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TIP LEAF MANAGEMENT PRACTICES FOR MAXIMIZING RIPE LEAF PRODUCTION OF NLS GROWN FCV TOBACCO

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In the pursuit of enhancing proportion of ripe leaf production of Northern Light Soil (NLS) grown FCV tobacco of Andhra Pradesh, a field experiment was conducted in the NLS zone for three consecutive years from 2002-3 to 2004-05 by testing various topping levels and harvest intervals to strike a balance between them to improve the semi-ripe leaf to ripe through manipulation of agronomical practices. The crop was topped at 16, 18, 20 and 22-leaf levels and harvested at 7, 9, 11 and 13-day intervals under factorial randomized block design using the variety, Kanchan. The data pooled over three seasons revealed that topping at 20 leaf level and priming the leaves at 9 to 11-days intervals yielded significantly higher cured leaf (2,246 to 2,432 kg/ha) and grade index (1475 to 1573) with better leaf chemistry containing higher reducing sugars (10.48 to 11.24%). This combination produced significantly higher quantities of ripe leaf (930 to 959 kg/ha, corresponding to 38 to 43% of total cured leaf) over the traditional method of harvesting between 7-days intervals. Thus, a combination of topping at 20-leaf stage and harvesting at 9 to 11-days intervals was found to be optimum for obtaining maximum ripe leaf production.

Key words: FCV tobacco, NLS, Ripe leaf, Yield

INTRODUCTION

Of late, the concept of producing ripe tobacco gained importance in view of changing international market scenario as well as Indian FCV tobacco market. Fully ripe or slightly over-ripe leaves are preferred for the best physical appearance and compositional balance (Weybrew *et al.*, 1984). Priming ripe tobacco at right maturity stage is essential for obtaining better grades with greater elasticity, porosity and graininess. Many authors reported the benefit of topping in increasing the yield and quality of the leaf. Carr and Neas (1941), Rashid *et al.* (1974) and Suryanarayana Reddy *et al.* (1997) reported that topping levels of 16, 12 to 14 and 18-20 leaf-stages, respectively increased the cured leaf yield. Stage of maturity also influences the leaf chemistry (Mosely, 1963). The topping levels may depend upon various factors like the variety, topography and climatic conditions. Introduction of the exotic variety, Kanchan, increased the cured leaf yield to above 2000 kg/ha. When compared to the earlier varieties like 16/103 and CM-12, this variety is more robust with broad and lengthy leaf and thick midrib. The traditional practice of topping at 24-leaf stage and harvesting at 7-days intervals are followed for this variety was found to be not sufficient for this variety under NLS areas to get higher quantities of better grade leaf. Hence, this study was taken up to arrive at an optimum topping level and harvest-intervals to strike a balance between topping level and harvest intervals.

MATERIALS AND METHODS

The field experiment was conducted at a farmer's field of NLS area at Ramanapalem, West Godavari district of Andhra Pradesh on sandy loamy soil for seasons (2002-03 to 2004-05). The experimental soil had a neutral pH (6.8), high P (60 kg/ha), medium K (224 kg/ha), medium in Organic Carbon (0.7 %) and EC (0.08 dS/m) in lower range. The variety, Kanchan was topped at four leaf-stages (16, 18, 20 and 22) and harvested at four intervals (7, 9, 11 and 13 days) replicating thrice in factorial randomized design. The other agronomic practices were followed as per the recommendations of the CTRI, Rajahmundry. The cured leaf obtained was graded into ripe, semi-ripe and unripe leaf based on their physical appraisal *viz.,* aroma colour, openness, graininess, thickness and roughness of the surface of the leaf. Yields of green leaf, cured leaf, grade index, ripe leaf, semi-ripe leaf and unripe-leaf were recorded. The leaf samples were analyzed for chemical quality constituents.

RESULTS AND DISCUSSION

Effect of topping levels and harvest intervals on yield attributes

The results revealed that different topping levels and harvest intervals did not influence green leaf yield, but had significant impact on cured leaf yields and grade index (Table 1). Topping at 20 leaf level significantly increased cured leaf yield (2246 kg/ha) and grade index (1479). This was in accordance with results of Reddy *et al.* (1997) who reported that topping at 18 to 20 leaf levels gave higher cured leaf yield and grade index of FCV tobacco. Giridhar (2000) also found that the topping level of 17 to 19 leaves was optimum for maximum FCV tobacco yields in Karnataka Light Soils (KLS). Topping at 16 leaf level gave the lowest cured leaf yield (1983 kg/ha) and grade index (1311). Similar finding of lower yields at lower topping levels was reported (Cambell *et al.*, 1982; Suryanarayana Reddy *et al.*, 1997). Among the harvest intervals, 9-days intervals registered significantly higher cured leaf yield of 2281 kg/ha and grade index of 1470 compared to the traditional method of harvesting at 7- days intervals that gave a cured leaf of 1992 kg/ha and grade index of 1276. The next best was 11- days harvest interval which registered a cured leaf yield of 2,135 kg/ha and grade index of 1388.

The interaction was significant with respect to cured leaf yield and grade index (Table 3). Topping at 20 leaf level in combination with 9-days harvest intervals gave significantly the highest cured leaf yield (2432 kg/ha) and grade index (1573). This indicates that optimum maturity is attained under this combination. This was followed

Table 1: Effect of topping and harvest intervals on yield of green leaf, cured leaf and grade index

Seasons	2002-03			2003-04			2004-05			Mean		
Treatment	Green leaf (kg/ha)	Cured leaf (kg/ha)	Grade index	Green leaf (kg/ha)	Cured leaf (kg/ha)	Grade index	Green leaf (kg/ha)	Cured leaf (kg/ha)	Grade index	Green leaf (kg/ha)	Cured leaf (kg/ha)	Grade index
Topping levels												
16 leaf	12,654	1,978	1,301	12,598	1,943	1,235	13,878	2,033	1,397	13,043	1,983	1,311
18 leaf	14,314	2,161	1,336	13,086	2,089	1,247	14,102	2,192	1,483	13,834	2,147	1,355
20 leaf	14,194	2,145	1,331	13,283	2,184	1,358	14,108	2,411	1,747	14,040	2,246	1,479
22 leaf	13,414	2,060	1,283	13,808	2,158	1,304	13,782	2,223	1,410	13,668	2,147	1,332
SEm±	**225**	**52**	**35**	**259**	**43**	**34**	**358**	**48**	**33**	**165**	**27**	**19**
CD (P=0.05)	**666**	**154**	**NS**	**718.6**	**121**	**NS**	**NS**	**133**	**93**	**459**	**77**	**55**
CV (%)	**6.6**	**9.9**	**10.6**	**7.7**	**8.3**	**10.7**	**10.7**	**8.6**	**8.8**	**13.3**	**17.3**	**20.7**
Harvest Intervals												
7 days	13,674	1,986	1,267	12,986	1,923	1,185	14117	2,066	1,375	13,592	1,992	1,276
9 days	13,735	2,325	1,492	13,995	2,221	1,381	14375	2,297	1,539	14,035	2,281	1,470
11 days	13,394	1,979	1,244	13,594	2,170	1,364	13550	2,250	1,555	13,512	2,135	1,388
13 days	13,776	2,054	1,248	12,724	2,053	1,215	13878	2,244	1,569	13,459	2,117	1,344
SEm±	**225**	**52**	**35**	**259**	**43**	**34**	**358**	**48**	**33**	**165**	**27**	**19**
CD (P=0.05)	**NS**	**154**	**103**	**718**	**121**	**96**	**NS**	**133**	**93**	**NS**	**77**	**55**
CV (%)	**6.60**	**9.99**	**10.63**	**7.78**	**7.78**	**7.78**	**10.27**	**8.69**	**8.86**	**8.41**	**8.92**	**10.02**

by 18 leaf level topping with 9 days harvest intervals recording cured leaf yield of 2260 kg/ha and grade index of 1467. Harvesting at 7 days intervals under topping at 20 leaf level registered lower yields of cured leaf (2,104 kg/ha).

Ripe leaf (cured) production

The pooled data (Table 2) revealed topping at 18 and 20 leaf stages, being comparable with each other and was significantly superior in ripe leaf outturn (823 and 856 kg/ha respectively, registering 38 % of cured leaf yield) over 16 and 22 leaf levels. The decrease in ripe leaf production under 16 leaf topping level (761 kg/ha) might be due to the lower cured leaf yield. Topping at 18, 20 and 22 leaf levels were comparable with each other and gave significantly higher semi-ripe leaf yield (670 to 697 kg/ha which was equal to 31 to 32% of cured leaf) over 16 leaf level that recorded 610 kg/ha. Among the harvest intervals, harvesting at 11 and 13 days intervals were comparable among themselves with respect to ripe leaf yield of 853 kg/ha registering 40 % of total cured leaf yield and superior to 7 days intervals (676 kg/ha, 34% of cured leaf). Harvesting at 9 days intervals yielded significantly higher semi-ripe leaf (721 kg/ha, 31% of cured leaf). Least quantity of unripe leaf was obtained with 13 days harvest intervals (613 kg/ha, 29% of cured leaf). Harvesting at 7 days intervals under topping at 20 leaf level registered lower yield of ripe leaf (741 kg/ha; 35% of the cured leaf). This indicates that leaving and also more time between harvest intervals leads to completion of leaf growth attaining physiologically optimum senescence. By and large, it could be observed that the percentage ripe leaf out-turn of the respective cured leaf yields increases with lowering the topping level and increasing the harvesting intervals.

The interaction was significant with respect to ripe leaf and semi-ripe leaf yields (Table 3). Harvesting between 9 and 11 days intervals at

Table 2: Effect of topping and harvest intervals on yield of ripe, semi and un-ripe leaf (kg/ha)

Seasons	2002-03			2003-04			2004-05			Mean		
Treatment	**Ripe leaf**	**Semi-ripe**	**Un-ripe leaf**	**Ripe leaf**	**Semi-ripe**	**Un-ripe leaf**	**Ripe leaf**	**Semi-ripe**	**Un-ripe leaf**	**Ripe leaf**	**Semi-ripe**	**Un-ripe leaf**
Topping levels												
16-leaf	641	668	669	632	559	752	1012	605	416	761(38)	610(30)	612(30)
18-leaf	746	742	673	668	609	812	1055	659	478	823(38)	670(31)	654(30)
20-leaf	719	725	701	697	640	847	1153	726	532	856(38)	697(31)	693(31)
22-leaf	691	711	658	588	683	887	999	682	542	759(35)	692(32)	696(32)
SEm±	**28.0**	**23.3**	**26.9**	**13.95**	**12.31**	**11.81**	**16.99**	**20.88**	**19.88**	**11.87**	**11.21**	**11.84**
CD (P=0.05)	**NS**	**NS**	**NS**	**39**	**34**	**33**	**47**	**57**	**55**	**33**	**31**	**33**
CV (%)	**16.15**	**13.11**	**15.97**	**8.63**	**7.91**	**8.83**	**6.51**	**12.94**	**16.96**	**16.15**	**22.58**	**14.33**
Harvest Intervals												
7 days	600	701	685	559	591	773	868	658	540	676(34)	650(33)	666(33)
9 days	783	769	773	678	684	859	995	711	591	818(36)	721(31)	741(32)
11 days	707	657	615	714	616	844	1139	669	442	853(40)	648(30)	633(29)
13 days	708	718	629	634	600	819	1217	634	393	853(40)	651(31)	613(30)
SEm±	**28.0**	**23.3**	**26.96**	**13.95**	**12.31**	**11.81**	**16.99**	**20.88**	**19.88**	**11.87**	**11.21**	**11.84**
CD (P=0.05)	**78**	**65**	**75**	**39**	**34**	**33**	**47**	**57**	**55**	**33**	**31**	**33**
CV (%)	**16.15**	**13.11**	**15.97**	**8.63**	**7.91**	**8.83**	**6.51**	**12.94**	**16.96**	**10.35**	**11.74**	**14.65**

*The values in the parentheses are the percentages of the corresponding total cured leaf yields of the respective treatments

20 leaf level topping, was comparable to 11 and 13 days intervals under 18 leaf level topping gave significantly higher quantity of ripe leaf of 916 and 959 kg/ha respectively, which was 38 and 43 % of the corresponding cured leaf yields. It appears that these combinations were congenial for the physiological activity to come to an end with optimum required senescence in the leaf *viz.*, the right stage of maturity for harvest. Whereas, a combination of 9 days harvest intervals and 18 leaf level topping and 13 days harvest intervals and 20 leaf level topping, being at a par, yielded significantly higher semi-ripe leaf recording 722 and 798 kg/ha corresponding to 32 and 33% of cured leaf yield respectively. The interaction effect was non-significant with respect to unripe leaf yields. It is implied that harvesting the tobacco at the ripe leaf stage would increase the yield characters with maximum ripe leaf outturn.

Seasonal impact on the treatments was significant with respect to harvest interval in cured leaf yields and with both topping levels and harvest intervals in grade index. The third crop season of the experiment (2004-05) produced higher quantity of cured leaf, ripe leaf and unripe leaf yields which might be due to favourable weather conditions.

Priming-wise yields of ripe, semi-ripe and unripe tobacco from 5th to 9th primings

In view to have an idea on priming-wise out turn of ripe, semi-ripe and unripe tobacco, data were recorded from 5th to 9th priming and presented

Table 3: Interaction between topping levels and harvest intervals on yield parameters (kg/ha), pooled data (2002-03 to 2004-05)

Treatments	Green leaf	Cured leaf	Grade index	Ripe leaf	Semi-ripe leaf	Unripe leaf
16 leaf – 7 days	12,818	1,919	1,271	718 (37)	667 (35)	534 (28)
9 days	13,657	2,044	1,363	803 (39)	647 (32)	595 (29)
11 days	13,351	2,104	1,433	873 (41)	674 (32)	556 (26)
13 days	12,347	1,865	1,177	796 (43)	599 (32)	476 (26)
18 leaf – 7 days	13,325	1,976	1,203	718 (36)	644 (32)	614 (31)
9 days	14,193	2,260	1,467	845 (37)	752 (32)	663 (29)
11 days	13,707	2,175	1,373	916 (42)	693 (32)	566 (26)
13 days	14,112	2,179	1,379	945 (43)	722 (33)	513 (23)
20 leaf – 7 days	14,387	2,104	1,420	741 (35)	681 (32)	682 (32)
9 days	14,286	2,432	1,573	930 (38)	798 (33)	704 (29)
11 days	13,984	2,246	1,475	959 (43)	689 (31)	598 (27)
13 days	13,501	2,204	1,447	892 (40)	748 (33)	564 (25)
22 leaf – 7 days	13,840	1,967	1,208	597 (30)	711 (36)	659 (34)
9 days	14,005	2,388	1,479	817 (34)	810 (34)	760 (32)
11 days	13,009	2,016	1,271	805 (40)	672 (33)	539 (27)
13 days	13,877	2,214	1,373	934 (42)	690 (31)	590 (27)
SEm±	**286**	**47**	**34**	**23**	**22**	**23**
CD (P=0.05)	**NS**	**132**	**95**	**66**	**62**	**NS**
CV (%)	**8.41**	**8.92**	**10.02**	**16.15**	**22.56**	**14.33**

* The values in the parentheses are the percentages of the corresponding total cured leaf yields of the respective treatments

Table 4: Effect of topping and harvest intervals on pick-wise yield (kg/ha) of ripe, semi-ripe and unripe leaf, pooled data (2002-03 to 2004-05)

Seasons	5th pick			6th pick			7th pick			8th pick			9th pick		
Treatment	**Ripe**	**Semi-ripe**	**Unripe**	**Ripe**	**Semi-ripe**	**Unripe**	**Ripe**	**Semi-ripe**	**Unripe**	**Ripe**	**Semi-ripe**	**Unripe**	**Ripe**	**Semi-ripe**	**Unripe**
Topping levels															
16-leaf	98 (42)	71 (31)	63 (27)	115 (42)	84 (31)	72 (27)	121(43)	81(33)	68 (24)	129 (45)	94 (33)	65 (22)	99 (45)	77 (35)	44 (20)
18-leaf	108 (39)	93 (34)	73 (27)	150 (45)	102 (30)	84 (25)	132 (42)	100 (32)	81(26)	145 (46)	99 (31)	71 (23)	113 (43)	94 (36)	57 (23)
20-leaf	118 (39)	106 (36)	76 (25)	131(40)	112 (34)	84 (26)	126 (41)	104 (33)	80 (26)	134 (43)	105 (33)	75 (24)	150 (47)	101 (31)	70 (22)
22-leaf	96 (34)	107 (38)	78 (28)	124 (38)	114 (35)	87 (27)	117 (39)	100 (33)	85 (28)	118 (40)	97 (33)	81(27)	109 (36)	113 (36)	80 (27)
SEm±	**3.88**	**4.7**	**3.97**	**4.07**	**4.65**	**4.82**	**3.93**	**4.69**	**4.71**	**3.78**	**4.78**	**4.27**	**3.94**	**4.57**	**5.33**
CD (P=0.05)	**11**	**13**	**NS**	**11**	**13**	**NS**	**NS**	**NS**	**NS**	**10**	**NS**	**NS**	**11**	**13**	**15**
CV (%)	**28.1**	**30.3**	**44.5**	**22.1**	**31.2**	**32.5**	**34.6**	**27.7**	**32.4**	**29.2**	**28.6**	**66.1**	**16.6**	**39.4**	**62.3**
Harvest Intervals															
7 days	81(32)	96 (37)	80 (31)	103 (36)	101(35)	83 (29)	105 (38)	93 (33)	81(29)	111(39)	90 (32)	84 (29)	94 (36)	95 (36)	75 (28)
9 days	104 (37)	100 (36)	77 (27)	144 (41)	113 (32)	95 (27)	119 (38)	103 (33)	91(29)	129 (41)	111(35)	77 (24)	118 (39)	106 (35)	81(26)
11 days	117 (42)	90 (33)	69 (25)	126 (41)	96 (32)	83 (27)	129 (43)	97 (33)	72 (24)	140 (46)	96 (31)	70 (23)	135 (43)	102 (32)	50 (25)
13 days	117 (42)	98 (35)	64 (23)	148 (45)	102 (31)	77 (24)	142 (45)	102 (33)	69 (22)	147 (48)	99 (32)	61(20)	124 (50)	81 (32)	45 (18)
SEm±	**3.88**	**4.7**	**3.97**	**4.07**	**4.65**	**4.82**	**3.93**	**4.69**	**4.71**	**3.78**	**4.78**	**4.27**	**3.94**	**4.57**	**5.33**
CD (P=0.05)	**11**	**NS**	**11**	**11**	**NS**	**13**	**11**	**NS**	**13**	**10**	**13**	**11**	**11**	**13**	**15**
CV (%)	**25.7**	**33.9**	**37.8**	**21.6**	**31.2**	**40.7**	**21.9**	**32.8**	**41.5**	**19.9**	**33.4**	**40.5**	**23.1**	**32.8**	**58.8**

*The values in the parentheses are the percentages of the corresponding total cured leaf yields of the respective treatments

in Table 4, with the values in the parentheses indicating the percentage outturn of the particular priming. The results indicated that both the topping levels and harvest intervals influenced significantly all the yield components with reference to ripeness in almost all the picks except in 7th priming. In general, it was observed that low topping levels and increased harvest intervals yielded higher quantity of ripe and semi-ripe leaf and lower quantity of unripe leaf. Significant increase in ripe leaf yield was registered in topping at 18 leaf level in 6th and 8th priming (145 and 150 kg/ha, 45 and 46 %) and 20 leaf level in 5th and 9th priming (118 and 150 kg/ha, 39 and 47%) over other topping levels. The interaction effects were non-significant.

Chemical quality parameters

The influence of topping levels on leaf chemistry was non-significant in all the chemical characters (Table 5). Whereas, harvest intervals significantly influenced the reducing sugar content of the leaf and not the nicotine and chlorides. Harvesting at 7, 9 and 11 days intervals were comparable in reducing sugar content (10.2 to 10.83%) and better than 13 days harvest intervals. The interaction (Table 6) was also significant in respect of reducing sugar content of the leaf. Topping at 16 leaf level x harvesting at 7 days intervals, that at 18 leaf x 7 to 11 days and 20 leaf x 9 days resulted in significantly higher reducing sugars (11.24 to 12.29%) in cured leaf than other combinations.

It was concluded from the study that, taking into consideration of obtaining maximum ripe leaf and higher cured leaf yields coupled with better quality, a combination of topping the crop at 20 leaf level and harvesting at 9-11 days intervals from 5th pick onwards was found to be preferable.

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Table 5: Influence of topping levels and harvest intervals on leaf chemical composition (2002-03 to 2004-05)

Treatment	Nicotine (%)	Reducing sugars (%)	Chlorides (%)
Topping levels			
16-leaf	3.05	10.75	0.61
18-leaf	2.94	9.82	0.61
20-leaf	3.13	10.42	0.54
22-leaf	3.14	10.09	0.57
SEm±	**0.06**	**0.20**	**0.04**
CD (P=0.05)	**NS**	**NS**	**0.50**
CV (%)	**13.6**	**15.7**	**27.2**
Harvest Intervals			
7 days	3.03	10.82	0.58
9 days	2.97	10.02	0.59
11 days	3.13	10.83	0.58
13 days	3.14	9.41	0.59
SEm±	**0.06**	**0.31**	**0.10**
CD (P=0.05)	**NS**	**0.86**	**NS**
CV (%)	**12.5**	**20.8**	**17.3**

Table 6: Interaction effect of topping levels and harvest intervals on chemical constituents of leaf (2002-03 to 2004-05)

Treatment	Nicotine (%)	Reducing sugars (%)	Chlorides (%)
16 leaf – 7 days	2.81	11.30	0.60
9 days	3.05	10.27	0.56
11 days	3.05	10.28	0.64
13 days	3.30	7.61	0.62
18 leaf – 7 days	2.87	11.39	0.61
9 days	2.99	8.87	0.64
11 days	2.97	12.29	0.57
13 days	2.94	10.44	0.62
20 leaf – 7 days	3.17	10.21	0.53
9 days	2.93	11.24	0.56
11 days	3.29	10.48	0.53
13 days	3.15	9.76	0.55
22 leaf – 7 days	3.28	10.57	0.56
9 days	2.92	9.68	0.59
11 days	3.20	10.27	0.57
13 days	3.15	9.83	0.56
SEm±	**0.10**	**0.54**	**0.03**
CD (P=0.05)	**NS**	**1.49**	**NS**

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