



Research article

Effect of crop stage and leaf number for topping on performance of *bidi* tobacco (*Nicotiana tabacum* L.) rainfed vertisols

S. Jaffar Basha*¹, P. Pulli Bai¹, K. Prabhakar¹, J. Manjunath¹,
S. Kasturi Krishna² and C. Chandrasekhara Rao²

¹Regional Agricultural Research Station, Acharya N. G. Ranga Agricultural University, Nandyal-51850, Kurnool District, Andhra Pradesh, India

²All India Network Project on Tobacco, ICAR-Central Tobacco Research Institute, Rajamahendravaram, Andhra Pradesh, India

*Corresponding Author: shaik.jaffarbasha@gmail.com

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Abstract: A field experiment was undertaken at Regional Agriculture Research Station, Nandyal, Andhra Pradesh from 2016–17 to 2018–19 vertisols under rainfed condition to find out the optimum crop stage and leaf number for topping in *bidi* tobacco (*Nicotiana tabacum*) for higher cured leaf yield and quality. The experiment consists of 11 treatments (combination of button, early flowering stages for topping leaving 8, 9, 10, 11 and 12 leaves). The experiment was laid out in randomized block design with three replications. Significantly higher cured leaf yield (1660 kg ha⁻¹) was recorded with control (topping at early flowering stage keeping 15 leaves) and was at par with topping at early flowering stage keeping 12 leaves (1628 kg ha⁻¹) and topping at button stage keeping 12 leaves (1587 kg ha⁻¹). The leaf chemical parameters *i.e.*, nicotine, reducing sugars and chlorides did not differ significantly due to different topping crop stage and leaf number. The nicotine values were ranging from 5.30% to 5.80% whereas reducing sugars were from 2.91% and 3.32% and chlorides from 1.24% to 1.75% and were in permissible limits with respect to quality. The topping at early flowering stage keeping 15 leaves recorded higher net returns (Rs 71,550 ha⁻¹) and benefit : cost ratio (2.35) followed by topping at early flowering stage keeping 12 leaves (Rs 69,150 ha⁻¹ and 2.31) and topping at button stage keeping 12 leaves (Rs 66,075 ha⁻¹ and 2.25). Reduction in cured leaf yield was observed in topping either at bud or early flowering stage keeping from higher (15 leaves) to lower number of leaves (8 leaves).

Keywords: *Bidi* tobacco - Topping - Crop stage - Leaf number - Cured leaf yield.

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INTRODUCTION

Bidi tobacco (*Nicotiana tabacum* L.) is commercially cultivated under rainfed vertisols in late rainy season *i.e.*, September (2nd fortnight) in Andhra Pradesh. The rainfed agriculture suffers from a number of hydro-physical and socio-economic constraints, which affect the productivity of rainy and post-rainy season crops. These include erratic and undependable rainfall, excess and deficient moisture within a season and low level of input use (Gupta 2002). Topping (removal of the flowering head and young leaves) is an essential cultivating measure to maximize leaf production and encourage leaf-ripening for air-cured tobacco, which switches the plant from reproductive to vegetative phase (Guo *et al.* 2011, Gooden *et al.* 2011, Czubacka *et al.* 2012). Topping increases the size and weight of leaves, increasing the overall yield per hectare (Singh *et al.* 2000, Reed *et al.* 2012). Topping is the cultural practice during early button stage which gives tobacco its desired chemical and physical characteristics that lead to high quality cured leaf yield (Singh *et al.* 2000). In tobacco, stage of topping is important for development of agricultural measures to promote the quality of leaves (Reed *et al.* 2012). Many authors reported the benefit of topping in increasing the yield and quality of the leaf. The topping

at higher level resulted in significantly higher cured leaf, bright leaf yield and total bright leaf equivalent as compared to low level of topping in FCV tobacco (Reddy *et al.* 1997). Farmers were adopting different levels of topping for optimum cured leaf yield and quality. Different tobacco trade companies also insisting the tobacco farmers for topping at lower number of leaves. Topping of tobacco not only increases the yield but also improves the quality of cured leaf. The topping levels may depend upon various factors like the variety, topography and climatic conditions. Release of the new variety, NandyalPogaku -1 increased the cured leaf yield when compared to the earlier variety A 119 and this variety is more robust with broad and lengthy leaf and thick midrib. The traditional practice of topping at 15 leaf stage was not possible during period of moisture stress condition after planting due to poor vegetative growth. In this context it is necessary to study the effect of different topping stages and crop stages on growth yield and quality of *bidi* tobacco to recommend suitable topping stage to farmers for harvesting of maximum yields with high leaf quality. Keeping these observations in view, the present investigation was designed to arrive at an optimum topping crop stage and level of number of leaves for higher cured leaf yield and quality in rainfed vertisols of Andhra Pradesh.

MATERIAL AND METHODS

A field experiment was undertaken at Regional Agriculture Research Station, Nandyal, Andhra Pradesh from 2016–17 to 2018–19 vertisols under rainfed condition to find out the optimum crop stage and optimum leaf number for topping in *bidi* tobacco for higher yield and quality. 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 P₂O₅ (32.5 kg ha⁻¹) and high in available K₂O (350.9 kg ha⁻¹). The 11 treatments (stages of topping) consisted of T₁- Control (15 leaf stage at early flowering stage), T₂- 8 leaf at Button stage, T₃- 8 leaf at early flowering stage, T₄- 9 leaf at Button stage, T₅- 9 leaf at early flowering stage, T₆- 10 leaf at Button stage, T₇- 10 leaf at early flowering stage, T₈- 11 leaf at Button stage, T₉- 11 leaf at early flowering stage, T₁₀- 12 leaf at Button stage and T₁₁- 12 leaf at early flowering stage. The experiment was laid out in a randomized block design with three replications. The *bidi* tobacco variety used for experimentation is Nandyal Pogaku-1 and was planted at planting geometry of 75 cm × 75 cm. The treatments were imposed through manual topping at respective crop stage by keeping selected number of leaves. Crop management practices like nursery raising, land preparation, N, P and K fertilizer application, weed control, intercultivation, desuckering, need based plant protection and sun curing were followed as per recommended practice. The data were recorded on plant height, leaf length, leaf width, leaf thickness, spangle score and cured leaf yield at harvest. Leaf samples were analysed for chemical constituents *viz.*, nicotine, reducing sugars and chlorides at Central Tobacco Research Institute, Rajamahendravaram. The mean values of all the quantitative characters were subjected to statistical analysis by adopting Fisher's method of analysis of variance as outlined by (Gomez & Gomez 1984). The level of significance used in 'F' test was at 5 per cent.

RESULTS AND DISCUSSION

Rainfall during crop growth period

During the experimentation period *bidi* tobacco nurseries were sown during July and transplanting of 45–60 days old seedlings was done during September. Rainfall during September and October was critical for transplanting and establishment of nurseries. There was lower rainfall reported during October 2016 (-78.9%), September 2017 (-21.6%), September 2018 (-35.1%) and October 2018 (-95.2%) (Table 1). The total amount of rainfall received during crop growth period (nursery to harvest) was less than the normal during 2016-17 (-6.8%) and 2018-19 (-65.8%). The crop growth was affected after transplanting due to moisture deficit condition resulting varied cured leaf yields during the experimentation period.

Growth parameters and cured leaf yield

Pooled analysis (2016–17 to 2018–19) of the data indicated that the growth and yield parameters differed significantly due to different topping crop stage and leaf number (Table 2). Significantly higher plant height (57.6 cm) was recorded with control (topping at early flowering stage keeping 15 leaves) and was at par with topping at button stage keeping 12 leaves (51.8 cm) and topping at early flowering stage keeping 12 leaves (51.3 cm). Significantly lower plant height (40.3 cm) was observed with topping at button stage keeping 8 leaves. This could be due to lower number of leaves after topping. Significantly higher leaf length (42.9 cm) and leaf width (18.3 cm) was observed with topping at button stage keeping 8 leaves. Significantly lower leaf length (34.9 cm) and leaf width (14.0 cm) was observed with topping at early flowering stage keeping 15 leaves and was at par with topping at button stage keeping 12 leaves (40.0 cm and 17.9 cm) and topping at early

flowering stage keeping 12 leaves (37.6 cm and 16.9 cm). There was a significant difference in dry wt unit leaf area⁻¹ and spangle score among different treatments. There was increase in dry wt/unit leaf area due to lower level of topping i.e. at 8 leaf stage (15.1 mg cm⁻²) when compared to 15 leaf stage (12.5 mg cm⁻²). Spangle score did not differ due to topping crop stages and number of leaves and was in permissible limits. Significantly higher cured leaf yield (1660 kg ha⁻¹) was recorded with control (15 leaf stage at early flowering stage) and was at par with topping at early flowering stage keeping 12 leaves (1628 kg ha⁻¹) and topping at button stage keeping 12 leaves (1587 kg ha⁻¹). Cured leaf yield increased with increase in topping level (King 1986, Reddy *et al.* 2003, Krishna *et al.* 2004). Significantly lower cured leaf yield (1159 kg ha⁻¹) was observed with topping at button stage keeping 8 leaves. Similar findings of lower yields at lower topping levels (Reddy *et al.* 1997, Sannibabu *et al.* 2014).

Table 1. Rainfall during crop growth period

Month	2016–17		2017–18		2018–19	
	Rainfall (mm)	Deviation (%)	Rainfall (mm)	Deviation (%)	Rainfall (mm)	Deviation (%)
July	136.6	-14.8	134.8	-15.9	38.4	-76.8
August	247.0	47.7	255.6	36.0	42.2	-76.7
September	174.8	4.6	134.0	-21.6	103.4	-35.1
October	16.2	-78.9	124.8	66.2	4.0	-95.2
November	0.0	-100.0	3.2	-91.9	8.2	-78.2
December	2.0	-9.1	0	-100.0	3.0	11.1
January	1.0	-23.1	0	-100.0	18.0	1185.7
February	0.0	-100.0	0	-100.0	0	-100.0
Total	577.6	-6.8	652.4	1.7	217.2	-65.8

Table 2. Effect of topping crop stage and number of leaves on growth parameters, cured leaf yield, leaf chemical parameters and economics of *bidi* tobacco.

Trt.	Pl.Ht. (cm)	L.Lt. (cm)	L.Wd. (cm)	Dr.Wt. (mg cm ⁻²)	Sp.S.	CLY (kg ha ⁻¹)	Nicotine (%)	Rd.S. (%)	Chlorides (%)	NR (Rs ha ⁻¹)	BCR
T ₁	57.6	34.9	14.0	12.5	8.0	1660	5.64	3.14	1.24	71550	2.35
T ₂	40.3	42.9	18.3	15.1	6.7	1159	5.48	3.32	1.33	33975	1.64
T ₃	42.7	41.9	18.0	14.3	6.3	1304	5.48	3.19	1.46	44850	1.85
T ₄	43.1	41.7	17.9	14.1	7.0	1364	5.67	3.28	1.38	49350	1.93
T ₅	46.6	41.5	17.3	13.7	7.0	1370	5.51	2.97	1.27	49800	1.94
T ₆	49.1	42.2	17.6	13.3	7.0	1437	5.30	3.17	1.50	54825	2.04
T ₇	48.9	40.4	17.2	13.3	6.7	1337	5.50	3.13	1.31	47325	1.89
T ₈	50.1	41.1	18.3	13.1	7.3	1427	5.44	3.30	1.75	56550	2.07
T ₉	50.8	40.9	17.2	13.3	6.7	1451	5.61	3.23	1.41	55875	2.06
T ₁₀	51.8	40.0	17.7	13.5	7.0	1587	5.35	3.28	1.26	66075	2.25
T ₁₁	51.3	37.6	16.9	13.8	7.3	1628	5.80	2.91	1.39	69150	2.31
S.Em±	2.7	2.3	1.0	1.13	0.4	64	0.35	0.23	0.10		
CD @ 5%	7.9	6.7	3.0	NS	NS	193	NS	NS	NS		
CV (%)	9.5	9.9	10.4	14.4	9.2	10.5	9.7	12.5	17.0		

Note: Trt.- Treatments; Pl.Ht.- Plant height; L.Lt.- Leaf length; L.Wd.- Leaf width; Dr.Wt.- Dry wt/unit leaf area; Sp.S.- Spangle score; CLY- Cured leaf yield; Rd.S.- Reducing sugars; NR- Net returns; BCR- Benefit : Cost Ratio.

T1- Control (Early flowering stage - 15 leaves); T2- Button stage - 8 leaves; T3- Early flowering stage - 8 leaves; T4- Button stage - 9 leaves; T5- Early flowering stage - 9 leaves; T6- Button stage - 10 leaves; T7- Early flowering stage - 10 leaves; T8- Button stage - 11 leaves; T9- Early flowering stage - 11 leaves; T10-Button stage - 12 leaves; T11- Early flowering - 12 leaves.

Leaf chemical parameters

The leaf chemical parameters *viz.*, nicotine, reducing sugars and chlorides did not differ significantly due to different topping crop stage and leaf number. The nicotine values were ranging from 5.30% to 5.80% whereas reducing sugars were from 2.91% and 3.32% and chlorides from 1.24% to 1.75% and were in permissible limits with respect to quality. The influence of topping levels on leaf chemistry was non-significant in all the chemical characters (Patel *et al.* 2003, Kumaresan *et al.* 2008, Sannibabu *et al.* 2014).

Economics

The topping at early flowering stage by keeping 15 leaves recorded higher net returns (Rs 71,550 ha⁻¹) with benefit : cost ratio (BCR) of 2.35 followed by topping at early flowering stage by keeping 12 leaves (Rs 69,150 ha⁻¹ with BCR of 2.31) and topping at button stage by keeping 12 leaves (Rs 66,075 ha⁻¹ with BCR of 2.25). Lower net returns of Rs 33,975 ha⁻¹ with BCR of 1.64 was observed with topping at button stage keeping 8 leaves. Maximum gross and net returns and benefit: cost ratio were recorded when tobacco leaves were topped at 14 leaf stage followed by 12 and 10 leaf stage whereas minimum was realized in topping at 8 leaf stage (Arya www.tropicalplantresearch.com

et al. 2011). Higher net returns and benefit: cost ratio by topping at 18 leaves stage in chewing tobacco in the vedaranyam area of Tamil Nadu (Kumaresan *et al.* 2001, Kumaresan & Palanichamy 2002).

CONCLUSION

Among the field operation in tobacco, topping is important operation to enhance plant growth, development and quantity. It was concluded from the study that, taking into consideration of obtaining higher cured leaf yields coupled with better quality, *bidi* tobacco could be grown profitably by topping either at bud stage or early flowering stage by keeping 12–15 leaves even during period of moisture stress condition. Topping at lower number of leaves was not desirable for cured leaf yield and quality.

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