citizens. Night Schools for adults and working men's institutes give good opportunities to combat ignorance amongst the masses. Under their auspices Agricultural and Medical Officers should go about as peripatetic teachers giving lectures illustrated by lantern slides, projecting lantern and stereoscopic displays on useful topics pertaining to Agriculture, Sanitation and Geography.

With the education of adults, the question of primary education is easily solved and the chances for children to take to education more unreservedly will be proportionately greater.

A CONTRIBUTION TO THE STUDY OF BLACK SOIL PLANTS

BY P. S. JIVANNA RAO, M.A.

Introduction—Black soil also known as regur or regada covers a total area of 300,000 square miles of the Indian soil and the great bulk of the cotton crop in India is grown on it. Of this area about three million acres are within the Presidency of Madras and belong to the districts of Bellary, Cuddapah, Kurnool and Anantapur forming the Ceded or Deccan districts and portions of Guntur, Salem, Trichinopoly, Ramnad and Tinnevelly districts.

The cause of the black colour and the nature of the constituents, both physical and chemical, of this soil formed the subject of special investigation by Leather (1898), Annett (1910) and Harrison (1912) who have expressed divergent views on the matter.

The characteristic features of the soil are: it consists of black clay friable when dry, sticky and adhesive when wet and cracking deeply in hot weather. It varies in depth and fertility from 1½ to 5 feet in Coimbatore and 5 to 10 feet or more in parts of Bellary and Kurnool districts being underlain in one case by kankar and by beds of red earth in the other. Retention of moisture is its most valuable property which varies according to texture and depth. Though the soil is derived from diverse formations, it possesses common characteristics which go to support an interesting type of vegetation consisting more of herbs and shrubs than trees. In addition to cotton several other crops are raised on it; namely, sorghum, tenal and cambu among grasses, bengal gram, groundnut, red gram, black gram and indigo among the legumes, tobacco and chili, onion, safflower, gingelly, castor, linseed, mustard, cummin, coriander etc.

Flora—By reason of its cracking during dry weather which injures the root system the soil is ill fitted for tree vegetation in general and this gives the appearance of barrenness to extensive tracts of land which are otherwise fertile. The tree flora is thus very limited and consists of a few species like Acacia arabica, Balanites racemosa, Eucalyptus grandis, Dichrostachys cinerea and Zizyphus jujuba. The Nirm (Azadirachta indica) and the tamarind (Tamarindus indica) are planted in avenues and among shrubs may be noticed Calotropis gigantea, Cassia auriculata and Opuntia Dillenii. The half shrubs and herbs, however, are a much larger number of which the more characteristic are: Alstonia scholaris, Asitachicia bracleti, Chrozophora pleiada, Hibiscus tiliaceus, Ischaemum pilosum, Jatropha gaudiffiera, Monodora tuberosa, Panicum Isachne, Phyllanthus madraspatensis and Wilthania somitiera.
The peculiarities that may be observed among these plants relate to the modifications of roots, stems and leaves, the extent of root system, and the depth of the absorbing portion thereof, and perennation methods adopted by some of them.

Subterrannean modifications—A study of the underground parts made in some of these plants discloses very interesting adaptations for successful modes of life in relation to the soil. The similarity to well-known types will be manifest in many of these but attention is here drawn to them as the plants are members of a definite formation in which the soil is the principal guiding factor. Further, as Hilgard (1860, 1906), Chamberlin (1877) and others long ago realised the native vegetation consists as it does of ‘nature’s crops’ is an important indicator of the agricultural capabilities of a district and a study of this from various aspects is calculated to be of service in understanding the raison d’être of crop distribution.

The simplest modifications are to be seen in Withania somnifera and Datura Metel, where the tap roots are swollen and fleshy and could be cut easily with a knife the latter root suggesting the appearance of radish. In Monardica tuberosa a common circumtibaceous weed of the Ceded districts the root swells into a tuberous body beneath the attachments of the cotyledons which are hypogeal in germination and gives rise to new shoots from the base of the old ones aided by the abundance of water and reserve material stored in the tuber. Potato-like tubers developing at intervals are a striking feature in the roots of Cyamadia carvosa (Vitis carvosa, Well) in which suckers are formed from injured roots—a peculiarity which is noticeable in Aristolochia bracteata and Clerodendron Palumidis. Small tubers terminating the roots are a conspicuous feature in the root clusters of Chlorophyrum tuberosum a weed found in Bellary (Hagari) and Kurnool (Nandyal). Circulus Orchidoides (Amaryllidaceae) is characterised by ‘pull roots’ which may be said to lower the depth of the vertically elongated rhizomes. Scilla indica and Dipcord montana possess onion-like bulbs. Small bulbs terminate the slender underground shoots in Cyperus bulbosus and later grow into fresh plants. Cyperus rotundus, Cynodon dactylon, and Ischaemum pilosum develop underground shoots of a varying nature.

Leaf forms—As organs of transpiration the leaves of species in any association merit special consideration. From being utterly absent in Opuntia Dillenii they are about 2x25 m.m. in Oldenlandia espea, minutely divided in Acacia arbusia and attain a size of 60x100 m.m. in Tylephora asthma. Those of Jatropha gangetica, Datura Metel and Withania somnifera are large and herbaceous and in Solanum xanthocarpum and Argeumuxi mexicana they are armed with prickles. Very striking differences in size were thus observed in the leaves of plants collected from what may be termed a ‘Withania Formation’—an extensive area of black soil land near the Agricultural College and Research Institute, Coimbatore long under cultivation but given over for house sites some years ago. Withania somnifera is the dominant constituent of this vegetation and the chief associates are: Alysicarpus rugosus, Argemone mexicana, Aristida adscendens, Aristolochia bracteata, Brachia cvrepens, Calotropis gigantea, Citrullus colocynthis, Cynodon dactylon, Opuntia Dillenii, Panicum Ischiae, Solanum xanthocarpum, Tylephora asthma, Vohlerella diversicata.
Root Development—Wide diversity exists in the matter of root behaviour. The tap roots in *Withania somnifera*, *Boerhaavia repens*, *Pentapodium microphylla* and *Echoloma Linnaeum* penetrate to beyond 2½ feet depth in the soil. That of the hardy and persistent *Cocculus pendulus* penetrates to beyond 8 or 9 feet, maintaining a tortuous course and giving suckers from injured roots thus defying all attempts at eradication. Surface absorbing roots with spreading laterals are a special feature of the adventitious roots in *Opuntia Dillemii* and *Tylophora asthmatica* and in the laterals of *Withania somnifera* which sometimes measure even about 6 feet in length and are occasionally attacked by the parasite *Orobanche ceratia* at some distance from the main root. The absorbing roots in the bulbous *Sallia indica* and *Dipsaci montana* and the tuberous *Monordica tuberosa* generally arise beyond 6 inches in the soil and in *Chlorophytum tuberosum* they arise in delicate tufts from the ends of the tubers. In *Jatropha glandulifera* the first four laterals arise from the same point immediately within the soil and grow in advance of the main root.

Economics—In the assemblage of crops cultivated on black soils one notices prototypes of plants composing the natural vegetation. Thus: *Abutilon indicum*, *Hibiscus cannabinus*, *H. florinanae* and *H. pandurastormi* are allied to cotton (*Gossypium herbaceum*, *G. indicum*), *Benilipatam jute* (*H. cannabina*us) and *ovra* (*H. esculenta*). The leguminous weeds *Indigofera tritica* and *Phascolus truncatus* though particularly related to *Indigo* (*I. tinctoria*) and *Black gram* (*P. Mungo*) respectively, offer further possibilities for leguminous crops in general of which groundnut has now spread with extraordinary rapidity in new areas. It is interesting to note that *Volutarella divaricata* a weed of black soils is from the systematic point of view a close relative of safflower (*Carthamus tinctorius*). The solanaceous crops may likewise be said to be well suited for the black soil like their wild forbears. Other examples may be given for the orders *Gramineae*, *Euphorbiaceae*, *Pedaliaceae*, *Cucurbitaceae*, *Vitaceae* etc. It may be said that cultivation methods have intensified in these crops the responses and modifications which are a natural though less conspicuous feature of the corresponding wild types.

Of the large number of plants referred to in this paper though a few happen to be pests in agriculture like *Aristolochia bracteata*, *Clerodendron Phionia*, *Cocculus pendulus*, *Cynodon dactylon*, *Cyphus rotundus*, and the parasites *Striga* and *Orobanche* others possess special qualifications for being exploited. Mention may only be made of *Sticta indica* the Indian squill, *Tylophora asthmatica* having properties similar to those of *Ipecacuanha*, *Datura Metal*, *Withania somnifera* (*Astragalus*), *Boerhaavia repens* (*Punarnava*), *Cardiospermum Halicacabum* and others of wide repute in Indian medicine.

The leguminous weeds *Rhynchosia minima* and *Phascolus truncatus* and the grasses *Panicum ischaemum*, *Cynodon dactylon*, *Isellina lacunum* and *Andropogon annulatus* are good fodder for cattle while one weed *Euphorbia corrigioides* is said to fatten sheep.

Finally a word of suggestion may also be made with regard to *Ziziphus Jujuba* a hardy perennial indigenous to black soil districts which may be turned to very good account by being employed as stocks for superior varieties by budding. *Jujube* is said to be a very remunerative crop among fruits requiring less labour and attention and notable success has already
been achieved by horticulturists in Kurnool district (Panyam) where a Citrus × Feronia combination was tried with success in 1924.

REFERENCES


ECONOMICS OF GRAPEVINE CULTIVATION

By C. RANGASWAMI AYYANGAR

(*Assistant Demonstrator in Mycology*)

The cultivation of grapevine was introduced in Tamil country forty years ago. Rev. Larmey was the first to introduce it in Panjampatti village in the Madura district. The cultivation of vine gradually spread from one village to another and now nearly eighty acres are under this crop in several villages in Madura and Trichy districts. The cultivation aspect of it has already been dealt with in an article published in the Madras Agricultural Students' Union Journal, Vol. XI. 1923.

About three hundred vines are planted to an acre. Each garden on an average consists of fifteen to twenty vines and seldom can a cultivator pay attention to more than fifty vines. The vines begin to yield only two years after planting and the following statement gives a record of income and expenditure for the first three years after planting.

**Details**

<table>
<thead>
<tr>
<th>Year</th>
<th>Preparatory cultivation (i.e., ploughing)</th>
<th>Rs</th>
<th>A</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levelling, and digging of pits</td>
<td>80</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Erecting pandal</td>
<td>280</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Maunuring (leafmould)</td>
<td>130</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>After cultivation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maunuring, cattle manure at 70 cartloads, per acre</td>
<td>70</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Weeding</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td>270</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>860</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>