

# LEAF QUALITY TRENDS

*in*

# FCV TOBACCO



L.K. Prasad  
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M. Sheshu Madhav  
N. Johnson



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**ICAR - CENTRAL TOBACCO RESEARCH INSTITUTE**  
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## **Leaf Quality Trends in FCV Tobacco**

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## Preface

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In India, Flue Cured Virginia tobacco which is a quality conscious crop is grown in an area of 0.146 million hectares producing 241 million kg annually. The price and export demand for FCV tobacco are largely influenced by the quality of the leaf. A favorable market price and consistent demand provide advantages to local buyers, which ultimately benefit tobacco farmers. The quality of FCV tobacco varies across different agro-climatic regions and crop seasons. To effectively know track changes in leaf quality, a detailed evaluation of key quality parameters is essential.



The institute is actively engaged in the regular analysis, evaluation, and monitoring of these critical quality indicators, particularly in FCV tobacco. Analyzing chemically especially for the nicotine, reducing sugar and chlorides play a key role in chemical quality assessment of tobacco grown in different seasons. However, comparing these quality parameters across regions and seasons is very essential to find out the decadal trend. In this bulletin, the authors illustrated the decadal trend of different leaf quality parameters of FCV tobacco regions and their sub regions which will certainly assist to improve the leaf chemical quality and in visualizing the market price and exports more effectively. I sincerely wish that the proposed approach of evaluation of leaf quality is of immense help to the community in tobacco research and development.

Date: 01.10.2024

  
(M. SHESHU MADHAV)  
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## Introduction

FCV tobacco is grown in an area of 1.46lakh hectares in India with a production of 241 million kg. India is globally known for its production, quality and exports in international market.

It is grown in four agroclimatic regions i.e NLS, KLS, SLS and SBS in the states of Andhra Pradesh and Karnataka. Tobacco leaf quality is mainly influenced by soil types and agro-climatic conditions in which it is grown. As it is a highly commercial crop, seasonal monitoring of production and quality is done by the concerned departments and research organizations to ensure better market price for the farmer and Indian tobacco.

Analyzing tobacco leaf quality especially for nicotine, reducing sugar and chloride contents and assessing their trends to know or to detect changes in its quality spatially and temporally is essential which will help in visualizing the spatial and temporal dimensions of leaf quality in a region is crucial to make monitoring process simple and effective. Keeping in view the present study was attempted to know the decadal trend (2014-2024) of the leaf quality of FCV tobacco in different FCV tobacco regions and their sub regions (under Tobacco Board Auction Platforms). This will help in comparing quality among the regions and to provide agronomic and post-harvest recommendations to manage and to improve the leaf chemical quality parameters which dictates finally the market price and exports.

### **Leaf Chemical Quality of FCV Tobacco and its Importance**

The FCV tobacco is a highly commercial product that is marketed in the national and international market under strict quality standards which always influence the Indian exports. The competitive price and sustained market benefit the local buyers in turn the tobacco farmers. Different agronomic practices and post-harvest practices influences the leaf quality during the production and post production.

The changes in content of nicotine, reducing sugars and chlorides in the FCV tobacco leaf influences the quality of the product i.e cigarette especially smoke quality, burning pattern and flavour. Hence, studying regularly auction platform level or regional level leaf quality through trends and managing through appropriate agronomic interventions is required.

To ensure the better acceptability of our tobacco in the national and international market the quality of tobacco produced should be within the limits of acceptability. Therefore, assessment of important quality parameters of tobacco using standard ISO analytical protocols to monitor temporal leaf quality is essential especially in rainfed situations.

The major quality parameters necessary to know the trends for assessing and monitoring the leaf chemical quality especially for better commercial use are as follows:

**Nicotine:** It is synthesized in roots of the plant and transported to leaf. It is considered that a nicotine level of 1.75 to 2.0% in FCV tobacco is most satisfactory. Acceptable Range: 0.70 - 3.0 %.

**Reducing Sugar:** Reducing Sugar is formed during initial stages of curing process of tobacco leaf. The enzymatic hydrolysis of starch present in the leaf formed during crop growth results in reducing sugars. It is a reducing form of Glucose. Acceptable Range: 8-24 %.

**Chlorides (Cl):** Chlorine is one of the essential nutrients in the production of tobacco. It plays a key role in influencing leaf quality and burn. It is absorbed with ease from the soil solution. It is a free ion mostly accumulated in the leaf from the irrigation water and soil during the crop growth absorbed by the roots. Leaf having more chlorides (greater than 2%), which was found to have poor burn and keeping quality. Acceptable Range: < 1.0 %.



## Decadal trends in Leaf Quality parameters in FCV Tobacco

### Leaf quality of FCV tobacco in Northern Light Soils

The FCV tobacco is grown in five sub regions based on soil type under NLS zone during Rabi season under irrigated conditions. It is under Krishna – Godavari agroclimatic zone with red sandy soils having poor soil nitrogen and medium to high potassium content. The recommended dosage of fertilizers of NPK: 135- 40- 150 kg/ha. The results of leaf quality are described sub-region wise under NLS.

#### Sub region wise trend of leaf quality in NLS

**Leaf nicotine:** In Devarapalli region of Northern Light Soils grown FCV tobacco leaf nicotine content varied from 0.78 to 5.84 % with a mean of 3.03%. The range and mean nicotine content in the leaf samples of other sub-regions viz., Jangareddy Gudem-I, Jangareddy Gudem-II, Koyyalagudem, and Gopalpuram regions were 1.14-4.53% (Mean: 2.84%), 1.18-4.43% (Mean: 2.57%), 1.29-5.81% (Mean: 2.99%), and 1.48-5.49% (Mean: 3.06%) respectively. Highest mean nicotine was found in Gopalpuram sub-region followed by Devarapalli sub-region. The highest nicotine content was observed during the period of 2020-21 in almost all sub-regions except Jangareddy Gudem-II (2019-20) and Gopalpuram (2023-24) sub regions. It is noteworthy from figure 1 to 5 that the trend of leaf nicotine content is gradually increasing in all sub regions over the period of last ten years (2014-2024). As it is to be mentioned here that there was introduction of high yield potential varieties/hybrids need high requirement of nitrogen which led to application of more fertilizer nitrogen helped in increase in leaf nicotine content even under irrigated crop. However, the average nicotine content observed is not very high or abnormal.

**Leaf reducing sugars:** The reducing sugars of tobacco leaf in Devarapalli sub-zone/region ranged from 4.35 to 26.87 % (Mean: 16.45%). The highest to lowest mean values of reducing sugars of other sub regions were in the order of Jangareddy Gudem-II(17.07%), Koyyalagudem (16.90%) Gopalpuram (15.70 %) and Jangareddy Gudem-I (15.62 %). The peak reducing sugars content were noticed invariably different

regions during different duration viz., Devarapalli (2018-19), Jangareddy Gudem (2020-21), Jangareddy Gudem-II (2016-17), Koyyalagudem (2014-15) and Gopalpuram (2017-18) which epitomize that the variation of reducing sugar content in leaf does exist over the decadal years (Fig. 1 to 5). On the contrary to leaf nicotine, the trend of reducing sugar content is decreasing over the period of time in all sub regions. The probable reason may be due to the high uptake of fertilizer nitrogen by the crop led to high vegetative growth without proper ratio of potassium. Hence, while curing improper conversion of starch to sugars causing decrease in reducing sugars.

**Leaf chlorides:** The leaf chloride content during the year of 2014-2024 in different regions of NLS were 0.11-3.71% (Mean: 1.11%), 0.11-3.63% (Mean: 0.89%), 0.1-1.84% (Mean: 0.63%), and 0.16-2.44% (Mean: 0.78%) and 0.24-2.33% (Mean: 0.80%) for Devarapalli, Jangareddy Gudem-I, Jangareddy Gudem-II, Koyyalagudem, and Gopalpuram sub-regions respectively. In Devarapalli and Jangareddy Gudem-I sub regions, highest chloride content was observed during 2022-23, whereas, in Jangareddy Gudem-II, Koyyalagudem highest was observed during the season of 2016-17. In the period of 2019-20, significant high chloride content was highlighted in Gopalpuram sub-region (Fig. 1 to 5). The decadal trend of leaf chloride content in all sub regions of NLS is stable, except increasing in Jangareddy Gudem-I, and especially in Devarapalli region are more inclining. It is due to heavy irrigation and improvement in water table due to Polavaram canal leads to movement of salts to upper layers contaminating root zone and influencing the uptake of chlorides.

Overall, the leaf nicotine, reducing sugar and chloride content in whole NLS region varied from 0.78-5.84% (Mean: 2.80%), 4.35-28.07% (Mean: 16.94%) and 0.1-3.71% (Mean: 0.81%) respectively. On the other hand, highest nicotine (3.50%), reducing sugar (18.90%) and chloride content (1.02%) were noted during the period of 2020-21, 2017-18 and 2019-20 respectively. On the contrary, lowest were observed during the period of 2014-15, 2021-22 and 2014-15 respectively. Among all the parameters, most notably, nicotine content recorded highest in NLS regions in comparison to KLS, SLS and SBS regions. From the figure 6, it is visualized that the trend is gradual increasing for nicotine and chlorides whereas decreasing in case of reducing sugars over the period of ten years (2014-2024).

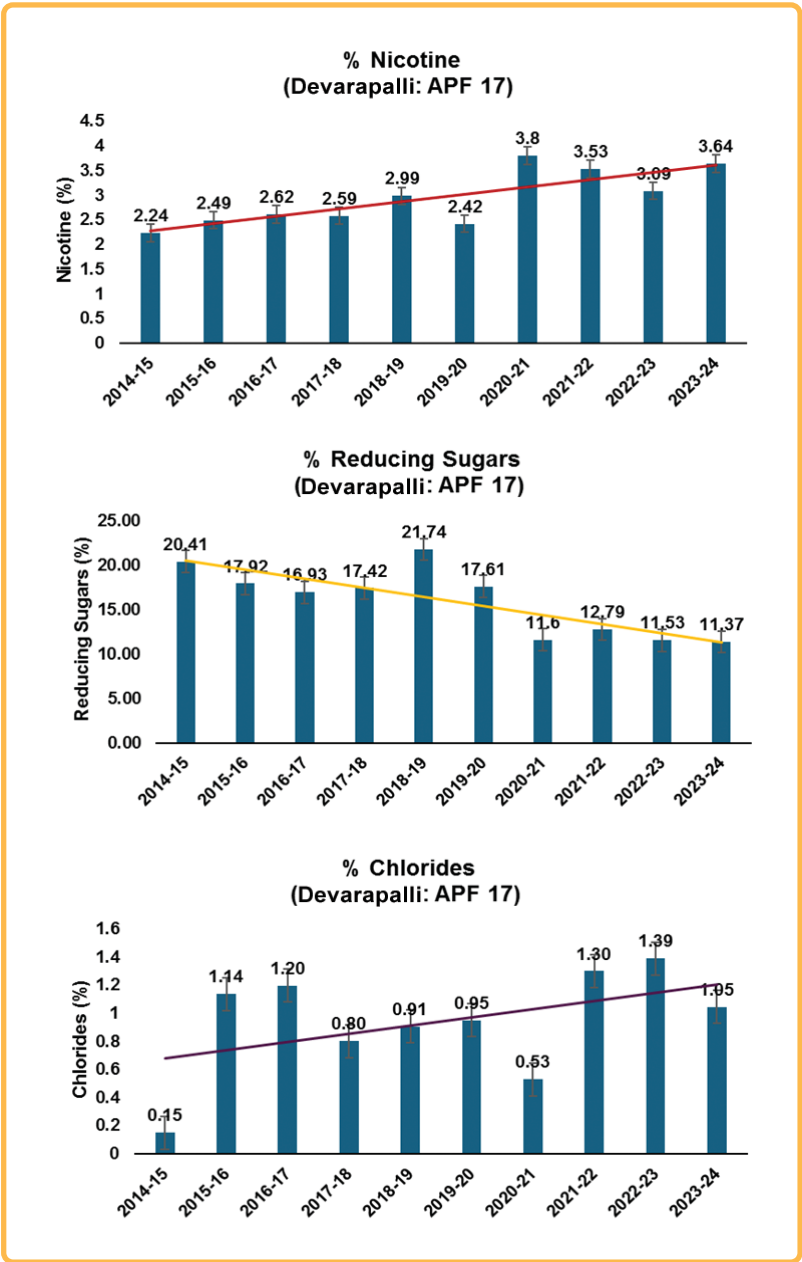


Fig.1: Decadal trend of Nicotine, Reducing sugars and Chlorides in Devarapalli sub-region of Northern Light Soil

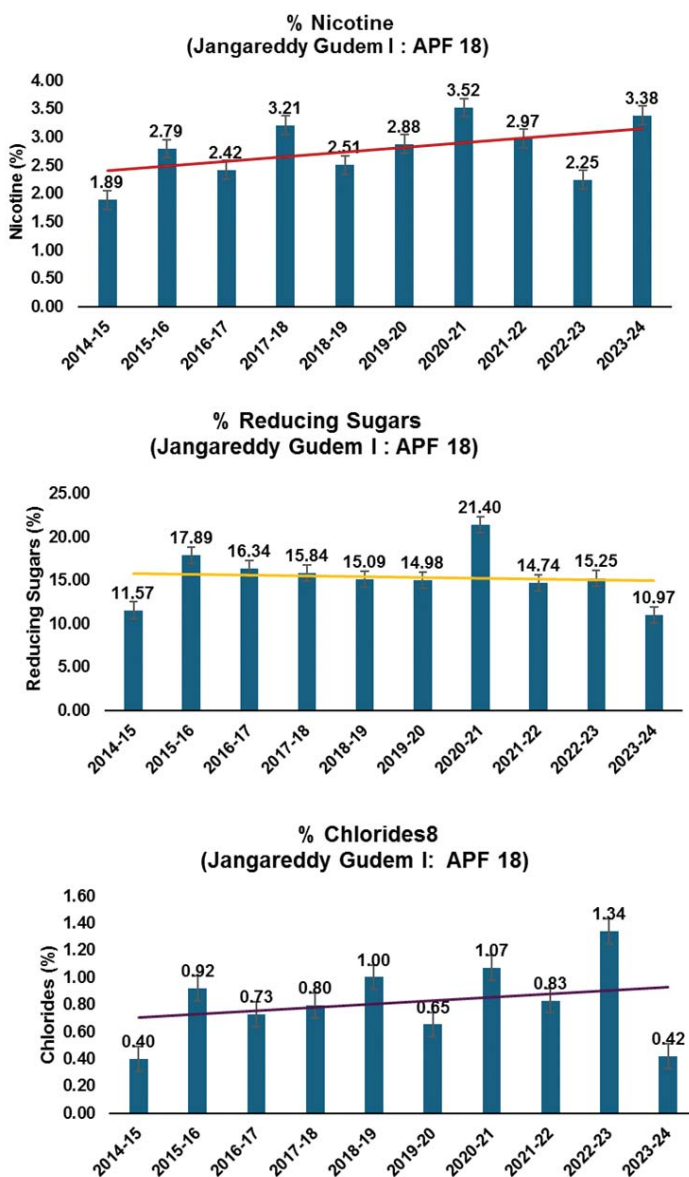


Fig.2: Decadal trend of Nicotine, Reducing sugars and Chlorides in Jangareddy Gudem-I sub-region of Northern Light Soil

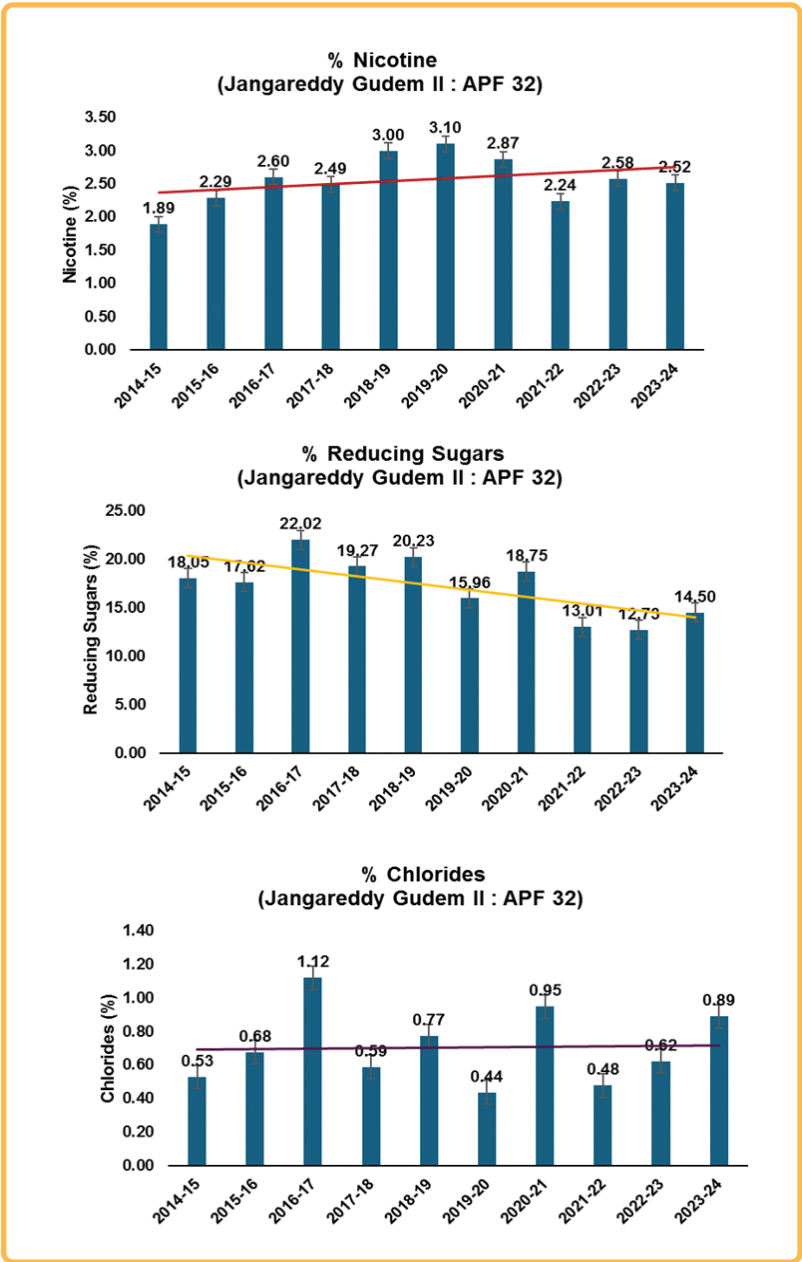


Fig.3: Decadal trend of Nicotine, Reducing sugars and Chlorides in Jangareddy Gudem-II sub-region of Northern Light Soil

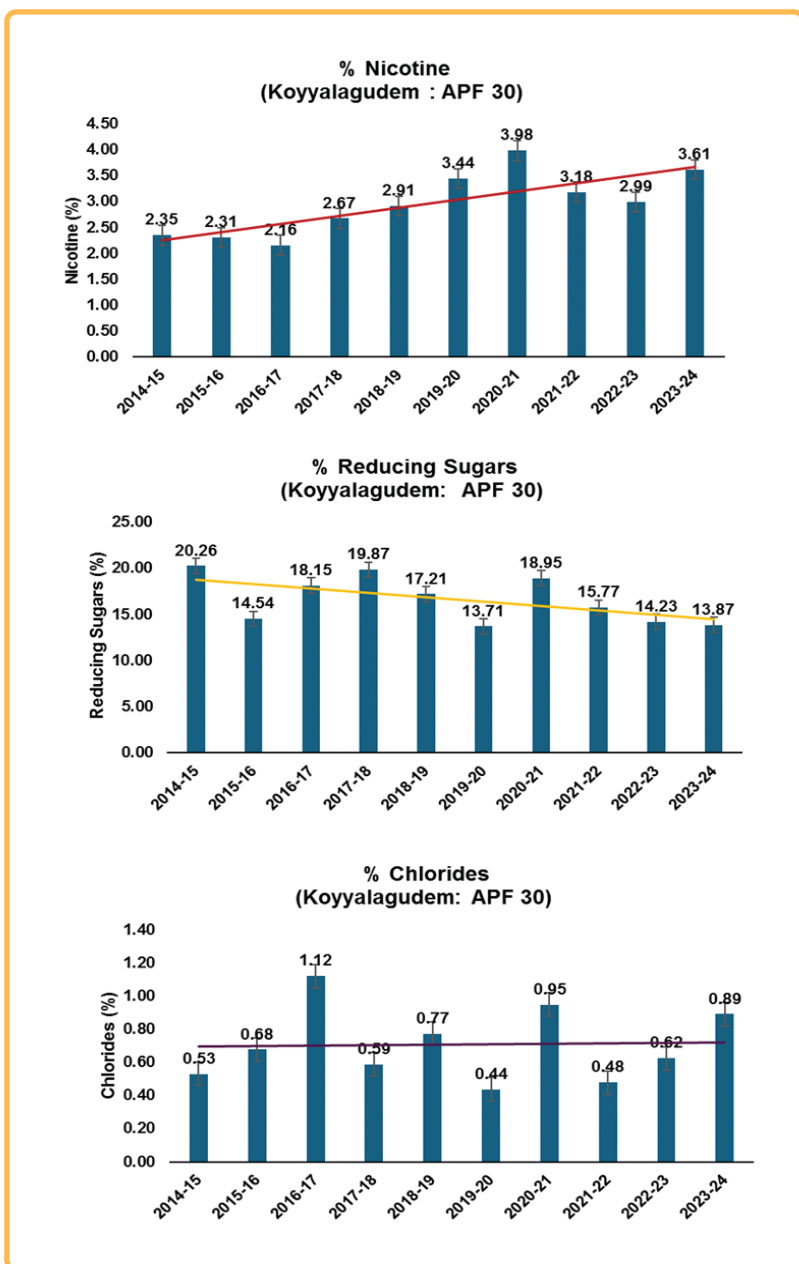


Fig.4: Decadal trend of Nicotine, Reducing sugars and Chlorides in Koyyalagudem sub-region of Northern Light Soil

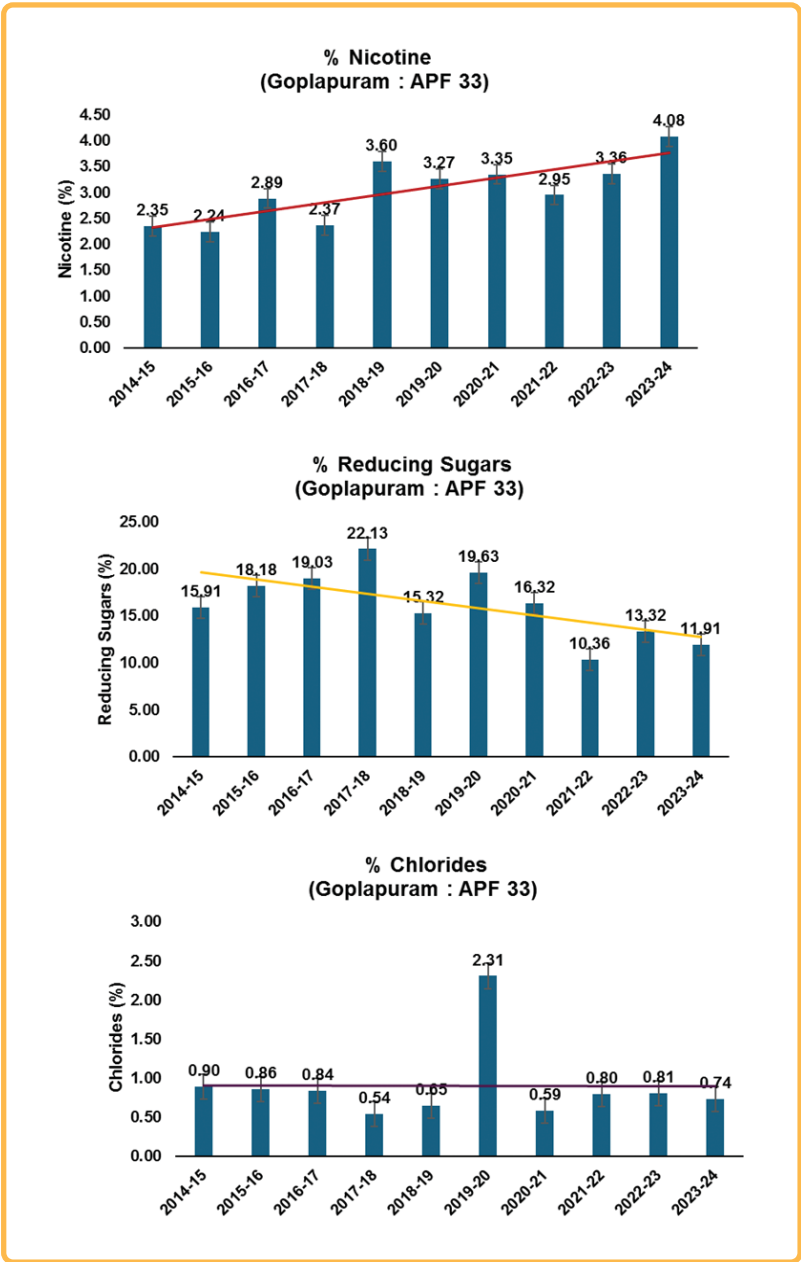


Fig.5: Decadal trend of Nicotine, Reducing sugars and Chlorides in Goplapuram sub-region of Northern Light Soil

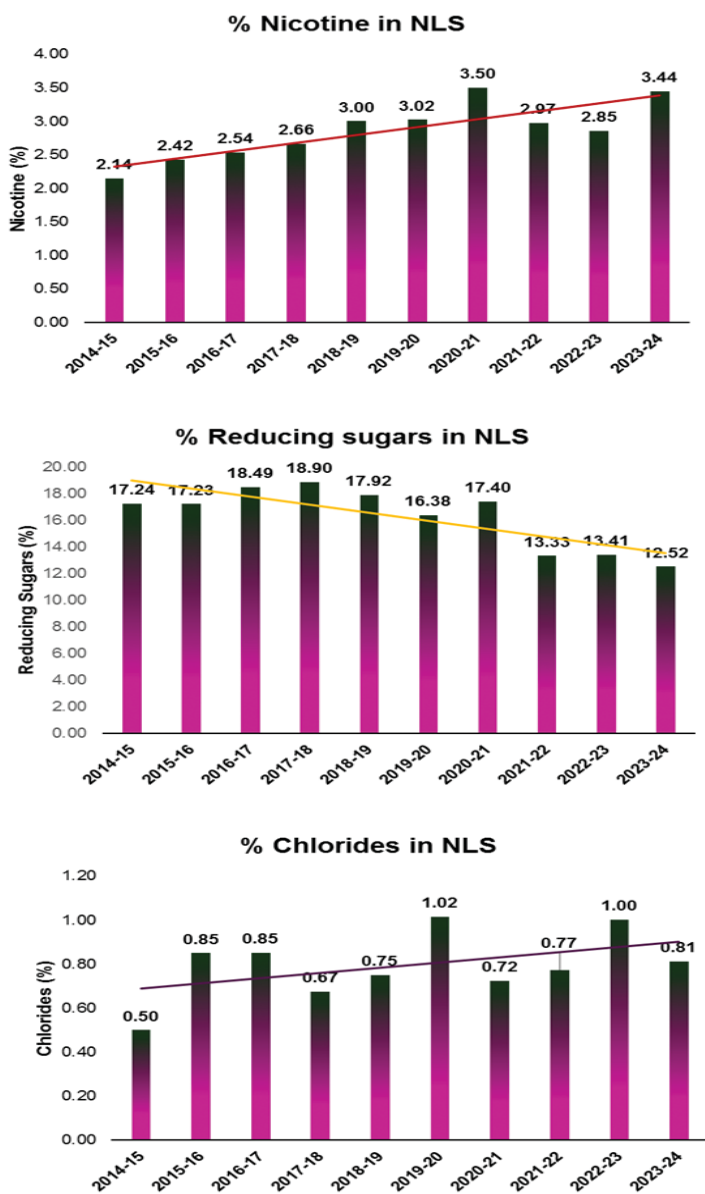


Fig. 6: Decadal trend of Nicotine, Reducing sugars and Chlorides in total Northern Light Soil (NLS) region



## Leaf quality of FCV tobacco in Karnataka Light Soils

The FCV tobacco is grown in ten sub regions based on soil type in KLS zone during Kharif season under rainfed conditions. It is under Southern Transition Agroclimatic zone representing Karnataka Light soils with red, black, alluvial, lateritic and brown forest soils. Southern Transition Zone has a normal drought condition, with a Rainfall Anomaly Index (RAI) of +0.3 to -0.3. This means that the zone is neither wet nor dry. The leaf quality of KLS zone is described sub-region (APFs) wise for better comparison.

### Sub-region wise trend of leaf quality in KLS

**Leaf Nicotine:** The leaf nicotine content of different sub regions of KLS zone varied from 0.51-3.58%, 0.9-3.2%, 0.72-3.46%, 0.91-3.69%, 0.46-3.58%, 0.77-3.75%, 0.56-3.09%, 0.56-3.05%, 0.59-4.09% and 0.42-2.91%, for H D Kote, Hunsur-I, Hunsur-II, Hunsur-III, Periyapatna-I, Periyapatna-II, Periyapatna-III, Ramnathpura-I, Ramnathpura-II and Chilkunda respectively. The mean leaf nicotine content in different sub regions/sub zones were in the order (lowest to highest) of Periyapatna-I (1.45%) < Ramnathpura-I (1.48%) = Chilkunda (1.48 %) < Hunsur I (1.55%) < Ramnathpura-II (1.57%) < H D Kote (1.64%) < Hunsur-III (1.66%) < Periyapatna-III (1.68%) < Periyapatna-II, (1.72%) < Hunsur II (1.83%). The highest nicotine content was detected during the period of 2017-18 in case of H D Kote, Hunsur-III, Periyapatna-III, Ramnathpura-I and Ramnathpura-II sub-regions, whereas during the year of 2016-17 Hunsur-I, Periyapatna-I, Periyapatna-II and in the year of 2018-19 Hunsur-II and Chilkunda got highest nicotine content. The trend of leaf nicotine content is almost stable (Fig. 7 to 16) in HD Kote, Hunsue I, Hunsur II, Kampalapura; declining in, Hunsue III, Periyapatna-I, Periyapatna-II, Periyapatna-III, Ramnathpura-I, Ramnathpura-II, Chilkunda over the period of ten years (2014-2024).

**Leaf reducing sugars:** The reducing sugars in different sub regions viz., H D Kote, Hunsur-I, Hunsur-II, Hunsur-III, Periyapatna-I, Periyapatna-II, Periyapatna-III, Ramnathpura-I, Ramnathpura-II and Chilkunda varied from 10.11-28.5%, 14.99-25.88%, 11.26-25.53%, 13.64-27.54%, 12.53-28.08%, 4.17-26.46%, 5.9-26.9%, 11.73-27.21%, 14-27% and 11.56-28.94%, respectively in KLS zone. At the same time, during the year of

2018-19, 2018-19, 2015-16, 2015-16, 2020-21, 2018-19, 2015-16, 2016-17, 2016-17 and 2018-19 the above mentioned sub-regions recorded highest reducing sugar in tobacco cured leaf. The mean leaf RS content in different sub regions/sub zones were in the order (highest to lowest) of Hunsur-III (21.12 %) >Chilkunda (20.39%) >Ramnathpura-I (20.37 %) Hunsur-I (20.04 %) >Periyapatna-I (20.03 %) >Ramnathapura-II (20.00 %) >H D Kote (19.42 %) >Periyapatna-III (19.07%)> Hunsur II (19.02%) >Periyapatna-II (17.74%). The trend of reducing sugar content is declining in all sub regions of KLS over the decade (Fig. 7 to 16).

**Leaf chlorides:** The chlorides ranged from 0.02 to 2.45% (Mean: 0.52%), 0.05 to 1.39% (Mean: 0.48%), 0.13 to 1.50% (Mean: 0.43), 0.1 to 1.32% (Mean: 0.44%) 0.03 to 2.67% (Mean: 0.57%), 0.03 to 1.81% (Mean: 0.48%), 0.09 to 1.37% (Mean: 0.40%), 0.04 to 2.12% (Mean: 0.50%), 0.06 to 1.78% (Mean: 0.42%) and 0.04 to 2.38% (Mean: 0.49%) in H D Kote, Hunsur-I, Hunsur-II, Hunsur-III, Periyapatna-I, Periyapatna-II, Periyapatna-III, Ramnathpura-I, Ramnathapura-II, and Chilkunda sub-regions respectively in KLS zone. The highest chloride content was observed in recent past (2023-24) in the areas of Hunsur-I, Hunsur-III, Periyapatna-I, Periyapatna-II, Periyapatna-III regions. Similarly, in the areas of H D Kote, Ramnathpura-I regions, highest chloride content exhibited during 2019-20 season. In the area of Hunsur-II, Ramnathapura-II, and Chilkunda sub-regions highest level recorded during 2015-16, 2017-18 and 2017-18 season respectively. The depicted decadal trend of leaf chloride content is increasing in HD Kote, Periyapatna-I, Periyapatna-II, Periyapatna-III and Chilkunda sub-regions; stable in, Hunsur I, Hunsur III declining in Hunsur II, Ramnathpura-I and Ramnathpura-II sub-regions (Fig 7 to 16).

Overall, the leaf nicotine, reducing sugar and chloride content in whole KLS region varied from 0.42-4.09%, 4.17-28.94% and 0.02-2.67% with an average of 1.58, 19.68 and 0.47% respectively. Moreover, the above mentioned parameters recorded as highest (in total KLS region) during the year of 2017-18, 2024-15 and 2023-24 and lowest in 2023-24. 2023-24 and 2018-19 respectively. The Figure 17 depicts that among all the parameters reducing sugar content (21.64%; during 2014-15)recorded highest in KLS regions in comparison to NLS, SLS and SBS regions. Above all, that trend is declining for nicotine and reducing sugars and increasing for chloride content in KLS over the period of ten years (2014-2024).

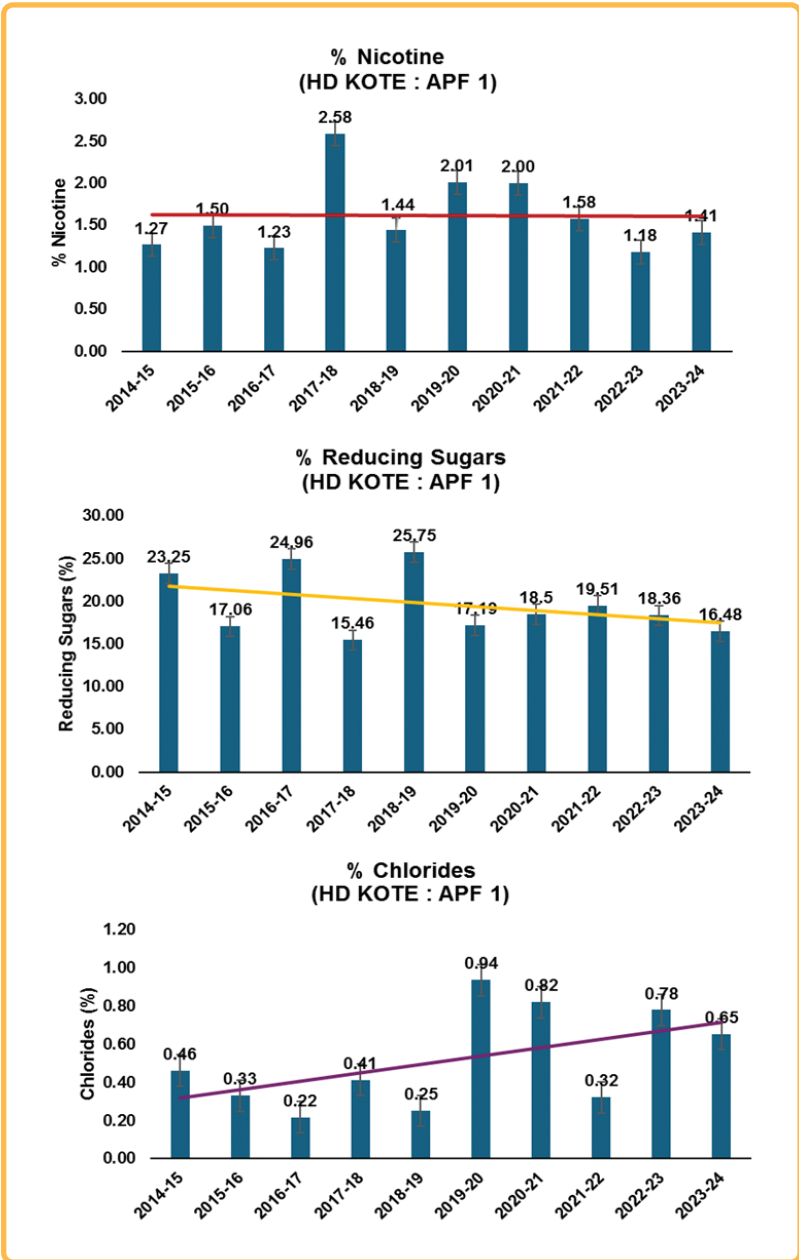


Fig.7: Decadal trend of Nicotine, Reducing sugars and Chlorides in HD Kote sub-region of Karnataka Light Soil

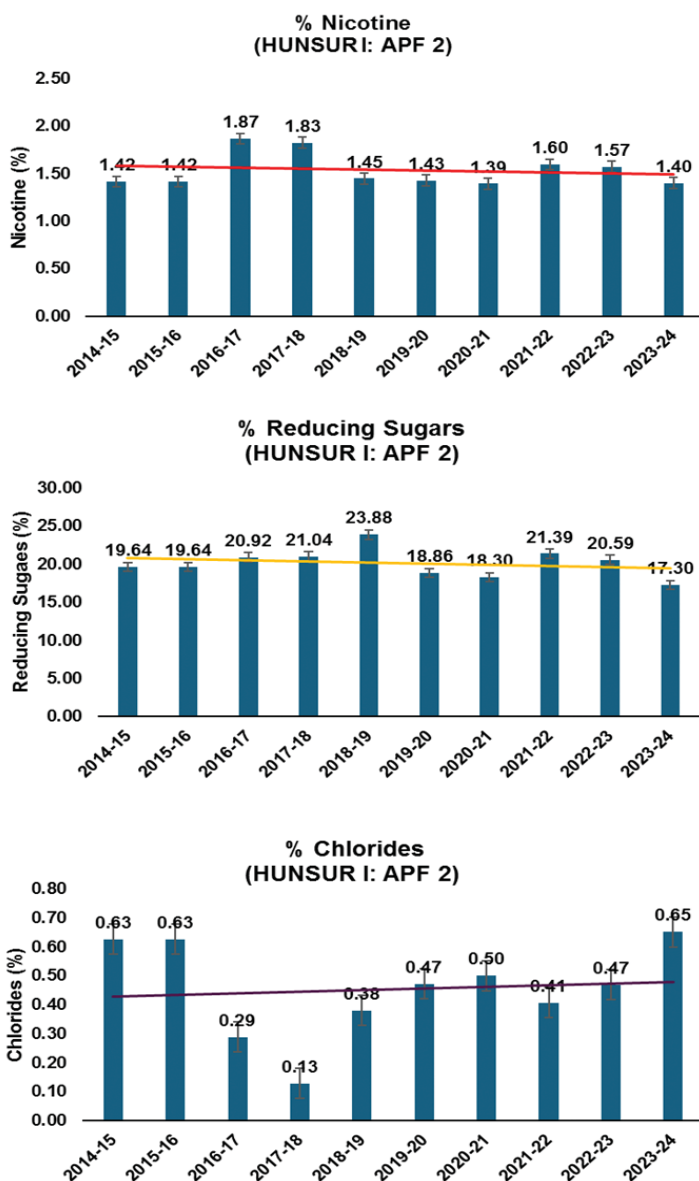


Fig.8: Decadal trend of Nicotine, Reducing sugars and Chlorides in Hunsur-I sub-region of Karnataka Light Soil

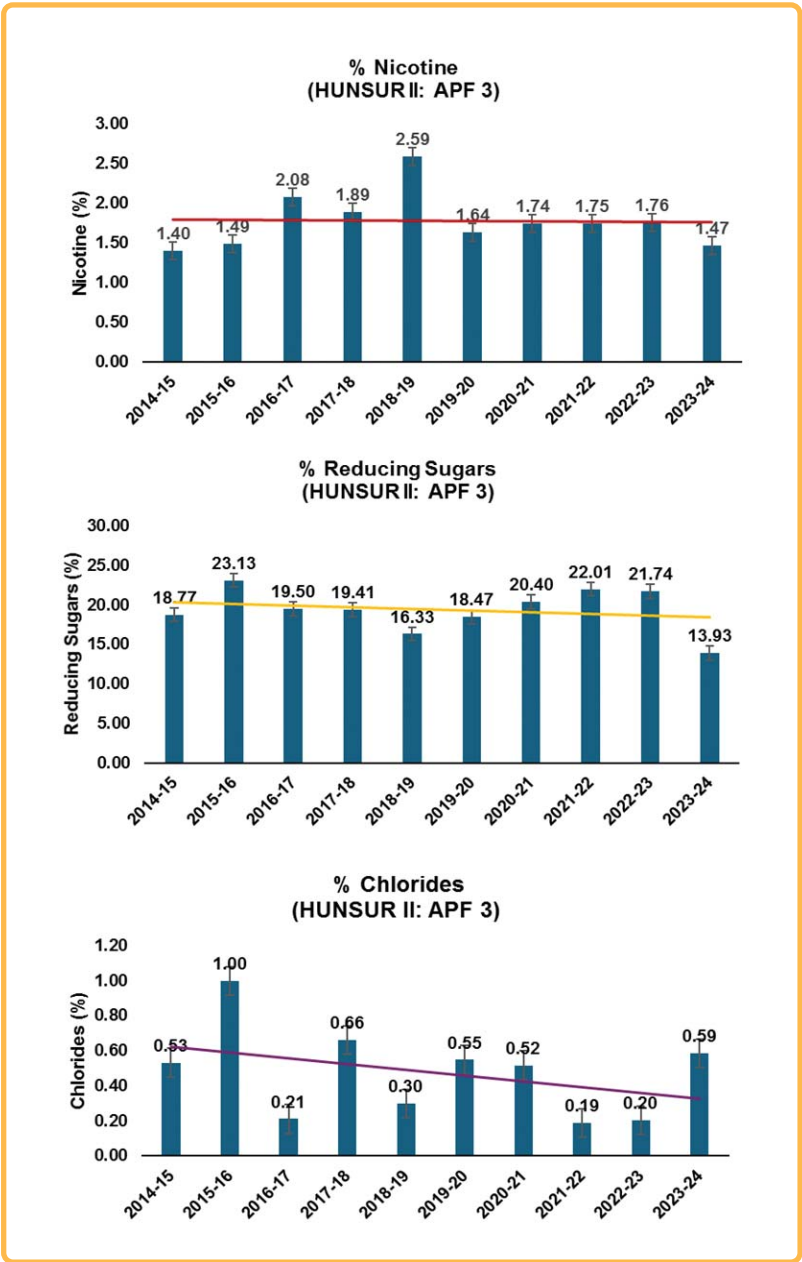


Fig.9: Decadal trend of Nicotine, Reducing sugars and Chlorides in Hunsur-II sub-region of Karnataka Light Soil

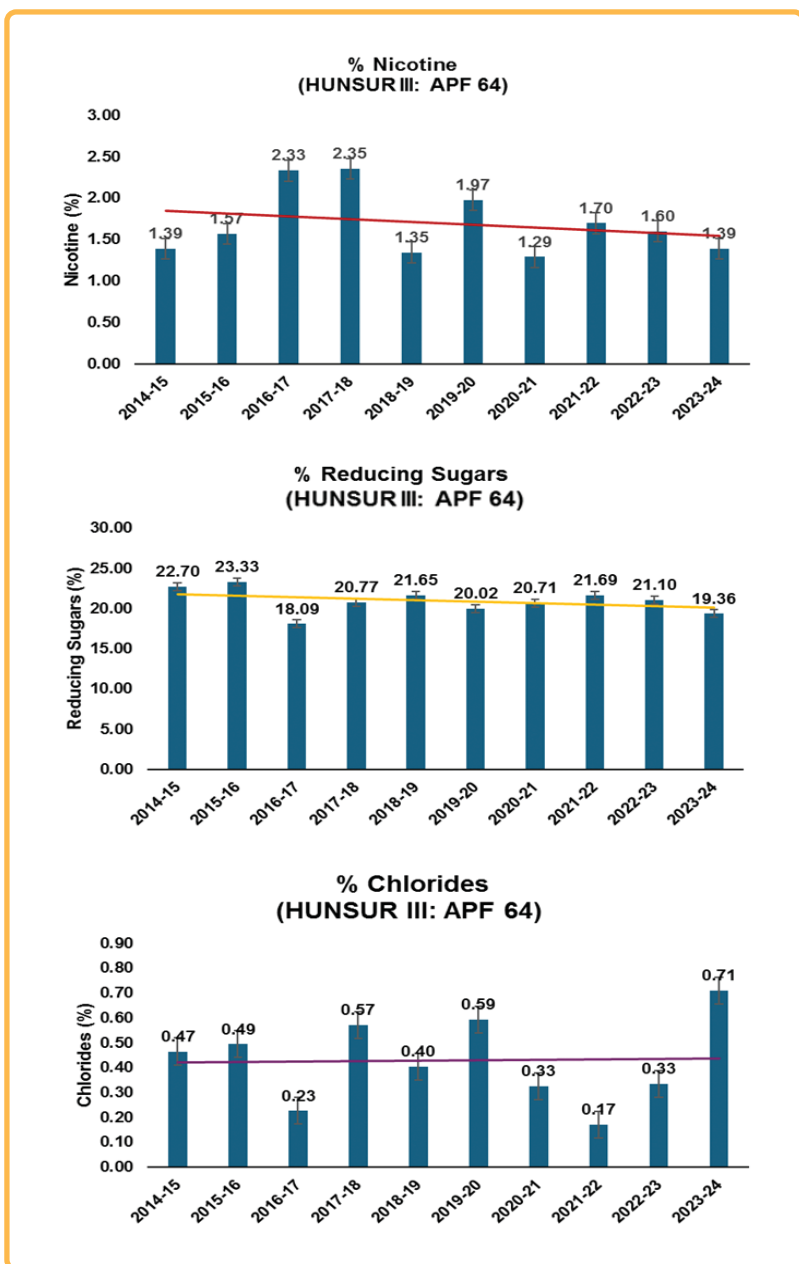


Fig.10: Decadal trend of Nicotine, Reducing sugars and Chlorides in Hunsur-III sub-region of Karnataka Light Soil

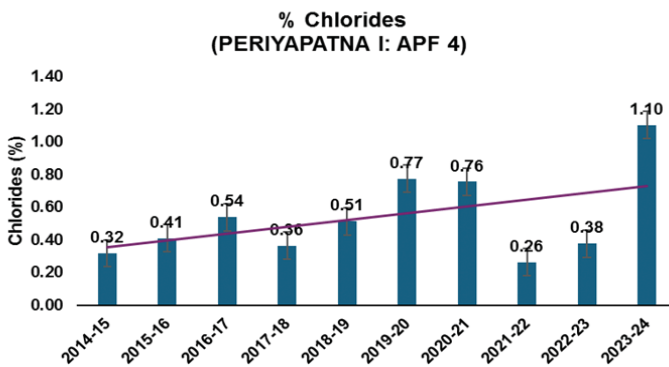
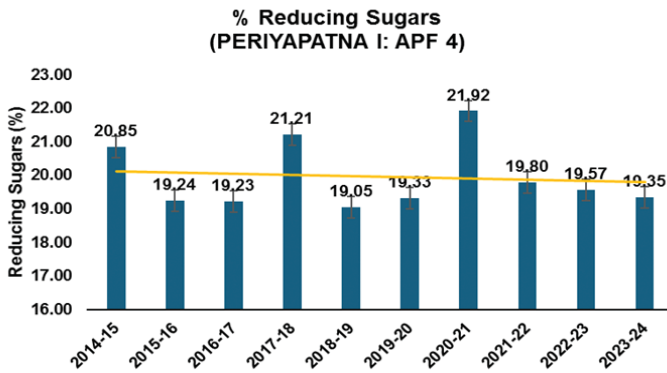
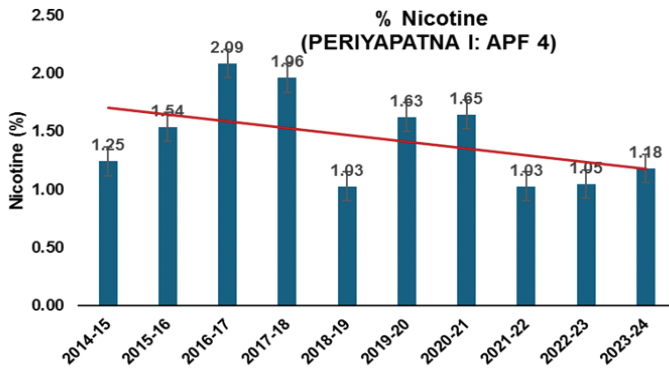


Fig.11:Decadal trend of Nicotine, Reducing sugars and Chlorides in Periyapatna-I sub-region of Karnataka Light Soil

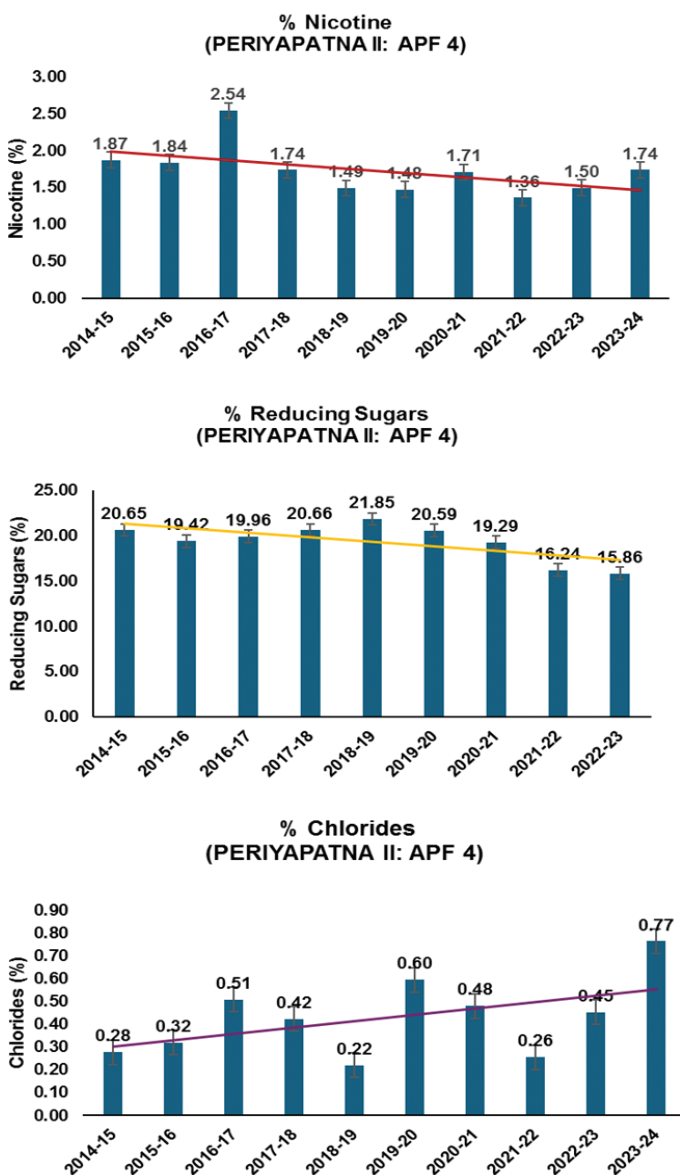


Fig 12: Decadal trend of Nicotine, Reducing sugars and Chlorides in Periyapatna-II sub-region of Karnataka Light Soil



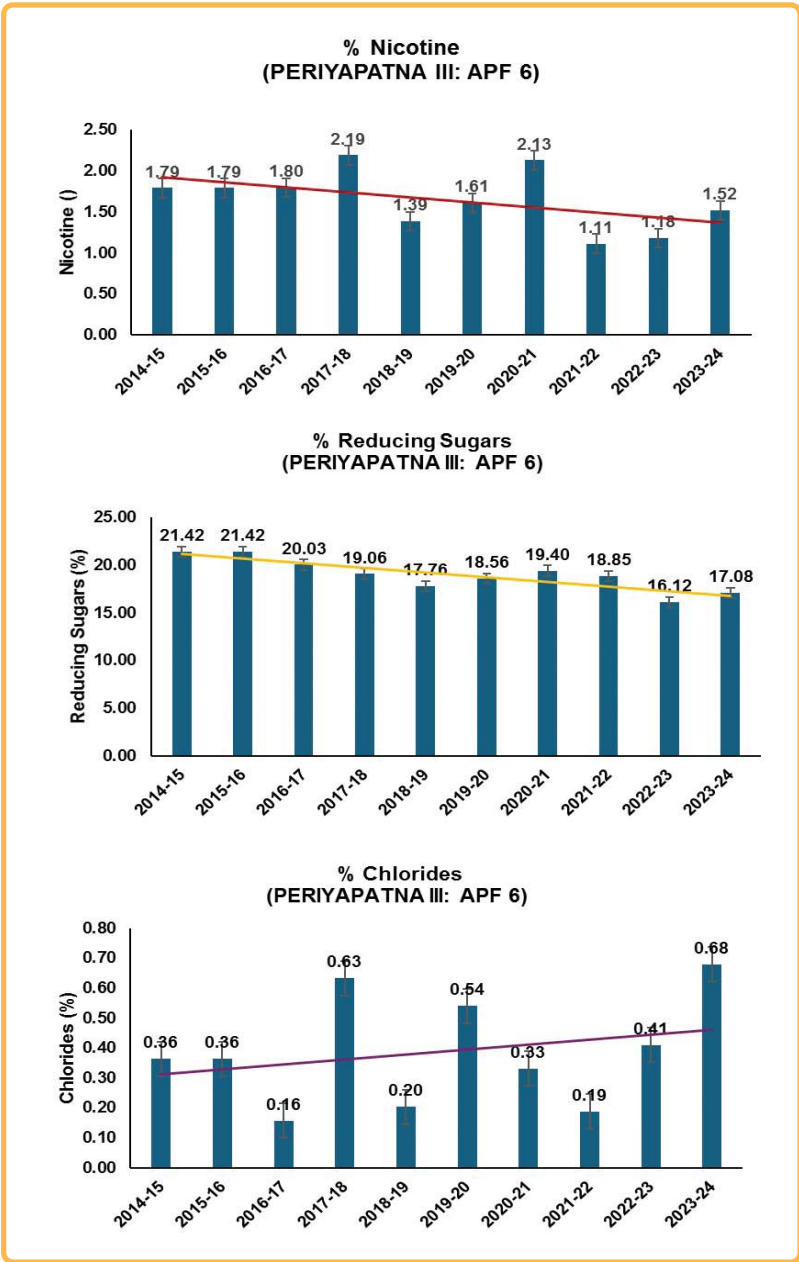


Fig.13:Decadal trend of Nicotine, Reducing sugars and Chlorides in Periyapatna-III sub-region of Karnataka Light Soil

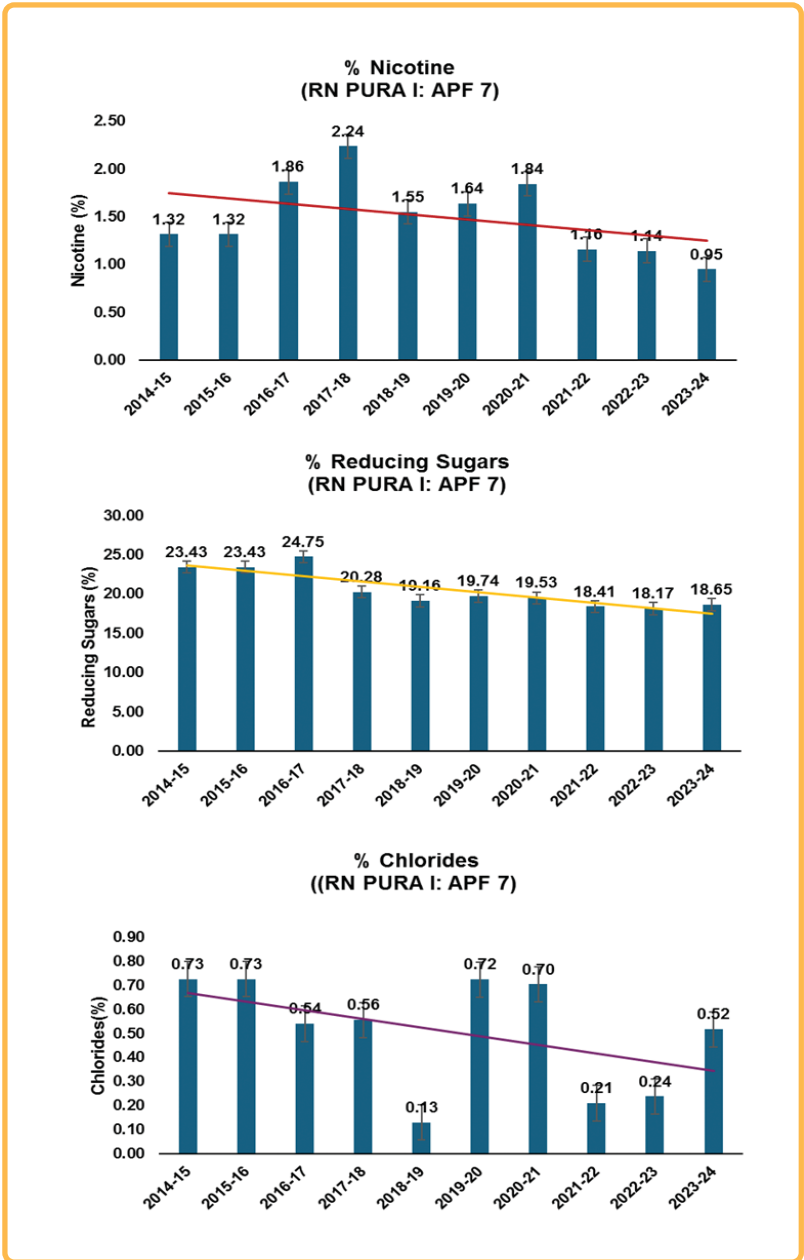


Fig.14: Decadal trend of Nicotine, Reducing sugars and Chlorides in Ramnath Pura-I sub-region of Karnataka Light Soil

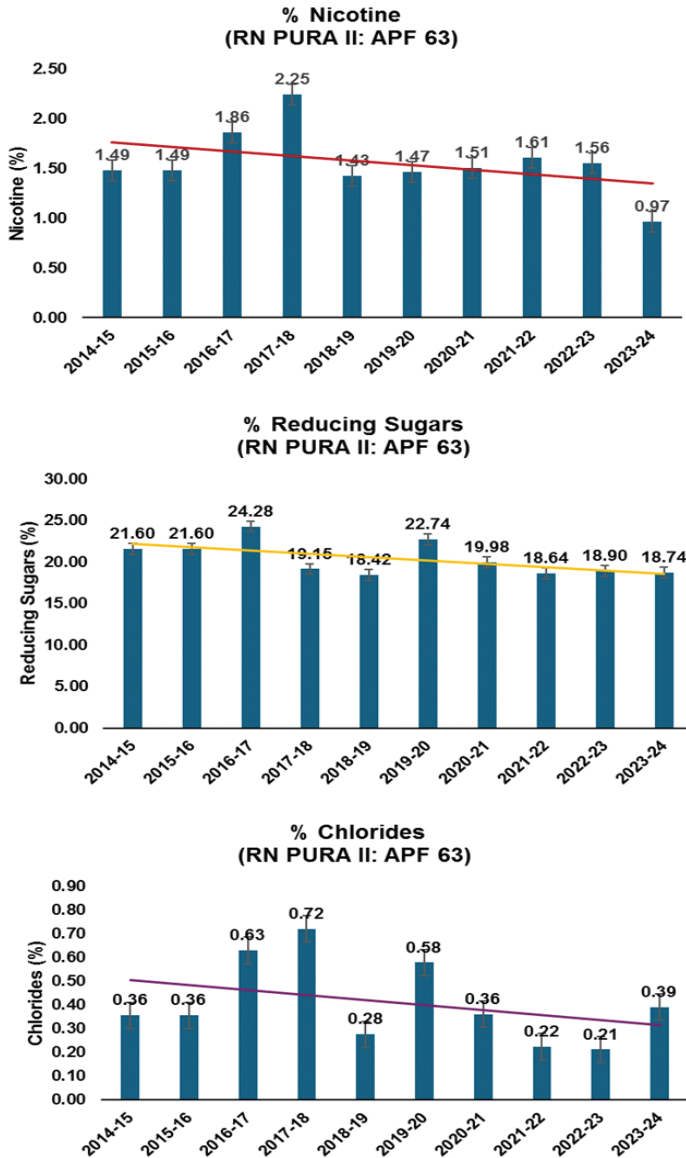


Fig.15: Decadal trend of Nicotine, Reducing sugars and Chlorides in Ramnath Pura-II sub-region of Karnataka Light Soil

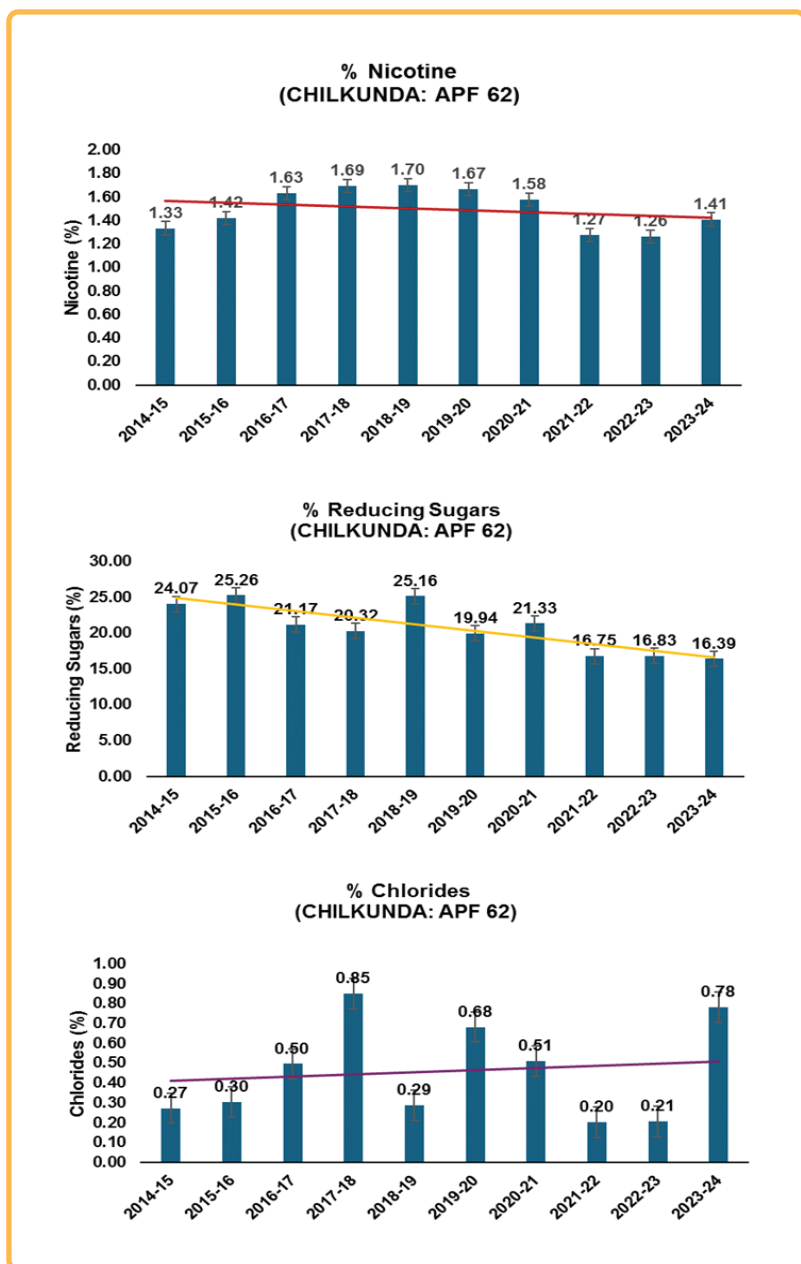


Fig.16: Decadal trend of Nicotine, Reducing sugars and Chlorides in Chilkunda sub-region of Karnataka Light Soil

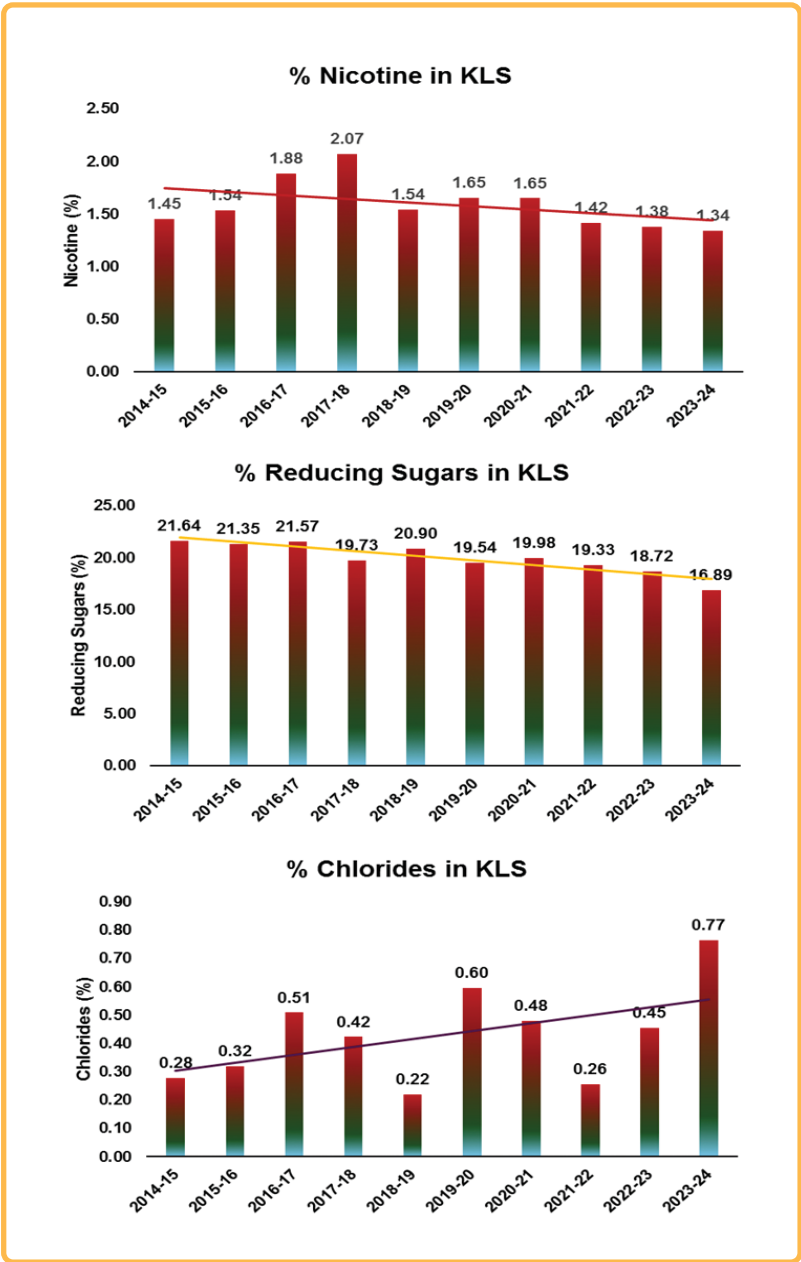


Fig. 17: Decadal trend of Nicotine, Reducing sugars and Chlorides in total Karnataka Light Soil (KLS) region

## Leaf quality of FCV tobacco in Southern Light Soils

The FCV tobacco is grown in six sub-regions i.e Podili, Kandukur I, Kandukur II, Kaligiri, D.C. Palli, and Kanigiri based on soil type in the SLS zone during rabi season under rainfed conditions. It is under Krishna – Godavari agroclimatic zone representing southern light soils region with light textured red soils with poor nitrogen and medium potassium content in the soil. Due to erratic rainfall, crop growth and leaf yield are low compared to irrigated conditions. The rainfed situation dictates the leaf quality. Chemical quality parameters in general are poor compared to other irrigated zones. The trends in leaf quality of the SLS zone over a period of 2014-2024 is described under sub-regions delineated under each auction platform for better comparison.

### Sub-region wise trend of leaf quality in SLS

**Leaf nicotine:** Leaf nicotine content of Southern Light Soils grown FCV tobacco of Podili region varied from 0.86 to 4.93 % with a mean of 2.29 %. The mean nicotine content in the leaf samples of other regions, viz., Kandukur I, Kandukur II, Kaligiri, D.C. Palli, and Kanigiri, were 2.55, 2.36, 2.03, 2.11 and 2.14 %, respectively and the range is varying from 0.93-4.95%, 0.81-4.52%, 0.98-4.15%, 1.10-4.56% and 1.12-4.78% respectively. The highest mean nicotine was found in the Kandukur I, followed by the Kandukur II. The highest nicotine content was observed in the year of 2016-17 for Podili and D.C. Palli, 2018-19, 2018-19 for Kandukur I & II and Kanigiri, 2017-18 for Kaligiri I sub-regions. The trend is gradually declining in the case of Podili, Kandukur I, Kandukur II, D.C. Palli, and Kanigiri region and almost stable in the case of Kaligiri region over the period of ten years (2014-2024; Fig 18 to 23). In general, the nicotine content will be more compared to NLS region as it is mostly grown under rainfed drought situations. The critical irrigation during the drought periods certainly optimises the nicotine content where better and uniform crop growth can be obtained. Application of nitrogen fertiliser in recommended dose and method would optimise the leaf nicotine content.

**Leaf reducing sugars:** The reducing sugars of tobacco leaves in the SLS zone of the Podili region ranged from 2.24 to 22.18 % (mean: 12.59 %). Whereas in other regions, viz., Kandukur I, Kandukur II, Kaligiri, D.C. Palli, and Kanigiri, reducing sugar varies between 1.99-18.85 % (Mean: 11.71 %), 1.03-21.65 % (Mean: 12.33%), 3.61-22.4 % (Mean: 14.14%), 6.59-23.3% (Mean: 13.44%) and 5.44-20.4 % (Mean: 12.80%) respectively. In Podili sub-region highest reducing sugars were detected during 2014-15, whereas, in Kandukur I, Kaligiri, and Kanigiri maximum were observed during the period of 2015-16, 2016-17 and 2021-22 respectively (Fig. 18 to 23). In Kandukur II and D.C. Palli highest reducing sugars were observed in the year of 2020-21. The trend is declining in the case of Podili and Kaligiri, slightly increasing in the case of Kandukur I and stable in the case of Kandukur II, D.C. Palli and Kanigiri region over the period of ten years (2014-2024). Irregular rainfall, drought spells and lack of providing critical irrigations timely leads to lower reducing sugars in these sub-regions. Optimum time of planting will certainly improve the reducing sugars especially in rainfed under the changing climatic scenario.

**Leaf chlorides:** The decadal average of lowest to highest leaf chlorides were in the order of Kandukur I (0.38 %), Kanigiri (0.44%), Kandukur II (0.50%), D.C. Palli (0.52%), Kaligiri (0.57%) and Podili (0.75%). During the season of 2016-17, 2018-19, 2016-17, 2017-18, 2018-19 and 2015-16 the highest leaf chloride was observed of the above mentioned sub-regions. The decadal trend of chloride content is declining across all the sub-regions of SLS (Fig. 18 to 23).

Overall, the leaf nicotine, reducing sugar, and chloride content in the whole SLS region varied from 0.81-4.95%, 2.44-23.33%, and 0.09-0.3.81%, respectively and highest (nicotine: 2.88%; reducing sugars: 15.83%; chlorides: 0.88%) recorded in the year of 2018-19, 2020-21 and 2016-17 whereas, lowest (nicotine: 1.82%; reducing sugars: 9.96%; chlorides: 0.23%) recorded in 2019-20, 2023-24 and 2022-23 respectively. The trend is almost stable for reducing sugars but declining for nicotine and chlorides over the period of ten years (2014-2024) is a better sign mainly due to use of stream water with lesser chlorides during critical irrigation and soils with relatively low chlorides (Fig. 24).

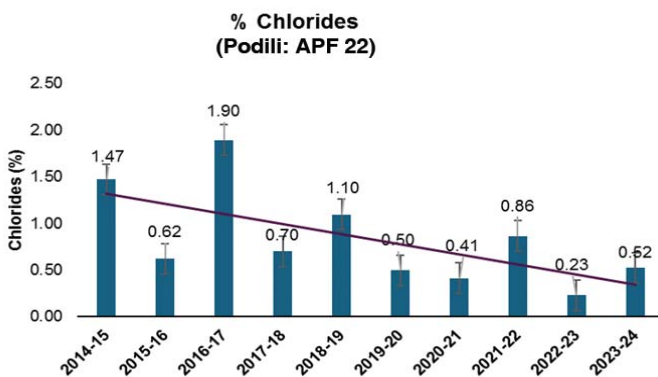
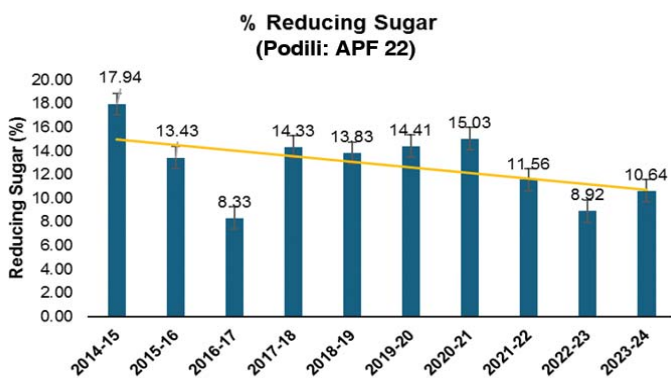
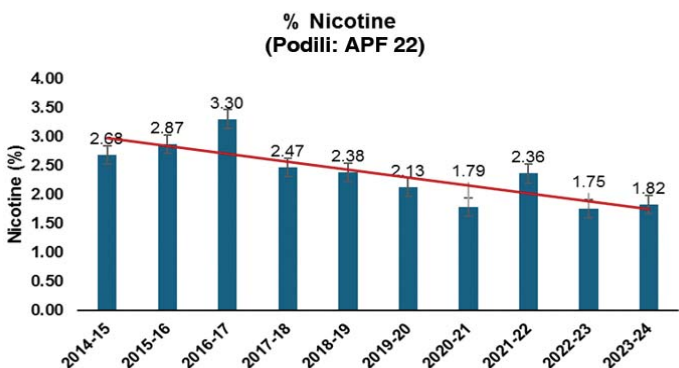


Fig.18: Decadal trend of Nicotine, Reducing sugars and Chlorides in Podili sub-region of Southern Light Soil



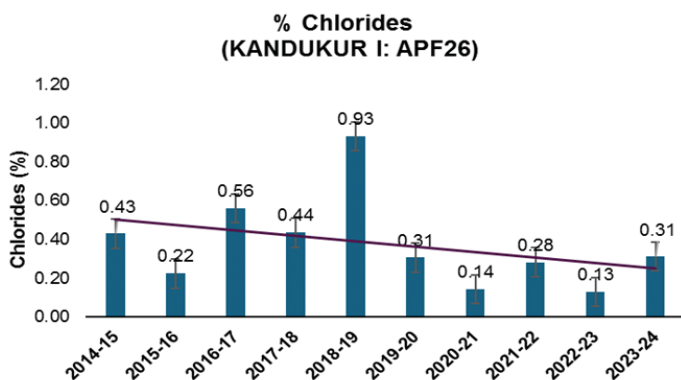
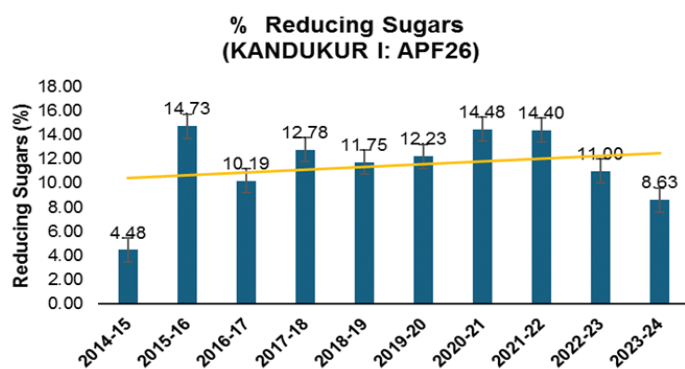
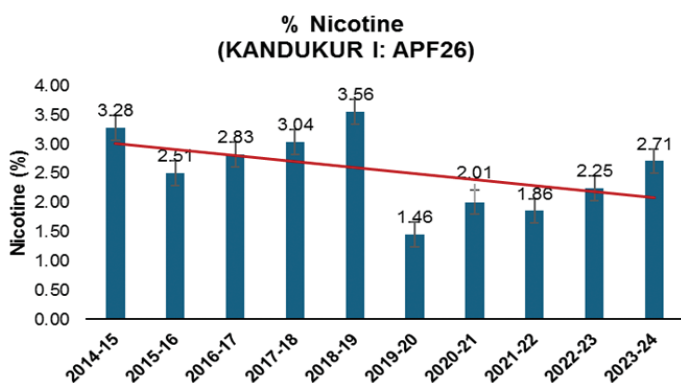


Fig.19:Decadal trend of Nicotine, Reducing sugars and Chlorides in Kandukur-I sub-region of Southern Light Soil

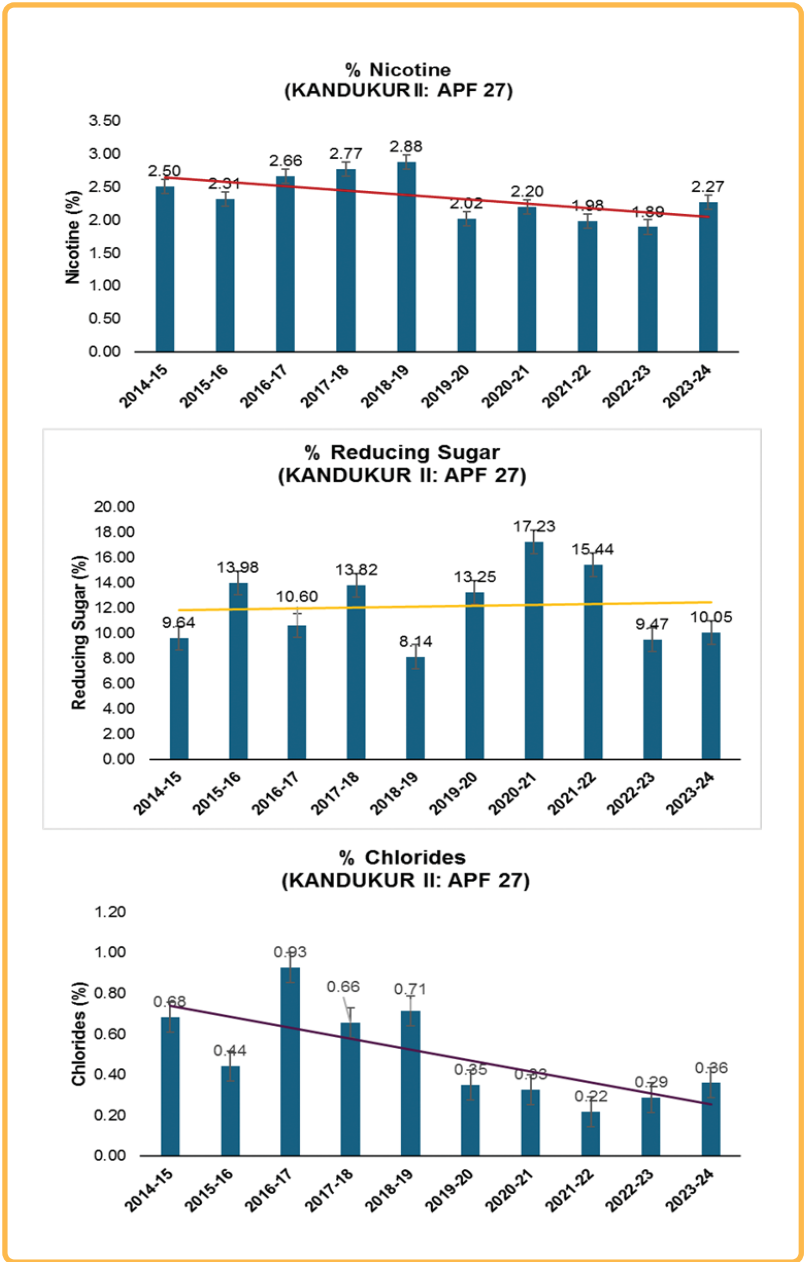


Fig.20: Decadal trend of Nicotine, Reducing sugars and Chlorides in Kandukur-II sub-region of Southern Light Soil

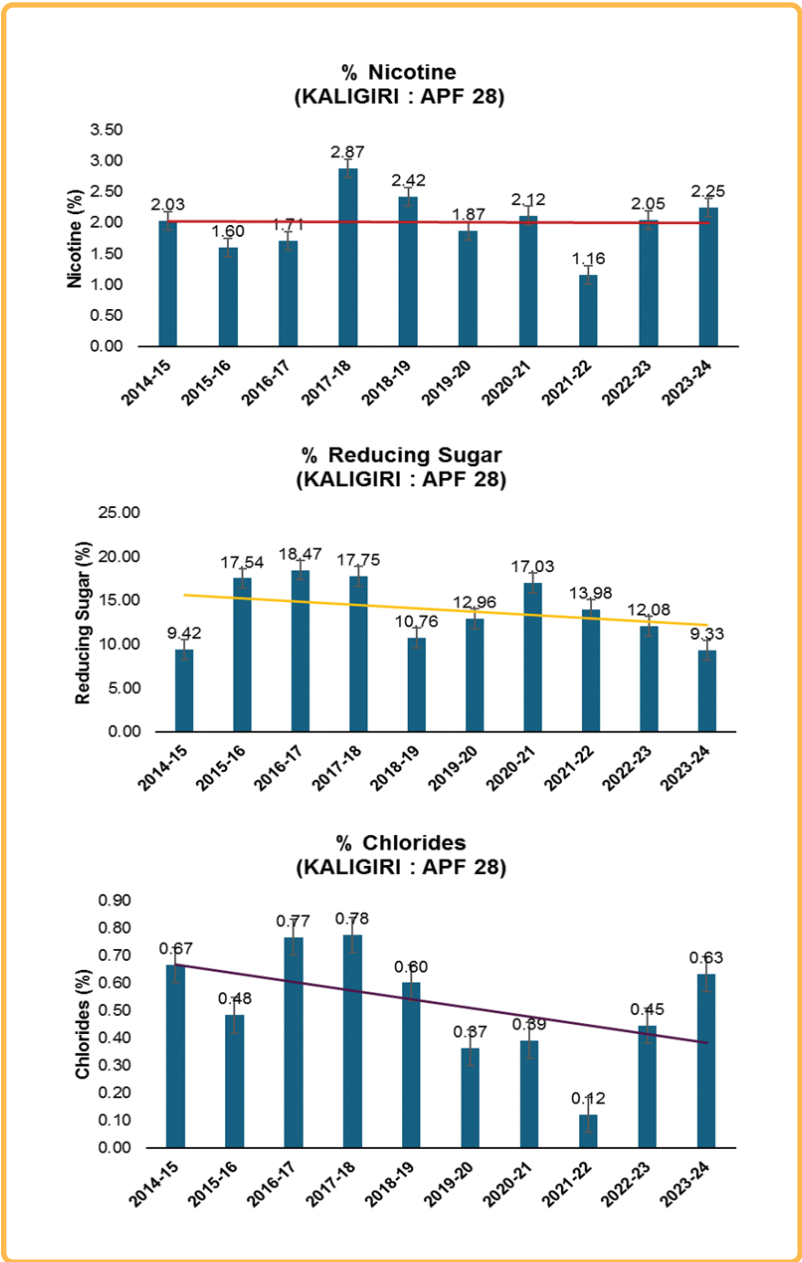


Fig.21: Decadal trend of Nicotine, Reducing sugars and Chlorides in Kaligiri sub-region of Southern Light Soil

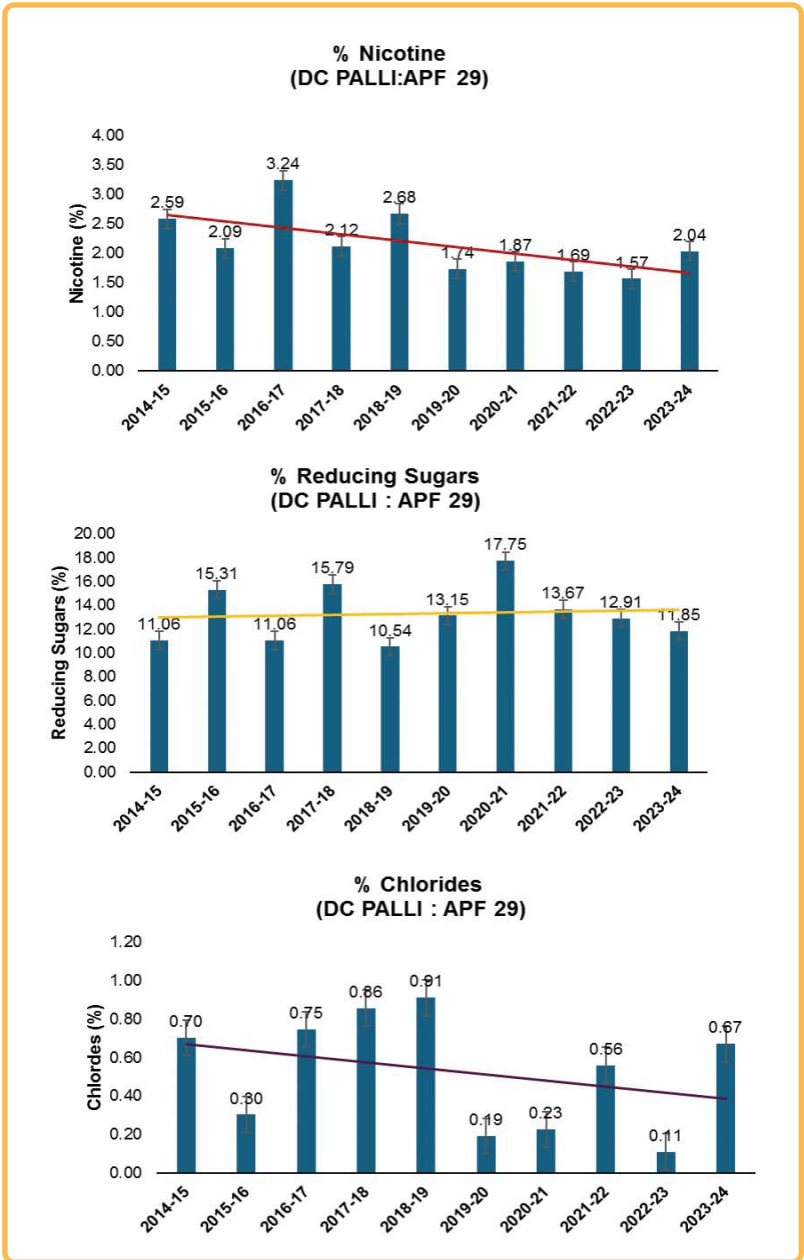


Fig.22: Decadal trend of Nicotine, Reducing sugars and Chlorides in D.C. Palli sub-region of Southern Light Soil

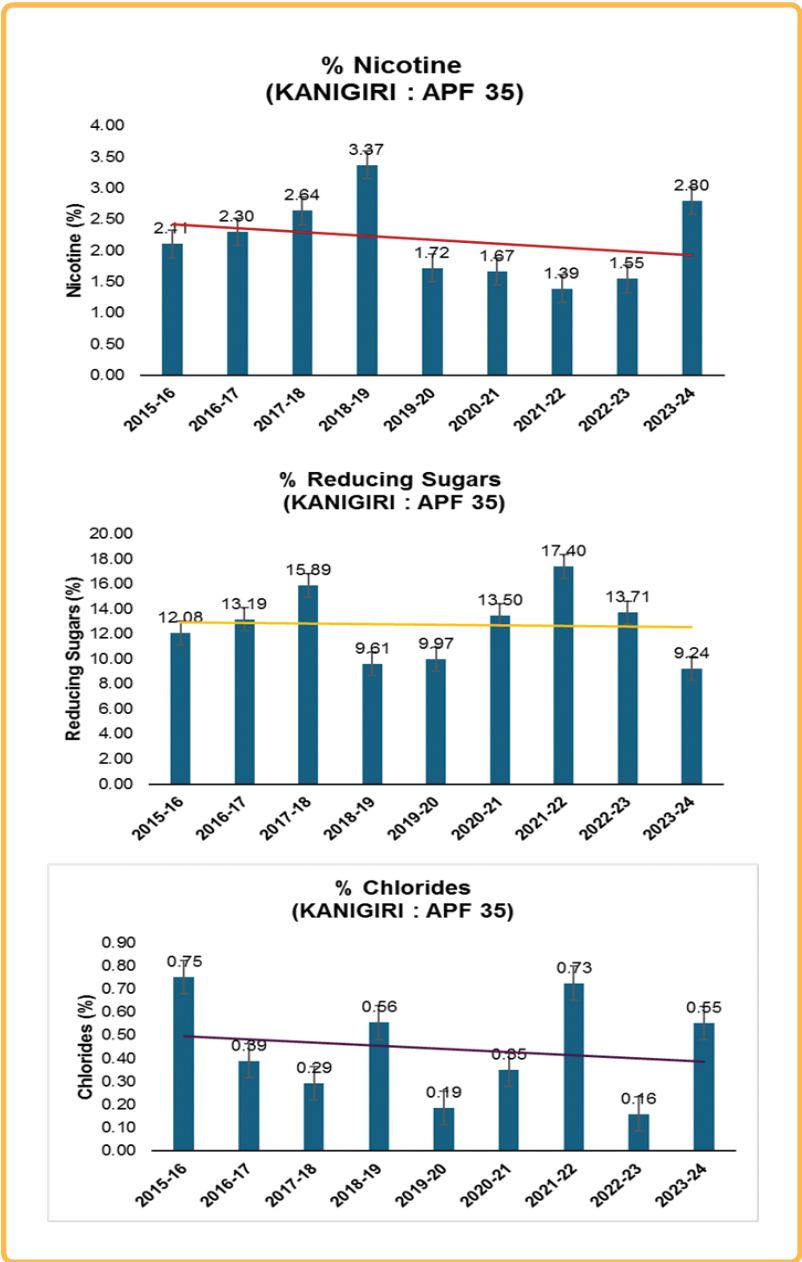


Fig.23: Decadal trend of Nicotine, Reducing sugars and Chlorides in Kanigiri sub-region of Southern Light Soil

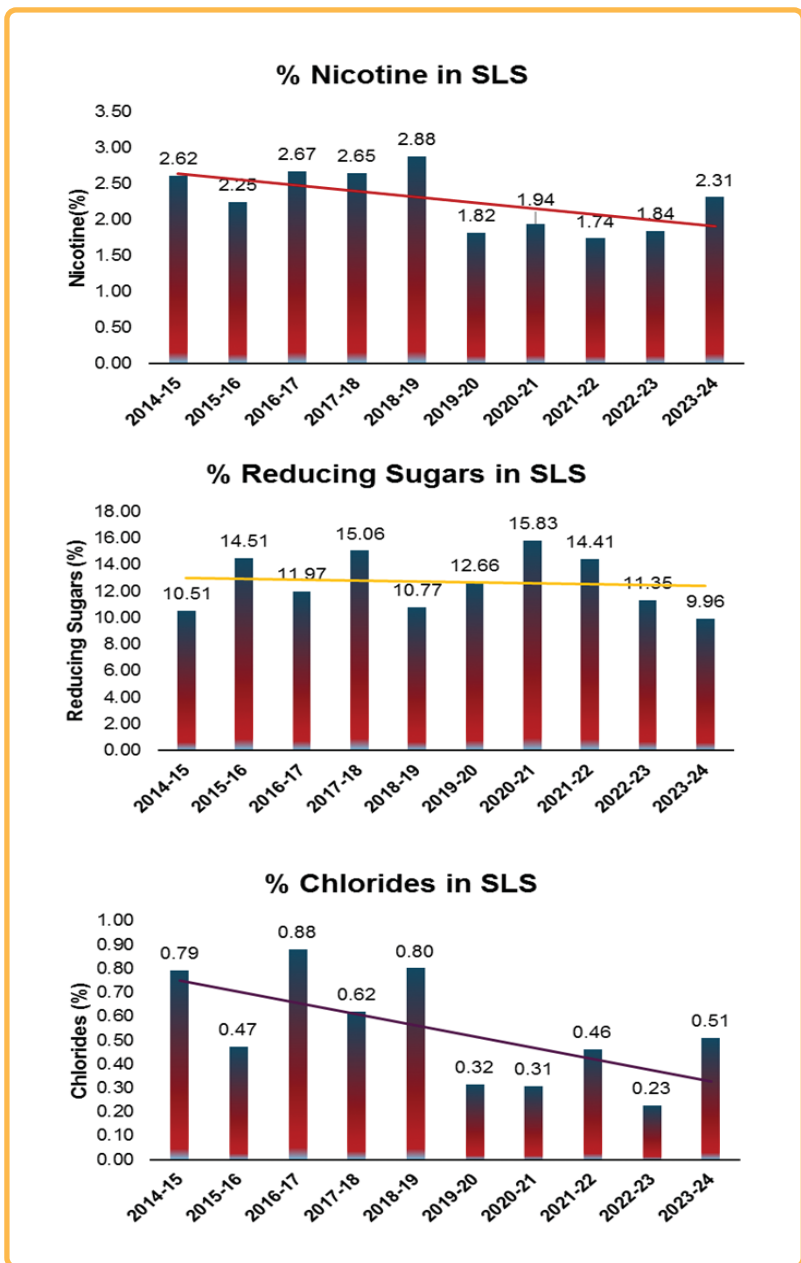


Fig.24: Decadal trend of Nicotine, Reducing sugars and Chlorides in total Southern Light Soil (SLS) region

## Leaf quality of FCV tobacco in Southern Black Soils (SBS)

The FCV tobacco is grown in five sub-regions i.e Ongole I, Ongole II, Tangutur, Kondapi and Vellampalli based on soil type in the SBS zone during *rabi* season under rainfed conditions. The soil in this zone is mostly black soil, followed by mixed soil. The climate has erratic rainfall distribution, and sometimes the crop withstands critical irrigation. The leaf quality of the SBS zone is described in sub-regions (APFs) for better comparison.

### Sub-region wise trend of leaf quality in SBS

**Leaf nicotine:** The leaf nicotine content of Southern Black Soils grown FCV tobacco of Ongole I sub-region varied from 1.37 to 3.79 % with a mean of 2.32 %. The variation of nicotine content in other sub regions, viz., Ongole II, Tangutur, Kondapi and Vellampalli, is 1.23-5.30% (Mean: 2.73%), 1.24 - 4.83 % (Mean: 2.78 %), 0.85-5.54% (Mean: 2.42%) and 1.13-4.48% (Mean: 2.63%) respectively. The highest nicotine content were observed in Ongole I and Vellampalli sub-regions during the period of 2016-17, whereas in Ongole II, Tangutur and Kondapi sub-regions, highest were recorded during the year of 2018-19 (Fig. 25 to 29). The decadal trend of nicotine content is declining in all sub-regions. Reduction in nicotine content is a better sign in rainfed black soils showing no excess nitrogen is used during the cultivation.

**Leaf reducing sugars:** The leaf-reducing sugar content of the Ongole I sub-region varied from 3.64 to 20.60 percent with an average of 11.99%. The mean RS content in different sub-regions of SBS was in the order (highest to lowest) of Ongole-I (11.99 %) >Kondapi (11.96) >Ongole-II (11.70 %) >Tangutur (11.62 %) >Vellampalli (11.45%). During the period of 2020-21, highest reducing sugars were recorded in case of Ongole I, Ongole II, Vellampalli sub-regions and whereas, in Tangutur, Kondapi sub-regions highest was recorded during 2017-18. The trend is stable in the case of Ongole-I, increasing in the case of Ongole-II, Tangutur and Vellampalli, and declining in the case of Kondapi, sub-region over

the period of ten years (2014-2024; Fig 25 to 29). To improve the declining trend of RS in Kondepi, and Vellampalli and to improve in other APF regions maintaining optimum time of planting and avoiding application of excess nitrogen and fallow recommended method of N application is required to follow.

**Leaf chlorides:** The leaf chloride content in Ongole I region varied from 0.08 to 3.02 with a mean of 0.72 %. The mean chloride content in different sub-regions of SBS was in the order (lowest to highest) of Kondepi (0.53 %) <Ongole-I (0.72 %) <Tangutur (0.76 %), <Vellampalli (0.89 %) <Ongole-II (0.98 %). The peak chloride content was recorded in all sub-regions during the period of 2018-19 except in Kondapi (2014-15) and Vellampalli (2017-18). The decadal trend of chloride content is declining in all sub-regions (Fig 25 to 29). Decrease in chlorides is due to optimum time of planting and cultivating on the soils with low chlorides. Growing FCV tobacco in low lying areas certainly increase the chloride content in the lea, hence, such areas should be avoided.

Overall, the leaf nicotine, reducing sugar, and chloride content in the whole SBS region varied from 0.85-5.54 %, 1.40-23.66 %, and 0.08-3.14 %, respectively, with a mean value of 2.58, 11.74, and 0.77 respectively. Highest nicotine (3.47%), reducing sugars (16.16%) and chloride (1.38%) content was recorded during the year of 2018-19, 2017-18 and 2018-19 respectively, whereas, lowest were recorded during the year of 2022-23, 2016-17 and 2019-20 respectively (Fig. 30). The trend is almost stable for reducing sugars but declining for nicotine and chlorides over the period of ten years (2014-2024). Declining in chloride content in the leaf is better sign. Lower leaf nicotine needs to be monitored and as per the requirement of trade. However, use of high nitrogen than recommended dose would reduce the content of reducing sugars in the cured leaf.



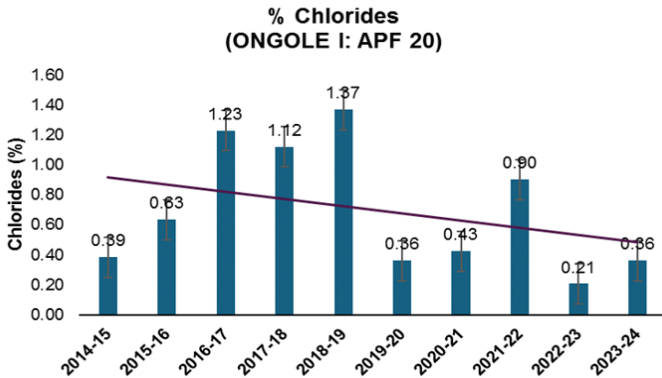
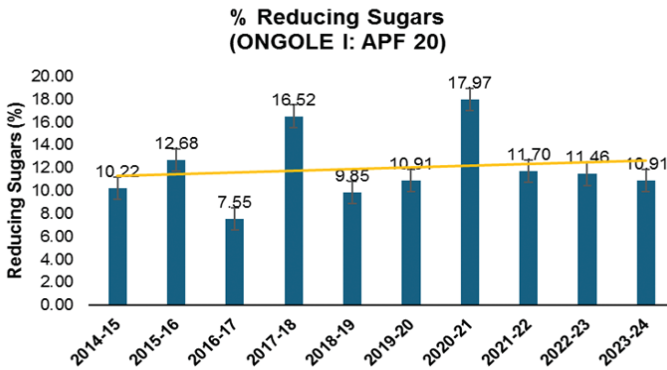
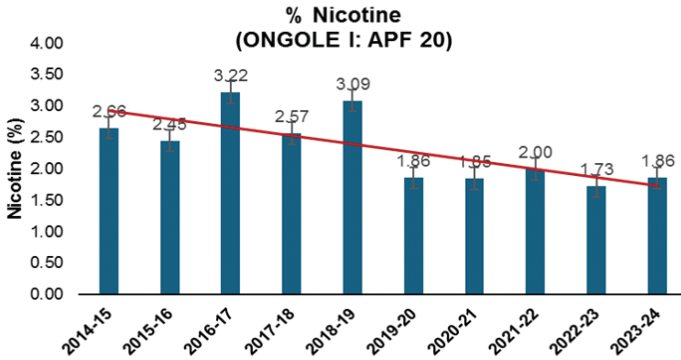


Fig.25:Decadal trend of Nicotine, Reducing sugars and Chlorides in Ongole-I sub-region of Southern Black Soil

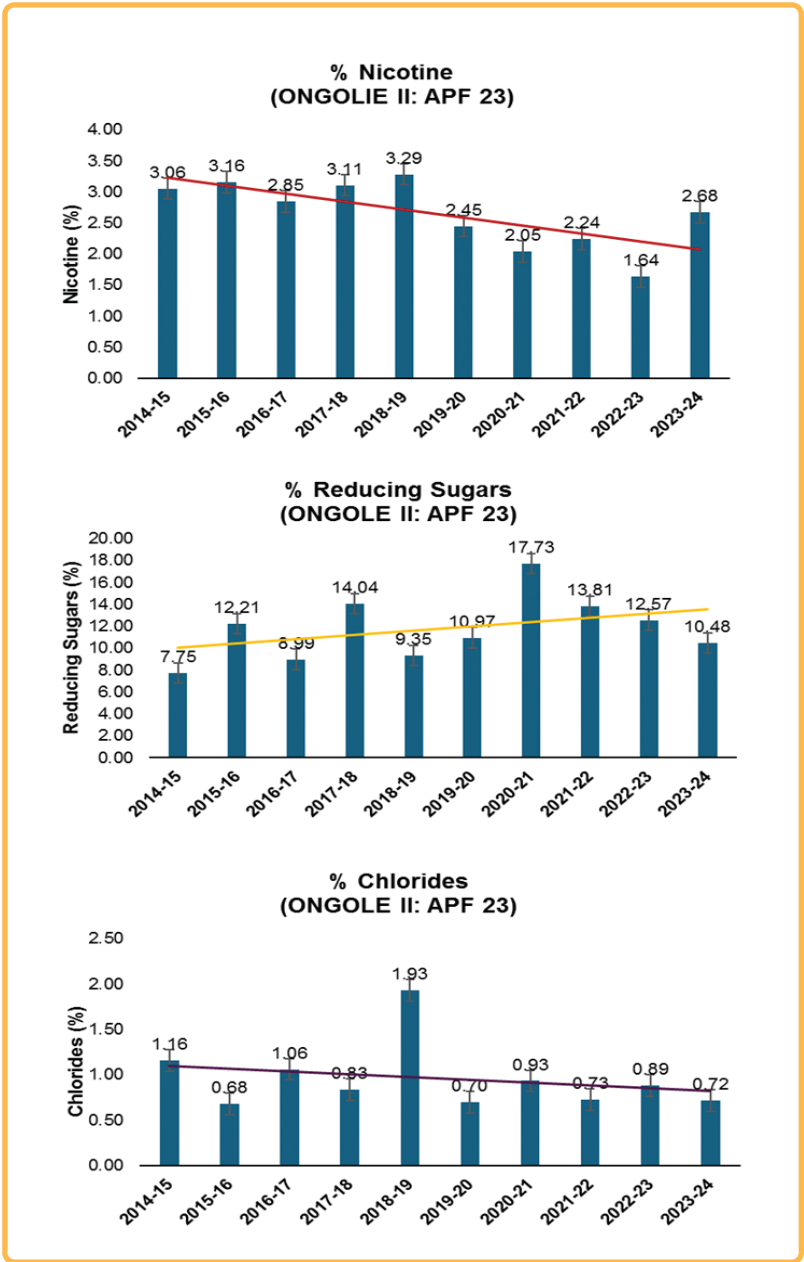


Fig.26: Decadal trend of Nicotine, Reducing sugars and Chlorides in Ongole-II sub-region of Southern Black Soil

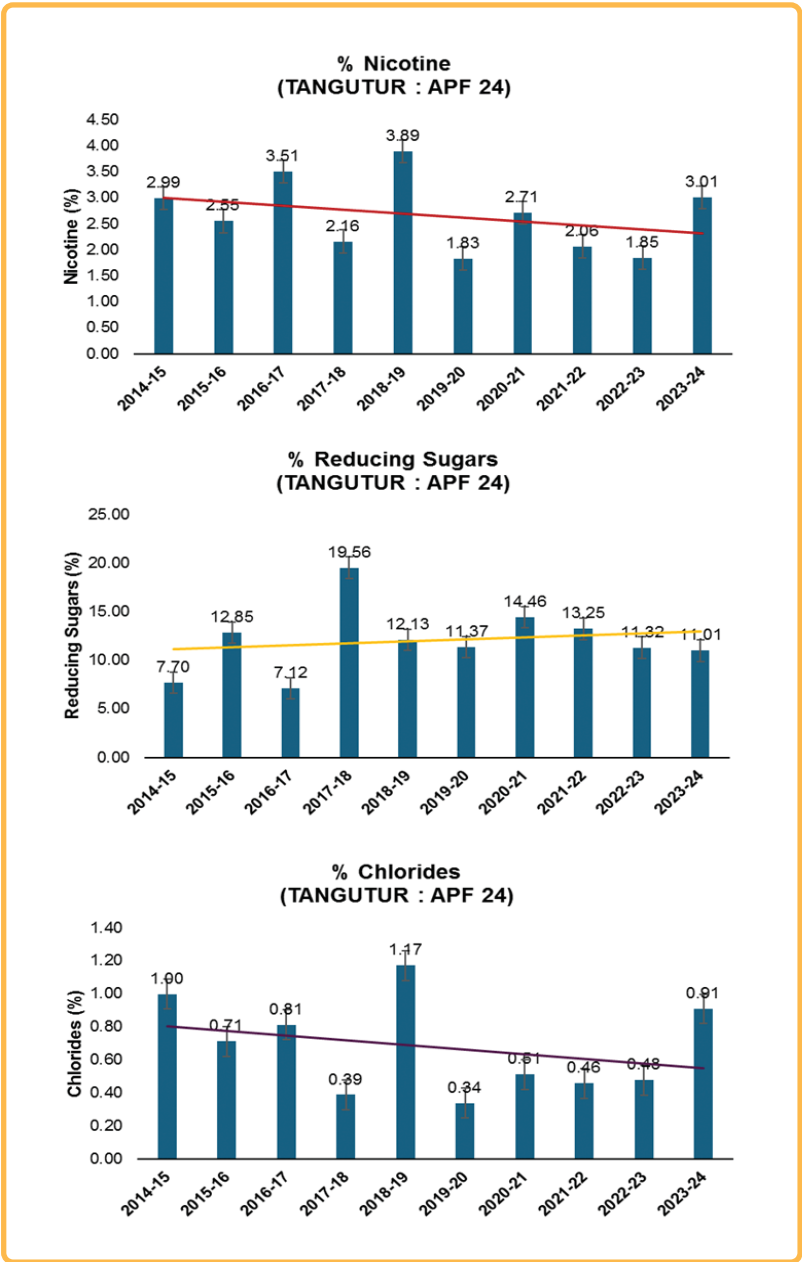


Fig 27: Decadal trend of Nicotine, Reducing sugars and Chlorides in Tangutur sub-region of Southern Black Soil

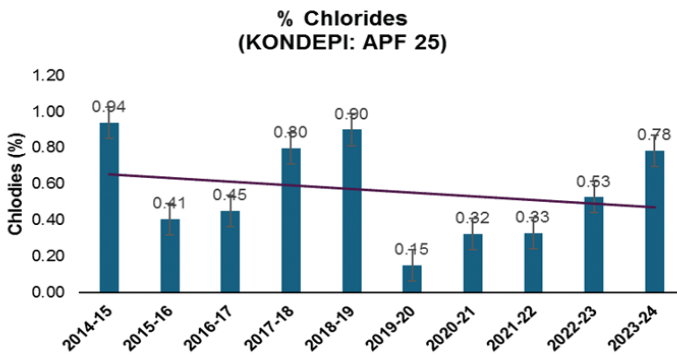
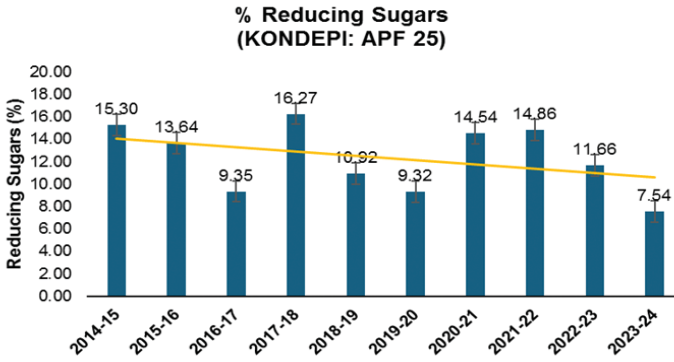
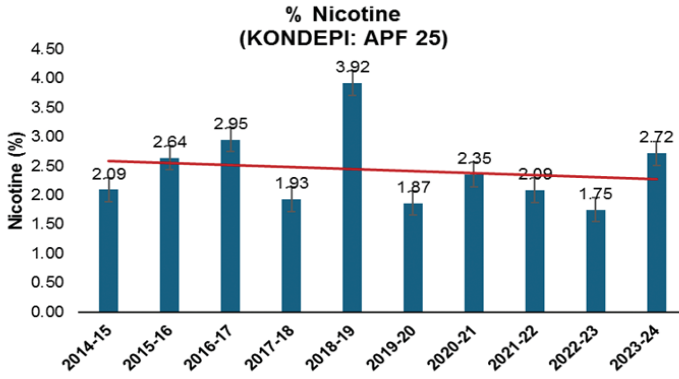


Fig.28: Decadal trend of Nicotine, Reducing sugars and Chlorides in Kondepi sub-region of Southern Black Soil

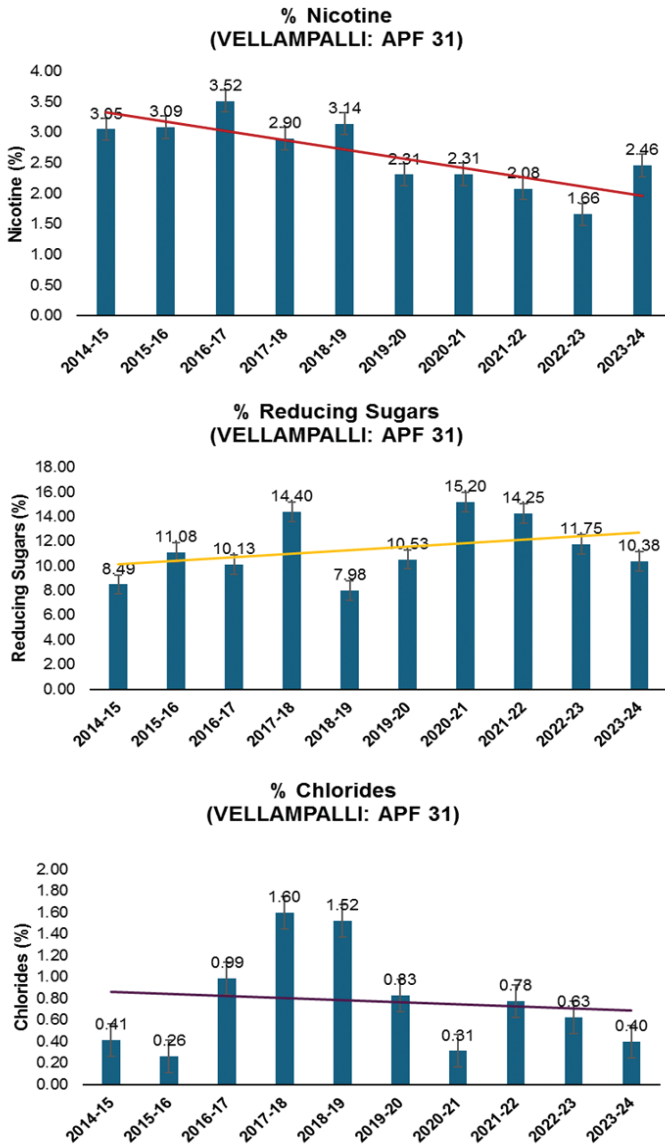


Fig.29:Decadal trend of Nicotine, Reducing sugars and Chlorides in Vellampalli sub-region of Southern Black Soil

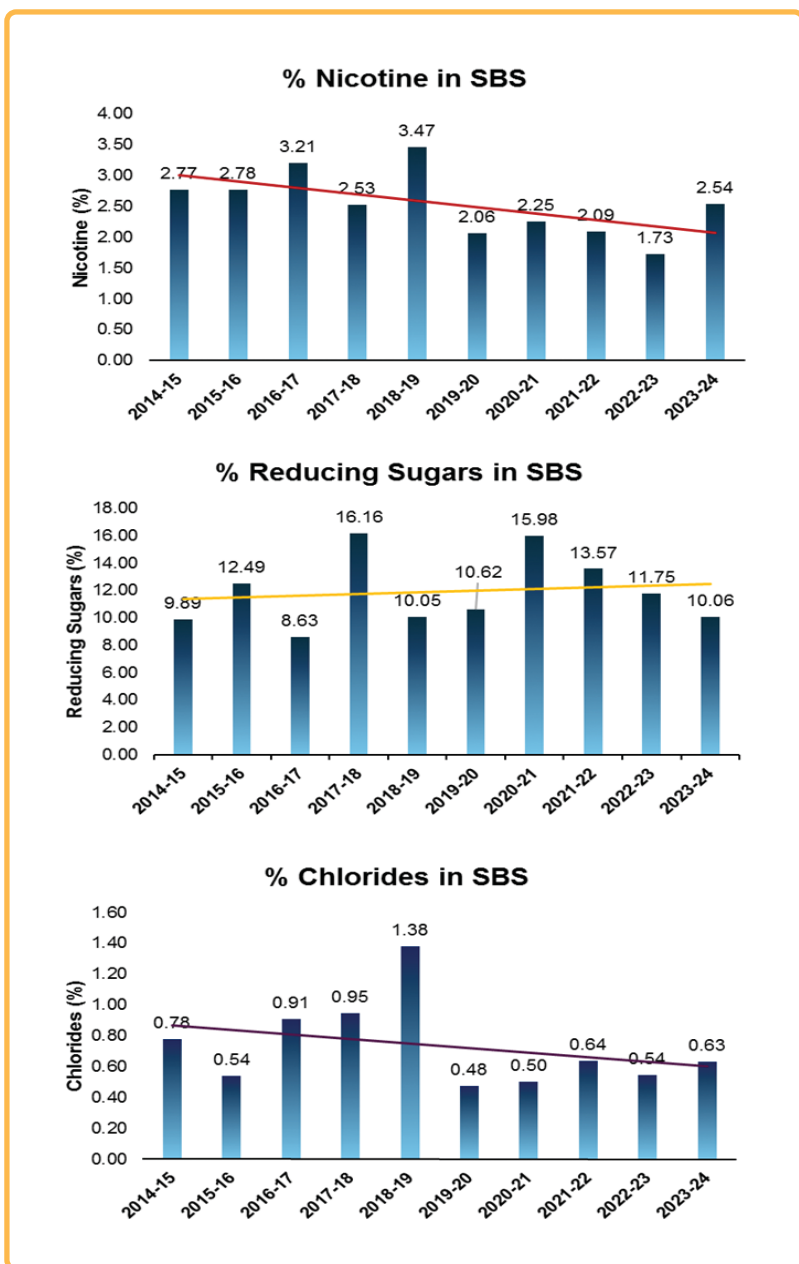


Fig.30: Decadal trend of Nicotine, Reducing sugars and Chlorides in total Southern Black Soil (SBS) region

## Conclusions

### Northern Light Soils (NLS)

In the NLS region the trend of leaf nicotine content has gradually increased in all the auction platform areas (sub-regions) over the last ten years (2014-2024). Because of introduction of high-yield potential varieties/hybrids led to the application of more fertilizer nitrogen increased leaf nicotine content even under irrigated crops. While the trend of reducing sugar content is decreasing in all the sub-regions.

It is due to the more fertilizer nitrogen leading to high vegetative growth and improper conversion of starch to sugars during the curing process causes a decrease in reducing sugars.

Application of excess nitrogen especially in irrigated conditions to improve the reducing sugars. Gradual increase in the leaf chlorides due to heavy irrigation and movement of salts to the upper layers due to low water table is influencing the uptake of chlorides. Hence, provide only recommended number of irrigation and fertiliser dosage.

### Karnataka Light Soils (KLS)

Stable leaf nicotine content was observed in KLS region, and it indicates that the N uptake was optimum, and the recommended fertilizer N is less in rainfed compared to irrigated conditions. While in the other sub-regions (Hunsur II, Periyapatna-I, Periyapatna-II, Periyapatna-III, Ramnathpura-I, Ramnathpura-II, and Chilkunda) decline in the leaf nicotine content is not high and it is within the acceptable range. The trend of reducing sugar content has been declining in all sub-regions of KLS over the decade. However, reducing sugars in all the subregions under acceptable limits for Karnataka Tobacco. The little decline in the reducing sugars may be attributed to seasonal variations in rainfall and non-uniformity in crop growth.

The decadal trend of leaf chloride content is increasing in HD Kote, Periyapatna-I, Periyapatna-II, Periyapatna-III and Chilkunda while stable or declining in other sub-regions. Gradual buildup of chlorides in the upper layers of the soil and root zone due to improper wet and spells of rainfall. However, in overall KLS region the trend is almost stable for all parameters (nicotine and reducing sugars and chlorides) over the period of ten years (2014-2024) and well within acceptable limits.

### **Southern Light Soils (SLS)**

In general, the nicotine content will be more in SLS region compared to NLS as it is grown under rainfed situations. Application of life saving irrigation during the drought periods will optimises the nicotine content. Application of nitrogen fertiliser in recommended dose and method would also optimise the leaf nicotine content. Declining in reducing sugars may be mitigated by following optimum time of planting especially in rainfed under the changing climatic scenario. The trend is almost stable for reducing sugars but declining for nicotine and chlorides over the period of ten years (2014-2024) is a better sign mainly due to use of stream water with lesser chlorides during critical irrigation and soils with relatively low chlorides. The decadal trend of chloride content is declining across all the regions of SLS.

### **Southern Black Soils (SBS)**

In this rainfed black soils region the decadal trend of nicotine content is declining in case of all sub regions. The highest nicotine content was observed in Ongole I and Vellampalli sub-regions during the period of 2016-17, whereas in Ongole II, Tangutur and Kondapi sub-regions, highest were recorded during the year of 2018-19. Reduction in nicotine content is a better sign indicating that no excess nitrogen is being applied by the farmers during the cultivation. While in case of reducing sugars declining trend in Kondapi, and Vellampalli was observed. To improve the content of reducing sugars in cured leaf it is suggested to follow optimum time of planting and not to apply excess nitrogen and fallow recommended method of N application.







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