INDIAN TOBACCO LITERATURE
1984

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JANUARY - 1988
CENTRAL TOBACCO RESEARCH INSTITUTE
(INDIAN COUNCIL OF AGRICULTURAL RESEARCH)
RAJAHMUNDRY-533105, INDIA
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The Indian Tobacco Literature, published during 1900 to 1983 in India and Abroad was compiled and published in 1986. This bibliography contains the literature published during 1984.

We are grateful to Dr. M.S. Chari, Director, Central Tobacco Research Institute, Rajahmundry, for kindly permitting us to publish this bibliography. We are also thankful to Mrs V. Bhagya Lakshmi for her help in bringing out this bibliography.

RAJAHMUNDARY-533105
INDIA

Y. V. SURYANARAYANA
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BOOKS & OTHER PUBLICATIONS

1

The book brings out all the recent advances in research in the past two decades reoriented to meet the changing needs of consumers, farmers, and domestic and international market quality requirements. It is a valuable source of information to the scientist, the farmer, the trader and the consumer. The book is divided into ten chapters giving details on Soils & Climate, Genetics, Agronomy, Plant Nutrition, Biochemistry & Technology, Insect Pest and Diseases, Marketing and Production, etc.

2

Investigates the leaf and smoke chemistry with reference to its typical aroma and its carcinogenic potential. Thoroughly examined for essential oil composition, some selected lipid constituents, fatty acids, carbonyls and phenolic substances. Smoke TPM (Total Particulate Matter) was also analysed for the lipid constituents, semivolatiles, non volatiles and hydroxy benzenes. Leaf to smoke transfer rates were computed for the lipid components. The chemical analysis was carried out by employing classical techniques as well as modern instrumentation (GC, GC—MS, HPLC and IR). A total of two hundred and forty four compounds were identified in lanka tobacco leaf and its smoke.
2

3


This consists of 10 maps of different states of India cultivating tobacco. Each map gives the different types of tobacco cultivation in different areas in the state. And also gives detailed data of area and production of each state in India.

4


This bulletin reports the aims and objectives of the C.T.R.I library and states the different types of reference books and other macro and micro, documents available in the library and different services to its readers are also mentioned.

5

RAMAM, M; SYAMPRASAD, N. and SURYANARAYANA. YV. (C T. R. I. Rajahmundry - 533 105, A. P.) Directory of periodicals and annual reports available in the library of Central Tobacco Research Institute, Rajahmundry, 1984 71p

This directory is the revision of 1974 edition. It gives all the current and back volumes of Indian & Foreign periodicals (received either by gratis/exchange or subscribed) available in the library. List of serials and Annuals and Annual reports of Foreign & Indian Institutions is also given. Subject index with broad subject headings is given at the end.

6

This bibliography contains books, research reports, bulletins, monographs, dictionaries, bibliographies, Theses etc., on tobacco obtained in C. T. R I. Library during 1947-83. This contains nearly 932 titles arranged in alphabetically by authors name. Subject index is given at the end.

GENETICS & PLANT BREEDING


Study of a diallel set of 21 hybrids of seven bidi tobacco varieties along with the parents revealed the GCA variance was significant for leaf thickness, whereas GCA as well as SCA variances were significant for leaf potential and spangling ability. Significant SCA variance was observed for leaf length, leaf breadth and cured leaf yield. Both additive and non-additive gene effects governed the expression was more predominant in leaf potentiality, while the latter type of gene effect had more influence on the expressivity of spangling ability. Additive effect governed leaf thickness, while non-additive effects were involved in the expression of leaf length, leaf breadth and cured leaf yield. Cyclic method of breeding involving selection of desired recombinants and their inter se crossing is suggested for evolving elite cultivars.

Phenotypic stability in Jatí tobacco (N. tabacum L.) were studied for yield by growing seven genotypes in 8 environments to find out a suitable genotype. Genotype HD 65-25 was identified as the most desirable genotype. Taking into consideration high mean cured leaf yield and first grade leaf, genotype HD 65-25 could be recommended for general cultivation.

Three newly developed cigar filler tobacco (N. tabacum L.) hybrids along with Olor (Popular) variety as check were evaluated for stability at three locations in three different years of Cooch Bihar. The genotype-environment interaction (linear) was significant, indicating that the hybrids performed differently in different environments. Olor x Havana had poor adaptability. Maryland x Olor gave the highest yield and responded well under favourable conditions. Swarhibsman x Olor met all the basic requirements of stable variety viz., high mean yield unit regression coefficient and least deviation from linearity.

Data on cured leaf yield/plant and total green weight of curable leaves/plant (TCL) from a 10 x 10 diallel cross, including reciprocals, indicated that both general and specific combining ability (SCA) variances were significant for both traits and that additive and additive x additive gene action predominated. Olor, Penbel Creider and Topaz showed high general combining
ability effects for both traits. High positive SCA effects were observed in one cross for cured-leaf yield and, in another for TCL. Appreciable reciprocal effects were observed in 3 crosses for TCL and in 5 for cured-leaf yield.


The combining ability and gene effects of nicotine, reducing sugar and total sugar contents were studied using eight fertile non-FCV cultivars, two male sterils FCV lines and their 16 hybrids. The general combining ability variance component of males was significant for nicotine and reducing sugar, while the same was significant for nicotine only among females. The specific combining ability variances for all the traits were not significant. Additive effects were involved in the expression of nicotine and reducing sugar contents. Kumkumathri and I-423 were found to be the best donors for low nicotine and high reducing sugars respectively.


The shoot apex in Nicotiana tabacum Linn, was studied from the mature embryo to flowering. The apex of the 2-day old seedling shows initial stages in the establishment of the peripheral zone and at 5-days the shoot apex shows well-established cytohistological zonation with a central mother cell zone, peripheral zone and pith meristem. There is an age-related
increase in size of the apex up to 13 weeks followed by the development of the reproductive apex with a 3 to 4-layered mantle covering the larger and lightly stained cells of the core. The contribution of cells from the central mother cell zone to the peripheral and proximal zones indicates its role as initials. The data also bring out the involvement and reorganisation of the entire apex in the formation of the reproductive apex.


Twenty seven exotic varieties of flue-cured tobacco obtained from USA, Australia, Japan and Bulgaria were evaluated for their yield and quality against three local standard varieties in a replicated trial during 1982-83. The differences due to cultivars were significant for all the four kinds of yields green, cured bright leaf and 'TBLE and also to the plant height and number of economic leaves per plant with a wide range of variation. Among the two important chemical constituents, the percentage nicotine was significant due to cultivars. However, there were no significant differences among the cultivars for the character reducing sugars, and for the four physical quality characteristics equilibrium moisture content, filling value, Shatter Index and pore volume. Heritability, genetic coefficient of variation and genetic advance were estimated for all the characters.


Seeds treated with ethyl methanesulphonate (EMS) produced plants with chlorophyll and other abnormalities as well as reduced growth, survival and fertility. However, the addition
of myo-inositol to seeds undergoing treatment with EMS stimulated growth and increased survival of subsequent plants with negligible effect on the mutation frequency of abnormalities.

15


Information is presented on combining ability effects of yield (green leaf, bright grade and total) and yield-related traits from analysis of data from a 9 x 9 diallel, excluding reciprocals, studied at Hunsur, Karnataka, during May-August, 1979. Additive genetic factors were predominant for all traits except bright grades and total bright-grade equivalent. Virginia 145, L 69/1 and Speight G 28 showed significant general combining ability effects for most traits. Recurrent selection or the pedigree method are suggested as means of obtaining high-yielding strains from the material studied.

16


An experiment was conducted to study the degree of genetic variability, combining ability and heritability of physio-chemical traits of rustica tobacco. The material consisted of six genotypes and their 15 possible crosses ignoring the reciprocals. The population lacked significant genetic variability for leaf thickness, lamina to midrib ratio, leaf moisture content, chloride content and total nitrogen content. Significant variability was observed for protein-nitrogen and nicotine contents. The gca and sca estimates were significant for protein-nitrogen and nicotine contents. Mothihari hemti was found to be a good donor for reducing protein-nitrogen content, while Cocker 1 Kuraila small leaf cross was superior for evolving low protein-nitrogen recombs. T 174 was a good general combi-
ner to improve nicotine content, while Kuraila small leaf x T174 cross was promising for evolving recombs having more nicotine content. The estimates of heritability for protein-nitrogen were moderate to low ($H = 0.455$ and $h^2 = 0.364$), while for nicotine content the estimates were moderate to high ($H = 0.558$ and $h^2 = 0.793$). Cyclic method of breeding is suggested for simultaneous improvement of these two traits.


To find out the role of genotypes in the colour retention of tobacco during storage, an experiment was conducted in the Northern Light Soils of Andhra Pradesh. Light Medium and dark cast varieties were grown under irrigation and the crop was topped and suckered.


Eight varieties of flue cured tobacco viz., Speight G 41, NC 13, L 2178, Coker 213, M. Nair 14 M 43, Strain 94, V 71 Medows Giant and GSH3 were evaluated for heterosis and combining ability for three yield characters (Cured leaf, Bright leaf and T.B.L.E.) Biological Yield (BY) and Harvest Index (HI) during 1981-82. The 28 F's and their parents were grown in row replicated four times. Heterosis was considered as percentage increase over Better Parent (BP). Biological Yield (BY) and Harvest Index (HI) were calculated on plant basis. In cured leaf yield very few hybrids surpassed
their better parent. In bright leaf and TBLE yields many hybrids particularly Speight G 41 × McNair 14 not only gave about 90% and 49% increased yields over better parent, but even surpassed the highest yielding variety GSH3. The varieties GSH3 and McNair 14 had higher effects for all the characters. Predominant additive gene action was observed for quality leaf and HI while non-additive type of gene action for cured leaf and BY. For combining high yield together with quality leaf the proper method is to grow specific cross combinations and intermating of proper genotypes so as to concentrate desirable alleles into a few genotypes.

19


Describes the details of certain chewing tobacco selections such as Gandak Bahar (HP-620), Sona (HP-63-3) and Prabha (HP-67-5) which are better than the DP 401 which is released for cultivation in Bihar. Gives the distinguishing features of yield and quality and performance of these new varieties. Concludes that these high yielding varieties require heavy nitrogenous fertilization and as such apart from 45 tonnes compost per hectare, it should be manured with 168 Kg N, 50 Kg each of P2O5 and K2O per hectare as basal dose before transplanting in plant row plough furrow with spacing of 90 x 90 cm, 90 x 75 cm, and 90 x 60 cm, should be adopted for Gandak Bahar, Sona and Prabha respectively and these varieties should be toped at 14 leaves stage.

SEED SCIENCE & TECHNOLOGY

20

Tobacco seed with two moisture contents viz., 5% to 6% (normal) and 2% to 3% (low) were stored at laboratory temperature in different containers. Seed samples were drawn periodically for moisture and germination. The results showed that the one extreme, the seed remained viable irrespective of seed moisture content and containers of storage up to 6 1/2 months. At the other extreme irrespective of initial and seed moisture content the seed remained viable so far up to 78 1/2 months when stored in which calcium chloride was kept in a beaker and the lids sealed with cellophone tape. Between the two extremes the viability of the seed depended on two factors viz., (1) the initial seed moisture content and (2) the efficacy of the container in preventing changes in the seed moisture. Based on the results the best method of storage of tobacco seed is to store it in bins in which calcium chloride (a dessicant) was kept in a beaker and the lids sealed with cellophone tape.

21

Describes three wild species of Nicotiana viz. N. Panniculata L., N. tōmentosa Ruiz and Pevon and N. undulata Ruiz and Pevon growing in Peve was undertaken with a view to provide information on seed characters and their utility in species identification. Seeds shape, colour and measurements of length, width were made with a light microscope. SEM photographs were taken of gold coated seeds following the sputtering technique using Cambridge Stereoscan Microscope S4-10 model at IIT, New Delhi. Finally observed that in all the three species the cells surrounding the hilum are particularly deeper than those of remaining cells possibly to enhance absorption.

22
CULTURAL PRACTICES

23


This experiment was conducted during 1982-83 season on the Northern light soil farm, Devarapalli. Four treatments drips 150 mm, 200 mm, 250 mm and furrow irrigation with plot size 20.0 m x 9.6 m and with 60 Kg. N, 80 Kg P₂O₅ and 120 K₂O/ha fertilizer dose by dollop method were used. Drip was on the ridge 10 cm away from the plant and the rate of drip was maintained at 1.2 liters/hour. The results show that 250 mm drip is the best in promoting faster growth of the crop in terms of leaf area increase. Physical & Chemical quality characters are within limits. Concludes that there is 14% save of water over furrow irrigation. The initial cost of setting up the drip irrigation system is Rs. 10,000/ha.

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25


The optimum plot size for field experimentation on bidi tobacco was worked out using uniformity trail data. Two methods, Viz, (i) the maximum curvature and (ii) Fairfield Smith's variance law were used for the purpose. The optimum plot size of 8 unit (1.8 x 3.0 m) worked out by using maximum curvature method has more reliability. The Smith's law served as a guide line only.

The estimates of cost of cultivation of VFC tobacco obtained from the study during 1975-76 to 1979-80 are presented. Cost accounting method was adopted for the purpose of collection of field data. During the five years 1975-76 to 1979-80 the total cost of cultivation of VFC tobacco in AP (Cost C) ranged between Rs. 4541 and Rs. 48541 per ha. The paid out cost or expenses incurred in cash & kind (Cost A 2) ranged between Rs. 3242 and Rs. 3554 per ha, constituting 70-75% of the total cost of cultivation (Cost C). There was a reduction in the cost of cultivation of VFC tobacco during the last two years as compared with the first three years and, lastly suggests that top priority should be accorded for the establishment of regulated markets equipped with auction platforms, redrying and warehousing facilities for the farmers for better prices of tobacco.


This experiment was conducted at the Central Tobacco Research Institute, Research Station, Pusa (Bihar) during 1976-77, 1977-78 and 1978-79 with sannhemp, greengram, cowpea, sesameum and sorghum as preceding crops of chewing tobacco. Legumes, in general, were better predecessors of tobacco than non-legumes. Tobacco after sannhemp, recorded the maximum yield, leaf size, leaf spangle, puckering and maturity in leaf. However, its superiority over other legumes was not significant. Non-legumes (sesamum and sorghum and fallow had depressing effect on the succeeding tobacco. Suppression of orobanche in tobacco by sannhemp as a green
manure was not significant. Hence, chewing tobacco preceded by legumes preferably sannhemp may be practised under rainfed conditions.

28


Hookah tobacco varieties NP 220 and R-12 were studied at 4 dates of planting in combination with 3 levels of topping during three crop seasons. Length and breadth of leaf under planting on 10th October being at par to 25th October were significantly superior to the planting in November. With increase in the level of topping from 8 leaves to 12 leaves or removal of flower head, there was increase in leaf and decrease in the length and breadth of leaf. With delay in the date of planting, there was reduction in the crop maturity period by 2 to 6 days. Lower topping at 8 leaves enhanced the crop maturity by 3 days in comparison to other levels of topping. Irrespective of topping level and time of planting, variety NP 220 gave 13.7% lower yield and matured 3 days earlier than R-12. Planting on 10th October, 10th November and 25th November recorded 10.4%, 28.3% and 29% higher yield of cured leaf respectively than planting on 25th October. Topping at 12 leaves or removal of flower head recorded 11.7% to 12.2% higher yield than lower topping at 8 leaves. Planting of hookah tobacco early in the first fortnight of October and high topping at 12 leaves or flower head, hence, are suitable for the high yield and thereby high return per unit area in Bihar.

29

The field investigations were carried out at the Central Tobacco Research Institute Research Station, Pusa during 1976—77, 1977—78 and 1978—79 to study the effect of planting time (10th, 20th and 30th September and 10th October), spacing (90 cm x 90 cm, 90 cm x 75 cm and 90 cm x 60 cm) and nitrogen levels (100, 150 and 200 Kg/ha) on yield and quality of newly developed chewing tobacco varieties, Gandak Bahar and Sona. Yield of total cured leaf and first grade leaf of the varieties was significantly higher when planting was done on 20th and 30th September as compared to earlier or later plantings. The plant spacing of 90 cm x 75 cm with a plant population of 14814/ha was found to be better than higher spacing (90 cm x 90 cm) or lower spacing (90 cm x 60 cm) in yield, leaf quality and net return. 150 Kg N/ha was found to be a suitable dose for both the varieties in the region. Hence, planting Gandak Bahar and Sona during 20th to 30th September at 90 cm x 75 cm spacing and fertilising the crop with 150 Kg N/ha in combination with 50 Kg each of P2O5 and K2O over basal green manuring with sannhemp might be recommended for the region.


G-8/1 and G-11/1 VFC tobacco varieties were tested for their performance against a locally adopted variety at five locations in the black soils tracts of AP. The variety G-8/1 was the highest yielder (4.85 qt/ac) with a regression slope of 0.8609 and deviation mean square of 0.2593 where as G-11/1 showed average performance over the environments with unit slope and negligible deviation component. Concludes that G-11/1 could perform well even in the marginal environments.

The results indicated that dry matter production per plant of cigar filler tobacco varied with leaf area index (LAI) which was found to change with soil moisture regimes and plant spacings. Decrease in plant spacing resulted in corresponding increase in LAI. Cured leaf yield increased significantly with irrigations at higher soil moisture regimes of 60% ASM.

NUTRITION

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In this study nitrogenous fertilizer such as calcium nitrate, suphala (20 : 20 : 0), diammonium phosphate, ammonium sulphate and urea were compared against mustard cake plus ammonium sulphate and organic manure through green manuring with sunhemp and tobacco ratoon were tested against compost on chewing tobacco and their residual effect on succeeding maize was studied. Green manuring with sunhemp being on par with compost was significantly superior to no green manuring and green manuring with tobacco ratoon in puckering, maturity, leaf size and yield of tobacco. Suphala gave significantly higher yield of total cured leaf than other nitrogenous fertilizers barring mustard cake plus ammonium sulphate. Interaction effect of organic manure and nitrogenous fertilizers was not significant. Use of both sunhemp green manure as well as suphala gave more yield and higher net return of tobacco and succeeding maize and hence is advisable for farmers in place of usual practice of compost and mustard cake plus ammonium sulphate.

33

Pot culture, nursery and field experiments are conducted in northern light soils of coastal Andhra Pradesh clearly indicated that these soils are quickly depleted of their available K under continuous tobacco cultivation. When no potash fertilizer or potash at 50 Kg K₂O/ha annum is given leading to severe potassium deficiency in tobacco crop there by reducing cured leaf yields and quality. Suggests that an application of at least 80 Kg K₂O/ha every year is essential to maintain the available K status of soil at a level sufficient for getting high yields and good quality leaf.


An attempt was made to assess the available nitrogen status of flue-cured tobacco soils in Andhra Pradesh by testing 6,596 surface samples and an equal number of the subsoil samples collected from 551 coastal villages in the state. Taking organic carbon as a measure of available nitrogen in soil, soil test summaries and the nutrient index values were calculated for each district and the nitrogen fertility maps for light and heavy soils of Andhra Pradesh under FCV tobacco cultivation were prepared. From these studies, a universal deficiency of nitrogen in flue-cured tobacco soils of Andhra Pradesh was established.


In India flue cured virginia tobacco, an important export product is mostly grown in AP State, about 70% of the tobacco soils are vertisols and 30% alfisols. They differ in the contents of available potassium and in K dynamics. In pot studies yields
cf tobacco leaf were raised by increasing rates of potash application on both soils. However, an improvement of the K content a quality characteristics of the tobacco leaf was obtained only on the alfisol. In plants growing on the vertisol leaf-K rose only marginally at increasing K supply due to the high potassium buffer power of that soil. As the yield response to potassium rates was linear, it is assumed that higher levels of application may raise both yield and leaf-K content on the vertisol. The differences in K dynamics between the 2 soil types were well reflected in the soil test data.

36


Fertility survey of the flue-cured tobacco soils of East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore Districts in AP was carried out from 1977-1981. Soil test summary of available K for light and heavy textured soils was prepared from the soil test data giving their percent distribution into low, medium and high categories from which the nutrient index value were calculated. Conclude that the alfisols of East Godavari and Nellore districts which have more than 50% of the soils in low and medium available K categories need immediate potash application. For the rest of the light soils with initial available K and low K-buffering capacity only moderate doses of potash may be sufficient for the present. Vertisols with high available K status and high K-buffering capacity may not pose immediate nutritional problems w.r.t. potassium and their case may be received once in three to five years in respect of potash fertilization.

37

Deficiency of potash was detected in the field grown crop of flue-cured tobacco in Kalavacharla and Murali area of NLS of East Godavari Dt during 1982 – 83. Describes the symptoms of potash deficiency in green tobacco plant and suggests that the growers are advised to get their soils tested in C. T. R. I, Rajahmundry before taking up the flue-cured tobacco cultivation.


Various organic manures like cake-o-meal, mustard cake, pongamia cake and neem cake in combination with inorganic fertilizers such as calcium ammonium nitrate, ammonium sulphate and suphala were compared as nutrient sources for chewing tobacco crop (variety Sona) at 168 Kg N/ha using randomised block design with four replications. Number of curable leaves per plant and plant height were though significantly influenced, length, breadth, puckering, spangling, maturity, nicotine content of leaf as well as leaf yield were statistically alike under different treatments. Suphala alone and mustard cake plus pongamia cake plus suphala (25 : 25 : 50 N), faring better in general growth, yield, quality and net return than the other treatments, are advisable for the crop in place of common recommendation of mustard cake and ammonium sulphate. Suphala inorganic fertilizer was even more economical (Rs, 391 / ha) than mustard cake plus pongamia cake plus suphala (25 : 25 : 50 N).


On an average, 2.14, 0.25 and 1.85 kg N, P and K respectively are required for production of one quintal of tobacco leaf. For nutrition of tobacco, the contributions of fertilizer nutrients were found to be 19.2, 4.2 and 46.7 per cent of applied N, P and K respectively. Similarly the contribution from available N (alkaline KMnO₄-N) status of soil is 9.9 available P (Olsen extractable) 25.3 and available K (ammonium acetate extractable) 24.5 per cent. With 113 Kg N/ha, 58 Kg P₂O₅/ha and 41 Kg K₂O/ha application for soils having available N 350 Kg/ha, available P 20 Kg/ha and available K 130 Kg/ha, 30 quintal tobacco leaf/ha can be produced.


A crop sequence trial was conducted with 10 treatments with twin plots for each treatments in black cotton soils of AP during 1975-76 and 1976-77. The date on composition and uptake of micronutrients such as copper, zinc and iron by using varion Techtron Atomic Absorption spectrophotometer is presented. Concludes that the different crop sequences did not effect the iron content of tobacco leaf, and tobacco after green gram and fallow-tobacco resulted in lower copper content. No consistent trends were noticed regarding the zinc content of tobacco.


The nutrient composition of tobacco as influenced by different crop sequences was studied in black cotton soils of Andhra Pradesh. Fallow – tobacco and greengram tobacco treatments showed higher N and Ca contents while gingelly–tobacco treatment gave less nitrogen content in tobacco leaf than the other rotations. Tobacco after paddy was in the intermediate range and gave good quality leaf. Fallow tobacco after fallow cotton also gave good quality leaf with lesser N and higher P and K contents. The relationship of the main quality characters of tobacco i.e. reducing sugars and nicotine with the nutrient composition was also worked out using simple correlations, linear multiple regressions and standard partial regressions. It was observed that 72 to 74% of the variation in reducing sugars could be accounted for by the nutrient composition and nicotine, and the Ca content appeared to be the dominant factor. Similarly 64 to 65% of the variation in nicotine content was dependent mostly on N, K and reducing sugar content of the leaf.


An experiment was conducted at C. T. R. I. light soil farm, Devarapalli during 1977-78 to study the response of VFC tobacco to 4 levels of nitrogen (30, 40, 50, and 60 Kg/ha) under 4 irrigation schedules with irrigation water/cumulative pan evaporation (1 W/CPE) ratio of 0.50, 0.75, 1.0 and a mixed ratio of 0.5 + 1.0 + 0.75 at different stages of plant growth, in terms of yield and quality of VFC tobacco in northern light soils of Andhra Pradesh. The study revealed that irrigation with 200 mm. of irrigation water as mixed 1W/CPE ratio of 0.50 from 0 to 45 days, 1.00 from 45 to 75 days and 0.75 from 75 days after planting to final harvest was beneficial for better
quality leaf production compared to other irrigation schedules. The optimum and economic doses of N for higher TBLE production were found to be 48.08 and 47.66 Kg/ha, respectively.

44


Presents the yield data of a field trial which was conducted during monsoon seasons of the years 1975 to 1978 at Burley Tobacco Res Centre, Jaddangi, with five varieties viz. Burley-21, La Burley-21, HDBRG, KY-4 and KY-58 with three levels of nitrogen (40, 60 and 80 Kg/ha) in randomised block design with four replications by adopting a spacing of 1.0 m x 0.5 m. Concludes that KY-14 and Burley-21 gave significantly higher cured leaf and middle leaf yields than the other varieties. Obtained a linear response to nitrogen up to 60 Kg N/ha.

45


An experiment was conducted during 1976-77 and 1977-78 at Dinhata, West Bengal, India on Entisols to determine the uptake of nutrients and dry matter accumulation of ‘Dixie Shade’ cigar wrapper tobacco (Nicotiana tabacum L.) at different stages of growth. Accumulation of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), chloride (Cl) and nicotine by wrapper tobacco at 10-day intervals was studied. The wrapper tobacco accumulated 185 kg N, 21 kg P, 294 kg K, 89 kg Ca, 66 kg Mg, 37 kg Cl and 72 kg nicotine per hectare during the 120-day growth period. The rate of accumulation was very rapid during the reproductive phase of the growth period, followed closely by the active vegetative growth phase.
An experiment with four kharif cropping practices viz. fallow (A), gingelly green manuring (B), gingelly for oil seeds (C) and gingelly for oilseeds manured with 5.0 tonnes FYM/ha (D), and three NPK levels namely, 15 : 15 : 15 (X), 30 : 30 : 30 (Y) and 45 : 45 : 45 (Z) and six nitrogen levels viz., 0 (N₀), 10 (N₁), 20 (N₂), 30 (N₃), 40 (N₄), and 50 (N₅) Kg/ha was conducted at the Tobacco Research Station, Guntur, during 1975-76 to 1978-79 seasons. The results indicated that gingelly green manuring did not show any beneficial effect on cured leaf yield, but bright leaf and TBLE yields were considerably improved when gingely for green manuring was manured with 30 : 30 : 30 Kg NPK/ha, yield and quality of tobacco after gingelly for oilseed were inferior to the produce after fallow. Application of 20Kg N/ha before planting tobacco was found to be optimum. Nicotine content was found to increase with nitrogen levels, while reducing sugars showed declining trend. Seasonal fluctuation in temperature and rainfall reflected considerable effects on yield, bright grades and chemical quality attributes.

**CHEMISTRY**

Chemical and physical quality characters of burley tobacco grown in light soils of agency tracks of East Godavari district of Andhra Pradesh have been studied in different grades and from different locations to obtain comprehensive information about this type and results discussed.

Chemical quality characteristics of fermented sun-cured chewing tobacco were studied in relation to their physical characteristics as assessed by the chewing experts. Treatment with 10% palmyrah jaggery solution improved the chewability and physical characters of the leaf. The physical and chemical appraisals showed that variety 1-115 showed better physical and chemical characters than 1-64. It was found, as a general trend, that the superior grades contained more of total-N, Protein-N, nicotine, petroleum ether extractables and K and less of Calcium, sand and silica.


Presents the data on chemical composition of six grades of chewing tobacco variety 'Perivadamugam' (PV 7). The fermented cured leaf samples were collected from three locations viz. Dharapuram and Kangayam of Coimbatore Dt and Oddanchatram of Madurai Dt. in 1973-74 season. Concludes that the superior grades possess better chemical and physical characters in respect of quality. The top three grades are generally less in sand and silica, chlorides, total ash, potassium and are having better chewability and physical characters. Superior grade of tobacco appears to contain less potassium when compared to other grades which is being balanced by the low chloride content of the leaf.

Granular systemic insecticides such as a) phorate 10 G, b) Disulfoton 5 G, c) Carbofuran 3 G, d) Aldicarb 10 G and e) Terberfos 5 G were used. Aphid infestation score was recorded at 50 and 70 days after planting. Combined analysis data for the year 1977–78 and 1978–79 are presented. A gradual significant decrease of total nitrogen and increase of nicotine content were observed from 50 to 110 days stages. Chlorogenic acid and rutin increased significantly from 50 to 90 days stages and stabilised thereafter. It was observed that in the case of treatments higher nicotine and chlorogenic acids were associated with lower aphid infestation and in the case of stages of plant growth reverse trend was noted.


An experiment conducted in northern light soils of Andhra Pradesh to find out the effect of different irrigation schedules and nitrogen levels on the chemical and physical quality characteristics of VFC tobacco, was revealed that irrigating tobacco with 200 mm. water on the basis of mixed IW / CPE ratio 0.5 from planting to 45 days, after planting of 1.00 from 45 days to 75 days and of 0.75 from 75 days after planting to final harvest and fertilizing with 30 Kg or 40 Kg N / ha, gave good quality leaf with comparatively lower nitrogen and nicotine conte-
higher reducing sugars and reasonable low chloride content with better quality ratios than the other irrigation schedules and nitrogen levels tried. The variable trends of the physical characters due to irrigation schedules and nitrogen levels were not perceptible. In general the leaf was characterised by higher porevolume, poor filling value, normal E. M. C. and Shatterability Index.

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The average quality parameters are: total nitrogen 2.95%, protein nitrogen 1.5%, soluble nitrogen 1.45%, nicotine 1.47%, chloride 0.35%, K₂O 3.83%, P₂O₅ 0.38%, cigar burnscore 74.22/100. The quality ratio (total N/nicotine) was found to be 2.9. Rassi grades were found superior to Cruz grades in their chemical and physical quality characteristics. In respect of quality, the tobacco of 5 regions could be arranged as follows: Dinhata, Adabari, Okrabari, Pakhiakaga and Natabari.

53


Four dates of planting (10th October, 25th October, 10th November, and 25th November), three nitrogen fertilizer levels (60, 120 and 180 kg/ha) and three plant densities (24, 691; 29, 629 and 37, 037 plants/ha) were studied in a field experiment conducted during 1976-77 and 1977-78 in the northern sand soil of West Bengal for their effect on certain chemical quality characteristics. Dates of planting and plant densities have no significant effect on the total nitrogen and nicotine content of the
leaf. However, protein nitrogen was decreased significantly due to late planting and higher plant densities. Increasing levels of nitrogen fertilization increased the total nitrogen and nicotine contents of the leaf significantly.

**DISEASES**

54

In comparative tests with 4 high yielding cultivars under conditions of natural infection by Phytophthora parasitica (P. nicotianae) var. nicotiana and the highly susceptible S-20, none showed resistance but Anand-119 was comparatively tolerant (disease index 3.39 compared with 20.76 for S-20).

55

This fungus, recorded for the first time on a member of the Solanaceae, was identified on a tobacco seed sample from Japan received for quarantine processing at New Delhi.

56

Describes the occurrence of common virus disease such as TMV, leaf curl virus, Tobacco distorting virus, Tobacco Etch virus, Rosette and Bushy Top, Phyllody on tobacco fields in India and their symptoms and their control measures. The resistant varieties that are available for cultivation are also described.

The nematicidal efficacy of the antibiotic (KT-199) was studied on the growth and vigour of tobacco and also on the nematode development and reproduction Meloidogyne javanica both as soil drench and foliar spray. The antibiotic, in comparison with nematicide (phenamiphos) had no adverse effect on the growth of tobacco plants infected with M. javanica when applied as soil drench and foliar spray. However, the highest concentration of the antibiotic (1000 ppm) when applied as foliar spray caused scorching effect on the leaves. Further, they significantly inhibited the development and reproduction of M. javanica. In general, the antibiotic when given as foliar spray was better in decreasing the number of galls, production when compared to the soil drench.


The aqueous extract of the leaves of fern Ampelopteris prolifers showed maximum inhibition when applied local lesion or systemic hosts 24 hrs prior to virus inoculation (TMV or CMV). In post inoculation treatments, the inhibition of both the viruses was very little and was maximum when the fern leaf extract was applied immediately after the virus inoculation. Besides affording local protection the fern leaf extract when applied on lower leaves, induced systemic resistance in N. glutinosa against TMV and in N. tabacum against CMV. The resistance thus induced was sensitive to Actinomycin D when applied simultaneously with the extract on the two lower leaves of test plants. The maximum inhibition which was obtained
by extracts of mature leaves with or without sori was most active up to a temperature of 50°C and a dilution of 1:10. It lost its inhibitor power from 70% to 14% after 36 hrs of storage. The inhibitor present in this extract was nondialyzable.


The study conducted on life cycle of *Rotylenchulus reniformis* consisting of embryonic, post embryonic and post infection development pertaining to the period required for completion of egg. Second, third, fourth, immature female and male stages indicated that *R. reniformis* completed its life cycle from egg to egg in 27 to 32 days on bidi tobacco at 30 to 32°C. The fecundity of nematode was on average 83 eggs per egg mass and reproduction was sexual.


Pot experiment with treatments 1) mixture of four parts of sterilized soil and one part of normal tobacco dust and 2) mixture of four parts of composted tobacco dust in ten replications was conducted to determine the effect of tobacco dust, uncomposted as well as composted on the development of TMV infection in two varieties viz. A 119 (bidi type) and CTRI Special (Fcv type). Suggest that practice of applying normal tobacco dust in either nursery beds or fields could be highly disadvantageous and therefore unadvisable.

Five systemic fungicides viz. Bavistin, Topsin - M, Rido­mil, Bayer 5072, and kitazin and ten non-systemic fungicides viz. Bordeaux mixture, Blitox, Captaf, Cuman-L, Daconil-2787, Difolatan, Dithane M-45, Fytolan, Thiram and ziram were tested at various doses against frog-eye spot control in seed beds. Systemic fungicides like Topsin-M@0.025, 0.05, and 0.1% and Bavisin @ 0.03% gave 63.31 to 98.75% control of the disease. Non-systemic fungicides like Captaf, Thiram and Difolatan @ 0.1%, Fytolan, Ziram and Daconil - 2787 @ 0.2%, Blitox @ 0.3% and Bordeaux mixture @ 0.4% also significantly reduced the leaf spot incidence from 48.69 to 93.31%. Rabbing the seed beds with Paddy husk followed by Bordeaux mixture spray @ 0.4% was equally found effective as the above treatments.


Three doses carbendazim (Bavistin 5% WP) viz. 125.0 gm, 107.5 gm and 250.0 gm/ha along with a control (Water spray only) applied three times at 10 and 20 days interval during the season were studied in a randomized block design. The susceptible variety 16/103 was used for this purpose. Based on the effectiveness of the fungicide and the favourable, the dose of 125 g/ha of carbendazim (Bavistin 50% WP) applied at 10 days interval for three times after the onset of infection could be recommended in managing the disease under field conditions,
INSECT PEST

63

Chitin-synthesis inhibitor SIR8514 was tested against different stages of tobacco caterpillar, Spodoptera litura F. both as contact and stomach poison. SIR8514 completely inhibited the matching of eggs at 0.065% and was effective against early instar larvae both by contact and stomach action. It was more effective as stomach poison against the last-instar-larvae. All the treated pupae completed their normal development but malformation of some adults was observed when higher concentrations of SIR8514 were used.

64

Observations made in the laboratory in Uttar Pradesh, India on the mating and oviposition of Nesidiocoris caesar an important pest of tobacco and Lagenaria vulgaris (L. siceraria), are described. Both mating and oviposition occurred throughout the year. Mating lasted an average of 2.08 h, the preoviposition period 3.5 days and adults life span 3-10 days for males and 5-20 days for females. The oviposition site in the plant tissue usually turned brown.

65
During 1981–82 season, some tobacco mosaic virus (TMV) and leaf curl virus (LCV) effected plants of cigar wrapper tobacco \((N\, tabacum\, L.)\) were observed to get damaged by \(S.\, litura\, F.\) at C. T. R. I. Research Station, Dinhata farm. Larvae were collected from field and were reared in laboratory on healthy cigar wrapper tobacco \((\text{Dixice Shade variety})\) leaves. Concludes that the diseased plants being favourable food source for \(S.\, litura\, F.\) should be immediately removed from field not only to check the spread of disease but also to prevent population built-up of tobacco caterpillar, \(S.\, litura\, F.\)

**66**


Fifteen cigar wrapper tobacco varieties including the susceptible check of Dixice Shade variety are raised in a screening trail for leaf curl disease during 1980–81 to 1982–83 seasons. These were planted individually in plots of \(5.4\, \text{m} \times 2.25\, \text{m}\) size at the spacing of \(90\, \text{cm} \times 45\, \text{cm}\). Concludes that cigar wrapper tobacco varieties such as Jamaica, Cuban, Fransorl, Marila, Madole, Little Crittendent and Sumatra can be utilized as resistance source against green peach aphid, \(M.\, persicae\) in breeding for resistant cultivars.

**67**


The pest was found damaging the tobacco seedlings from first week of October till the removal of seedlings from nurseries in the last week of October or first week of November. The eggs were laid singly on lower surface of leaves. Each female laid on an average 429 eggs and the incubation period lasted for \(4.6\pm0.8\) days. There were six larval instars and the larvae of fifth and sixth instar stages were found to be most harmful to tobacco nurseries. Total larval period took \(18.3\pm0.9\) days for
Pupation took place in loosely woven silken cocoons. The prepupal and pupal periods lasted for 23 ± 0.5 days and 11.4 ± 0.7 days respectively. Longevity of male moth was 8.2 ± 0.4 days and of female moth 12.2 ± 0.3 days. Pre-oviposition periods lasted for 3.0 ± 0.9 days, 7.83 ± 0.95 days, and 1.16 ± 0.75 days respectively. The total life cycle was completed in 46.6 ± 2.6 days. Three weed plants were recorded as new alternate hosts for the pest. Two larval parasites and one pupal parasite were obtained from field collected larvae and pupae of the pest respectively.


... The parastic cocoons were found emerging from 3rd and 4th instar larvae of the pest. On an average 20 to 30 parasites were recorded from single larva. The percentage parasitization of A. signata larvae due to Apanteles sp. was more i.e. 10 to 15 per cent during the month of November when pest population was also at its peak.


... Field experiments showed that neem (Azadirachta indica A. Juss) seed kernel suspension (NSKS) at 0.5%, 0.75% or 1% concentration gave significant protection to the tobacco crop against the tobacco caterpillar up to 7 days after spraying. None of the treatments had any adverse effect on yield on chemical
and physical quality characteristics of flue-cured virginia tobacco. The smoke quality assessment revealed that tobacco leaves sampled from 0.5% NSKS sprayed plots did not have any perceptible taint in the smoke and were acceptable by the trade. In an organoleptic evaluation of NSKS treated tobacco samples, the testers preferred cigarettes made from tobacco of either untreated samples or those treated with 0.5% NSKS. Thus the tobacco crop can be effectively and economically protected against S. litura damage by spraying the tobacco leaves with 0.5% NSKS.


Explains in the procedure followed to obtain the fresh eggs of the hosts and the other preparations made for parasiting the host eggs by T. remus. T. remus accepted the eggs of all the three hosts. A. janata was found to be the most favourable host with significant high percentage of parasite emergence, longer adult and total life periods. H. assulta was more favourable than H. armigera because of longer adult and total life periods.


The biology of a Reduviid bug, Rhinocoris squalis (Dist) was studied under laboratory conditions on tobacco caterpillar, Spodoptera litura F. The male and female bugs take 114.4 ± or –4.77 and 110.0 ± or –2.88 days respectively for completing their
life cycle. There are in total five instars with five moults. A female can lay 205.0± or-13.61 eggs in 3 to 4 batches during its life period. The bug can consume 104.3± or-3.98 and 206.0± or-11.20 larvae during nymphal and adult stages respectively.


The effectiveness of 9 insecticides was tested in 1976-78 in Maharastra, India, for the control of *Myzus persicae* on tobacco. Analysis of the pooled data for the 3 years indicated that spray treatment with 0.05% dimethoate was the most effective, although it was statistically similar to 0.03% dimethoate, 0.02 and 0.05% malathion and 0.02% thiothion. No residues were detected at harvest in the leaves of trees treated with 0.03% dimethoate, 0.02 and 0.05% Metasystox (demeton-S-methyl) or 0.05% malathion.


Describes the study to compare the alternativeness of synthetic pheromone mixture with 5, 10 and 20 females as well as the major component of the six pheromone viz. 9, 11-TDDA under the conditions of Rajahmundry, and a mixture of 9, 11-TDDA and 9, 12-TDDA (10 : 1) It is observed that the polythene vials containg 1 mg, synthetic pheromone (mixture of 9, 11-TDDA and 9, 12-TDDA) were more attractive than 5, 10 and 20 virgin females and the major component of the synthetic lura.
74


75


76


Laboratory and field studies were conducted to study the suitability and efficiency of Brinckochrysa selestes Banks as a predator on Myzus persicae Sulzer in tobacco fields. Laboratory bred 2nd instar larvae of B. Seleste at 6 per tobacco plant reduced the aphid population to the extent of 78% in 2 weeks. The movement of the predatory larvae on the tobacco plant and leaf was not at all hampered by the glandular trichomes and their secretions. The larvae moved freely and fed well and their pupae were recovered from all over the plant.

77


It was observed that all the developmental stages of the aphid and the adults were susceptible to parasitization. Two hyper parasites observed on this parasite were also recorded and were identified as Aphidiencyrtus aphidivorus, Mayr and Liocyrtus aphidivorus shafee. Further it is observed that Aphelinus was noticed on FCV tobacco also.

As a result of a survey in Andhra Pradesh, India, on the natural enemies of Spodoptera litura and Myzus persicae, the 2 most important pests of tobacco in that state, lists of 4 species of Hymenoptera parasitizing the 1st species, a reduviid and a chrysopid preying on that species and 3 species of Hymenoptera parasitizing and 1 species of chrysopid preying on the 2nd species are given. Zele chlorophthalma a larval parasite of S. litura, is recorded for the first time in India, while the pupal parasite Lasiochalcidia, erythropodus is recorded for the first time in S. litura and the predator Anisochrysa boninensis for the first time attacking nymphs and adults of M persicae.

BIOCHEMISTRY


Generation of carbonyl compounds during curing of tobacco contribute to the aroma in tobacco 4th primery leaves of ‘Kanakaprabha’, a popular variety of flue cured tobacco were used in this expt. The method followed for extraction and identification of carbonyl compounds and the preparation of standard DNPH derivatives are given. Data relates to individual carbonyl compounds in test samples are given. Concludes that the carbonyl compounds which partly contributes to aroma in tobacco are generated in an abundant measure during curing and post curing operation.

The radioactive tracer studies on flue-cured tobacco during curing and ageing have firmly established that both amino acids and unsaturated fatty acid, C18.3, are responsible, at least partially, for the generation of carbonyl compounds some of the aroma-bearing constituents are recognized in flue-cured tobacco.


BI - PRODUCTS

DAEHADE, SB. and GOGTE, BB. (LIT, Nagapur University, Nagpur). Modified tobacco seed oil for improved alkaloids. Paint India 34 (3) : 3-5, 1984. 21 Ref.

PRODUCTION, MARKETING AND TRADE


A special correspondent Mr. P. Seshagiri Rao reports about the production, trade, marketing of tobacco in India. He reports on

1) Small crop reflects farm anger over slow payment.
2) Sales by auction please - Trade and producers
   India's largest scale tobacco auction in Karnataka.
3) How sound Tobacco Board reforms become diluted.
4) What future for exports of cigars and cheroots.

It includes topics by Sri P. Seshagiri Rao on
1) Drop in India's 1983/84 tobacco exports
2) Flue-cured tobacco auctioned for the first time in Karnataka.


This special project development efforts put in by ILTD in collaboration with Tobacco Board. Explaining the present position of the crop and its quality and its international demand. Explains the aims and objectives of the project. Mention the guidelines given to the farmers by the experts at different stages of production. Lastly states that the yield per hectare in the special project area has increased by at least 50% more than the average yields normally achieved and the quality of the leaf is found to be far superior to the general run in that it is bodied orange colour, with good luster and nicotine levels are more than 2.5% on an average.


Gives details of production trends and development programmes for the last six Five Yearly Plans and future programmes of 7th Plan are briefly given. The note worthy feature of the 7th Plan would be to increase the light soil area from present level of 80,000 ha. to 1,20,000 ha. under virginia tobacco and reduce the area under other types of tobacco to some extent.

Describes the details about the progress of VFC tobacco in 1983-84 season and the damage caused to the crop due to cyclone in Oct. 1983. Some of the steps taken by the Govt. of India and Govt. of AP in improving the marketing situation and in the disposal of the farmers produce are given.

89


After the implementation of AICRP on Tobacco at Nipani efforts were made to increase the production of quality tobacco at Nipani tract mainly through varietal improvement programme and agronomical manipulations. There has been an increase in yield to the extent of about 40 to 50 per cent due to high yielding varieties like Anand-2, Anand-119 and NPN-190 which is a major contribution to the farming community. Fertilizer application either at the time of incorporation of green manure crop in plough furrows or prior to planting deep in the soil not only increased the yield but improved the quality of tobacco and saved the labour required for the application of fertilizers. Topping at 16 leaves under dry condition and at 18-20 leaves under irrigation increased the yield of tobacco. With spacing of 100 cm x 75 cm or 75 cm x 75 cm it was possible to increase the yield without affecting the quality.

90


Discussed various aspects of market research its inadequacies vis-a-vis the need for organising the market monitoring and research apparatus to improve marketing competence. The role of Tobacco Board in India for production-cum-export promotional and their plan of action are given.
GOPALACHARI, NC (C. T. R. I. Rajahmundry - 533 105)

Gives grade index for FCV tobacco grown in black soils Southern light soils of AP and another grade index for northern light soils of AP and transition belt of Karnataka.

PATEL, CP. (Gujarat Agric. University, Anand Campus, Anand).


Narrate the present situation and problems of grower-seller in getting good prices for produced quality tobacco. Describes some of the buying tactics adopted by the big and other small firms in buying quality tobacco. Gives some improvements in the present marketing system. The differences between the manufacturers language of quality and growers language of quality is given. The quality is not alone that decides the growers price but it depends on the demand and supply position. Concludes by giving some points in order to bridge the quality language gap between seller-grower and the buyer-manufacturer.


Defines the superior quality in tobacco and how to identify it on the auction floors. Breifs about the important physical
characters such as colour, body texture and aroma by which the quality of tobacco is judged. Gives the factors to determining the grade of leaf within a given type of tobacco. Describes the drawbacks of grade standard in FCV tobacco under the AG mark system. The distinguishing features of the absolute concept and commercial or relative concept to determine the quality in tobacco are summarised at the end.

95


96

SINGH, SB. PATEL, GJ and PATEL, JB. (Tob. Projects, GAU, Anand Campus, Anand). Economics of bidi tobacco production in Belgaum district of Karnataka state. Indian Tob. J. 16 (2) : 9-12, 1994

Study covered the agric year 1981-82. Twenty Villages were chosen at random and 300 cultivators (159 small, 86 medium 55 large) were selected for the study. The study revealed that average cost per hectare was Rs. 5961.96 on sample farms. It was highest (6407.28) on large farms and lowest (Rs. 5334.89) on small farms. The higher cost was on the large farms because large farmers invested more on seedlings, manures and cakes, irrigation, bullock labour, tractor, fertilizers and pesticides as compared to small cultivators. The cost of production per quintal and input-output ratios were worked out on the basis of different cost concepts and the same are presented. Average cost production, and bulk line cost are also given.

97

SUBBARAO, N. Changing marketing structure and policy—A case of tobacco in AP. Indian J. Agric. Econ. 39 : 185-91, 1984. Examined marketing structure of tobacco in AP. The relative roles played by different agencies in the marketing process and
high lightened the changes in the marketing structure and their consequences. Discussed the policy of state intervention & support prices and suggest ways and means to remove bottlenecks in the present structure of marketing.

SMOKING & HEALTH

PARKMAE, SS. JAYANT, K. and SANGGVI, LD. (Cancer Res. Instit. Tata memorial Centre, PAREL, Bombay - 400012)
A less Harmful Bidi. Tob. Res. 10: 51-7, 1984. 10 Ref

Bidi smoking is the most prevalent smoking habit in India and is shown to be a high risk factor for cancers of upper alimentary and respiratory tract. Bidis with filter could result in reduction of risk of the above mentioned cancers. With this in view, experimental work on filter bidis was carried out. Introduction of cotton and viscose silvers as filter as well as perforation at butt end reduced total particulate matter and nicotine. Filter efficiency of cotton filter (5 mm, 10 mg) was 24-28% for TPM and 27-29% for nicotine and for filter efficiency of viscose and perforation efficiency (for 5 perforations) were poorer than that of cotton filter (5 mm, 20 mg). Cotton silver filters are simple and inexpensive and can be easily introduced at the cottage industry level.


The effect of introducing filters in bidi to reduce some of the harmful smoke constituents like dry TPM, CO, smoke nicotine and phenols were investigated. The results revealed that flavoured cotton filter reduced the dry TPM and CO by 71.5 and 46.6 per cent respectively. The reduction in smoke nicotine (75.6%) and phenols (84.9%) was maximum in sponge-
in-chorder treatment. From feasibility view point flavoured cotton filter holds promise for product modifications in the manufactured bidis.


An Automatic smoking machine developed for sampling smoke under reproducible smoking conditions is described. The machine simulates average human smoking pattern as adopted by scientists of most of the countries engaged in this research. The machine has been calibrated with standard reference cigarettes. The performance of the machine has been studied by comparing total particulate matter values for certain brands of cigarettes measured on this machine as well as on some of the commercially available ones.


Discuss the use of filters in cigarettes. Says the harmful effect of tobacco in cigarette can be reduced by blending with non-tobacco material gives added advantages of non-tobacco material over tobacco and stress on the development of new smoking material which can be used with tobacco for making less harmful cigarettes. Mention some companies which are producing new smoking material and usage of different types of tobacco in different countries for less hazards. Concludes that low sugar tobacco (air & sun cured) are less hazardous than high sugar tobacco (flue-cured).
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