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Effect of nitrogen and topping on performance of bidi tobacco (*Nicotiana tabacum L.*) varieties under rainfed conditions

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ABSTRACT

A field experiment was undertaken at Regional Agriculture Research Station, Nandyal, Andhra Pradesh for two consecutive years viz., 2018-19 and 2019-20 on Vertisols under rainfed condition to study the effect of different levels of nitrogen and topping on performance of bidi tobacco (Nicotiana tabacum L.) varieties. The treatments consisted of two varieties as main plots, three nitrogen levels as sub plots and three topping levels as sub sub plots in split split plot design and replicated thrice. The data pooled over two seasons revealed that significantly higher leaf length (47.6 cm), leaf width (21.3 cm) and cured leaf yield (2217 kg ha^{-1}) were recorded with variety ABD 132 over other variety Nandyal Pogaku 1. Application of 140 kg N ha^{-1} recorded higher leaf length (47.7 cm), leaf width (20.9 cm) and cured leaf yield (2110 kg ha^{-1}). The topping at 15 leaf stage recoded higher cured leaf yield (2147 kg ha^{-1}) over other topping stages. Higher net returns (Rs 105544 ha^{-1}) with BCR of 2.72 were recorded with ABD 132 over Nandyal Pogaku 1. Application of 110 kg N ha^{-1} recorded higher BCR of 2.55 whereas topping at 15 leaf stage recorded higher net returns (Rs 100275 ha^{-1}) with BCR of 2.64. ABD 132 recorded higher nicotine (5.94%), lower reducing sugars (2.25%) and higher chlorides (1.61%) when compared to Nandyal Pogaku 1 (5.71%, 2.97% and 1.23% respectively). The levels of nitrogen and topping had non-significant effect on leaf chemical constituents. The interactive effect among various treatments had significantly beneficial effect on cured leaf yield of bidi tobacco and maximum cured leaf yield was obtained with ABD 132 with 140 kg N ha^{-1}and topping at 15 leaf stage.

Keywords*:* Nitrogen, topping, cured leaf yield, economics, leaf quality

INTRODUCTION

In Andhra Pradesh, bidi tobacco (*Nicotiana tabacum* L.) is commercially cultivated under rainfed Vertisols during late rainy season i.e., September (2nd fortnight). Usually, farmers apply recommended fertilizer dose in two splits i.e. one as basal and one as top dressing at 30 days after transplanting (DAT). Among the major production factors, optimum nutrition especially nitrogen and level of topping play an important role for maximizing the productivity as well as the quality. Nitrogen is the element that has the highest effect on the growth and quality of 'flue-cured' tobacco (Smith, 2009). Nitrogen determines the performance of leaf blade, the qualities and taste of aroma, and the smoke taste (Marchetti *et al.*, 2006). Excessive or improper applications of N may affect the yield and quality of 'flue-cured' tobacco. Excess nitrogen produces strong and spicy flavors, which are not associated with high nicotine contents. The application of N greatly influences the crop growth, gas exchange parameters, specific leaf weight, chlorophyll content which in turn affect yield and quality of tobacco (Anuradha *et al.*, 2010). Topping (removal of the flowering head and young leaves) is an essential cultivating measure for air-cured tobacco, which switches the plant from reproductive to vegetative phase (Gooden *et al.,* 2011). Topping increases the size and weight of leaves, increasing the overall yield per hectare (Reed *et al.,* 2012). Topping stage of tobacco is a key time for development of agricultural measures to promote the quality of leaves. Topping stimulates the production of secondary plant products that accumulate in the leaves. These products give the cured leaf improved quality and smoking characteristics. Topping is a turning point for nicotine formation and accumulation inside tobacco plant (Guo *et al.,* 2011). Topping of tobacco not only increases the yield but also improves the quality of cured leaf (Krishna

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Reddy *et al.,* 2012). The package of production technology for bidi tobacco crop involves growing of improved varieties, key agronomic operations including application of optimum dose of nitrogen and topping at proper leaf stage. Nandyala pogaku-1 was released during 2015 from All India Network Project on Tobacco, Regional Agricultural Research Station, Nandyal for cultivation in Vertisols of Andhra Pradesh under rainfed condition. The variety ABD 132 has recorded more leaf thickness, good puckering, less smoke toxicants, high yielding ability with good leaf quality under varietal improvement breeding trials and was in pipeline for release after agronomic evaluation. Hence, the present study was conducted to study the response of bidi tobacco varieties viz., Nandyal Pogaku 1 and ABD 132 to different levels of nitrogen and topping leaf stage.

MATERIALS AND METHODS

A field experiment was undertaken at Regional Agriculture Research Station, Nandyal, Andhra Pradesh for two consecutive years viz., 2018-19 and 2019-20 on Vertisols under rainfed condition. The treatments consisted of two varieties (ABD 132 and Nandyal Pogaku-1) as main plots, three nitrogen levels (80,110 and 140 kg ha^{-1}) as sub plots and three topping levels (12,15 and 18 leaf stage) as sub sub plots in split split plot design and replicated thrice. The soil of experimental site was medium deep black, moderately alkaline (pH-8.2), non saline (EC- 0.11 ds m^{-1}), low in nitrogen (152.3 kg ha^{-1}), medium in available P_2O_5 (32.5 kg ha^{-1}) and high in available K_2O (350.9 kg ha^{-1}). The seedlings were transplanted at planting geometry of 75 cm x 75 cm. The treatments were imposed through ammonium sulphate for nitrogen, single superphosphate for phosphorus and sulphate of potash for potassium. Half of the nitrogen, total phosphorus and total potassium were applied as basal and remaining half was applied as top dressing within 30-40 days after planting. An amount of 217.2 mm rainfall was received in 20 rainy days with 65.8 % deficit compared to normal during 2018 whereas 856.0 mm rainfall was received in 39 rain days with 45.1% excess rainfall during 2019.Crop management practices like land preparation, weed control, intercultivation, need based plant protection, de suckering and sun curing were followed as recommended for local area. The data were recorded for plant height, leaf length, leaf width and cured leaf yield at harvest. The leaf samples were used for estimating chemical quality constituents *viz.,* nicotine, reducing sugars (Harvey *et al.*, 1969) and chlorides (Hanumantha Rao *et al.*, 1980). The data gathered in each observation were statistically evaluated using analysis of variance (ANOVA) technique (Panse and Sukhatme 1985). The critical difference (CD) was computed to assess the significance of treatment means at 5% level of probability.

RESULTS AND DISCUSSION

Varieties

The varieties differed significantly for growth parameters, cured leaf yield, economics and leaf chemical parameters (Table 1). Variety ABD 132 recorded higher leaf length (47.6 cm), leaf width (21.3 cm), cured leaf yield (2217 kg ha^{-1}), net returns (Rs 105544 ha^{-1}), BCR (2.72) and chlorides (1.61 %) and lower dry weight per unit area (9.34 mg cm^{-2}) and reducing sugars (2.25%). Variety Nandyal Pogaku 1 recorded lower leaf length (43.8 cm), leaf width (18.8 cm), cured leaf yield (1866 kg ha^{-1}), Chlorides (1.23%) and high reducing sugars (2.97%). Similar genetic constitutions of the varieties might have contributed for uniformity in plant height, spangle score and nicotine (Gupta *et al.,* 2014; Damodar Reddy, 2015).

Effect of nitrogen

Plant height did not differ significantly due to nitrogen levels. Application of 140 kg N ha^{-1} recorded significantly higher leaf length (47.7 cm), leaf width (20.9 cm), cured leaf yield (2110 kg ha^{-1}), net returns (Rs 95,966 ha^{-1}) with BCR of 2.53 over 80 kg N ha^{-1}. Both higher levels of N (110 and 140 kg ha^{-1}) were statistically at par with respect the cured leaf yield. This was probably owing to greater availability of nitrogen and metabolites for growth and yield of the crop. Kumaresan *et al. (*2014) reported similar results. Leaf chemical parameters did not differ due to different levels of nitrogen. However, higher nicotine (5.99%), chlorides (1.47 %), and lower reducing sugars (2.56%) were observed with application of 140 kg N ha^{-1}.As nitrogen has positive correlation

Table 1:Effect of different levels of nitrogen and topping on growth, cured leaf yield, economics and leaf chemical parameters of bidi tobacco varieties

Treatments	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Spangle score	Dry wt/ unit leaf area ($mgcm^{-2}$)	Cured leaf yield ($kgha^{-1}$)	Net returns (Rs ha^{-1})	BCR	Nicotine (%)	Reducing sugars (%)	Chlorides (%)
Varieties											
ABD-132	81.7	47.6	21.3	8.06	9.34	2217	105544	2.72	5.94	2.25	1.61
Nandyal Pogaku 1	79.8	43.8	18.8	7.91	10.06	1866	79174	2.29	5.71	2.97	1.23
S.Em±	2.3	0.5	0.3	0.14	0.07	40.5			0.10	0.02	0.01
C.D.(P=0.05)	NS	3.2	1.9	NS	0.45	246			NS	0.12	0.09
Nitrogen(kg ha^{-1})											
80	78.8	43.2	19.2	7.89	9.18	1945	86689	2.46	5.63	2.63	1.36
110	81.3	46.3	20.2	7.96	9.74	2070	94473	2.55	5.86	2.64	1.42
140	82.3	47.7	20.9	8.11	10.25	2110	95966	2.53	5.99	2.56	1.47
S.Em±	1.9	0.4	0.3	0.10	0.32	33.5			0.14	0.06	0.06
C.D.(P=0.05)	NS	1.3	0.9	NS	NS	109			NS	NS	NS
Topping stage											
12 Leaf stage	69.9	47.9	21.5	7.90	10.33	1908	82360	2.34	5.78	2.70	1.38
15 Leaf stage	82.4	45.8	20.0	8.05	9.73	2147	100275	2.64	5.87	2.59	1.43
18 Leaf stage	89.9	43.4	18.6	8.00	9.08	2069	94443	2.54	5.82	2.54	1.45
S.Em±	1.7	0.9	0.3	0.10	0.23	49.5			0.14	0.06	0.05
C.D.(P=0.05)	4.8	2.6	0.9	NS	0.67	145			NS	NS	NS
Interactions	NS	NS	NS	NS	NS	NS			NS	NS	NS
CV (%)	11.1	9.2	9.2	8.4	12.6	11.2			12.2	9.7	15.3

with nicotine content, there was an increase in nicotine content at higher levels of nitrogen. Marowa *et al.* (2015) reported that there is still need to establish the nitrogen and priming levels which may vary with place and variety. None of the chemical constituents were significantly changed due to nitrogen levels (Patel *et al.,* 2011). The increase in yield and yield attributes due to increase in N level was reported by Basha *et al.* (2018).

Table 2: Interaction effect of nitrogen levels and topping on cured leaf yield (kg ha^{-1}) of bidi tobacco varieties (Pooled)

Varieties	N levels (kg ha^{-1})	Topping levels			Mean
		12 L	15 L	18 L	
ABD 132	80	1840	2190	2102	2044
	110	2215	2329	2447	2330
	140	2149	2414	2269	2277
	Mean	2068	2311	2273	2217
Nandyal pogaku 1	80	1643	2068	1825	1845
	110	1633	1865	1929	1809
	140	1969	2018	1842	1943
	Mean	1749	1983	1866	1866
Mean of N	80	1741	2129	1964	1945
	110	1924	2097	2188	2070
	140	2059	2216	2056	2110
Topping		1908	2147	2069	
CD (P=0.05) Varieties 246, N 109, Topping 145, V x N 154, V x T NS, N x T NS, V x N x T NS					

Effect of topping

Significantly higher plant height (89.9 cm) was observed when plants were topped at 18 leaf stage and significantly lower (69.9 cm) with 12 leaf stage topping. Among three topping stages tested, significantly higher leaf length (47.9 cm), leaf width (21.5 cm) and dry weight per unit area (10.33 mg/cm^2) were recorded with topping at 12 leaf stage. Significantly higher cured leaf yield (2147 kg ha^{-1}), net returns (Rs 1,00,275/ ha) with BCR of 2.64 were recorded S.

418with topping at 15 leaf stage and was at par with topping at 18 leaf stage (2069 kg ha^{-1}, Rs 94,443 ha^{-1} and 2.54 respectively) owing to better topping at 15 leaf stage as compared to other stages of leaf topping. Kasturi Krishna *et al.* (2004) reported yield increase with increase in topping level. The influence of topping levels on leaf chemistry was non-significant in all the chemical characters (Sannibabu *et al.,* 2014). Similarly Bglar and Behghan **(**2014) reported that topping at optimum growth stage enhanced tobacco leaf quality in field. Leaf chemical parameters did not differ due to different levels of topping. However, maximum values of these chemical constituents were recorded with topping at 15 leaf stage.

Interaction effect

There was no significant difference in cured leaf yield among the interactions except between varieties and nitrogen. ABD 132 recorded higher cured leaf yield (2447 kg ha^{-1}) with application of 110 kg N ha^{-1} and topped at 18 leaf stage and was at par with application of 140 kg N ha^{-1} and topped at 15 leaf stage (2414 kg/ha) and 110 kg N ha^{-1} and topped at 15 leaf stage (2329 kg ha^{-1}) (Table 2). The lower cured leaf yield was recorded with variety Nandyal pogaku-1 under different N levels and topping leaf stages. This may be attributed to greater response of N to variety ABD 132 at different topping leaf stages as compared to Nandyal pogaku-1 variety.It may be concluded from the results that, ABD 132 was responding to higher levels of nitrogen and topping and performing better than Nandyal Pogaku 1 in terms of cured leaf yield, leaf quality and net returns. ABD 132 could be accepted for suitability for commercial cultivation in *bidi* tobacco growing areas of Andhra Pradesh with 140 kg N ha^{-1} and topping at 15 leaf stage.

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