Environment & Ecology 35 (2) : 735—738, April—June 2017
Website: environmentandecology.com ISSN 0970-0420

Effect of Nitrogen and Potasium Levels on Yield, Quality, Nutrient Uptake and Economics of Pikka Tobacco (*Nicotiana tabacum* L.) in Odisha

A. K. B. Mohapatra, K. C. Pradhan

Received 6 June 2016; Accepted 11 July 2016; Published online 25 July 2016

Abstract A field experiment was conducted during rainy seasons of 2010–2012 to study the effect of four levels e.g. 0, 40, 80 and 120 kg/ha of nitrogen and four levels e.g. 0, 30, 60 and 90 kg/ha of potassium on growth, yield, cured leaf quality, nutrient uptake and economics of *Pikka tobacco*. Among the 16 treatment combinations 120-40-90 kg N-P_2O_5-K_2O/ha recorded tobacco leaves having the maximum length and breadth, maximum number of leaves/plant, cured leaf yield kg/ha, quality leaves having, desirable levels of nicotine, reducing sugar and chloride content which was at par with 80-40-60 kg N-P_2O_5-K_2O/ha. But considering the economics, application of 80-40-60 kg N-P_2O_5-K_2O/ha has the highest net return of Rs 32, 125/ha with benefit : cost ratio of 1.95.

Keywords Nitrogen, Potassium, Tobacco, Nicotine, Reducing sugar.

Introduction

Tobacco (*Nicotiana tabacum* L.) an important cash crop of Odisha is cultivated as rainfed crop in an area of 1700 hectare with a production of 1000 tonnes and productivity of 598 kg/ha annually [1]. The decline in production of tobacco is due to indiscriminate and imbalanced use of chemical fertilizer. Nitrogen and potassium are the two key elements in nutrition in tobacco. Balanced nitrogen, potassium fertilization enhance tobacco growth and quality parameters such as leaf color, texture, hygroscopic properties, combustibility, sugar and alkaloid contents and improves the uptake of such nutrients which in turn reduces nitrate loss during and after cropping season. There should be sufficient available nitrogen for more numbers of leaves, plant height and leaf expansion and weight of leaves during development phase as a result it must be depleted from soil at the end of growth stage. Excess nitrogen causes prolonged delay in maturity lowers the quality and yield of leaves [2]. The role of potassium on plant are disease resistant, transfer of starch, sugar and fat. Potassium concentration in tobacco leaves ranges 2 to 8% which some

A. K. B. Mohapatra*, K. C. Pradhan
All India Network Research Project on Tobacco,
Orissa University of Agriculture and Technology,
Berhampur, Odisha 761001, India
e-mail : arayamohapatra@gmail.com
*Correspondence

Table 1. Effect of nitrogen and potassium level on plant growth, cured leaf yield and economics in *pikka* tobacco (2010–2013).

Treatments (N-P_2O_5-K_2O kg/ha)	Topped plant height (cm) at harvest	No of leaves/ plant	Leaf length (cm)	Leaf breadth (cm)	Cured leaf yield (kg/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	B:C ratio (Rs/ha)
F_1	31.02	6.65	28.87	14.77	559	15093	25000	-9907	0.60
F_2	31.62	6.64	30.90	15.13	589	15903	25900	-9997	0.61
F_3	32.02	6.85	31.49	15.39	614	16578	26800	-10222	0.62
F_4	32.26	6.90	32.01	15.66	644	17388	27700	-10312	0.63
F_5	43.94	7.24	35.66	16.15	752	30080	28520	1560	1.05
F_6	48.21	7.28	38.14	16.33	845	33800	29420	4380	1.15
F_7	49.12	7.42	38.38	17.26	912	36480	30320	6160	1.20
F_8	52.41	7.57	40.13	17.61	957	38280	31220	7060	1.23
F_9	57.47	7.57	42.76	20.00	926	37040	32040	5000	1.16
F_{10}	60.01	8.26	46.40	22.69	1267	57015	32940	24075	1.73
F_{11}	61.11	8.61	54.13	26.13	1465	65925	33800	32125	1.95
F_{12}	61.89	8.78	54.39	26.67	1501	67545	35800	31745	1.89
F_{13}	61.76	8.02	46.03	20.37	990	39600	32560	7040	1.22
F_{14}	62.13	8.46	46.56	24.57	1323	59535	33460	26075	1.78
F_{15}	63.44	8.97	55.63	27.11	1515	68175	36300	31875	1.88
F_{16}	65.56	9.04	56.14	27.19	1538	69210	37200	32010	1.86
SEm ±	2.32	0.245	2.42	0.624	33.35	1166.5	215.9	960.9	0.03
CD (0.05)	7.02	NS	7.18	1.91	101.5	3371	624.2	2777.1	0.08

times reaches 10%. Tobacco leaves that do not contain enough potassium after curing are brittle and straw like while leaves having enough potassium are soft and bright yellow. Thus this experiment was conducted to determine the effect of different levels of nitrogen and potassium on quality and productivity of pikka tobacco.

Materials and Methods

The field experiment was conducted at Center for Pulses Research, Orissa University of Agriculture and Technology, Berhampur (19°18´ north latitude, 84°54´ east longitude and 34 m above MSL.) in the East and South Eastern Coastal plain zone of Orissa, during rainy season of 2010, 2011 ana 2012. The soil of the experimental site was loamy sand class Aerid Haplustalfs, order Alfisols with pH 5.5, low in available N, P and S (186.4, 3.5 and 18.2 kg/ha) respectively, medium in K (164.2 kg/ha), low in boron (0.204 ppm) and exchangeable calcium 1.5 c.mol (p^+) kg^{-1}. Lime requirement (LR) of soil was 2.6 t/ha. The experiment was conducted with four levels of nitrogen e.g. 0. 40, 80, 120 kg/ha and four levels of potassium e.g. 0, 30, 60, 90 kg/ha laid out in factorial randomized block design with three replications involving sixteen treatments e.g. F_1 (0-40-0), F_2 (0-40-30), F_3 (0-40-60), F_4 (0-40-90), F_5 (40-40-0), F_6 (40-40-30), F_7 (40-40-60), F_8 (40-40-90), F_9 (80-40-0), F_{10} (80-40-30), F_{11} (80-40-60), F_{12} (80-40-90), F_{13} (120-40-0), F_{14} (120-40-30), F_{15} (120-40-60) and F_{16} (120-40-90) kg N-P_2O_5-K_2O/ha. Fifty days old tobacco seedlings variety 'Gajapati' were planted at a spacing of 75 cm × 50 cm on 11th, 10th and 28th August and it was harvested on 20th November, 21st November and 15th December during 2010, 2011 and 2012 respectively. A common dose of 40 kg P_2O_5/ha and farm yard manure @ 5 tonnes/ha was applied as basal in all the treatments. Potassium was applied in form of potassium sulfate. Half of nitrogen and all the P_2O_5 and K_2O were applied basal at planting. Rest 50% nitrogen was applied after 25—30 days after planting. Topping was done at 9 leaf stage. All the agronomic and plant protection practices were followed as per the treatments during crop growth. The available N, P and K content in the leaves were determined by alkaline potassium permanganate, spectro photo metrically by molybdo phosphoric acid yellow color, flame photometric, respectively. The plant samples at harvest were collected and dried sepa-

Table 2. Effect of nitrogen and potassium levels on laminar nutrient uptake, laminar chemical content of *pikka* tobacco (2001–2012).

Treatments ($N-P_2O_5-K_2O$ kg/ha)	Laminar nutrient uptake			Laminar chemical content		
	N	P	K	Reducing sugar (%)	Nicotine (%)	Chlorides (%)
F_1	13.1	3.20	14.74	5.78	1.18	1.35
F_2	14.8	3.51	2.79	5.79	1.22	1.33
F_3	16.4	4.07	31.39	5.77	1.25	1.30
F_4	18.5	4.6	40.05	6.68	1.28	1.13
F_5	31.7	5.03	20.84	7.38	1.72	1.30
F_6	40.5	6.38	28.76	8.10	1.73	1.20
F_7	45.6	7.17	36.96	8.33	1.75	1.15
F_8	48.9	7.48	50.15	9.12	1.75	1.00
F_9	44.4	7.10	18.31	12.18	1.92	1.10
F_{10}	62.5	9.99	42.61	12.15	1.94	0.75
F_{11}	71.3	11.19	54.19	15.16	2.0	0.68
F_{12}	73.5	11.56	77.39	15.28	2.0	0.60
F_{13}	58.0	7.97	20.73	15.48	.03	1.0
F_{14}	78.9	10.83	45.96	16.12	2.04	0.60
F_{15}	87.3	12.03	60.87	16.38	2.05	0.50
F_{16}	89.5	12.57	80.22	16.68	2.06	0.50

rately for stem, leaf, leaf midrib and roots and N, P and K content were determined through standard procedures.

Results and Discussion

Growth and cured leaf yield

Growth parameters i.e. topped plant height, number of leaves per plant, leaf length and leaf breadth, differed significantly due to application of increasing leaves of nitrogen and potassium. Maximum plant height and other growth parameters were recorded in applying F_{16} (120-40-90) kg $N-P_2O_5-K_2O$/ha which was statistically significant with F_{11} (80-40-60) kg $N-P_2O_5-K_2O$/ha (Table 1). As regards to plant height application of F_{16} (120-40-90) kg $N-P_2O_5-K_2O$/ha is statistically at par with applying, F_{15} (120-40-60), F_{14} (120-40-30), F_{13} (120-40-0), F_{12} (80-40-90), F_{11} (80=40-60), and F_{10} (80-40-30) kg $N-P_2O_5-K_2O$/ha. Increasing application of nitrogen 80 to 120 kg/ha increased plant height. Leaf length and breadth are the two yield attributing characters increased by applying F_{15} (120-40-60) kg N $P_2O_5-K_2O$/ha was significantly at par with F_{12} (80-40-90) and F_{11} (80-40-60) kg $N-P_2O_5-K_2O$/ha. Nitrogen stimulates the biosynthesis and export cytokinin hormone from roots to leaves causes increase in cell division in length and width [3].

Sufficient potassium increased the intensity of photosynthesis speed of transfer of material made during photosynthesis positive role in nitrogen and protein synthesis. Higher levels of nitrogen combined with higher levels of potassium increased leaf dimension. Tobacco absorb about 95% of the total nutrients within 9 weeks after planting [4]. Higher doses of both nitrogen and potassium was retained in the rhizosphere by farm yard manure applied uniformly to all the treatments then their continuous supply, resulted in maximum cured tobacco leaf yield in the F_{16} (120-40-90) kg N-P-K/ha treatment, which was at par with F_{15} (120-40-60), F_{12} (80-40-90) and F_{11} (80-40-60) kg $N-P_2O_5-K_2O$/ha.

Leaf quality

The nicotine content reduced to the lowest of 1.18% resulting poor quality tobacco leaves when no nitrogen and potassium were applied (Table 2). Minimum nicotine was related to lowest level of nitrogen. There was increase in the nicotine content of leaves with increase in nitrogen fertilizer. The nicotine content was in the acceptable limit of 2% in the cured tobacco leaves by applying 80 to 120 kg/ha in combination with potassium 60 kg/ha. Because the nicotine is an alkaloid with formula ($C_{10}H_{14}N_2$) which the nitrogen element in the structure has been produced in the root and then transfered to leaves if environmental factors such as water and nutrients are provided. The reducing sugar per cent in the cured leaves were in the acceptable limit of 15–16% in the treatments fertilizer with higher doses of 60–90 kg of potassium per hectare (Table 2). In presence of potassium stomata will be opened and more carbon dioxide is converted in to glucose and sugar percentage increased in the leaf with increase in potassium level [5, 6].

Nutrient uptake

Nutrient up take increased with increase in fertilizer application. Adequate amount of uptake of nutrient has been reflected in higher yield and quality of leaves (Table 2).

Economics

Application of F_{16} (120-40-90) N-P_2O_5-K_2O/ha recorded the maximum cured leaf yield of 1538 kg/ha which is at par with F_{11} (80-40-60) kg N-P_2O_5-K_2O/ha with the cured leaf yield of 1465 kg/ha. But F_{11} and has the highest net return of Rs 32, 125/ha and benefit: cost ratio of 1.95.

It may be concluded that pikka tobacco may be fertilized with F_{11} (80-40-60) kg N-P_2O_5-K_2O kg/ha for maximizing the yield.

References

1. Odisha Agriculture Statistics 2012-14.
2. Collins WK (2003) The growth habit of the tobacco plant. Tobacco Res 29 : 77—79.
3. Kasturi Krishna S, Krishna Reddy SV, Deosingh K, Harishkumar P, Chandrasekhar Rao C, Krisnamurty V (2009) Effect of organic and inorganic sources of nitrogen on productivity, quality and economics of FCV tobacco (*Nicotiana tabacum*). Ind J Agron 54 : 336—341.
4. Dinesh Kumar M, Vageesgh TS, Sridhar S, Girijesh GK (2013) Effect of nitrogen and potassium levels on yield and quality of promising FCV tobacco genotypes (KST-28). Karnataka J Agric Sci 26 : 205—208.
5. Marchetti R, Castelli F, Contillo R (2006) Nitrogen requirement for flue cured tobacco. Agron J 98 : 666—674.
6. Hossein H, San Daliri M, Hamid RM, Mosavi AA (2011) Effect of different nitrogen and potassium fertilizer level on quality and quantity yield of flue cured tobacco (Coker 347). World Appl Sci J 15 : 941—946.