Tobacco (Nicotiana tabacum L.), the sovereign weed, is one of the important commercial crops grown world-wide. It is an important economic commodity, not only as a source of income and foreign currency for a number of countries, but also generates vast employment opportunities in developing countries. The top ten countries which grow tobacco are China, USA, India, Brazil, Turkey, Zimbabwe, Indonesia, Greece, Italy and Malawi.

The genus, 'Nicotiana', is presumed to have had its origin in and around the Andes region in South America. Out of the total 65 species in the genus, 45 are indigenous to North and South America and 20 are native to Australasia. In India, Nicotiana tabacum and N. rustica are the two species widely grown and consumed in various forms. Tobacco was probably introduced in India by Portuguese sailors in 1605, during Akbar’s reign. Virginia tobacco was, however, introduced by the Indian Leaf Tobacco Development company in 1920.

India has unique feature of cultivating different types of tobacco like FCV (Flue Cured Virginia), bidi, burley, natu, cheroot, hookah, snuff, chewing, cigar and lanka under different agro-climatic zones in states like Andhra Pradesh, Karnataka, Gujarat, Bihar, West Bengal, Tamil Nadu, Maharashtra, Orissa and Uttar Pradesh (Fig. 1). Though tobacco is cultivated in only 0.23 % (4.1 lakh ha) of arable land in the country, its contribution to Indian economy amounts to 10 % of the total excise collection and nearly 6.7 % of the value of agricultural exports (Anon., 1998c). It is third among the top ten excise revenue yielding commodities. From tobacco, India earns around Rs. 5,500 crores as central excise and Rs. 1060 crores through foreign exchange. In addition, over 28 million people are dependent for their livelihood on the tobacco industry. This includes one million tobacco farmers, five million farm workers and 15 lakh retailers. In the world, India ranks third in production of tobacco with an output of approximately 580 m. kg, of which FCV tobacco accounts for 180 m. kg. It ranks fifth in exports which consist of about 110 m. kg tobacco in unmanufactured form and 11 m. kg in the form of manufactured products (Anon., 1998b). It has the potential to improve its present share of less than 7 % in the world annual tobacco trade valued at US $ 30 billion. (Anon., 1998a).
Fig. 1. Tobacco Map of India

LEGEND

- FCV TOBACCO
- SUN CURED TOBACCO
- BIDI TOBACCO
- WRAPPER TOBACCO
- HOOKAH TOBACCO
- CIGAR TOBACCO
- CHEWING TOBACCO
- CHEROOT TOBACCO
- BURLY TOBACCO
In view of the recent anti-tobacco campaign all over the world, it is essential to have a socio-economic insight of tobacco not only in India but also elsewhere. Recently, UK based international tobacco growers association published an article entitled ‘Tobacco in the developing world’, which gives a perspective view of the importance of tobacco in a country like India (Nagarajan, 1998). Stability of world-wide demand of the crop, the crop’s hardiness and ability to grow in climates and soils unsuitable for other crops, relative ease in transporting tobacco and its profitability compared to other crops are the incentives for farmers growing tobacco in the developing world, thus making tobacco one of the most appealing cash crops in nations like India (Anon., 1998c).

World-wide, tobacco crop is considered as a major employer. Despite technical progress, tobacco cultivation remained as one of the most labour intensive among all agricultural crops. Women in particular, and skilled labourers, who would otherwise have little chance of employment, are able to earn living by working in tobacco cultivation. World Health Organization (WHO) made a systematic study of tobacco cultivation in various countries and acknowledged that in developing countries, tobacco creates vast employment. Tobacco is backbone of the economy of countries like Zimbabwe and Malawi which holds good for India also (Nagarajan, 1998). Another favourable factor for tobacco cultivation is its high degree of price stability which enhances its foreign exchange earning capacity. Whereas, widely fluctuating prices for other farm products in international market, present problems for many developing nations.

The main strength of Indian tobacco is its competitive price, with production cost of about US $ 0.80 per kg compared to $ 2.70 in USA, $ 1.50 in Zimbabwe and Brazil (Nagarajan, 1998). In international trade circles, Indian tobacco is recognised as ‘value for money tobacco’ at all quality levels. Another positive aspect is availability of various styles of tobacco from different agro-climatic zones. Low heavy metal (lead and cadmium) concentration in tobacco leaf and pesticide residues being within the tolerance limits stipulated by some of the importing countries are the key factors which govern export of Indian tobacco (Shenoi and Nagarajan, 1999). Besides its usage for smoking, chewing, etc., there are several alternative uses of tobacco for which the crop can be
grown to a certain extent. It is a rich source of several phytochemicals like nicotine, solanesol, organic acids, edible proteins and tobacco seed oil. The production potential for nicotine sulphate, organic acids and solanesol from tobacco waste works out to be 326, 1358, 68 tonnes, respectively. Tobacco seed contains about 35% semi-dry oil which is nicotine free and is used in paint and soap industries (Chakraborty, 1998).

Of all the tobaccos grown in India, FCV tobacco which is used for the manufacture of cigarettes is the major exportable type occupying 80-85% of the total tobacco exports. The current preference for FCV tobacco in world market is for the crop grown under irrigated conditions in the Northern Light Soils (NLS) of Andhra Pradesh and in the rainfed situation in the light soils of Karnataka during south-west monsoon season.

Karnataka state occupies an important position in FCV tobacco production, next to Andhra pradesh, with an area of 40-50 thousand hectares and annual production of 40-50 m. kg. More than 70% of the tobacco produced here is exported to several countries like Algeria, Bangladesh, Belgium, Czechoslovakia, Egypt, France, Germany, Jordan, Nepal, Russia, Singapore, UK, etc. earning considerable foreign exchange (Shenoi, 1998). Soil and the climatic conditions prevailing during the crop period are highly conducive for producing high quality neutral filler or semi-flavourful tobacco of exportable quality. Also, since the crop is grown naturally under rainfed conditions in Karnataka and contains low chlorides and pesticide residues, it is preferred by foreign traders. Among the rainfed crops, FCV tobacco gives maximum net returns to the farmer and there is no sustainable alternative to it.

In Karnataka, FCV tobacco is grown during kharif season in the southern transitional zone (STZ) of western ghats extending from south of Mysore district to Shimoga district (Fig. 2). This zone is popularly known as Karnataka Light Soil (KLS) region and mostly consists of sandy loam and loamy sand soils. 80% of the area is concentrated in H.D.Kote, Hunsur, Periyapatna and K.R.Nagar taluks of Mysore district.

KLS region with monsoonic climate, lower diurnal temperatures, higher relative humidities, well distributed rains and average annual rainfall of 650-1000 mm of which
Fig. 2. FCV Tobacco Map of Karnataka
80% is received during May to October period, coinciding with FCV tobacco crop season
is ideally suited for production of quality tobacco.

In Karnataka, FCV tobacco nurseries are usually sown during March-April period. About 60 days old, healthy seedlings are transplanted in the field. As the crop is grown under rainfed conditions, planting time is dependent on onset of monsoon and it extends from early May to mid-July. Seedlings are transplanted on to the ridges at a spacing of 100 x 55 cm (row to row - 100 cm; plant to plant - 55 cm). FYM @ 10 t/ha is applied to field by broadcasting before transplanting. Fertilisers NPK @ 30: 80: 80 kg/ha are applied as basal dressing within ten days after transplanting (DAT). Top dressing with 10 kg N/ha is given before 35 DAT. Interculture, topping and desuckering are done at timely intervals. Leaves are harvested as soon as they ripen, generally at six days interval, starting from 60 DAT. At each harvest, 2 to 3 matured leaves are primed from bottom of each plant. In general, a crop is fully harvested in seven primings in KLS region. The harvested leaves are flue-cured, graded and baled before marketing (Shenoi, 1998).

Unlike most other agricultural commodities, leaf is the final produce of commercial importance in tobacco and hence there is every need to protect the crop at the green leaf stage itself. One of the several important factors to achieve high quality tobacco is to manage diseases and pests which inflict significant loss in the overall yield and quality of the produce. The prevailing weather factors influence tremendously initiation and spread of several diseases caused by fungi, bacteria, viruses and nematodes at different stages of crop growth (Fig. 3) (Shenoi and Nagarajan, 1999). Among the important diseases, foliar spot diseases caused by fungal pathogens belonging to the group 'fungi imperfecti' are a constant threat to the tobacco grower despite serious efforts on improving crop management. Brown spot disease caused by *Alternaria alternata* (Fries) Keissler, hitherto a very important disease of bidi tobacco in Karnataka, is one among several foliar spot diseases which has now established as a major disease of FCV tobacco as well, causing at times significant loss in yield and quality of tobacco (Shenoi, 1998).

Brown spot disease is quite often referred to as a disease of maturity and senescence and is very sensitive to weather conditions. Its severity increases as the
### FIG. 3. DISEASES OF TOBACCO IN KARNATAKA

<table>
<thead>
<tr>
<th>NURSERY</th>
<th>FIELD CROP</th>
</tr>
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<tbody>
<tr>
<td><strong>NEMATODE DISEASE</strong></td>
<td><strong>NEMATODE DISEASE</strong></td>
</tr>
<tr>
<td>Root-Knot Nematode*</td>
<td>Root-Knot Nematode*</td>
</tr>
<tr>
<td><strong>FUNGAL DISEASE</strong></td>
<td><strong>FUNGAL DISEASE</strong></td>
</tr>
<tr>
<td>Damping-Off *</td>
<td>Black Shank*</td>
</tr>
<tr>
<td>Leaf Blight*</td>
<td>Frog-Eye Spot*</td>
</tr>
</tbody>
</table>
| Black Shank* | Brown Spot *
| Anthracnose * | Powdery Mildew *
| Frog-Eye Spot * | Fusarium Wilt *
| **BACTERIAL DISEASE** | **BACTERIAL DISEASE** |
| Angular Leaf Spot * | |
| **VIRAL DISEASE** | **VIRAL DISEASE** |
| Tobacco Mosaic* |
| Leaf Curl 2* |
| Ring Spot 2* |
| CMV 2* |
| Rosette 2* |

*Major problem

* Severity depends on seasonal weather factors

* Severe in certain endemic areas

* Isolated/rare/minor.

1. Mechanically transmitted

2. Vector transmitted
season progresses causing serious economic loss. According to Lucas (1975), most damage to the commercial flue cured tobacco crop in the world is due to the brown spots. Frog-eye spot, caused by *Cercospora nicotianae* and the brown spot disease play major roles in the classification and marketing of KLS tobacco, since these two diseases directly affect appearance and quality parameters of cured leaf. Brown spot is now known to alter the quality of cured tobacco in many ways. The affected tobacco has poor ageing capacity, produces more acrid and irritating smoke, causes loss of weight, increases filling value and shatter index and decreases the equilibrium moisture content, and affects colour intensity. These adverse qualities due to the disease seriously affect classification and market value of the produce (Lucas, 1975). According to Main and Chaplin (1972), decrease in equilibrium moisture content alone is known to reduce the yield sufficiently to constitute an economic loss to the farmer, if the crop is severely affected by brown spot disease. The disease is now gaining importance in FCV tobacco growing areas of Karnataka, particularly, in several pockets of hot spot areas and in late planted crop fields. The disease has been found to be spreading to more areas every year. Besides FCV tobacco of KLS region and NLS and TBS areas in Andhra Pradesh, the disease also causes serious damage in other tobaccos like bidi tobacco of Nippani area in Belgaum district of Karnataka and hookah tobacco of Cooch-Behar in West Bengal (Anon., 1998c). Production of a successful and profitable tobacco crop in such areas now depends on the management of brown spot disease in addition to other diseases and constraints.

Scanty information is available on this disease, particularly on Indian tobaccos. Hence, a detailed study on brown spot disease is need of the hour. Since there is every chance of the disease becoming a new threat to FCV tobacco cultivation in the near future in this country, an indepth study on brown spot has been taken up on the following aspects:
1. **Brown spot disease survey and assessment of disease severity levels under different agro-ecological situations of KLS region**

2. **Epidemiological studies**
   a) **Study of brown spot disease progress curve and factors influencing the disease spread**
   b) **Critical study of the period between the inoculation of leaves and disease manifestation**
   c) **Role of abiotic factors influencing disease manifestation**
   d) **Influence of biotic factors on disease perpetuation**
      (i) **Weed host range studies**
      (ii) **Survival of Alternaria alternata on host crop residues**
   e) **Interaction with root-knot nematode**

3. **Crop loss assessment—Quantification of yield and quality loss due to brown spot disease**

4. **Disease management studies**
   a) **In vitro evaluation of potentially effective botanical species and fungicides for the suppression of growth and sporulation of A. alternata**
   b) **Evaluation of chemical fungicides and determining effective spray schedules for disease management**
   c) **Evaluation of tobacco germplasm for identification of resistant donors and studies on disease inheritance**