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.

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A CONTRIBUTION TO THE STUDY OF BLACK SOIL PLANTS

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Introduction—Black soil also known as regur or regada covers a total area of 200,000 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, tenai and cumbu among grasses, bengal gram, groundnut, red gram, black gram and indigo among the legumes, tobacco and chilli, 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 Roxburghii*, *Butea frondosa*, *Dichrostachys cinerea* and *Zizyphus Jujuba*. The *Nim* (*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: *Alysicarpus rugosus*, *Aristolochia bracteata*, *Chrozophora plicata*, *Hibiscus ficulneus*, *Ischaemum pilosum*, *Jatropha glandulifera*, *Momordica tuberosa*, *Panicum Isachne*, *Phyllanthus maderaspatensis* and *Withania somnifera*.

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.

Subterranean 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 consisting 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'etre* 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 *Momordica tuberosa* a common cucurbitaceous 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 *Cayratia carnosa* (*Vitis carnosa, Wall*) in which suckers are formed from injured roots—a pecularity which is noticeable in *Aristolochia bracteata* and *Clerodendron Phlomidis*. Small tubers terminating the roots are a conspicuous feature in the root clusters of *Chlorophytum tuberosum* a weed found in Bellary (Hagari) and Kurnool (Nandyal). *Curculigo Orchioides* (*Amaryllidaceae*) is characterised by 'pull roots' which may be said to lower the depth of the verticaliy elongated rhizomes. *Scilla indica* and *Dipcadi 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 2×25 m.m. in *Oldenlandia aspera*, minutely divided in *Acacia arabica* and attain a size of 60×100 m.m. in *Tylophora asthmatica*. Those of *Jatropha glandulifera*, *Datura Metel* and *Withania somnifera* are large and herbaceous and in *Solanum xanthocarpum* and *Argemone mexicana* they are armed with prickles. Very striking diffrences 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 adscencionis*, *Aristolochia bracteata*, *Boerhaavia repens*, *Calotropis gigantea*, *Citrullus colocynthus*, *Cynodon dactylon*, *Opuntia Dillenii*, *Panicum Isachne*, *Solanum xanthocarpum*, *Tylophora asthmatica*, *Volutarella divaricata*.

Root Development—Wide diversity exists in the matter of root behaviour. The tap roots in *Withania somnifera*, *Boerhaavia repens*, *Pentatropis microphylla* and *Ecbolium Linneanum* 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 Dillenii* 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 cernua* at some distance from the main root. The absorbing roots in the bulbous *Scilla indica* and *Dipcadi montana* and the tuberous *Momordica 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 micranthus*, *H. ficulneus* and *H. panduraeformis* are allied to cotton (*Gossypium herbaceum*, *G. indicum*), Bimilipatam jute (*H. cannabinus*) and *okra* (*H. esculentus*). The leguminous weeds *Indigofera trita* and *Phaseolus trilobus* 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 (*Carrhamus 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 *Gramineæ*, *Euphorbiaceæ*, *Pedaliaceæ*, *Cucurbitaceæ*, *Vitaceæ* 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 Phlomidis*, *Cocculus pendulus*, *Cynodon dactylon*, *Cyperus rotundus*, and the parasites *Striga* and *Orobanche* others possess special qualifications for being exploited. Mention may only be made of *Scilla indica* the Indian squill, *Tylophora asthmatica* having properties similar to those of *Ipecacuanha*, *Datura Metel*, *Withania somnifera* (*Aswagandha*), *Boerhaavia repens* (*Punarnava*), *Cardiospermum Halicacabum* and others of wide repute in Indian medicine.

The leguminous weeds *Rhynchosia minima* and *Phaseolus trilobus* and the grasses *Panicum Isachne*, *Cynodon dactylon*, *Iseilema laxum* and *Andropogon annulatus* are good fodder for cattle while one weed *Euphorbia corrigioloides* is said to fatten sheep.

Finally a word of suggestion may also be made with regard to *Zizyphus 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.

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ECONOMICS OF GRAPEVINE CULTIVATION

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The cultivation of grapevine was introduced in Tamil country forty years ago. Rev. Larney 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

1 YEAR:

Preparatory cultivation (i.e.) ploughing

	Rs	A	P
Levelling, and digging of pits	80	0	0
Erecting pandal	280	0	0
Manuring (leafmould)	130	0	0
After cultivation			
Manuring, cattle manure at 70 cartloads. per acre ...	70	0	0
Weeding	30	0	0
Irrigation	270	0	0
Total ...	860	0	0