare. Intercropping between tobacco rows is a common feature. Short canopy crops e.g. garlic, potato, rajmash having high market value are widely grown as intercrop between tobacco rows. The present study was taken up with a view to find out optimum fertility levels for these highly remunerative intercropping systems without affecting the yield and quality of base crop of tobacco.

### Methods

A field experiment was conducted for three consecutive seasons from 2000-01 to 2002-03 during *rabi* seasons at the Crop Research Program Farm, Pusa for studies on nutrient management in tobacco based intercropping system in Bihar. The soil of the

experimental field was sandy loam in texture having pH 7.6 and EC 0.44 ds/m. The fertility status of the soil was low in organic carbon (0.42%) and available potassium (48.0 kg/ha) and medium in available phosphorus (20.56 kg/ha); 45 days old healthy tobacco seedlings were transplanted in the experimental plots. The treatment combinations comprised three intercrops—garlic, rajmash and potato and five fertility levels viz. 100, 75, 50, 25 and 0% of recommended dose of fertilizers (RDF) and were replicated thrice under randomized block design. The gross plot size was 6.0 m × 5.4 m and net plot 4 m × 3.6 m. Tobacco variety PT-76 was planted at 90 × 90 cm spacing in the first week of October. Plants were topped at button stage retrieving 14 leaves per plant and pierced by a needle at 80—85 days at 2—3 cm deep for breaking the apical dominance; 50% of total N at of 250 kg/ha for tobacco was applied through mustard cake and remaining through urea. Single super phosphate and murate of potash were used as sources of P and K to supply 70 kg each per hectare at 10 days before planting of tobacco. Two rows of each intercrops were planted in between alternate rows of tobacco after 10—15 days of planting. Recommended doses of NPK were applied following recommendation for

**Table 1.** Yield of tobacco and intercrops as influenced by intercrops and fertility levels. RDF = Recommended dose of fertilizer.

Treatments	Yield of tobacco (kg/ha)				Yield of intercrops (kg/ha)							
	Total cured leaf		First grade leaf		Total cured leaf		First grade leaf					
	2000-01	2001-02	2002-03	Pooled	2000-01	2001-02	2002-03	Pooled				
<b>Intercrops</b>												
Garlic	2664	2062	2150	2292	1278	1191	1299	1256	802	1690	1060	1184
Rajmash	2607	2104	2136	2283	1230	1225	1278	1244	849	991	887	789
Potato	2413	1954	2063	2143	1088	1147	1257	1164	7981	8074	3692	6582
SE ±	30	19	29	13	15	22	16	10	—	—	—	—
CD ( <i>P</i> = 0.05)	86	55	57	37	44	NS	NS	29	—	—	—	—
<b>Fertility Levels (RDF)</b>												
100%	2698	2168	2257	2371	1253	1282	1404	1314	3538	3954	2107	3199
75%	2673	2157	2221	2350	1262	1289	1366	1305	3355	3935	2107	3132
50%	2590	2033	2113	2245	1230	1188	1269	1229	3173	3715	1887	2925
25%	2443	1975	2035	2151	1157	1138	1169	1164	2982	3287	1840	2703
0%	2413	1867	1954	2078	1092	1042	1150	1065	2406	3033	1458	2299
SE ±	38	24	25	17	20	28	21	13	—	—	—	—
CD ( <i>P</i> = 0.05)	111	71	73	48	51	81	60	37	—	—	—	—
CV %	4.5	3.6	3.6	4.0	4.9	7.1	4.9	5.7	—	—	—	—

intercrop i.e., garlic (100 : 60 : 80 NPK kg/ha), rajmash (60 : 60 : 40 NPK kg/ha) and potato (120 : 60 : 80 NPK kg/ha) as a basal application.

Physical leaf quality parameters such as span-gling, puckering and maturity were measured at 0 to 10 scales. Data on total cured and first grade leaf yield were subjected to statistical analysis. Economics of the treatments were worked out on the basis of prevailing market values of input and output. Weather parameters including rainfall were almost favorable

**Table 2.** Interaction of yield between years and intercrops. TCL—Total cured leaf yield, FGL—First grade leaf yield.

Year	Yield (kg/ha)					
	Garlic		Intercrop		Potato	
	TCL	FGL	TCL	FGL	TCL	FGL
2000-01	2663	1278	2607	1330	2413	1088
2001-02	2063	1191	2104	1225	1954	1147
2002-03	2150	1299	2136	1278	2063	1257
SE ±	TCL		FGL			
	30		23			
CD ( <i>P</i> = 0.05)	83		64			

**Table 3.** Economics of different treatments.

Treatments	Cost of cultivation (kg/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	C : B ratio
<b>Intercrops</b>				
Garlic	54982	97930	42948	1 : 1.78
Rajma	54998	95579	41581	1 : 1.74
Potato	56762	93547	36785	1 : 1.65
<b>Fertility Levels (RDF)</b>				
100%	56923	102831	45908	1 : 1.81
75%	56276	101827	45551	1 : 1.81
50%	55551	96854	41302	1 : 1.74
25%	54889	91769	36870	1 : 1.67
0%	54264	86822	32558	1 : 1.60
<b>Market rate /selling price (Rs/q)</b>				
Mustard cake	550	Tobacco leaf	3516.67	
Urea	395	Garlic	1466.67	
SSP	380	Rajma	2033.33	
MOP	380	Potato	283.33	
DAP	830			
Man days	50 per day each			

**Table 4.** Plant growth and physical leaf quality parameters as influenced by different intercrops and fertility levels.

Treat- ments	Plant growth		Physical leaf quality parameters × 10		
	No. of curable leaves/ plant	Leaf area (sq m/ plant)	Spang- ling score	Puc- ke- ring score	Matu- rity score
<b>Intercrops</b>					
Garlic	13.39	2.05	8.04	8.12	8.43
Rajmash	13.21	2.08	8.14	8.19	8.33
Potato	13.23	2.03	7.77	7.78	8.26
SE ±	0.07	0.02	0.05	0.05	0.04
CD ( <i>P</i> = 0.05)	NS	NS	0.13	0.14	0.12
<b>Fertility Levels (RDF)</b>					
100%	13.31	2.11	8.24	8.13	8.44
75%	13.37	2.14	8.24	8.28	8.43
50%	13.28	2.05	8.02	8.13	8.41
25%	13.20	2.01	7.85	7.89	8.26
0%	13.22	1.96	7.57	7.72	8.17
SE ±	0.09	0.03	0.06	0.06	0.06
CD ( <i>P</i> = 0.05)	NS	0.09	0.17	0.18	0.15
CV%	3.4	8.1	4.1	4.1	3.5

during the entire crop period.

### Results and Discussion

Data revealed that tobacco + garlic intercropping significantly increased total cured and first grade leaf yields of tobacco as compared to tobacco + potato intercrop system. Significantly higher cured and first grade leaf yield of tobacco was obtained in tobacco + rajmash intercropping than tobacco + potato intercropping (Table 1). The increase in cured and first grade leaf yield of tobacco in tobacco + garlic was 6.95 and 7.95% respectively than tobacco + potato intercropping system. The interaction between intercrops and years was significant for total cured and first grade leaf yield of tobacco (Table 2). The increase in cured and first grade leaf yield of tobacco in tobacco + garlic intercropping system might be due to less competition for space, light and nutrients. Significant increase in total cured and first grade leaf yield of tobacco with garlic intercropping has been reported earlier in terms of maximum cured and first grade leaf yield and higher benefit : cost

**Table 5.** Physical and chemical composition of soil as influenced by different intercrops and fertility levels.

Treat- ments	pH	EC (ds/ m)	Orga- nic car- bon (%)	Chlo- ride (ppm)	Avail- able	Avail- able
					phos- pho- rus (kg/ ha)	potas- sium (kg/ ha)
<b>Intercrops</b>						
Garlic	7.61	0.55	0.43	24.80	16.89	114.26
Rajma	7.42	0.42	0.41	29.06	15.39	77.32
Potato	7.53	0.57	0.44	28.27	16.22	98.87
<b>Fertility Levels (RDF)</b>						
100%	7.56	0.51	0.45	34.67	19.90	112.44
75%	7.54	0.49	0.44	32.45	17.53	109.00
50%	7.49	0.48	0.44	28.89	17.35	106.21
25%	7.46	0.46	0.43	27.11	15.30	99.11
0%	5.57	0.45	0.43	27.11	14.95	79.56

ratio compared to rajmash and potato (Singh et al. 1998, CTRI 2005, 2006). The beneficial effect of sugarcane and papaya intercropping on yield improvement has also been reported earlier (Sinha et al. 1982, Ram et al. 1990).

Among the fertility levels, application of 100% RDF significantly increased cured and first grade leaf yield of tobacco over fertility levels of 50, 25 and 0% (Table 1). Application of 75% RDF also recorded significantly higher cured and first grade leaf yield of tobacco as compared to other fertility levels. Significant improvement in cured and first grade leaf yield of tobacco with the application of 100% RDF was observed earlier (Sinha et al. 1982). Application of recommended dose of fertilizers might increase the availability of major plant nutrients particularly nitrogen, phosphorus and potash in tobacco plants thus resulting in the increase of total cured and first grade leaf yield of tobacco.

The economics of tobacco was greatly influenced under different intercropping systems and fertility levels. Highest gross return (Rs 97,930/ha), net return (Rs 42,948/ha) and cost : benefit ratio (1 : 1.78) were obtained in tobacco + garlic followed by tobacco + rajmash and tobacco + potato intercropping systems. The minimum gross return (Rs 93,547/ha), net return (Rs 36,785/ha) and cost benefit ratio (1 :

1.65) were registered in tobacco + potato intercropping systems. Application of 100% RDF treatments recorded highest gross return (Rs 102,831/ha), net return (Rs 45,908/ha) and benefit : cost ratio (1 : 1.81) followed by 75%, 50% and 25% of RDF. Minimum gross return (Rs 86,822/ha), net return (Rs 36,870/ha) and cost : benefit ratio (1 : 1.60) was recorded in control plots. The net return and benefit : cost ratio in tobacco + garlic intercropping has similarly been reported to be superior over tobacco + potato intercropping systems in terai agro-ecological region of West Bengal (CTRI 2005, 2006). Highest net return of Rs 42,948/ha was recorded under tobacco + garlic intercropping system followed by tobacco + rajmash intercropping system (Rs 41,581/ha). The difference between the two intercropping system was Rs 1,367/ha. Among the fertility levels, the difference between 100 or 75% of RDF for intercrops gave only a marginal difference of Rs 375/ha (Table 3).

Physical leaf quality parameters of tobacco were significantly influenced by different intercrops and fertility levels. Spangling, puckering and maturity scores were significantly higher when tobacco was intercropped with potato. It may be attributed to more availability of plant nutrients due to high fertility gradient recommended for potato. The difference between rajmash and potato intercropped with tobacco on these quality parameters were non-significant (Table 4). Application of different levels of fertilizers significantly influenced physical quality parameters of tobacco. Spangling, puckering and maturity scores significantly increased with increasing levels of fertilizers. Significantly highest spangling (8.24), puckering (8.28) and maturity (8.44) scores were recorded in 100% RDF than control. The differences on physical quality parameters were non-significant with the application in 100 and 75% RDF. The minimum values of spangling (7.57), puckering (7.72) and maturity (8.17) scores were recorded under control plots.

The physical and chemical composition of soil after harvest of tobacco crop showed that highest organic carbon (0.44%) and EC (0.57 ds/m) was restored in tobacco + potato followed by tobacco +

garlic and tobacco + rajmash intercropping systems (Table 5). The chloride content (24.80 ppm) in the soil was more in tobacco + rajmash followed by tobacco + potato (28.27 ppm) and tobacco + garlic (24.80 ppm). Tobacco + garlic recorded highest pH (7.61), available P (16.89 kg/ha) and available potassium (114.26 kg/ha) followed by tobacco + potato and tobacco + rajmash. Application of 100% RDF restored more pH, EC, organic carbon, chloride, available phosphorus and available potassium in the soil followed by 75, 50 and 25% of RDF. The minimum values of physical and chemical composition of soil were recorded in control.

The result of the present investigation and the findings of other workers strongly indicate that intercropping with low canopy crop like garlic is superior compared to other crops like potato and rajmash. Garlic intercropping has proved its superiority in significantly increasing the cured and first grade leaf yields of tobacco with higher return and benefit : cost ratio. There is added advantage with low canopy crop like garlic as it poses minimum risk during inter-culturing operations in between rows and do not interfere in competition for space, light, and nutrients. The allelopathic effect of garlic has synergistic action in checking the soil born pathogens and pests in soil. Compared to other crops garlic has edge over other crops owing to its higher shelf life.

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