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STUDIES ON INTERRELATIONSHIPS AMONG SELECTED LEAF AND SMOKE CONSTITUENTS IN FCV TOBACCO. III. SOUTHERN LIGHT SOILS OF ANDHRA PRADESH

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In an attempt to study the influence of soil, climate and production practices on the leaf chemical constituents which influence the cigarette smoke deliveries, 42 FCV tobacco samples were collected from different locations in Southern Light Soils (SLS) during 2006-07, 2007-08 and 2008-09 crop seasons for analysis of leaf and smoke constituents. Based on the mean values of all the samples, the levels of smoke constituents were: TPM (24.82 mg/cig), tar (21.21 mg/cig), nicotine (1.77 mg/cig), solanesol (0.32 mg/cig) and carbon monoxide (10.71 mg/cig); the levels of leaf constituents were: nicotine (2.30%), reducing sugars (14.10%), potassium (2.05%), solanesol (0.65%), PEE (6.78%), RS/Nic. (6.67) and K/Cl (6.51). The data revealed that lower leaf nicotine, chlorides, solanesol and PEE and higher reducing sugars, potassium, RS/Nic. and K/Cl are associated with low TPM and vice-a-versa.

INTRODUCTION

In the background of variants such as, soil, climate, variety, fertilization, position of the leaf on the plant and grading, an attempt was made to correlate leaf and smoke constituents in the samples collected from different locations in the region. According to Tso (1972), leaf composition differs from type to type and from crop to crop. In addition, leaves from various stalk positions on the same plant vary considerably in their physical properties and chemical composition. Such variation also exists among different parts of the single leaf. SLS soils are red loams (Alfisols) with moderate quantities of clay, neutral to slightly alkaline, limited drainage, moderate water holding capacity, low to medium cation exchange capacity, low in organic matter, low in P and medium to high in potash. The crop is grown as rainfed crop under high moisture stress and hence the yields are very low. Some times the crop also face water logging situation in the initial stages leading to low productivity. Lower doses of nitrogenous fertilizer (40 kg/ha) are applied to the crop. SLS tobacco is classified as medium sized, lemon to orange, lustrous, ripe and open grained with low to medium nicotine content, medium nitrogen and sugar contents.

MATERIALS AND METHODS

A total number of 42 FCV tobacco samples from SLS during 2006-07, 2007-08 and 2008-09 crop seasons were collected for analysis of leaf [nicotine, reducing sugars, chlorides, potassium, solanesol and petroleum ether extractives (PEE)] and smoke [total particulate matter (TPM), tar, nicotine, carbon monoxide and solanesol] constituents (Gangadhar, 2010). The statistical parameters *viz.,* CV, SD and SEm were calculated.

RESULTS AND DISCUSSION

The data on physical parameters of the cigarettes are summarized in Table 1. Generally, physical parameters of cigarettes have profound influence on the yields of smoke constituents and puff count. In general, variations in the parameters like weight of cigarette (CV: 8.36 – 12.98%), circumference (CV: 1.16 – 1.67%) and moisture in tobacco (CV: 4.34 – 10.28%) are within the acceptable limits which could be attributed to the rigorous selection procedure before smoke analysis**.** However, higher variation was observed in the case of pressure drop (CV: 12.51 – 23.02%) which could be attributed to higher variation in cigarette weight, particularly in the samples of 2007-08.

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Table 1: Physical parameters of cigarettes of SLS samples (2006-09)

Parameter	PD (mm WG)	Wt. of cig (g)	Moisture (%)	Circumference (mm)	Puff count
2006-07 (3)					
Mean	50.76	0.86	11.38	24.19	7.00
SD	6.35	0.10	0.49	0.40	0.98
CV (%)	12.51	11.24	4.34	1.67	14.07
SEm±	3.67	0.06	0.28	0.23	0.57
2007-08 (24)					
Mean	59.93	0.85	11.04	24.08	7.13
SD	13.80	0.11	0.52	0.31	1.33
CV (%)	23.02	12.98	4.69	1.27	18.67
SEm±	2.82	0.02	0.11	0.06	0.27
2008-09 (15)					
Mean	58.64	0.92	10.47	23.62	8.68
SD	10.27	0.077	1.08	0.27	0.89
CV (%)	17.52	8.36	10.28	1.16	10.30
SEm±	2.65	0.02	0.28	0.07	0.23

It is inferred from the smoke and leaf constituents data (Table 2) that collection of samples from different locations, soil & climatic conditions in the micro-zones of the region and cultural practices like fertilization, harvesting and curing may be the reasons for variations in the levels of leaf constituents *viz.*, nicotine, chlorides, potassium, PEE and solanesol which in turn contributed to variations in smoke constituents *viz.*, TPM, tar, nicotine, solanesol and carbon monoxide.

The highest TPM value (27.91 mg/cig) was recorded in the sample from Kondasamudram (Kandukur), collected in the 2006-07 crop season, with high leaf nicotine (2.31%), solanesol (0.58%) and low potassium (1.73%) and reducing sugars (10.79%). The lowest TPM value (22.12 mg/cig) was observed in the sample from a different location, Polinenipadu (Kandukur) with low leaf nicotine (1.87%), chlorides (0.13%), solanesol (0.40%), marginally high potassium (1.85%) and high K/Cl ratio (18.31). In the sample from Rachuvaripalli (Kaligiri), low TPM (23.46 mg/cig) was recorded with corresponding low leaf nicotine (1.92%), solanesol (0.40%) and high potassium (2.59%). Higher TPM value could be attributed high leaf nicotine, solanesol and low potassium and vice-a-versa.

In 2007-08 samples, highest TPM value (32.43 mg/cig) was recorded in the sample from Ramachandrapuram (Kandukur) with leaf nicotine (2.17%), solanesol (0.57%), high chlorides (0.95%) and low potassium (1.30%). The lowest TPM value (15.95 mg/cig) was observed in the sample from Kandrika (Kaligiri) with low leaf nicotine (1.50%), chlorides (0.34%), PEE (4.00%), solanesol (0.74%) and potassium (1.61%). In the sample from another location in Naidugunta (Kaligiri), low TPM (16.83 mg/cig) was recorded and the corresponding values of leaf nicotine, solanesol, PEE and potassium are 1.89, 0.45, 6.03 and 3.62%, respectively. It is inferred that apart from nicotine and solanesol, potassium and chlorides have profound influence on the TPM deliveries.

It is observed from the data of smoke and leaf constituents of SLS samples (2008-09), the highest TPM value (29.67 mg/cig) was recorded in the sample from Kambalapadu (Podili I) with leaf nicotine (4.59%), solanesol (0.74%), chlorides (0.55%), PEE (13.08%) and potassium (2.07%). In the samples from other locations, higher TPM values ranging from 28.27 to 29.41 mg/cig were observed with corresponding nicotine (2.38 – 4.35%), solanesol (0.59 – 1.15%) and PEE (5.45 – 11.27%). The lowest TPM value (21.03 mg/cig) was observed in the sample from Machavaram (Podili

Table 2: Smoke and leaf constituents of SLS tobacco samples (2006- 09)

S. No.	Smoke constituents (mg/cig)					Leaf constituents (%)						Ratios	
	TPM	Nicotine	Tar	CO	Solanesol	Nicotine	Red. sugars	Chlorides	Solanesol	Potassium	PEE	RS/Nic	K/Cl
2006-07 (3)													
Mean	24.50	1.96	19.27	10.88	0.39	2.03	12.52	0.28	0.46	2.23	6.22	6.26	10.52
Max	27.91	2.71	21.65	12.37	0.48	2.31	14.47	0.48	0.58	2.59	6.32	7.54	18.31
Min	22.12	1.58	17.59	9.72	0.34	1.87	10.79	0.13	0.40	1.73	6.10	4.67	5.40
SD	**3.03**	**0.65**	**2.12**	**1.36**	**0.081**	**0.24**	**1.85**	**0.18**	**0.10**	**0.45**	**0.11**	**1.46**	**6.85**
CV (%)	**12.4**	**33.1**	**11.0**	**12.5**	**20.90**	**11.85**	**14.77**	**65.69**	**22.59**	**20.07**	**1.79**	**23.30**	**65.14**
SEm±	**1.75**	**0.37**	**1.22**	**0.78**	**0.047**	**0.14**	**1.07**	**0.10**	**0.06**	**0.26**	**0.06**	**0.84**	**3.95**
2007-08 (24)													
Mean	22.95	1.92	18.10	11.26	0.30	2.03	14.90	0.47	0.60	2.09	6.18	7.81	5.44
Max	32.43	3.04	25.87	17.44	0.73	3.31	17.96	1.10	1.15	3.62	8.00	12.14	9.77
Min	15.95	1.18	11.00	8.58	0.18	1.40	11.07	0.22	0.31	1.30	4.00	3.34	1.40
SD	**3.25**	**0.42**	**2.80**	**1.82**	**0.14**	**0.48**	**2.45**	**0.23**	**0.24**	**0.47**	**0.85**	**2.48**	**2.29**
CV (%)	**14.18**	**22.14**	**15.49**	**16.17**	**48.39**	**23.63**	**16.43**	**48.73**	**40.05**	**22.58**	**13.72**	**31.76**	**42.10**
SEm±	**0.66**	**0.09**	**0.57**	**0.37**	**0.03**	**0.10**	**0.50**	**0.05**	**0.05**	**0.10**	**0.17**	**0.51**	**0.47**
2008-09 (15)													
Mean	27.00	1.44	21.75	10.01	0.27	2.86	14.90	0.62	0.79	1.83	7.95	5.96	3.51
Max	29.67	2.19	23.92	12.12	0.41	4.59	21.50	1.05	1.15	2.38	13.08	9.33	6.50
Min	21.03	1.27	16.86	8.74	0.13	1.81	6.51	0.30	0.57	1.18	4.16	1.61	1.48
SD	**2.31**	**0.24**	**1.91**	**0.84**	**0.10**	**0.90**	**4.33**	**0.24**	**0.19**	**0.39**	**2.52**	**2.69**	**1.75**
CV (%)	**8.56**	**16.71**	**8.77**	**8.43**	**35.61**	**31.54**	**29.06**	**39.29**	**23.52**	**21.71**	**31.75**	**45.15**	**49.78**
SEm±	**0.59**	**0.06**	**0.49**	**0.22**	**0.02**	**0.23**	**1.12**	**0.06**	**0.05**	**0.10**	**0.65**	**0.69**	**0.45**
Mean of three seasons													
G Mean	24.82	1.77	19.71	10.72	0.32	2.31	14.11	0.46	0.63	2.05	6.81	6.68	6.49
High and low values													
High	26.45	2.34	20.76	12.15	0.39	2.17	13.14	0.34	0.56	1.80	6.22	6.45	6.67
Low	22.54	1.68	17.91	10.11	0.29	2.20	14.59	0.49	0.60	2.17	6.47	6.92	6.67

Figures in parenthesis represent no. of leaf samples

II) with leaf nicotine (2.41%), chlorides (0.40%), PEE (4.16%), solanesol (0.57%) and potassium (1.94%).

As per the mean values of seasons, lower TPM and slightly higher smoke nicotine values were observed in the 2007-08 season compared to 2006-07 and 2008-09 seasons (Table 2) and during this particular season, lower leaf nicotine, chlorides, solanesol, PEE and higher potassium and K/Cl values were recorded. During this season higher rainfall (785.8 mm) and rainy days (27) were recorded compared to 2006-07 (rainfall: 559.4 mm) and 2008-09 (rainfall: 612.7 mm). The lower TPM and smoke nicotine could be attributed to lower leaf nicotine. It is reported that deficit in rainfall results in higher nicotine and vice-a-versa (Gopalachari and Gopinath, 1965).

All the 42 samples were segregated into two groups i.e. samples with low and high TPM, based on the mean values of both the seasons and mean values of smoke and leaf constituents in both the groups were calculated. The data revealed that lower leaf nicotine, chlorides, solanesol and PEE and higher reducing sugars, potassium, RS/Nic. and K/Cl are associated with low TPM and vice-a-versa.

Binopoulos *et al.* (1965) found a positive correlation between the resin content in the leaf and yield of smoke condensate, and also a positive correlation in relation to the nicotine content of the leaf. The positive influence of potassium on the fire-holding capacity of tobacco was expressed in a quadratic relationship (Attoe, 1945). A significant relationship between dry TPM and potassium was envisaged by Tso *et al.* (1980). Higher K/Cl value is considered to be an index of combustion (Salehi and Eharmi, 1998). Schlotzhauer *et al.* (1976) showed that solanesol contributes to more than 30% of smoke PAH and 40% of smoke BaP, thus emphasizing the desirability of low solanesol levels in tobacco.

It is concluded that higher leaf nicotine, solanesol and PEE have contributed to higher TPM deliveries and vice-a-versa.

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