

TOBIOS-6: A PROMISING TOBACCO SOMACLONE FOR NORTHERN LIGHT SOILS OF ANDHRA PRADESH

K. SARALA, K. PRABHAKARA RAO, P. VENKATESWARLU, Y. SUBBAIAH, T.G.K. MURTHY, A.V.S.R. SWAMY, D. DAMODAR REDDY AND C. CHANDRASEKHARA RAO

ICAR - Central tobacco research institute, Rajahmundry-533105, India

(Received on 22nd November, 2017 and accepted on 20th December, 2017)

Tobios-6 is a somaclone developed through the creation of somaclonal variation followed by pedigree method of selection using variety Kanchan, a popular light soil tobacco variety raised in both Andhra Pradesh and Karnataka states. Plant type is tall and open cylindrical type. The leaves are sessile, broad elliptic in shape with close internodal length. The leaves are dark green in colour with strong puckering. Tobios-6 produces around 33 total leaves with around 30 good bodied curable leaves. Cured leaf is bright lemon to orange in colour with good aroma. It recorded superior mean performance in station replicated trial (32%), AINP(T) trials (8%) and bulk trials (30%) conducted at CTRI RS, Jeelugumilli over control, Kanchan. In on-farm trials, the cultivar, Tobios-6 recorded 14% mean increase in cured leaf yield over Kanchan in NLS. The nicotine content and reducing sugars in 'cured leaf of X' and 'L' positions in the cultivar, Tobios-6 were in acceptable range. Further, Tobios-6 recorded higher benefit cost ratio than Kanchan indicating cultivation of Tobios-6 is beneficial to farmers. Tobios-6 found to have the cured leaf yield potential of around 3300 kg/ha under normal conditions. Performance of the entry in different trials clearly indicates that the cultivar is suited for cultivation in NLS tobacco growing areas with higher leaf yields, acceptable leaf quality and comparable response to biotic stresses as in control. In view of this, the line can be considered for release in these areas for cultivation.

Key words: Tobacco, Somaclone, FCV, NLS, Yield Improvement

INTRODUCTION

Tobacco is an important commercial crop grown in India. There are around 10 tobacco types that are cultivated in the country for their various end uses. Among various types, Flue-cured Virginia (FCV) tobacco is the major exportable type

with specific quality requirements. FCV tobacco grown in the irrigated Alfisols of the Northern Light Soils (NLS) covering West Godavari district of Andhra Pradesh and Khammam district of Telangana is known for its premium leaf quality and is exported to several countries (Sarala *et al.*, 2012). Kanchan is the popular variety grown in this region as its plant type and leaf morphology are preferred by farmers and traders. In order to increase the yield levels in the NLS area, an attempt was made to create somaclone variation from Kanchan variety followed by selection. The present paper deals with the performance of a promising Kanchan somaclone under NLS condition.

MATERIALS AND METHODS

Tobios-6 is a somaclone developed under *in vitro* through organogenesis during 2001-03 followed by selection. Its performance was assessed in progeny row trial under irrigated Alfisols at CTRI research station, Jeelugumilli during two seasons (2004-05 and 2005-06). After observing its promising performance in row trial, it was tested in replicated trial for three seasons (R₄-R₆ generations) during 2006-09. After confirming its promise in replicated trials, the line got tested in AINP(T) trials during 2010-13. In view of its superior performance, it was assessed in station bulk trials at CTRI -RS, Jeelugumilli (2013-16) and On-farm trials at NLS tobacco growing areas (2015-17).

In all the trials, green leaf was primed as and when matured, and cured in a flue-curing barn. Data were recorded on green leaf, cured leaf (leaf obtained after curing the green leaf) and grade index. Grade index is a weighted average of 64 different qualities (grades) of leaves that are

obtained, after flue-curing the leaves, in an entry. It is a measure of leaf quality and economic returns. The leaf yield data, thus, collected was statistically analyzed for individual years and pooled for two/three seasons, where ever necessary. Pest and disease incidence was recorded under natural conditions in the AINPT trials. Chemical quality characteristics (Harvey *et al.*, 1969) in cured leaf (both 'X' and 'L' positions) were estimated in different seasons. In order to understand the superiority of Tobios-6 over Kanchan, observations recorded on plant height, leaf length and width in the on-farm trials conducted during 2015-17 seasons along with Cost Benefit ratio (CB ratio).

RESULTS AND DISCUSSION

Tobios-6 was developed through the creation of somaclonal variation followed by pedigree method of selection using Kanchan, a popular light soil tobacco variety grown in both Andhra Pradesh and Karnataka states (Fig.1). Morphological description of the cultivar Tobios-6 is given at Table 1. Plant type is tall and open cylindrical type. The leaves are sessile, broad elliptic in shape with close internodal length. The leaves are dark green in colour with strong puckering. It produces around 33 total leaves with around 30 good bodied curable leaves. Cured leaf is bright lemon to arrange in colour with good aroma. After observing its performance, under row trials, the lines was assessed in replicated trial.

Table 1: Morphological description of Tobios-6

Plant Shape	Cylindrical
Plant Habit	Open
Plant Height	Tall
Plant Width	>80 cm
Plant Internodal Length	4.5 cm
Plant Colour of Main Stem	Light Green
Plant number of Leaves	Many (33 No)
Number of Economic Leaves	~30
Plant Tendency to Produce Suckers	Absent
Leaf Type	Sessile
Leaf Angle of Insertion	Moderately Acute
Leaf Length	Very Long
Width of Blade	Medium
Leaf Midrib	Thick
Thickness of Veins(Excluding Midrib)	Thick
Leaf Blade Shape	Broad Elliptic
Leaf Tip Shape	Strongly Pointed

Leaf Shape in Cross section	Convex
Leaf Longitudinal Profile	Strongly Recurved
Leaf Blistering of Blade	Strong
Leaf Undulations of Margin	Strong
Leaf Development of Auricles	Strong
Leaf Colour of Blade	Dark Green
Leaf Colour of Midrib on Lower Side	Green
Time of 1 st Flowering	~70 Days
Time of 50% of Flowering	Medium
Inflorescence Shape	Spherical
Inflorescence Position Relative to Upper Leaves	Above
Inflorescence Compactness	Medium
Flower Length Excluding Peduncle	Long
Flower: Calyx Nature	Equal
Flower Diameter of Tube	Medium
Flower Swelling of Tube	Medium
Flower Tube Length	Large
Flower Size of Corolla	Medium
Flower Shape of Corolla Limb	Pentagonal
Flower Expression of Tips of Corolla	Very Strongly Pointed
Flower Colour of Corolla	Verigated Pink to Pink
Flower Development of Stamens	Full
Flower Length of Pistle Relative to Stamens	Short
Seed Testa Colour	Brown

Replicated yield trial: After observing its performance, under row trials, the entry Tobios-6 was assessed for three seasons (2006-07 to 2008-09) in replicated trial (Table 2). In all the seasons, the entry recoded higher leaf yields than control, Kanchan. Except for cured leaf in 2008-09, leaf yields and grade index of Tobios-6 were significantly higher than Kanchan in individual years. Mean cured leaf yield (32%) and grade index values (51%) found to be significantly higher in Tobios-6 than check, Kanchan. In view of its superiority in replicated trial, the line was advanced for testing in AINPT trials.

AINP (T) trials: The entry was tested in AINP(T) trials during 2010-2013 (Table 3) for three seasons at CTRI RS, Jeelugumilli. In AVT, based on the pooled analysis, the line found to record significantly higher cured leaf (8%) and grade index (10%). Following AINPT trials, Tobios-6 was tested in station bulk trials at CTRI RS-Jeelugumilli and on-farm trials at various locations of NLS area.

Bulk trials: In bulk trials conducted for 3 seasons (2013-14 to 2015-16) at CTRI-RS, Jeelugumilli, Tobios-6 recorded a mean increase of 30% and 37% in cured leaf (2593), and grade index (1646) over check, respectively (Table 4).

Table 2: Performance of FCV cultivar, Tobios-6 in Station varietal trials at Northern light soil FCV tobacco growing areas of Andhra Pradesh

Year of Testing	Number of Trials	Cured leaf yield (kg/ha)			Grade Index		
		Tobios-6	Kanchan	CD (5%)	Tobios-6	Kanchan	CD (5%)
1st year 2006-07	1	2906 *	2349	414	1820 *	1218	303
2nd year 2007-08	1	3302*	2280	697	2388*	1523	461
3rd year 2008-09	1	2962	2228	NS	2065*	1409	409
Percentage increase or decrease over better checks	1 st year	24			49		
	2 nd year	45			57		
	3 rd year	33			47		
Pooled analysis mean		3023*	2285	304	2091*	1383	214
Percentage increase over better check		32			51		

*Significantly superior over control, Kanchan

Table 3: Performance of Tobios-6 in Advanced Varietal trial of AINPT at Jeelugumilli (Yield in kg/ha)

Entry	Cured leaf			Grade Index		
	AVT			AVT		
	2011-12	2012-13	Mean	2011-12	2012-13	Mean
	2252	2487* (18)	2369* (8)	1138	1415* (16)	1277* (10)
Kanchan (C)	2260	2107	2184	1110	1213	1161
G. Mean	2532	2466	2499	1296	1416	1356
S. Em. ±	96	77	61	43	46	31
CD at 5%	283	226	170	127	134	87
C.V. %	9.28	7.61	8.51	8.13	7.87	8

Note: Figure in the parenthesis are per cent increase over Kanchan

Table 4: Performance in bulk trial at Jeelugumilli (2013-16)

(Yield in kg/ha)

Entry	Tobios-6	Kanchan (C)
Cured leaf yield		
2013-14	2262 (25)	1798
2014-15	2517(40)	1803
2015-16	3000 (27)	2369
Mean	2593 (30)	1990
Grade index		
2013-14	1244 (26)	990
2014-15	2118(58)	1341
2015-16	1575(27)	1275
Mean	1646 (37)	1202

On-farm trials: In on-farm trials conducted over eight locations for twoyears (2015-16 and 2016-17), the cultivar, Tobios-6 recorded 14% mean increase in cured leaf yield over Kanchan in

NLS (Table 5). All the farmers of on-farm trials expressed their willingness to raise Tobios-6 on large scale in view of higher leaf yield, bright grades and early establishment.

In the on-farm trials conducted during 2015-16 and 2016-17, Tobios-6 found to record slightly higher plant height and higher leaf length and width values (Table 6). These results suggest that higher leaf length and width in Tobios-6 may be responsible for higher leaf yield in the entry compared to Kanchan. Further, Tobios-6 recorded higher benefit cost ratio than Kanchan indicating cultivation of Tobios-6 is beneficial to farmers (Table 7).

Table 7: BC Ratio in on-farm trials at NLS area

Year	Tobios-6	Kanchan
2015-16	1.51	1.39
2016-17	1.81	1.66
Mean	1.66	1.53

Table 5: Performance at On-farm trials at NLS area

S. No.	Village Name	Farmer Name	Tobios-6		Kanchan	
			Cured leaf (kg/ha)	% Bright Grades	Gured leaf (kg/ha)	% Bright Grades
2015-2016						
1	Bandepuram	Katragadda Parameswara Rao	2697 (16)	75	2335	80
2	Mangapathideva peta	Yaganti Sudhakar	2923(17)	78	2489	82
3	Muppinavarigudem	Pampana Srinivas	2552(12)	82	2286	80
	Mean		2724 (15)		2370	
2016-17						
4	Bandepuram	Katragadda Parameswara Rao	2647(16)	80	2287	80
5	Mangapathideva peta	Yaganti Sudhakar	2713(10)	75	2465	75
6	Muppinavarigudem	Pampana Srinivas	2575(17)	80	2193	75
	Mean		2645(14)		2315	
Over all mean			2685(14)	78	2343	79

Note: Figure in the parenthesis are per cent increase over Kanchan

Table 6: Morphological characters in on-farm trials (Mean of three locations)

Parameter	Year	Tobios-6	Kanchan
Plant Ht. (cm)	2015-16	135	130
	2016-17	138	132
	Mean	136.5	131
Leaf length / width (cm)	2015-16	81/36	74/33
	2016-17	84/39	75/34
	Mean	82.5/37.5	74.5/33.5

Table 8: Reaction to major diseases and pests under natural conditions in main field (% incidence)

Disease/ Pest	Year	Tobios-6	Kanchan
Brown leaf spot	2010-11 (IVT)	93	98
	2011-12 (AVT-1)	0	05
TMV	2010-11 (IVT)	20	68
	2011-12 (AVT-I)	30	42.5
	2012-13 (AVT-II)	10	12.5
Leaf curl	2012-13 (AVT-II)	05	10
<i>Orobanche</i>	2010-11 (IVT)	20	27.5
	2011-12 (AVT-1)	22.5	22.5
<i>Spodoptera litura</i>	2010-11 (IVT)	16.25	7.5
	2011-12 (AVT-1)	7.5	15
<i>Myzus nicotianae</i>	2010-11 (IVT)	33.75	30
	2011-12 (AVT-1)	10	12.5

Table 9: Chemical quality traits in various trials at Jeelugumilli in different seasons (%)

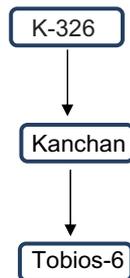
Entry	Year	Nicotine		Reducing sugars	
		'X' Position	'L' Position	'X' Position	'L' Position
Tobios-6	2008-09 (RYT)	2.75	4.42	09.89	07.52
	2012-13 (AVT-II)	1.63	1.74	11.73	19.07
	2013-14 (Bulk trial)	2.68	2.96	08.46	13.64
	2014-15 (Bulk trial)	2.20	2.21	17.57	18.34
	2015-16 (Bulk trial)	2.81	3.10	9.11	15.19
	Mean	2.41	2.89	11.35	14.75
Kanchan	2008-09(RYT)	2.61	4.82	08.86	05.05
	2012-13 (AVT-II)	1.32	1.52	21.88	28.40
	2013-14 (Bulk trial)	2.51	2.87	8.73	13.58
	2014-15 (Bulk trial)	3.01	2.91	11.94	13.49
	2015-16 (Bulk trial)	3.62	2.80	09.54	11.32
	Mean	2.61	2.98	12.19	14.37

Table 10: Leaf quality parameters (%) under On-farm trials at NLS

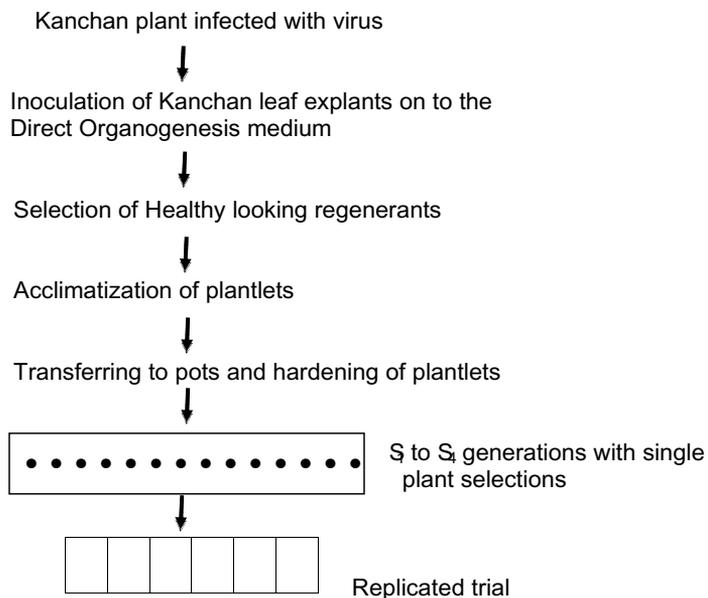
Parameter	Year	Tobios-6	Kanchan
Nicotine	2015-16	2.03	2.64
	2016-17	2.38	2.72
	Mean	2.21	2.68
Reducing Sugars	2015-16	13.1	12.18
	2016-17	14.2	12.24
	Mean	13.65	12.21

Fig.1: Pedigree details and Breeding Procedure Employed in Developing Tobios-6

Pedigree details and pedigree tree



Breeding Procedure Employed in Developing TOBIOS-6



Reaction to pests and diseases: Tobios-6 found to record lesser incidence of brown leaf spot, tobacco mosaic virus, leaf curl and *Orobanche* (Table 8) under natural condition. Regarding *Spodoptera litura* and *Myzus nicotianae*, the reaction of Tobios-6 is comparable to Kanchan.

Quality parameters: The acceptable limits for nicotine in NLS tobacco is 1.5-3.5% and reducing sugars is 5-21% (Prasada Rao, 1999; Krishnamurthy *et.al.*, 2005). Nicotine content and reducing sugars in 'cured leaf of X' and 'L' positions in the cultivar, Tobios-6 found to be in acceptable range (Table 9) in different trials conducted at CTRI RS, Jeelugumilli and on-farm trials (Table 10) conducted at NLS region and are comparable with control, Kanchan.

Overall performance of the entry in different trials clearly indicates that the cultivar is suited for cultivation in NLS tobacco growing areas. Tobios-6 is found to have the leaf yield potential of around 3300 kg/ha under normal conditions. In view of its higher leaf yields, acceptable leaf quality and comparable response to biotic stresses as in control, the line has the potential to increase the productivity of the target areas and increase the monetary benefits accrued to the farmers and a

suitable alternative to Kanchan. The line can also be used in further breeding programmes as parent in view of its yield contributing characters.

REFERENCES

- Harvey, W.R., H.M. Stahrand W.C. Smith. 1969. Automated determination of reducing sugars and nicotine alkaloids on the same extract of tobacco leaf. *Tob. Sci.* 13:13-15.
- Krishnamurthy, V., C.V Narasimha Rao and M. Anuradha. 2005. Division of Crop Chemistry and Soil Science: A Profile. Published by Central Tobacco Research Institute, Rajahmundry, India.
- Prasada Rao, J.A.V. 1999. Chemical and physical quality parameters of FCV tobacco and their significance. In *Tobacco production technology*. Published by Central Tobacco Research Institute, Rajahmundry.
- Sarala, K., T.G.K. Murthy and V. Krishnamurthy. 2012. Tobacco (*Nicotiana tabacum* L.). In: *Breeding of field crops*. Ed. D.N. Bharadwaj Published by Agrobios (India), Jodhpur. Pp.831-864.