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CLIMATIC INFLUENCE ON FCV TOBACCO PRODUCTIVITY AND QUALITY GROWN IN SOUTHERN TRANSITIONAL ZONE OF KARNATAKA

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Flue cued Virginia (FCV) tobacco is an important commercial crop grown under rainfed conditions (>70% area) in Southern Transitional Zone (STZ) of Karnataka and is typically characterized by dry-sub humid to semi-arid climate. Being a rainfed production system, the sustainable leaf productivity and cured leaf quality / chemistry is largely influenced by climate changes and prevailing weather situations during the crop growth period. Even though Meteorological Standard Week 26th was found to be a dry spell week indicating that the short term drought can occur during the active growth stage of the crop, the fluctuations or the coefficient of variations in rainfall (RF) intensity and rainy days of July month are very high enough (46.3 and 39.8%, respectively) to cause serious losses in productivity and leaf quality. Regression models based on RF data of 34 years (1981-2014) indicated that productivity followed sigmoid/ bell shaped curve with the July RF. Nicotine content in cured leaf found to be negatively correlated with increase in quantum of July RF, but on the other hand reducing sugars found to increase with increase in July RF. Leaf chlorides showed declining trend with increased rainfall. The study suggested that the reliable forecast of July month rainfall situation becomes very much relevant in determining not only yield estimates/ quality assessment, but also serves for planning possible climate mitigation/crop management strategies for maintaining better productivity and quality leaf required for sustaining the export potential and farm income in this rainfed agro-climatic zone.

Key words: Climate, Meteorological Standard Week, FCV Tobacco, Rainfall

INTRODUCTION

Flue cued Virginia (FCV) tobacco is an important commercial crop grown under rainfed conditions in Southern Transitional Zone (STZ) of Karnataka in an area of 0.85 to 1.00 lakh ha. The tobacco produced in this zone is popularly known as KLS (Karnataka Light Soils) tobacco which is having high export demand in the international market due to balanced chemistry, low TSNA, low heavy metals and more filling value. The FCV tobacco growing soils in this transitional zone are generally red sandy to sandy loam in nature with low water holding capacity and cation exchange capacity and as such soils are biologically inferior. Nearly 70% of the total cultivated area in this zone is mainly under rainfed farming and is typically characterized as dry-sub humid to semi-arid climate (Mahadevaswamy and Giridhar, 2003). Being a rainfed production system, the sustainable leaf productivity and cured leaf quality / chemistry is largely influenced by climate changes and prevailing weather situations during the crop growth period. The productivity of rainfed farming is always uncertain due to long temporal and spatial variation in the rainfall apart from the productive capacity of the land. The crop growing period should necessarily coincide with the availability of moisture to meet the evaporative demand of the crop for successful crop production on one side and the acceptable and desired leaf quality parameters and chemistry on the other hand. Any strategy to increase agriculture production on a sustained basis should take explicit account of the complementarity of the agro-meteorology and development (Biswas, 1994). Considering this, an attempt was made to identify the critical stage of moisture, climatic aberrations during the critical period and their influence on crop productivity and quality/chemistry in FCV tobacco growing areas of Karnataka Light Soils.

MATERIALS AND METHODS

Weekly Rainfall (RF) or Precipitation (P) and the Potential Evapo-transpiration (PET) data for 52 meteorological standard weeks of 20 years (1996-2015 period) were collected from the agro-meteorology observatory situated at ICAR-Central Tobacco Research Institute Research farm,

Hunsur, Mysore district, Karnataka. The agro-weather station is situated at an altitude of 826 MSL with a latitude of 12^0 to18^0 N and longitude of 76^0 to 81^0 E with long term average rainfall of 825-850 mm. Weekly RF and the weekly PET were determined for 20 years period and the average ratio of RF/ PET was computed for each of the meteorological standard week (Table 1). The dry spells (DS) were identified based on the standard weeks having RF/ PET ratio of <0.50 **(**Jeevananda reddy, 1983*)* within the growing season. After identifying the critical stage, the rainfall variability in terms of coefficient of variation (C.V%) for the long term data of 34 years (1981-2014) was worked out for the month of July which coincides with the active growth period of the crop in KLS. The long term July month weather data of 34 years (1981-2014) like average monthly rainfall,temperature, relative humidity, sunshine hours *etc.,* were correlated with productivity and various quality parameters (nicotine, reducing sugars and chlorides) using regression models. The results were interpreted based on the regression coefficients.

RESULTS AND DISCUSSION

Average weekly rainfall (RF), weekly Potential Evopo-transpiration (PET) and RF/PET ratio of 20 years (1996-2015) are presented in Table 1. In KLS region, majority of the plantings were done starting from the month of May (utilizing pre-monsoon rainfall). In tobacco crop the water requirement in the early growth phase and in the later crop stage is comparatively very less as compared to active grand growth period /stage. As per moisture use by tobacco, the water requirement will be maximum during 6^{th} to 11^{th} week after planting of the crop (Harrison and Whitty, 1971). The bulk of the FCV tobacco planting commences from the 2^{nd} week of May (i.e., coinciding with 19-20^{th} Standard week). Consequently the 6^{th} week to 11^{th} week after planting (the maximum water requirement period) coincides with 25^{th} to 30^{th} standard week. The cumulative potential water evopo-transpiration for the period from 25^{th} to 30^{th} standard week works out to 156.3 mm, while the actual precipitation or rainfall is 118.4 mm which meet almost 75% of the crop water requirement during this period (Table 1). However, the 26^{th} standard week falls under dry spell where the Precipitation/Potential Evopo-transpiration ratio is less than 0.50 (RF/PET <0.50) indicating that the short term drought can occur during the active growth stage of the crop (especially during in the second FN of July month depending upon the planting dates in the month of May).Thus July monthly RF will become critical for growth/ development, productivity and quality of FCV tobacco crop raised under monsoonic climate in Karnataka.

Even though the dry spells during the month of July is not long enough or intensive to result in any serious productivity losses, the fluctuations or the coefficient of variations in rainfall intensity and rainy days are very high enough which can greatly affect the productivity and leaf quality losses from year to year resulting in unsustainable productivity of this commercial crop in this zone (Table 2). Dry land agriculture in arid and semi arid regions where 40% of the world's population live is particularly vulnerable to risks of climate change and rainfall variability, drought in particular (Sivakumar, 2012). While the coefficient of variability was 18.9% for the total annual rainfall received during the long period average of 34 yaers (1981-2014), the C.V. % was as high as 46.3% for the month of July. Even the variations regarding the number of rainy days was around 40% indicating that the rainfall variability of July month with respect to both the amount and the distribution can greatly affect the sustainability of FCV tobacco production in rainfed farming situations of KLS.

Regression models based on RF data of 34 years (1981-2014) suggested that productivity followed sigmoid bell shaped curve with the July RF wherein much of the normal productivity points were concentrated at 100-120 mm rainfall range. However rainfall in excess of > 120-150 mm was not conducive for leaf development and productivity decline was very much observed during excess RF years (Fig.1a). Cured leaf nicotine found to be negatively correlated with increase in quantum of July RF, but on the other hand reducing sugars found to increase with increase in July RF. Leaf chlorides showed declining trend with increased rainfall (Fig. 1b,c,d). The analysis clearly indicated that July month RF becomes very critical for obtaining normal productivity as well as leaf quality. Similarly, *Steven jerie* and

Table 1: Average weekly rainfall (RF), weekly Potential Evopotranspiration (PET) and RF/PET ratio of 20 years (1996-2015) at CTRI Research Station farm, Hunsur

Standard week.	Weekly RF	Weekly PET	RF/PET Ratio	Standard week.	Weekly RF	Weekly PET	RF/PET Ratio
1	3.0	25.0	0.170	27	23.7	26.7	0.887
2	3.3	24.7	0.133	28	16.5	25.2	0.657
3	2.8	25.0	0.112	29	26.4	26.1	1.040
4	0.3	26.6	0.011	30	17.9	25.6	0.699
5	0.7	27.3	0.025	31	16.6	24.7	0.672
6	0.6	28.5	0.021	32	14.9	25.6	0.582
7	0.3	29.2	0.009	33	17.3	24.6	0.703
8	0.6	31.3	0.020	34	26.4	26.5	0.996
9	2.9	25.7	0.111	35	20.3	26.1	0.777
10	1.7	31.2	0.054	36	22.0	25.3	0.869
11	1.5	32.5	0.045	37	28.5	29.8	0.956
12	5.4	32.5	0.168	38	30.0	26.9	1.115
13	5.8	31.9	0.183	39	35.0	31.3	1.118
14	6.4	33.4	0.192	40	28.6	25.8	1.108
15	20.9	31.7	0.659	41	46.3	27.0	1.714
16	23.9	30.1	0.794	42	37.0	24.5	1.510
17	27.2	30.5	0.891	43	37.5	26.9	1.400
18	16.1	29.6	0.544	44	24.7	26.9	0.918
19	23.5	30.2	0.774	45	30.0	29.4	1.020
20	18.4	29.3	0.627	46	5.2	25.3	0.205
21	18.9	30.0	0.630	47	11.9	25.8	0461
22	27.5	28.6	0.961	48	4.6	26.2	0.175
23	15.7	29.8	0.526	49	4.0	25.2	0.158
24	24.0	26.0	0.923	50	6.5	23.1	0.281
25	21.6	24.8	0.870	51	2.0	22.9	0.087
26	13.0	27.9	0.466	52	3.4	27.5	0.123

Table 2: Raifall variability in the month of July in KLS regions (mean of 34 years 1981-2014)

Parameters	**Annual Rainfall**	**Rainfall variability**	**No.of rainy days**
Mean value	848.8 mm	93.4 mm	10.1
Range	478.5-1159.0	32.6-223.8	2-17
Coefficient of Variation (%)	18.9	46.3	39.8

Ndabaningi, 2011 studied the influence of different weather parameters and concluded that rainfall variability is a major factor influencing the yield and quality variations in tobacco.

Hence, the reliable forecast of July month rainfall situation becomes very much relevant in determining not only the yield estimates and quality assessment of this commercial crop, but also serves for planning possible climate mitigation/crop management strategies for maintaining better productivity and quality leaf required for sustaining the export potential thereby farm income in this rainfed agro-climatic zone.

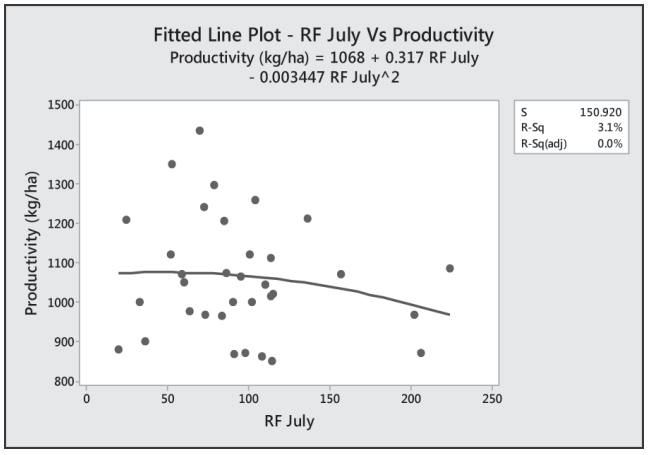

Fig. 1(a): Productivity of FCV tobacco as influenced by July RF

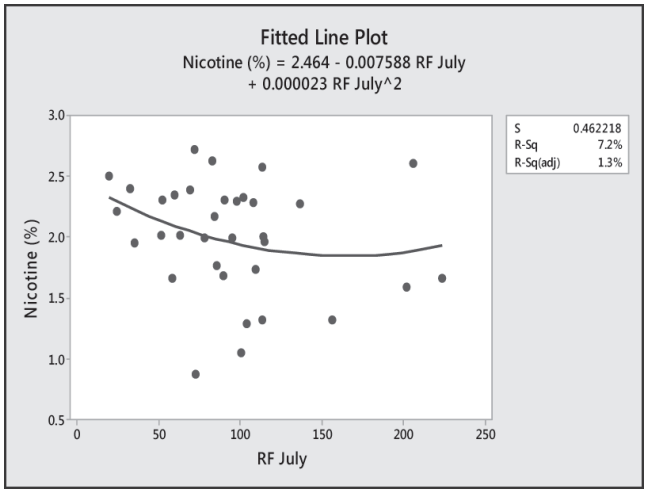

Fig. 1(b): Leaf nicotine as influenced by July RF

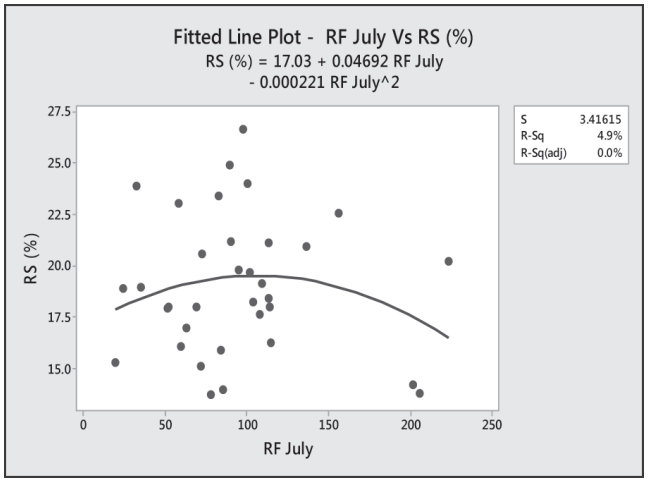

Fig. 1(c): Reducing sugars as influenced by July RF

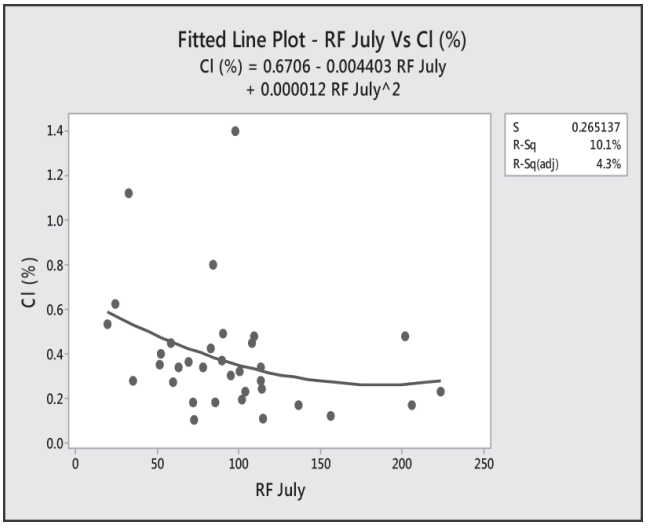

Fig. 1(d): Leaf chlorides as influenced by July RF

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