37

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37

CONTENTS

3

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EDITORIAL

The Madras Five Year Plan By the end of April 1945 the Government's five year plan of development in this province was published. The working of the plan will involve an expenditure of Rs. 136½ crores out of Rs. 146½ crores likely to be available. The plan of development will be in three stages. Those of the first stage includes the opening of two new Engineering Colleges, a new Medical College, Polytechnical Institutions, the reopening of the Madras Forest College at Coimbatore and the opening of an Agricultural College in the Telugu area. It also includes two other special priority schemes intended exclusively for the rehabilitation of the Ex-service men. The other two stages of the plan comprise all-province schemes, and schemes for the economic development of particular areas.

The agriculturist is naturally interested to know how the plan is going to deal with problems of agriculture, livestock, forests, fisheries and means of conveyance of his produce to markets. It is understood that the plan includes provision for the wide expansion of the activities of the respective departments. In the agricultural department there may be increased activity with regard to the multiplication and distribution of the improved strains of seeds not to speak of seeds for raising green manure crops, and the procurement and supply of manures and implements at concession prices to the farmers. Serious notice seems to have been taken of the deterioration of the soil of some of the areas by surface erosion. It is estimated that in the districts of Bellary and Vizagapatam nearly two lakhs of acres will be improved by contour embankments to prevent the loss of valuable surface soil. It is also contemplated to improve some portions of the deltas by taking measures to improve the drainage. It is expected that it would result in a higher output of rice from those areas.

The plan aims at the production of one lakh of bulls and one lakh of cows of good parentage by the establishment of breeding centres in the Ongole, Kangayam and Hallikar breed tracts. There is provision for the expansion of the veterinary help in tracts not yet provided and also for having breeding centres to improve sheep and poultry.

There are proposals for the acquisition and control of private forests, and for the return of the panchayat forests to the control of the department. This step seems to have been taken up after mature consideration in the interest of the province as a whole. Revenue producing schemes such as the extension of casuarina, soft wood and teak plantations have been proposed. It is hoped that as years go by both the village and the town dweller will be able to have his timber and fuel needs better met with. This is a measure of immense necessity as there have been premature and increased fellings in the forests as a result of war needs. It is also expected that there will be soil conservation activity in the forest department too, so that the care and conservation starts from the sources of deterioration in higher elevations. This together with what is proposed to be done by the agricultural department will make a complete whole with regard to this problem.

There is provision to increase the strength of the Department of Fisheries, to develop the pearl and chank fisheries and also set up centres for the demonstrations on fish manure manufacture. The agriculturist will be keenly interested in the latter, while the country as a whole would want the pearl fisheries to develop like what it was in Japan. The agricultural conditions are sought to be improved by taking up irrigation projects The five year plan includes the hope of executing seven major irrigation projects and several minor works The rural economy is expected to be improved by extending cheap electric power in the villages for lifting water from wells for irrigation. The agriculturists in fact are eagerly awaiting this, especially where cattle power has of late become very costly. In the scheme of road development which is expected to be completed in 15 years, there is provision to improve 8,800 miles of village roads To reduce the cost of road maintenance there is provision to afford facilities to bullock cart owners by way of grant of subsidies or by grant of loans on easy terms to enable them to fit pneumatic tyres to their carts or for the purchase of carts with pneumatic tyres This is more intended for town cart owners. The village carts need improvement. It has been held by some road engineers that the draft of the bullock cart can be improved by the use of ball bearing hubs to the wheels. Further it is claimed that the damage to the road may be lessened a good deal by having the iron tyre of the bullock cart wheel wider than what it is at present.

Above all there is urgent need to improve the life in villages. Unless there is improvement in the rural environment to the accepted standards of modern science an increase in wealth will only make the villager go and live in towns to the detriment of agriculture. Therefore the plan includes the execution of half of the programme of the provision of protected rural water supply drawn in 1938. It is also aimed in the plan that no village will be more than five miles from a rural dispensary. If these proposals are executed, there can be no doubt that the rural economy of this province will be gradually improved to the desired level.

Certain Peculiar Agricultural Practices in the Madras Presidency.

By V. T. SUBBIAH MUDALIAR AND M. NARASIMHAM

Accounts of special and peculiar agricultural practices prevailing in the different parts of the Madras Presidency were collected sometime back in the office of the Director of Agriculture. It is seen that these practices suit the local conditions that prevail in the different places, obviously as a result of centuries of experience. Many of them, no doubt, would be equally suitable for other places having similar conditions. With this end in view the following compilation has been made in the hope that it would be both informatory and useful. It has been attempted to group the practices under (1) Crops and (2) Cultivation practices, but there is a certain amount of unavoidable overlapping on account of their close interdependance.

Crops: (a) Paddy (1) *Dry nurseries in Kistna District.* Dry paddy nurseries are raised in sandy soils with liberal manuring, far ahead of the planting season The seed rate adopted is $8\frac{1}{2}$ lb. of seed per cent and seedlings from 2 cents of nursery plant an acre normally. This is about the lowest rate of seeding adopted for paddy. This practice is based on the facts that water is not available easily for raising nurseries, prior to the receipt of water in the canal and that early planting is advantageous and profitable in the locality. The need for reducing the seed bed area and the seed rate is obvious.

(2) *Semi dry paddy cultivation.* Water is received for the cultivation of paddy in August—September in parts of East Godavari, Chingleput, South Arcot, etc. The light soils are ploughed with the summer rains and paddy is sown broadcast or drilled with the early rains in June. Where the crop is drilled, intercultivating implements are worked in between the paddy rows to keep down the weeds. The crop is not irrigated for about 2 months. The fields are flooded on receipt of water in the tanks and small country ploughs are worked carefully to stir the soil and lightly disturb the paddy plants. The disturbed plants get re-established and make vigorous growth. Thereafter they are irrigated just like the ordinary wet crops. Wet paddy crops raised after the receipt of water in the tanks are generally poor in these tracts and hence early dry sowing is adopted.

(3) *Ratooning paddy.* Paddy is allowed to ratoon in single cropped wet lands in years when late rains are plentiful and water supply in the tanks is kept up. Certain varieties like *Peddamypalai* and *Yerra sannam* are known to ratoon well and yield about 400 lb of grain per acre.

(4) *Deep water paddy.* A paddy variety, called *Kolaivalai* is grown in the tank beds on the Periakulam taluk of the Madura District. It has the reputation of being able to stand submersion in water. The variety is said to be very nutritious and is preferred for making puffed rice.

(5) *Seed and grain preservation* Paddy seeds are stored in South Canara in straw bundles which are more or less round shaped. These are called *Muras* and contain about 85 lb. of seeds. The bundles are plastered over with cowdung and stored over the fire place. South Canara has heavy rains and the atmosphere is highly humid and paddy seeds stored otherwise lose their vitality.

Paddy grains are stored in receptacles made of twisted paddy straw and the top of the receptacle is covered by nice paddy straw thatch.

(6) *Lowering the levels of wet lands* When paddy fields get silted up, the level of the fields has to be reduced occasionally to facilitate irrigation in parts of the Tanjore District. A series of long pits running along the length or width of the field are dug parallel to each other in summer. The pits are nine inches to a foot in depth and of varying width. The soil removed from the pits is used for filling up depressions and low level fields. During puddling in the season the fields get levelled up.

(7) *Dry crops in single cropped wet lands.* In certain parts of the Trichinopoly district the water supply is uncertain at the beginning of the season. In such places a groundnut crop is raised in the beginning and this is followed by paddy. Mixed crops of *cholam* and pulses are grown under similar conditions in parts of the Tinnevelly District. Where water supply becomes uncertain for commencing a second crop of paddy, pulse crops—black gram and green gram—are raised. This may be possible in many of the single cropped wet lands also. If the pulse crop is sown just prior to the harvest of paddy and is established, it would come up with the moisture retained by the paddy fields.

(b) Cholam. (1) *Mixed cropping. Talaivirichan cholam,* a six month variety and *kullon cumbu,* a 3½ month variety are sown mixed in June with the advent of the south-west monsoon in parts of the Salem District. Pulses like black gram, green gram and *D. lablab* are also mixed with the above in certain cases. *Cumbu* is harvested in September and *cholam* in December. The mixture gives some crop at least during adverse seasons. When the south-west *monsoon* is satisfactory and the north-east monsoon poor a fair *cumbu* crop is had. When both the monsoons are satisfactory, good yields of both *cumbu* and *cholam* are obtained.

(2) *Cholam—cucumber mixture. Cholam* and *nakka dosakaya,* a variety of cucumber, are sown together in the black soils of Nandyal. The cucumber is used as a vegetable when fresh and the surplus is sliced, dried and preserved. The dry cucumber chips are fried in oil and used occasionally.

(3) *Transplanting cholam* *Cholam* is not normally transplanted, but it can be done. The onion crop in Dindigul comes to harvest in March and *cholam* seedlings are transplanted amidst the onion crop, 15 days prior to its harvest. This is a successful practice. The season for onions is December—March and for *cholam* March—June and the two seasons overlap and there is no time for preparing the land for the *cholam* crop after the harvest of the onion. The above device works satisfactorily and the cholam crop is given an extra deep hoeing to make up for the want of the preparatory cultivation.

Cholam seedlings about 25 days old are transplanted in the central districts, with the main object of saving two or three irrigations.

(4) *Transplanting in dry lands. Cholam* and *ragi* seedlings are dibbled in plough furrows in parts of Vizagapatam and Salem. *Cumbu* is similarly transplanted in parts of Cuddapah. The dibbling of the seedlings is done generally when there is drizzly weather. This system permits long duration varieties being grown, where otherwise short duration varieties only would have to be sown directly. This system is in vogue in tracts where rainfall is received rather late.

37

(c) Sugarcane (1) *Saving cane setts.* In the Bobbili taluk of the Vizagapatam district the later tillers and the big sized watershoots (gormandisers) of sugarcane crop is not cut at the time of harvest of the cane crop at maturity. The fields are irrigated occasionally and the tillers left behind make fair growth during the interval between harvest and planting and provide seed material. The amount of seed material secured is not negligible in early varieties and in profusely tillering varieties. Further as the setts are obtained from immature material their germination is very satisfactory.

(2) *Sugarcane trash.* The sugarcane trash obtained at the time of cane harvest is used as bedding in the cattle stalls, in parts of Anakapalli. The trash serves as litter. It is gathered and spread over the young cane fields as a good surface mulch. This practice is said to save a few irrigations initially and induce good growth in the young canes.

(3) *Cane planting season.* Sugarcane is planted mainly in two seasons round about Coimbatore, in February—March and July—August, though planting may be done all the year round to provide chewing canes. The February—March planting is preferred where water supply is limited in the summer months. This crop is however subject to the heavy westerly winds during the south-west monsoon season and flowers during the north-east monsoon. The July planted crop is however not subject to these disabilities, but the crop is full grown in summer and requires to be irrigated copiously, consequently an adequate water supply is required.

(4) *Cropping round sugarcane fields.* The sugarcane fields are planted all round with *agathi* (*Sesbania grandiflora*) in the Giddalore area of the Cuddapah District. The Agathi stems are well grown and provide props for putting up thatched pandals for jaggery boiling. The *agathi* leaves gathered by breaking off the side branches provide greens for the household for a large part of the year.

(d) Plantains. (1) *Inter-cropping in plantain area.* Plantains are planted 12—15 ft. apart round about Bhimilipatam in the Vizagapatam district and the crop is kept on the land for 5—6 years. In the first year two inter-crops are taken, the first one being either *pyru ragi* or chillies.

After the plantains put forth the bunches, three to four suckers only are retained and the leaves are periodically harvested. Inter-cropping the plantains is resorted to in this tract, as the garden land holdings are very small, generally less than an acre and the cultivators are anxious to make the most of the available land.

(2) *Inter planting plantains.* Plantain suckers are inter-planted in Turmeric fields during November in the Repalli taluk of the Guntur District. The plantain suckers establish themselves and make good growth after the turmeric is harvested in February—March. This practice permits quick succession of crops and saves time considerably.

(3) *Propping the plantains.* The plantains in Yellamanchili of the Vizagapatam district are supported by casurina props, struck vertically into the soil near the base of the plant at the rate of one per plant. The plant is tied to the prop at two or three places with plantain and palmyra fibres. Propping is resorted to as the cyclonic weather in November and May causes lodging and damage up to even 90% at times. Propping saves 50—60% of the plants. The plantain bunches in Godavari are supported by a fork made up of two bamboo poles tied together. By using single poles young plants are supported. It may be mentioned that the South Arcot cultivator plants the dwarfish 'Maruitius' variety to avoid damage by cyclonic winds.

(4) In *thella* and *karpura-chakrakeli* plantain garden of the Circars the common curry variety of plantains, *bontha* is planted all round. The *bontha* plantains are said to act as wind breaks, being more hardy and less liable to breakage than the *thella* and *karpura* chakrakelis.

(e) Turmeric *Mixtures in turmeric fields.* Many crops, particularly vegetables are grown mixed with turmeric in all parts of the Presidency. Coriander and amaranthus are sown in the beds along with turmeric and the sides of the irrigation channels are planted to vegetables like brinjals, ladies fingers, radish, cluster beans, etc., in Tirupattur. Coriander and amaranthus are harvested by the time turmeric germinates and starts growing. The other vegetables begin to yield in course of time. By adopting this system of cultivation the *ryot* is enabled to get income continuously by the sale of vegetables. The income may range from Rs. 10 to Rs. 20 an acre and comes in handy for meeting the cultivation expenses on the turmeric crop.

Occasionally *agathi* also is planted along the irrigation channels. Agathi is allowed to grow till June, though turmeric is harvested in February—March. The *agathi* stems are well formed during harvest and are purchased by gardeners to serve as props for betel vines. The side branches of *agathi* are broken off as they are formed and sold for use as greens and cattle feed. *Agathi* leaves contain more protein than the other leguminous plants and are said to increase the secretion of milk in cows.

In the Hindupur taluk (Anantapur), 10 lb of coriander, 2 lb of mustard and 2 lb of fenugreek (per acre) are broadcasted, beds are formed and

turmeric is planted. On the top of this one lb. of radish and 1½ lb. of chilli seeds are dibbled. All the crops come to harvest within three months except chillies and turmeric. The fields are given a deep hoeing thereafter. It is said that the money realised by the sale of the minor produce meets the cost of cultivation of turmeric.

Ragi and mustard are grown as a mixture with turmeric in Badvel of the Cuddapah district. Castor is sown 10—15 feet apart in Proddattur to provide shade for the turmeric crop. Red gram is sown likewise in Rajampet.

(f) Betel vine. (1) Drumstick and *agathi* seeds are sown far in advance of planting betel vine to serve as standard for the betel vine in the Guntur district.

(2) Regular *pandals* with *cumbu* straw are put up in the Vizagapatam area and provide shade for the young betel vines.

(3) Betel vine is interplanted in the arecanut gardens near about Calicut. The areca trees serve as standards for the betal vine to cling on.

(g) Fodder crops. Sunnhemp is sown extensively in the Circars a week before the harvest of paddy in wet lands. The sunnhemp crop makes good growth with the moisture retained in the soil. The crop is harvested, when in flower, dried into hay and stacked with paddy straw in alternate layers. The leguminous hay enriches the paddy straw.

Pillipesara, horsegram, *cholam* and maize are also grown for fodder, either pure or mixed, in wet lands after the harvest of paddy. Black gram and green gram are also grown for grain similarly in wetlands.

(h) Vegetables. Brinjals are planted in November in parts of Vizagapatam. The harvest of the fruits is completed by July when gourds and other cucurbits are inter-planted. The cucurbit vines trail over the brinjal plants and there is not any need for putting up *pandals* for the cucurbits. This appears to be a device worth copying in other places as well.

Cultural practices: *Manuring.* The white encrustations (*Pati-sovudu*) from the old village sites are applied as a top dressing to brinjal and chilli crops in Circars. Old village site earth (*Patt-Mannu*) is applied to paddy fields in large quantities and its effect is said to last for 5—10 years. Ordinary samples of the earth contain one per cent in each of potash and phosphoric acid.

Tamarind seeds are applied to wet lands at 10—12 bags an acre in Bellary district for purposes of manure and for correcting the alkalinity of the soil. Tamarind leaves and husk are used similarly in parts of Salem district.

Silt is collected from river beds in Malabar coastal areas, where the water in the river is saltish, and applied to coconut trees with beneficial effect.

Gingelly is sown in wetlands after the harvest of the sugarcane as green manure for the succeeding paddy crop in the Hospet taluk of the Bellary district. Gingelly is preferred to sunnhemp, as the latter is highly susceptible to insect damage.

Sunnhemp is sown mixed with *ragi* and *varagu* in parts of Vizagapatam. The sunnhemp is a long duration variety. After the harvest of the cereal crop the sunnhemp is ploughed in as green manure for the succeeding paddy crop. The holdings are small in these areas and setting apart land for growing green manure is not feasible. A similar practice prevails in the North Arcot district also. *Kolingi* or Indigo is sown in the standing crop of *ragi* planted in December—January. The green manure crop is usually sown after the first hoeing for ragi and is later ploughed in at the time of preparing the land for the next paddy crop.

Indigo is also sown mixed with gingelly in parts of North Arcot during December. The first cutting of indigo taken after the harvest of gingelly is used for manuring the *Kar* paddy crop in May. The indigo stubbles make further growth and the second cutting taken in July—August is used for manuring the *samba* crop. Indigo is also sown in the standing tobacco crop at the time of hoeing in December. The indigo plants are cut in July and used as green leaf manure. Indigo is sown similarly in ragi and groundnut fields in different parts of the Presidency. Gingelly, indigo and mustard are sown mixed in wet lands after the harvest of the paddy crop in February—March in the Tanjore District

Production of green manure seeds. Sunnhemp is sown mixed with cotton, groundnut and red gram in the Vizagapatam district, with dry paddy, red gram and cotton in the Godavari district, and with *jonna* or other dry crops in the Guntur district. It is rarely grown as a pure seed crop in parts of Kistna, Guntur and Vizagapatam. Indigo is sown mixed with *tenai* or pure in the dry lands of the Nandyal valley for production of seed. *Daincha* is sown for seed in single cropped wet lands after the harvest of paddy in the Salem district.

Cultivation. Tobacco seedlings are planted rather widely in a second nursery in the Nuzvid area of the Kistna district, and eventually in the field proper, when the seedlings are well grown and sturdy. The double transplantation hardens the seedlings and the crop is enabled to withstand diseases better.

Paddy seedlings are planted likewise in a second nursery in parts of Nellore and Tinnevelly districts in seasons when rains are late and water is not received in sufficient quantities in the tanks in time for taking up the planting of the main fields. This double transplantation arrests rank vegetative growth and enables long duration varieties being grown even in late seasons. This is particularly valuable in areas where short duration varieties fare badly when compared to the long duration season-bound varieties.

Chillies are transplanted in September and tobacco in October in the Gurazala taluk of the Guntur district. The gaps occuring in the chilli fields are filled up with tobacco seedlings in October, and the available space is thus fully utilised.

Groundnut and cotton are sown in the same line using the seed drill in parts of the Guntur district. It is claimed that this promotes the growth of the cotton crop.

Crops are sown in the Ceded districts with the help of country made seed drills called '*gorrus*'. The *gorru* consists of a common beam to which a number of small plough bodies called tynes are attached. The tynes are connected to a seed hopper by means of bamboo or tin tubes and the seeds dropped in the hopper get distributed in the furrows marked by the *gorrus*. The seeds are covered by working a blade harrow or *guntaka* behind the *gorru*. Mixed crops are also sown with the drill. The common mixture of the Ceded districts is cotton and *tenai*. The central hole in the hopper is blocked and *tenai* seeds are dropped in the two end rows. The cotton is sown in central furrow with a separate bamboo feeder called 'Akkadi'. Thus two rows of *tenai* and one row of cotton alternating are sown together. Since the spaces in between the rows of crops are equal, the interspaces are hoed later with bullock hoes of suitable width. Considerable labour is saved in sowing, and intercultivating. There is saving in seed also. Further the seeds are all deposited at a uniform depth and germination is therefore uniform.

Cholam is occasionally sown in the Ceded districts in between the early season (*Mungari*) *tenai* lines with the aid of a small sized plough; the seeds are dropped in the plough furrows with an *akkadi*.

Tobacco and mustard seeds are mixed and sown in the nursery in parts of Ramachandrapur taluk of East Godavari. The tobacco seedlings are pulled out when they get ready. The mustard produced in the tobacco nursery is reported to be extremely good and is preferred for making mango pickles.

Gogu is sown mixed with dry paddy, cotton and red gram in the uplands of the Godavari and Kistna districts. *Gogu* serves as a leafy vegetable in the early stages and is used for the extraction of fibre later. The *gogu* leaves are fed to cattle in Guntur district.

Onions and chillies form a favourite mixture in the dry black soils of East Godavari district. The chilli crop is first planted in lines and the onions are dibbled later in September between the chilli lines after the first weeding. The onion crop comes to harvest in 3—3½ months.

Garlic is grown between the plantains in the Siruguppa taluk of the Bellary district, during the first year of the plantains.

A special variety of Amaranthus is sown mixed with *ragi*, *cholam*, etc., in dry lands in certain hilly parts of the Coimbatore district. Amaranthus is used as a green in the tender stages. Later, however, Amaranthus is allowed to set seed and fairly big sized seed heads are formed. The seeds are popped and consumed with jaggery.

The cultivation of Sidhout melons is confined to the Pennar river beds in the Cuddapah district. Small channels 9 inches wide and 10—15 ft. long are formed in the river beds and melon seedlings having two leaves are planted in the channels, in holes 1½ ft apart with a handful of cattle manure in each. Ten days later a mixture of bat's guano and cattle manure is applied round the plants. A week afterwards, neem cake is mixed with either bat's guano or cattle manure in equal proportions and applied to the plants. The channels tend to get filled by this time. The next manuring is done a fortnight later. Small holes 4" × 4" are dug between the plants and filled with a mixture of neem cake and either bat's guano or cattle manure, and covered. The tips of the vines are pinched off to arrest further vegetative growth. The plants begin to flower by about the 45th day and the harvest of the fruits commences from about the 70th day after transplantation.

Tobacco is planted early in November in the stubbles immediately after the harvest of *ragi* in parts of the Periakulam taluk of the Madura district. Such early planted tobacco fields give a ratoon crop and the yield is nearly half that of the main crop.

Cumin is sown and chilli seeds are dibbled 2 ft. apart in the light black soils in parts of the Periakulam taluk, where there are summer drizzles. The crops are irrigated on alternate days. The cumin comes to harvest in 60 days and gives an income of nearly Rs. 150 an acre. The cumin crop is rather exhausting and fastidious and comes up only once in 4 or 5 years. Onions and chillies are grown mixed in a similar manner in the Andipati area.

A little water remains in the tanks at the time of the harvest of the *samba* paddy crop in the Bodinaickanoor area of the Periakulam taluk. *Ragi* and *cholam* crops are raised in the wetlands in April—May, utilising the limited supply of water in the tanks.

Castor seeds are dibbled in the main field bunds in the dry black soil areas immediately after cotton is sown in the Palni taluk of the Madura district. The castor pods are gathered in April—May and about 300 lb. of pods are obtained from an acre. The castor is pulled out along with the cotton crop.

Onions are planted on ridges in garden lands in September—October in the Palni taluk. Cambodia cotton seeds are also dibbled in the field 3 ft. apart both ways. The onion crop is harvested in about 3½ months and thereafter the Cambodia cotton is given a deep *mammottee* hoeing and is irrigated.

The villages on the Kodaikanal hills are higher above the paddy fields and carrying cattle manure from the villages to the fields is not feasible. The cattle dung pits are laid along the course of natural streams running from the village to the paddy fields. Cow dung alone is stored in these pits. When it is intended to manure the paddy fields the stream is diverted through the manure pits and the cow dung in the pits is kept stirred up. The ryots take turns and use the water from the stream that carries the cow dung in suspension and the whole paddy area is thereby manured.

Cambodia cotton is sown in February—March, after the harvest of paddy in wetlands, particularly in Ramnad and Tinnevelly districts. Horse gram is intersown in May—June to serve as a green manure crop for the succeeding paddy crop.

A Simplified Method of Conducting Yield Trials on Cultivator's Fields.

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It has been found by experience that, at least in rice, it is never safe to introduce a variety or strain without thorough trials in the tract, where its distribution is proposed. The object of introducing new strains especially in India for a long time to come, must be their capacity to yield well. It has also been found that strains which yield well in one season may be poor in others; such strains are also not desirable. It is therefore obvious, that a strain before it is released for general cultivation should be consistent in its high performance over the local standards in all seasons and all places. This can be judged only by yield trials conducted in as many representative localities as possible, run for at least three seasons to sample out seasonal conditions. The plant breeder is also interested in these trials as he will then be able to spot out the best cosmopolitan strain from amongst the cultures, all of which may be yielding well on his Research Station.

In the isolation of a high yielding strain in a variety a large number of selections is made to start with. This number is brought down to four or five by a series of trials extending over three or four years at an Agricultural Research Station. When the number of strains is reduced to a manageable limit, say four or five, they will require extensive testing in ryots' fields. However the number of experimental stations are few and it is possible that all of them may not be fully representative of the respective tracts. Hence it is imperative that the few promising cultures are again tried out on cultivators' fields to enable us to pick out the most cosmopolitan of the group. Endeavours were being made till recently to lay in each cultivator's fields a replicated trial as is done on a Research Station keeping the size of plots to the required minimum, but it is now found that it is difficult to carry out these trials due to several causes and sometimes one has to be satisfied with one or two such trials. Thus thorough testing of the strains in as many representative places as possible, is not achieved. A modified method of gaining this end is given below. The trial is split up into pairs of blocks and each pair of blocks can then be distributed to an individual cultivator who will plant them in one field or even two adjacent fields. For example we may fix a minimum of four cultivators in different representative areas where the variety is common and entrust to each one pair of blocks containing the strains to be tested and the standard variety. Thus we will be having in all, eight replications. Though six replications are generally adequate, it is better to provide for two extra number of blocks as it may not be that all the blocks may be carried to a successful end. If a pair of blocks is laid out in each village we will be gathering additional useful information on the interaction between strains and places. This will throw some light on the cosmopolitan nature of a particular strain. The pair of blocks may not be in the same field and it is enough even if two ryots in a village take each a block fairly close together. The cultivator can manage a single block more easily and appreciate the differences between strains much better. Even the separate harvesting of plots and their weighment, if need be, may be entrusted to him with some safety if an emergency arises. The size of the plots for trials with rice may be uniformly 5 cents and planting may be done according to the cultivator's usual practice.

This type of trials may also be adopted to ascertain differences in cultural and manurial practices. In such cases a single block comprising of the several treatments, laid out in typical centres of a tract will, not only provide a valid statistical analysis of results but will serve the purpose of demonstration plots In the conduct of these multiple trials the following precautions have to be taken.

(1) The size and shape of the plots and blocks in all places and shape of the plots and blocks in all places and years may be similar as otherwise there is difficulty in combining these results and

(2) The blocks should be randomised separately each time for each place.

The statistical computation of the results is quite straightforward provided the precautions mentioned above are taken. Supposing there are five varieties (four strains and one standard) run in duplicate plots in four centres for three seasons, the analysis of variance will be of the form

Source of error.	D. F.
(a) Varieties	4
(b) Centres	3
(c) Seasons	2
(d) Varieties × centres	12
(e) Varieties × seasons	8
(f) Centres × seasons	6
(g) Varieties × centres × seasons ...	24
(h) Error	60
Total ...	119

Of the several effects we are interested in (a), (d) and (e) If effects (d) and (e) are significant indicating differential response of strains to season and centres, recommendations should not be based on average differences of strains over all the seasons or centres If (d) and (e) are significant, the mean square of varieties (a) must then be compared with (d) or (e) as the case may be and only when it is significant, a particular strain can confidently be recommended as being useful over all the tract where the trials were conducted. It is hoped that this simplification of trials will be appreciated by those who have to arrange for large scale yield trials and being less laborious, they can be adopted to cover a wider area than is possible with replicated randomised trials run at one or two centres.

The Storage of *Cholam* or *Jonna* Grain (*Sorghum vulgare*, Pers.) Free From Insect Attack.

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The storage of sorghum, without the grain being damaged by insects during storage, has been a problem with the cultivators, merchants and organisations dealing with sorghum either for food or for sowing purposes. Sometimes large quantities of grain are imported from other provinces and in a short time the grains get badly damaged by insects and the stock becomes unfit for consumption. At the Agricultural Research Station, Hagari, (Bellary District—Madras Presidency) the need for storing about 10,000 lbs. of *jonna* grain (for seed purposes) for about 10 months, i. e. from May 1944, the time of commencement of storing the harvested grain, to February 1945, the time of harvesting the next crop, was keenly felt, in the absence of naphthalene or sulphur which are the usual preservatives at the station. Acorus powder was used to protect these grains and it was found to be very effective. The object of this short note is to bring to the notice of the public, cultivators, merchants and others interested in this problem, the results of a large scale experiment conducted at this station, on the storage of *jonna* grain with Acorus powder As new grain from the field is now coming on, the experiment has served its purpose.

2. The Government Entomologist was consulted with regard to the use of Acorus. He kindly arranged to supply 100 lbs. of rhizomes of Acorus and he also offered to help in the identification of the insects. The roots were cleaned and powdered by pounding. The dose recommended was 2 lbs. of powder to be well mixed with 100 lbs. of jonna grain.

3 The following are the details of this large scale experiment. There were two treatments and one control. (1) A large (condemned) iron tank (not air tight or water tight) which was the container commonly in use at this station was filled with 4,000 lbs of *cholam* which was well mixed with 80 lbs. of Acorus powder. This grain occupied ¾ the volume of the tank. There is an iron lid to the tank. (2) An iron ordinary seed drum was filled to about ¼ its capacity by 100 lbs. of *cholam* grain well mixed with 2 lbs. of Acorus powder and was closed with a lid; and (3) an exactly similar seed drum in which was poured 100 lbs. of *cholam* seed without any treatment, as control and closed with its lid. These drums are also not air tight. All these three containers were kept together in one place in the seed store. The grain used was of the strain M. 47-3 which was harvested in March 1944 and dried. The storage experiment commenced on 7-8-'44. As suggested by the Government Entomologist every month random

samples of 1 lb. were drawn from each of these containers and the number of live and dead insects were counted, for the estimation of the insect population and the extent of damage was estimated by counting the number of damaged grains in 4 sub samples of 400 grains each. The results obtained are given below:—

Large scale storage experiment on *Jonna (cholam)* with Acorus powder.
(Started on 7—8—1944)

		Dates of observations.						
		29–8–44	29–9–44	29–10–44	29–11–44	29–12–44	29–1–45	28–2–45
(1) Big iron tank with 4000 lbs of grain mixed with 80 lbs. of Acorus powder.	No. of insects in a lb. sample: Live	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
	Dead	Nil.	1	Nil.	Nil.	1	2	1
	No. of damaged grains in a sample of 1600 grains	Nil.	3	2	1	1	3	2
	Percentage of damage	Nil.	0·19	0·13	0·06	0·06	0·19	0·13
(2) Iron seed bin with 100 lbs. of grain mixed with 2 lbs. of Acorus powder.	No. of insects in a lb. sample: Live	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
	Dead	2	Nil.	3	2	Nil.	Nil.	Nil.
	No of damaged grains in a sample of 1600 grains	Nil	2	1	3	2	Nil.	5
	Percentage of damage	Nil.	0·13	0·06	0·19	0·13	Nil.	0·31
(3) Iron seed bin with 100 lbs. of grain not treated, as control.	No. of insects in a lb. sample: Live	20	10	24	13	54	61	54
	Dead	5	3	3	3	8	18	8
	No of damaged grains in a sample of 1600 grains	24	61	69	150	162	190	284
	Percentage of damage	1·5	3·81	4·31	9·38	10·12	11·88	17·75

4. From the above table it will be seen that within eight months, in the untreated control bin (3) there is a progressive increase in the number of insects. This cannot be taken as being very accurate as a number of live moths fly away each time the lid is opened. The extent of damage is however more correctly estimated. The damage has progressively increased to 17·75% within eight months. The grain has clotted and webbed with broken grains and flour. The stuff is practically unfit either for sowing or for human consumption. It means that out of every 100 bags, 17 bags are now mere dust. The loss is increasing rapidly. When the data for the two treatments (1 and 2) are examined the difference is striking and very clear. The damage to grains is practically nil and the grain appears to be quite new, both in the small seed bin as well as in the large tank. Acorus powder has effectively prevented insect damage to stored *jonna* grains.

5. The seed preserved with Acorus powder was tested for germination capacity and compared with seed of M. 47—3 not treated but well preserved by good and constant drying and cleaning, in another part of the storeroom. The germination percentages in both were good and equal being

80%. The seed preserved with Acorus powder was tested and eaten to see if any smell sticks to the grain. There was no smell either agreeable or disagreeable in the treated grain when well cleaned and dried. Acorus powder at 2 lbs. for every 100 lbs. of grain is recommended for extensive use in protecting stored *jonna* against insect pests.

6. *Acorus calamus*, L. is commonly called the "Sweet flag" or "Vasambu" in *Tamil* or "Vasa" in *Telugu*. It is a root crop cultivated in several districts of Southern India. It is very commonly known as a medicine for cold and cough. Its insecticidal properties are not so well known. The widespread use of these roots for this purpose will stimulate a wider cultivation of the same benefitting both the grower and the user.

7. The insects that were damaging the stored *jonna* grain were mostly the whitish caterpillars of moths (*Corcyra*). The next in the order of importance was the dark weevil (*Calandra*). The red beetle (*Tribolium*) was also found but was not so numerous.

8. The help and co-operation of the Government Entomologist in this experiment of preserving *jonna* grains in storage at this station by Acorus powder, are herewith acknowledged.

Summary. At the Agricultural Research Station, Hagari (Bellary Dist. – Madras Presidency) there is a need to protect the grains of sorghum (*Sorghum vulgare*) *cholam* or *jonna*, for about 8 months in the year, i. e. from the time of the harvest of the crop to the sowing time, against insect pests which badly damage the grains in storage. In a large scale experiment involving the use of 4,000 lbs. of grain, it was observed that the powdered roots of *Acorus calamus*, L. have effectively prevented damage from insects. The insect pests met with are *Corcyra* moths, *Calandra* weevils and *Tribolium* beetles. *Acorus calamus* is a root crop cultivated in Southern India.

SELECTED ARTICLE

Soils of India.*

By D. N WADIA

Introduction. Soil is the topmost layer of the earth's outer crust capping the rocks exposed at the surface. It is a natural body of variable thickness, composed of disintegrated rock material together with variable proportions of organic matter mostly unconsolidated, generally differentiated into zones or layers, the lowest of which passes imperceptibly into the parent rocks below.

Soils of all countries constitute the most valuable part of their ground surface and generally their greatest natural asset. Broadly speaking, soils are the subaerially altered residues of the mechanical and chemcial weathering of the surface rocks, proceeding slowly under the influence of climate, vegetation and relief of the land and mingled with varying proportion of decomposed organic matter (humus). A subordinate type of soils of less value in zonal soil types, but of vital importance in India because of its wide areal distribution is the alluvial or drift soil, where the soil cap is formed of deposits of alluvial detritus

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brought down by rivers and streams. The origin and growth of soil is a subject of great complexity involving a large number of natural agencies and a long series of changes ending in the production of the clay factor, much the most important constituent of soils. Parent rocks, weather and climate topography, altitude, rainfall, duration of time and biological agencies, all play significant parts in the genesis of soils and in determining their morphology and agronomic properties.

In the production of soils of the Indian region, among the other factors, the peculiar monsoonic climate of India, giving rise to alternate aridity and humidity, must have had a preponderant share. The residual soils of the Deccan, forming a number of groups varying more or less with the mineral composition of the subjacent rocks from which they have originated are in marked contrast to the more uniform zone of drift soils covering the great plains of North India, in respect of colour, texture, composition, consistency and humus content. The soils of the Peninsular region of India are of very great antiquity, this part of India being geologically one of the oldest land masses of the earth. They are highly mature soils, in contrast both with the drift soils of North India and with the soils of Europe, Russia and North America, which are largely of post-glacial and sub-recent growth in which the pedogenic processes have not been in operation long enough to mature them to the same extent. For these reasons the former exhibit comparatively less regional and geological variation, while the latter possess close affinities with their underlying parent substrata podsolisation (a series of processes involving the removal of bases by leaching and the formation of an acid organic layer at the surface) is a common characteristic of the soils of Europe, while in this country save for a few mountain and forest type soils podsols are un-known. The alluvial soils of the vast Indo-Gangetic plains also are largely immature and have not developed any prominent profile (the succession of horizons down the parent material); these soils in their age and origin have some points in common with the post-glacial drift soils of Europe and N. America being the alluvial deposits of the Indus-Ganges river systems formed since mid-Pleistocene times. The laterite and lateritic soil types of India are unrepresented in temperate countries of the world.

Studies on Indian soils on modern lines have only begun lately and a great deal of work remains to be done. It is only since the publication of the report of the Royal Agricultural Commission in 1928 that the principles of soil science, as propounded by Russian and American pedologists, are applied to the study of Indian soils. This data marks an important landmark and much useful investigation is done since then by the Soils Branch of the Imperial council of Agricultural Research and by the Provincial Agricultural Departments. Until lately soils in India were regarded from the standpoint of crop production and for assessment of taxable capacity of different soils. A Soil Map of India is in course of preparation at the Imperial Institute of Agricultural Research, New Delhi from such data as are now available from the recent work of the various Agricultural Departments. The Indian Society of Soil Science, founded in 1935, has created a healthy interest and activity in the genetic studies of soils on modern lines.

Regional Divisions of Indian Soils. Soils of India fall into three natural and fundamental regional divisions on the basis of their origin as well as geographic position. This classification is ultimately determined by the physiographic division of India into three quite distinct land forms. The soil groups in each of these three regions have certain zonal characters dependent on their origin from parent rocks, the topographic relief vegetation, and the nature and duration of the weathering processes which they have undergone during their formation.

1. The highly matured soils covering Peninsular India south of the Vindhya range, a region of igneous and metamorphosed sedimentary rocks of great geological age. Being very old soils, the effect of ages of soil forming processes has been to obliterate more or less the influence of parent rocks. They include the great zonal groups of Indian soils—the red soils, black soils (*regur*) laterite and lateritic soils, showing wide variations in the clay factors, structure and texture, moisture characteristics and organic matter. Besides the major types named above are the grey, semi-desert soils (*sierozem*), steppe, wood-land, grass-land soils, swamp soils, soils of the sea coasts and the comparatively less evolved sandy and stony soils capping the Gondawana rock belts. This division includes Ceylon.

2. The large group of alluvial soils of the plains of India covering Sind, Punjab, the United Provinces, Bihar, Bengal and areas of Assam. Though variations of minor character are met with from district to district, giving rise to subordinate types within this group, they encompass large areas of more or less uniform soils as regards colour, physical constitution, ground water conditions and organic components. This group includes the dry and wet meadow soils, steppe type soils, desert and semi desert types, saline and alkaline soils and delta soils.

3. The scanty soils of the mountain region of west, north and east India, composed mainly of Tertiary sandstones and clay strata with subordinate lime-stone element. These soils are the least mature being liable to frequent erosion, and renewal due to their precarious situation on the slopes of mountains and on the sides and bottoms of young imperfectly graded valleys. Except in the few broad valley basins, these soils are of restricted extent, they include the mountain meadow, grass-land and forest type soils, alluvial paddy soils, podsolised soils, bog and marsh soils, and thin residual soils on calcareous rocks, limestones and dolomite.

The Geological Foundations of Indian soils. The soil groups mentioned above have been derived originally from the following six parent rock bodies or formations on which they rest. Regional division I of the above para comprises the most varied soil groups and has as the substratum the first four of the geological systems on the list given below. Division II is underlaid by only one geological formation of great homogeneity of mineral composition, viz., No. 5 of the list below, of late post-Tertiary age. Division III encompasses again a number of rock-systems ranging from pre-Cambrian to Tertiary but which in their lithological composition can be broadly represented by one single group 6. In the Himalayas there are locally large areas occupied by group I.

(1) Ancient *crystalline rocks*—granites and gneisses largely acid alumino-siliceous in composition with subordinate ferromagnesian units.

(2) Ancient sedimentary formations—*Purana* and *Gondwana* systems argillaceous in the main, with subordinate calcareous components.

(3) The Deccan *plateau basalts*—basic alkaline and ferro-magnesian lavas and ash-beds.

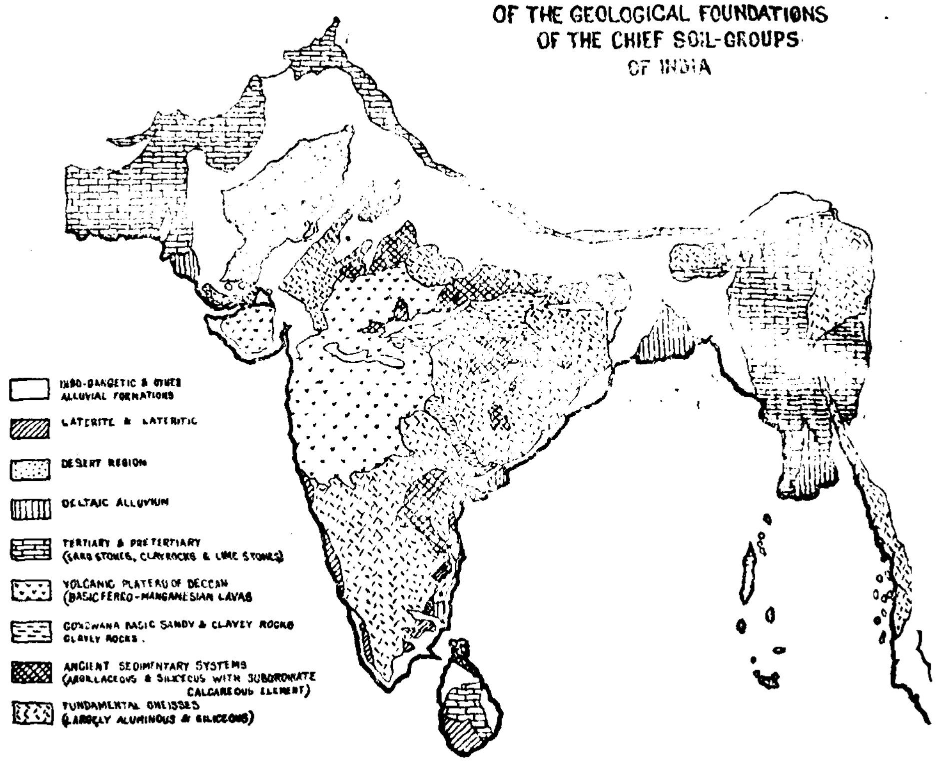
(4) *Laterite* of High and Low level type—surface formation composed of highly ferruginous and aluminous clay, poor in silica, lime and alkalies.

(5) *Indo-Gangetic alluvium*—river silts clay and sand beds with segregated calcareous concretions

(6) *Pre-Tertiary* and *Tertiary* sedimentary systems of extra peninsular mountains—sandstones clay-shales and lime-stones. The lower division of these rocks is more calcareous, the upper more sandy and clayey. There are large areas of intrusive granites resembling in composition (1).

The soils formed out of these materials are liable to ceaseless secondary changes and modifications through climate, topography, drainage, organic agencies, etc. Nevertheless it is a well-known fact that in India certain rocks give rise to definite types of soils. Variations in the ground rocks cause in certain districts wide differences in the overlying soils. At other times and in other districts, no such marked differences are recognizable in the soils resting on divergent rock types. On the whole, however, the principal characters of the main soil groups of India are generally deducible from the nature of their geological foundation. This is well established in the association and genesis of such well-marked groups as black soils, red soils, lateritic soils, no less than in the constantly changing patchy soils of the Himalaya mountains, where changes in the geological nature of the substratum are reflected in the composition, depth and profile of their soil caps.

SKETCH MAP
OF THE GEOLOGICAL FOUNDATIONS
OF THE CHIEF SOIL-GROUPS
OF INDIA



Soil Groups of Peninsular India. *Red Soils* This comprehensive term designates the largest soil group of India comprising several minor types. They cover the Archaean basement of Peninsular India from Bundelkhand to the extreme south, an area of 800,000 sq. miles embracing south Bengal, Orissa, parts of Central India and Central Provinces, Eastern Hyderabad and Mysore and major part of the Madras Presidency.

The parent rocks are acid granites and gneisses, quartzitic and felspathic, with only subordinate rock types rich in iron and magnesia-bearing minerals. Also the ancient sedimentary sandstones and clays of the Cuddapah and Vindhyan systems have contributed secondarily to the formation of the red soils. The colour of these soils is generally red, often grading into brown, chocolate, yellow, gray, or even black. The red colour is due more to the wide diffusion rather than to a high percentage of iron content. Many of the so-called "red soils" of South India have no red colour. On the other hand, some red coloured soils are of quite different constitution, being derived from the surface capping

of lateritised rocks. These are genetically quite distinct from the true red soils and are described below. The red soil formed on limestone terrains are also quite different, they are the residue left after dissolution of the bulk of the rock, its clayey and sandy impurities.

A number of subordinate groups and types come under the general designation of red soils. Conditions of free or restricted drainage determine whether salts leached out form a zone of accumulation in the soil profile. Also differences of texture, depth, porosity, humus, and presence or absence of calcareous segregations (*Kankar*) or ferruginous layers (*iron pan*) or of soluble free salts in the soil profile distinguish these types. For example there are the light coloured yellow sandy soils of the dry steppe area, the dry and wet upland and valley soils, there are areas of grey semi-desert saline soils (*sierosem*) enclosing patches of non-saline soil. There are also some belts or tracts of the characteristic black soil within red soil areas, originating from outcrops of basic plutonic or volcanic rocks rich in iron, soda, lime and magnesia and poor in silica and potash. There are met with all gradations and interminglings, in such cases between the red and black soils, especially where the mixing is favoured by the relief of the ground.

In general, the red soils derived from acid gneisses are poor in lime, magnesia, phosphates, nitrogen, and humus especially in the drier areas, but are fairly rich in potash. In their chemical composition they are mainly siliceous and aluminous with free quartz as sand; the percentage of iron is not high, the alkali content is fair, some parts being quite rich in potassium derived from the muscovite and orthoclase of the gneisses. In comparison with the black soils, red soils are as a group deficient in iron oxide, lime and phosphatic content. But there are wide variations within the group depending on the configuration of the ground and the amount of transport and redeposition the soil mantle has undergone, from the poor thin gravelly and light coloured varieties of the uplands to the much more fertile, deep, dark varieties of the plains and valleys.

The red soil group is, generally speaking, deficient in its content of soluable exchangeable bases, and their total base exchange capacity for K, Ca., etc., is generally low.

***Black soils (Regur)*:** This is another large group of soils of the Deccan, including several distinct sub-varieties and types. It is a general term applied to the large group of black or dark soils common in the Bombay, Deccan, Malwa, Berar, western parts of Central Provinces and Hyderabad, Gujarat and Kathiawar; with extension to Central India and Bundelkhand. Isolated patches of *regur*, though, less typical, occur also in Madras. The most characteristic black soils cap the volcanic plateau of the Deccan Traps, forming a mantle of rich residual soil of no great thickness or depth of profile. There are few sharply differentiated horizons, the lowest of which passes with easy gradation into the disintegrated basalt lava (*mooram*), of red to brown colour. The lava at first weathers into spheroidal boulders which by exfoliation pass into the *mooram* sub-soil. But the area of black soil is by no means conterminous with the boundary of the Deccan Trap formation, and a wide extent of this soil is found over the surrounding granitic and basic gneissic and other formations, Vindhyan or Cuddpah sandstones and slates. There are also large tracts of transported black soil. Where of latter origin, the profile is much deeper than usual, 40' or even more, without any zoning or differentiation into layers. Where clear profiles are observed, the mantle of black soil in situ is shallow, scarcely more than 2'–6' in depth exhibiting clear relationship with the parent substratum. The cause of the prevailing dense black colour of these soils over such wide areas is not yet definitely known, partly it may be due to iron or to some minute quantity of a titanium-iron compound, partly to carbon and organic matter. But many black soils contain very little organic substance.

Typical black soil, the familiar *black cotton soil* is highly argillaceous, with a large clay-factor, 62 per cent or more without gravel or coarse sand. It is very tenacious of moisture and exceedingly sticky when wet. Owing to considerable contraction on drying, large and deep cracks are formed after monsoon. The clay factor of *regur* contains 60 per cent of silica, 25 of alumina and 15 of ferric oxide, on the average. The heavy black soils of the cotton districts of Gujarat, Berar, etc., derived from the basalts, are by reason of their hydrology and climatic conditions very suitable for cotton cultivation. They are characterised by a high proportion of lime and magnesium carbonates (6—8 per cent.), iron oxide (9—10 per cent.) and fairly constant alumina (10 per cent.). Potash is variable (less than 0·5 per cent.) and phosphates, nitrogen and humus are low as a rule. In all *regur* areas in general, and those derived from ferruginous and basic schists in particular, there is generally a layer of *kankar* nodules forming a distinct horizon intermediate between the lower layer of the soil and the disintegrated *mooram* bed-rock. Areas of *regur* are credited with high fertility and do not require manuring for long periods, but some upland *regur* grounds are not very productive. They are more sandy on the hill slopes in rugged country, but in the lower ground and in depressions the soil becomes deeper and darker, enriched by accretions from the higher ground.

The *regur* soil of India has often been regarded as the tropical analogue of the Russian *chernozem*, but Glinka, Hilgrad and Annett did not find any genetic affinity between the two. In their composition, organic content, texture and structure the *chernozems* are markedly different from the *regur*. Some authorities consider the Deccan black soil as very similar to the prairie soil (*black adobe*) of California. In the production of *regur* the pedogenic processes have been complete and of much greater importance than the geological (petrological) factor. The latter, though cooperative, has been subordinate to the influence of climate, physiography, etc.

There are well-defined areas of black soil in the midst of red soil terrains. Examples of patches of black and red soil with overlapping boundaries, and even apparent transition from one type to another, are known. The former occurrence is easily explained as the black soil is seen to be formed over outcrops of basic gneiss or schist occurring as associates or as intrusives in the normally acid gneisses of Madras. The cause of the latter phenomenon, the apparent conversion of red into black soil, is not yet well understood.

The base exchange capacity of *regur* is fairly high throughout its profile. These soils are fairly well supplied with replaceable bases and a number of observers in India have studied this aspect of *regur*. Much attention is also of late paid to observation of the various field characteristics of *regur* in relation to its mechanical and chemical analyses According to Joffe there is yet, however, a scarcity of data on the morphology and physics of the *regur* profiles. Chemical composition is not of material assistance in determining the characters of the different secondary modifications of this group and their agricultural properties, etc.

Laterite and Lateritic Soils. These soils do not form such well-defined groups as the two described above. Laterite is a surface deposit formed by the subaerial alteration of rocks peculiar to India and a few other tropical countries. It is of widespread occurrence in Peninsular India, extending north-east to Assam and Burma. Though laterite itself is something of the nature of a soil-cap, passing down by clear gradation into subjacent rock, the pedogenic processes have stopped short beyond a certain stage and the resulting product, a deeply ferruginous compact clay, porous and vesicular, is not a soil. By further modification and the action of biologic and other soil forming agencies laterite is converted into a red coloured soil with a profile of 1—3', sometimes more, of disintegrated loam charged with segregated iron nodules or sometimes an iron pan. Downwards this soil passes into a soft easily sectile yellow or buff clay (*lithomarge*). Often the clay base of true laterite soil is not aluminium silicate but free alumina mixed with iron sesquioxide. Though the laterite cap may be of great thickness extending to 100' or even 200' on some plateau tops, laterite soils are usually thin rarely having a profile of more than 2—3'. Regionally the laterite soil group forms a belt of variable width round the Peninsula, in its best development capping the hills and plateaus of the Deccan, Central India, East Bengal and extending through Assam to Burma.

In their chemical composition, the red earthy soils derived from true laterite differ from the red soils described above in their being composed principally of hydrated sesquioxides of alumina and iron, with free silica in the form of quartz grains. Subordinate ingredients are phosphoric acid and titania; alkalies and alkaline earths are absent, lime and magnesia being notably deficient. They are acid in reaction and remarkably free from humus, or other material of plant food. Laterite being largely a product of monsoonic regions, with their alternate dry and moist conditions, leaching action in these soils is complete with the result they are denuded of exchangeable bases and other fertilizing consitutents, giving to the soil a more or less marked acid reaction. The $SiO_2 : Al_2O_3$ ratio is low in mature laterite, in true laterite combined SiO_2 being almost totally absent.

Because of the intensive leaching and the low base exchange capacity, typical laterite soils are lacking in elements of fertility and are of little value for crop production. But tillage and secondary changes have produced fair soils; parts of the Bombay Deccan have acquired enough potash, nitrogen and phosphates to support good cultivation. The laterite soils developed on the summits of plateaus of Malwa, Malabar, Central India, Central Provinces, the Eastern Ghats, Rajmahal hills, Orissa, and parts of Assam and Burma are generally poor agriculturally. The above are examples of high-level laterite soils; they are thin, and gravelly, not retentive of moisture and are of little importance in agriculture. Low-level, or detrital, laterite soils are often mixed soils, derived from different sources and transported to lower sites, they are dark heavy loams and clays found on the coastal lowlands and respond better to tillage.

A number of red earths and clays have been grouped with laterite soils in various parts of the country. The ferruginous clays of the Nilgiri hills, Madras and some red earths of other districts are often so designated but the term is wrongly used for many red soils, or for rusty out-crops of weathered rocks. Such soils are generally rich in silica and lime, with a high $SiO_2 : Al_2O_3$ ratio and they do not contain the colloids which are the essential characteristic of laterite. These as well as some modified low-level laterite soils are best designated *Lateritic Soils*.

There is an extensive literature on laterite and lateritic soils both Indian and foreign. But it cannot be said that the subject of the geological origin of laterite, or the agrological nature of the laterite soils, is yet fully known and wide differences of opinion prevail.

Other Soils of the Deccan. Less distinctive soil groups of the Deccan are those resting over the older sediments of the Cuddapah, Kurnool and Vindhyan systems— sandstones, slates and limestones. These are not prolific soil forming rock-groups and only support a thin residual cap, composed mainly of their insoluble ingredients, which have undergone repeated secondary changes These soils are highly mature and are in perfect equilibrium with their environment. The soils on the limestone members of these rock series are particularly thin, being the insoluble residues left after the dissolving away of the main body of the rock by the solvent action of carbonated ground waters. The nature of the limestone soils is determined by the impurities held by the original rock, whether argillaceous or arenaceous, pure limestone or dolomite having but little soil mantle. The extensive limestone plateaus of Eastern Burma (Northern and Southern Shan States) and the Jaffna peninsula of Ceylon have soils of this nature, while the mixed soils on the isolated Vindhyan and Trichinopoly limestone areas are similar but less distinctive. These soils are well supplied with replaceable bases and are somewhat alkaline in reaction but curiously often wanting in calcium base.

Gondwana sediments support thin immature soils of less variety and fertility. Outcrops of these rock groups are often barren or covered with scrub jungle.

Alluvial Soils of the Indo-Gangetic Plains. This great soils belt traverses the whole width of North India across Sind, North Rajputana, most of the Punjab, the United Provinces, the greater part of Bihar and Bengal and half of Assam. Though of little interest from the point of view of soil genesis its wide expanse of over 250,000 sq. miles supporting the bulk of India's population and contributing the largest share of its agricultural wealth makes it the most important soil group of the country. The parent material of these soils is all of transported origin, relatively recently deposited by rivers of the Indo-Ganges system. They are yet immature, the soil forming agencies having developed weak profiles, undifferentiated into defined horizons in the silts of the original river alluvia.

Biological agencies aridity or humidity, wind, rainfall distribution, etc., have introduced many variations in this otherwise uniform tract of unvarying alluvium, marking out areas of secondary soil characteristics. The alluvial tracts differ in consistency from drift sand to rich loams and from silts to stiff clays. Infiltrated calcium carbonate, *Kankar*, in the soils varies within wide limits. Pebbly, stony or gravelly soils however are very rare in this group, which in mechanical structure do not differ at all from the flood plain deposits of modern streams. In their composition they carry all the ingredients of good arable soils. The proportion of nitrogen is generally low, but potash, phosphoric acid and alkalies are adequate, while iron oxide and lime vary within wide limits. The grade of sand rarely exceeds fine to medium, the clay factor is generally high, but consistency, porosity and texture over wide areas are such as to provide good drainage and other conditions favouring crop growth. The exchangeable base content is generally satisfactory and the mineral and organic plant food reserves of these soils are enough and easily replenishable. The above characters of the alluvial soils of India have tended to make them agriculturally productive since early human occupation

A natural division of this soil group into the younger *Khadar* soils of the north west and relatively older *Bhangar* soils of the south-east has both a regional as well as a geological basis. The former soils are found in the Punjab and adjoining areas; they are pale brown sandy clays and loams, more dry and leached, less calcareous and carbonatic i e. with less *Kankar* segregations. In comparison with these markedly arenaceous soils the *Bhangar* group, mostly covering the Gangetic basin of Oudh, Bihar and Bengal are darker brown argillaceous loams with a considerably larger clay factor, less sand and greater proportion of moisture. The lime content is higher with thickly diffused nodular *Kankar*. The alkali, phosphorus and nitrogen elements show no serious difference from the *Khadar* areas. The water table in *Bhangar* is always relatively higher than in the north west alluvial tract where the sub-soil water may be as low as, or lower than 50'.

The presence of impervious clay layers while they help in the storage of underground water obtainable from wells (under a semi artesian pressure at places), also obstructs drainage and brings about the formation of hard pans. They also promote the accumulation of injurious sodium and magnesium salts

in the upper layers of the soil-profile rendering it sterile for agriculture. The leaching of these young soils under such conditions is imperfect and greatly restricted, hence artifical irrigation aids the transference of the various salts (originating from the decomposition of the rock particles which form the alluvial silts) to the upper part on the soil profile. The total depth of the Punjab and Bengal alluvium is immense, several thousand feet; the thickness of the soil mantle it supports, however, is rarely more than 3' to 5' but indistinctly marked into horizons.

Other areas of alluvial soils in India are the coastal plains of Gujarat and the broad strip on the Coromandel Coast with the deltaic stretches of Tanjore, Bezwada, and Cuttack. There are also fairly extensive plains of ancient alluvial deposits in the upper Narbada and Tapti valleys.

Delta Soils. In the great deltas of the Indus and Ganges and of the rivers draining to the East Coast, the soils are a continuation of the loamy alluvial soils upstream, but are generally richer in organic matter; there is excessive moisture because of defective drainage. These soils are periodically renewed by floods and are as a rule very fertile. The fresh water marshes, swamps and *jheels* in the deltaic flats have a moor type soil, the profile often carrying a *glei* horizon due to excessive moisture and poor drainage. These conditions favour paddy cultivation.

Desert Soils. The Thar area of Rajputana, over 40,000 sq. miles in extent, is generally devoid of a soil cap of agricultural utility, soil-forming conditions being absent in this extremely arid region. Its place is taken by a mantle of dry barren sands, derived from the mechanical disintegration of the ground rocks or blown in by the strong, prevailing S. W. monsoon winds from the Indus basin and the coast. The mean annual rainfall is less than 6". The Runn of Cutch in the South and Southern Punjab in the north are extensions of this desert which continues to the west as far as the edge of the Indus alluvium. Both Cutch and Sind are overspread by a surface mantle heavily impregnated with common salt and alkaline salts, dotted with salttarns and ponds (*dhands*).

Barren sandy soils without a clay factor are also common in the coastal dune regions of Orissa, Nellore, Madras and Tinnevelly as well as of the Malabar coast.

Minor Alluvial Soil Types. Included in the group of Indo-Gangetic alluvial soils, and showing tansition into them, are the *Bhabar* and *Terai* soil types, the former composed chiefly of gravel and shingle and covered by thick forests of *sal*, the latter of extensive areas of bog and marsh soils supporting high grass.

In Punjab and the north west, the dry plains and rocky prominence are covered under *loess*, a sandy loam deposited by wind action during dust storms, but similar in many respects to river deposited alluvium. The soil cap over *loess* is thin, without any developed profile. It is usually very arid, the water table being deep and often inaccessible over 100' in depth. The tracts of blown sand in the United Provinces, *Bhur* land, are similar to the *loess* tracts so far as their soil characters go.

Alkaline Soils (Reh, Usar, Kallar Soils). These are salt impregnated, or alkaline soils which form an important, albeit a negatively important, group in India. The soils on the drier parts of north Bihar, U. P., Punjab and Rajputana are liable to saline and alkaline efflorescences. There are yet in these soils many undecomposed rock and mineral fragments which on weathering liberate sodium, magnesium and calcium salts and sulphurous acid. Such soils are notably impervious, and, therefore, have impeded drainage. Large areas once fertile have become impregnated with these salts (*reh*, *kallar*), destroying the agricultural value of the ground. The salts are confined to the top layers of the soil being transferred from below by capillary action. Irrigation by canal water facilitates this transfer. thus a fairly large extent of such salt charged soils has resulted in the canal irrigated areas of the Punjab and elsewhere within the last two or three decades. Such lands are known as *usar* or *reh* in the north, *Kallar* in Sind and *chopan* in Bombay. The alkali content is high and there is a large excess of free salts combined with poverty in nitrogen and organic plant food material. The salts most common in the *reh* ground are sodium carbonate and sulphate, together with calcium and magnesium compounds. The reclamation of *usar* lands of the Indo-Gangetic plains would add some million acres to the cultivable area of North India. The subject has received much attention and a number of experiments at present in progress are being watched with great interest.

The nitre impregnated soils of Bihar and Punjab are a variant of the above, the difference being that the salt (potassium nitrate) is introduced into the soil cap from above by the activities of man in densely populated cultivated districts under a warm, humid climate. Animal and vegetable refuse of the villages is decomposed into ammonia and other nitrogenous substances; these are acted upon by nitrifying bacteria in the damp but hot weather, producing nitrous and then nitric acid in the soil. The salts of potassium from the large quantity of wood and dung ashes, which the villagers heap around their farms, are acted on by the nitric acid, producing nitre, which goes on accumulating in the sub-soil. It re-ascends to the surface by capillarity during the dry weather following the rains. The nitre crop from the soil of Bihar was a source of accessory revenue to the farmers in past years, when more than 20,000 tons of nitre was produced annually.

Mountain and Forest Soils of the Himalayan Region. These soils are found in the depressions within the mountains valley basins and on the less steeply inclined slopes. Generally, it is the north facing slopes of the Himalayan ranges which support a considerable soil cap; the south faces of the mountains are too precipitous and exposed to the denuding agencies to be commonly covered with soils Much the larger extent of these soils are of the wet forest type under heavy growth of perennial forests of conifers. They are of heterogeneous nature, varying with parent rocks, climate and local conditions, e. g., prevailing wind, rain snow ground-configuration, cultivation, etc., They do not form a compact soil group and, in the inner mountains, support but little of agriculture, except in the valleys of the more inhabited parts.

The soil cap on the broad zone of Tertiary sandstones and clays constituting the Siwalic foot hills from Afghanistan to Assam, are primary soils, shallow and immature, containing a large proportion of undecomposed mineral grains; they are sandy or gravelly, porous, devoid of humus and frequently impregnated with lime and soda salts. The higher ranges to the north of the foot hill belt are clothed in thick forests of pines and rhododendrons; the soils here are various types of mountain forest soils, podsol soil, mountain meadow and highland steppe soil. In the broad lateral valleys of this zone—the *doons*—as in Dehra Dun, Kashmir, Nepal etc., are alluvial soils of high fertility. In the regions above the limit of forest vegetation above 14,000' the soils are frozen for the greater part of the year; they are thin, clayey and podsolised, with a fairly developed profile containing a prominent ash-grey horizon due to excessive leaching action of ground waters. The most productive mountain soils are met with in the Middle Himalayas The southern slopes are generally bare of any kind of regolith, but mixtures of glacial, fluvio-glacial surface creep talus and rain wash soils clothe the northern slopes with mountain meadow and grass land soils at elevations above 6.000'. Some of the wet deep upland soils of the Central and Eastern Himalaya with their high humus content, when cultivated, make good tea soils in Kangra, Darjeeling and Assam ranges. Very little detailed work has been done so far on the soils of the Himalayas and data regarding their composition, profile characteristics, morphology and base exchange properties are not available.

Soil Erosion. The soil cap of the middle and outer Himalayan ranges perform a great service in conserving the perennial flow of water in the great rivers descending to the plains at their foot. The role of the Sub-Himalayan forests in building these soils and binding them to their parent rocks and then of protecting them from erosion is no less important. The relative ease with which the newly formed soil is eroded from such geological foundation and the necessity of conserving the exiguous soil mantle against the effects of rain, forest and wind are problems which involve serious consequences.

The ravages by floods in many Indian rivers can be moderated, if not checked, by conservation of forests and grass-lands in their upper reaches and in their catchments. These protect the soil cover of the hill slopes from rapid denudation and help it in holding back a large part of the rain water from rushing down the river precipitately and choking its outlets. These rushing floods take away with them millions of tons of silt, communuted soil.

Relation of the Soil Groups of India to Surrounding Regions. Broadly speaking, some of the soil groups of India extend with local modifications to Baluchistan, Burma and Ceylon, areas geographically as well as structurally allied to the Indian sub-continent. In Baluchistan the arid semi-desert type of climate operating on a great variety of rock formations has produced scanty, sandy, saliferous soils allied in many respects to those of Rajputana, S. Punjab and Sind. These are interspersed with lateral basins and wide depressions, filled with colluvial and alluvial accumulations. Much of the area is covered with bare limestones, sandstones and slaty rocks belonging to a wide range of geological formations, from Carboniferous to Recent. The groups of red, black and laterite soils are not typically developed in Baluchistan nor is the group of humid forest and mountain types represented

The more humid climate of Burma with its extensive forested hill-ranges has given rise to soil types akin to the wet tropical soils of N. E. India. The soils over the large limestone of the Shan States, are residual red earthy clays, of *terra rossa* type, derived from the dissolution of the limestone rock leaving behind its insoluble clay admixture. The soils in the Arakan and N. Burma mountains recall the mountain soils and the wet tropical forest soils on the Tertiary Sub-Himalayan zone of Assam. Laterite soils of Burma do not differ from those of the Malabar or East Coast regions of the Deccan. There is a broad belt of recent alluvial deposits in Central Burma, along the basin of the Irrawaddy with its deltaic prolongation similar in soil characters to the lower Ganges alluvium and delta.

The Soils of Ceylon, as in the Deccan, are derived from its Archaean basement, but they show less correspondence to their geological foundation than the Deccan soils, especially in the wet south west half of the island.

Here the deep mechanical and chemical weathering of rocks have caused profound changes, the colloidal elements being more in evidence and the profiles are usually deep and marked. In the dry plains of the north and east part of Ceylon, the soils resemble red and brown soils of S. Indian plains. A. W. Joachim (Trop. Agric. 1935, 84) has divided the soils of Ceylon into groups, the chief of which are: (1) laterite and lateritic soils of the wet, south and south west of the island; (2) *terra rossa* soils on the Jaffna limestone; (3) steppe soils of the central mountain zone; the wet deep acid soils of the Uva highlands make ideal soils for tea cultivation; (4) the sandy or gravelly earth, partly of alluvial origin, covering the wide, low plains of the north; and (5) the marshy (*glei*) soils of the low country and of the depressions in the mountains.

Abstracts.

A preliminary investigation into the influence of the fundamental dimensions of a plough on its performance. *(By P. V. Krishna Iyer and P. S. Rao. Ind. Jour. Agric. Sci., Vol. 14, part 3, June 1944).* The fundamental dimensions of a plough of the Indian type are (i) the length of the wedge, (ii) the angle between the beam and the wedge, (iii) the face angle of the wedge (i. e. the angle between the two edges of the wedge) and (iv) the weight of the plough. These are independent of one another and are adjustable within certain limitations in any desired manner. The function of a plough, particularly of the Indian type, is to cut and to crush the soil. The cutting is done while the plough is being dragged through the soil by the bullocks, during which it will have to overcome a certain amount of resisting force. During its forward drag, by the animals, the plough has also to overcome a certain amount of complex forces in the soil the resultant of which will act nearly at right angles to the wedge. For smooth working it is found that the inclination of the beam with the wedge will have to be between 40° and 50°. The weight of the plough should be adjusted in accordance with the strength required, but cannot be increased indefinitely as in that case the average bullocks will find it too difficult to drag the plough. Similarly, the face angle also has certain limitations. If the face angle is too large the resisting force against the penetration of the plough into the soil is also large and the ploughing will not go deep enough under ordinary conditions. On the other hand, if the face angle is very small, the wedge will be too narrow and the plough will penetrate to a greater depth, which sometimes is not required. Besides this, the side pressure will be more and the draw-bar pull will be large. The draw-bar pull is likely to depend more on the depth of ploughing than on any other factor. In the trials conducted with seventeen different ploughs of the Indian type the corelation coefficient between the draw-bar pull and the depth of ploughing was found to be 0·9259 for the conditions of the experiment. The depth of furrow will in turn depend on the weight of the plough, the length of the wedge, the face angle of the wedge and the angle which the wedge makes with the horizontal at the time of ploughing. The relationship between these various factors can be expressed in terms of appropriate regression equations which would enable us to calculate the draw-bar pull, the depth of furrow and the resistance, for ploughs of any dimensions, for the same conditions for which the relation was first established and these calculated values can be used to judge the relative merits of ploughs of different dimensions. Judged on these lines it would appear that the ploughs from Karnal, Baroda, Bankura, Chotanagpur, Daltonganj and Purelia that were tested in this experiment at the Imperial Research Institute farm area have their face angle, within the limits of minimum resistance and can be considered to be good designs, subject to the limitation of depth. Further work is in progress on this question of judging the merits of Indian ploughs from their fundamental dimensions. T. R. N.

The areas of origin of locust flights in India, with reference to the question of their control *(by Rao Bahadur Y. Ramachandra Rao, Cur. Sci. Vol. 14, No. 2, February 1945).* Although locust outbreaks and the devastation they cause to crops and vegetation have been experienced from very early times, there has been, until very recent times, very little information regarding the factors influencing, such movements of locust swarms. As a result of the work carried out during 1932 to 1939 by the Locust Control Organization of the Government of India a large amount of data has been collected and the following are a few preliminary observations based on these data.

In the nineteenth and early years of the twentieth century, the view was held that the primary locust swarms that ravaged India from time to time, came from the west from beyond the Indian borders and remained breeding in India for two or three years until they eventually perished. In 1921, *Uvarov* propounded his phase theory of locust migrations. According to him, during the times when swarms disappeared, locusts reverted to a solitary phase of life and when, under the influence of favourable weather conditions their numbers increased, they resumed their gregarious phase once again. This hypothesis has in the main, been confirmed by the data gathered during 1932–1939, though it has had to be modified in some details. Thus it is found that, contrary to the former view that the solitary phase locusts were non-migratory, the locusts in this phase also react to changes in the environment more or less like the gregarious phase and are capable of migrating long distances from one rainbelt to another with the change of seasons. The transformation of the solitary phase into the gregarious takes place in locations where the conditions are specially favourable for crowded breeding. It seems also clear that such breeding centres occur over a wide area and flights originating from such centres become fused together to form locust swarms large or small.

The general movements of locusts during years of outbreak in India. The sequence of events in these cycles of locust activities is more or less as outlined below. Locust outbreaks in India are set on foot by incursions of groups of locusts produced in centres situated partly in British Baluchistan and partly (possibly mainly.) in Iran and eastern Arabia. In some cases, these incursions may, to a certain extent, take the shape of regular swarms even at the outset. Such immigrant locusts breed intensively in the Sind—Rajputana area whenever the monsoon rainfall is favourable and start a new cycle of swarming infestation in the Indian areas, as in 1926 The season usually starts in May—June with the arrival of swarms from the direction of Iran. The strong south-west winds prevailing at this time of the year carry the locusts rapidly across Sind into the Rajputana desert areas and often beyond into the Punjab, United Provinces, and Central India and even into Bihar and Bengal. With the fall of monsoon rains in July, breeding and egg-laying begins in the desert areas of Sind and Rajputana and in parts of the Punjab and United Provinces and the new generation of locusts is ready for flight by the end of August or early in September.

In the case of the second or late generation of locusts produced in the Rajputana desert areas, cold weather would have set in by the time the insects assume wings and owing to this change in weather conditions, the urge for immediate migration is not so strong as in September—October. Limited migrations do however continue so that the desert area is generally clear of swarms by the middle of winter. Swarms are found during the winter months in other parts of India also in certain years e. g., in the Western India States, Bihar, Bengal and even in South India but none of these ever breed in these areas. On the other hand the swarms found in the Punjab, Sind and Baluchistan areas become mature and breed in the Spring, if the Spring rains are favourable.

Effect of control of breeding centres on locust outbreaks. The present cycle of locust infestation in India started in 1940, after a swarmless interval of nearly eight years from 1932 to 1939. During the years 1940—41, locust activity ran a natural course uneffected by any serious control measures. The flights in the autumn of 1940, radiated from the breeding centres in Rajputana to the west, north-west, north-east and south-east. In 1941, Spring breeding occurred in *Kachhi* and *Jalawan* and by June-July locusts appeared in several waves of migration and flew into Sind, Rajputana and the Western India States. During the monsoon months, extensive breeding occurred in the Thar area of Rajputana and the resultant swarms spread in October, south-east into Central Provinces and southwards as far as Belgaum district in Bombay and Bellary in Madras. In the subsequent years 1942–43 and 1944 locust activity was more or less normal so far as breeding was concerned, but the final Autumn flights were conspicuously poor. This is attributable to the progressively more efficient and well organized control measures adopted in the Sind-Rajputana areas and other tracts where Summer breeding takes place.

In spite of this however, it remains a fact that the greater part of the swarms, from the west had been derived from Spring-breeding areas in Iran and Arabia (and possibly even further west from the Red Sea areas) and the question of a more, thorough-going solution of the locust problem in India has assumed an international aspect and is clearly dependent on a control organization formed on an international basis. T. R. N.

Stabilisation of Agricultural Prices. *(By S. K. Muranjan—The Eastern Economist, Vol. 4, No. 6, page 161 February 1945.)* Agriculture passed recently through a phase of unprecedented distress and is now passing through a phase of remarkable prosperity, the cause in both cases being steep changes in price-levels. In the rapid deflation which succeeded the 1929 crisis, the prices of agricultural produce collapsed at a rate which turned the ratio of exchange to an unparalleled extent against agricultural produce. Thanks to the inflation of war, the recovery which was already taking place was transformed in a short time, into an era of unusual profits for most crops. It is hardly surprising that with the memory of the bad years of depression and the present prosperity in mind, the agricultural class generally has begun to place or seek its salvation in a stabilization of prices somewhere round the present levels. With the acceptance of this idea in the Bombay plan, it may be said that such stabilization has become almost an article of national economic faith.

The plea for stabilization of agricultural prices springs from a belief that the costs of production in agriculture are more or less rigid, particularly under a system of peasant proprietorship. This belief overlooks one or two important facts. One is that no scheme of stabilization can ever ensure the maintenance of this same relative prices among different agricultural produce. In the second place, the real burden of cost depends not on the absolute price the peasant receives for his produce, but this price relatively to the prices of non-agricultural goods he has to buy. Price stabilization will be a genuine boon only if the prices of other goods were assumed to remain stable or go down.

If price stabilization is agreed on as a desirable goal, the next question would be to devise the appropriate means to achieve the objective. This involves an analysis of the causes which tend to make the prices received by the cultivator low rather than high. In suggesting remedies to counter-act these causes the wider consequences of such price stabilization must necessarily occupy a good deal of our attention.

It is sometimes regarded as a serious loss to the cultivator that the whole of his produce has to be thrown, in the absence of storage and other facilities, on the market in a single instalment. This would be true only if the price ultimately paid by the consumer exceeds the price received by the cultivator by more than the expenses of storage, insurance against loss and deterioration, interest, transport and distribution charges etc. It would be a great gain if the alternating cycles of gluts and famines was replaced by a more even course of moderate but stable earnings. The remedy that suggests itself most readily is

some arrangement by which the surplus of bountiful years is carried over into the less bountiful years. But even if the problems of investible funds, storage facilities, technical personnel etc. were satisfactorily met, still this remedy has its limitations in that all agricultural produce is liable to deteriorate with time.

There is next the possibility of adjusting the output itself to the prospective prices. Leaving out the climatic factor as beyond human control, we have to deal with two major factors influencing prices, namely the acreage under cultivation and the fraction of the total output retained by the cultivator for his own use. The control of acreage by administrative restriction or subsidies might well become, in the hands of a planned economy, the instrument to secure a balanced supply of agricultural goods. With more accurate statistics of output and market conditions, it should be possible to correct the abundance of one season by deliberate curtailment in the next and thus overcome the difficulty of deterioration by prolonged storage.

Any scheme of adjusting output with a view to stabilise prices cannot overlook the fact that in the case of some agricultural produce at least, this country cannot function as a closed economy but only as a part of world economy. Most of our important crops like ~~cotton, wheat,~~ oilseeds etc., depend on foreign markets and must necessarily lie at the mercy of international prices. Where climatic or acreage factors cause harmful fluctuations in output, it is desirable that international cooperation should be invoked to prevent such maladjustment of supplies. The most difficult and perhaps commonest situation arises when improvement and efficiency cannot in the nature of things advance equally in all agricultural countries. This disparity of progress is apt to arise between countries under peasant proprietorship and others under large scale or capitalistic farming. While the latter find more or less full compensation for the fall in prices in their increase of output the peasant proprietors have more often than not to bear the full weight of diminished values. This was what happened to the Indian peasant after the last great war and particularly the great crisis of 1929. One remedy for such a situation would be to establish a complete control or monopoly of foreign trade in these staples and allow discriminating prices to prevail between the domestic and foreign consumer. But such a solution would mean difficulties for such of our industries, as use these staples as their raw materials and have to export a part of their manufactures.

Finally, account has to be taken of those cyclic changes in prices which affect all parts of the economic system. Agriculture is however apt to suffer much more in such times as spatial difficulties make them incapable of controlling the aggregate supplies in the market. For this reason, agriculture is much more interested in any general economic or monetary policy which is likely to avoid these fluctuations. Compulsory or voluntary reduction of agricultural output has sometimes been suggested as means to restore the parity of values between agricultural and non-agricultural output. But reduction of output, particularly of food in a phase of depression is hardly to be commanded as a socially desirable policy. The only other alternative would be to subsidise agricultural production i. e. transfer incomes by means of taxation from agricultural to non-agricultural classes. In a country like India, special remissions of land revenue counter-balanced by special taxation of non-agricultural incomes offer a particularly convenient means for such transfer of burdens. T. R. N.

Consolidation, Co-Operation or Collectivisation ? *(By Mahesh Chand. The Eastern Economist, Vol 4, No. 4, Pages 113–14. January 1945).* One of the most important problems of Indian Agriculture is how to increase the size and decrease the scatteredness of the holdings. Consolidation of holdings with steps to prevent subsequent fragmentation is an obvious solution. But there are many difficulties in the way. Inheritance laws will have to be changed. When land in a consolidated block is given to the most deserving among the claimants the others will have to be compensated for the loss, or provided with alternative means of livelihood. A *panchayat* or a village council properly constituted can be very helpful in the solution of some of the problems arising from the consolidation of holdings. The local governments which were carrying on with persuasive consolidation have of late realized that it is not very effective, and compulsory consolidation legislation has been enacted in some regions. The legislation is sure to hasten consolidation of holdings with the minimum of obstruction from unwilling owners, party feelings and legal tangles. To make this easy the records of rights will have to be prepared as in Hyderabad and Travancore. But consolidation is found to be unsuited to certain areas as in Bengal, Bihar and Orissa. So alternative solutions deserve consideration.

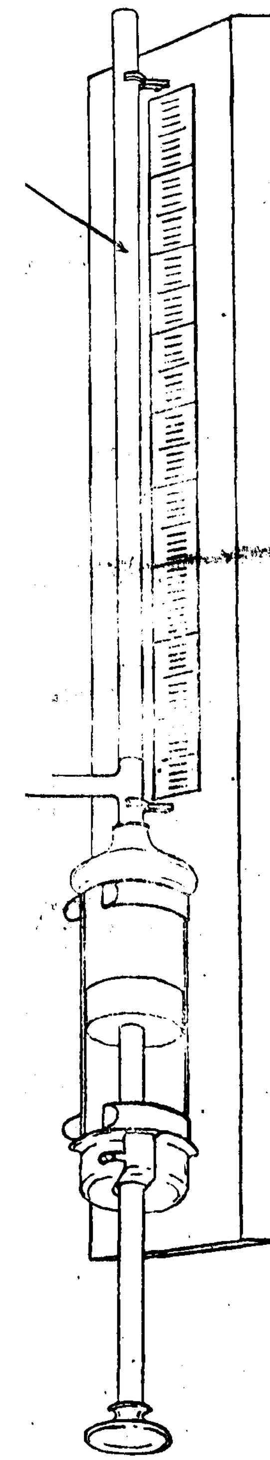
Cooperative farming is one alternative and collective farming is another. Collective farming has come to be established in Russia But though its managing committee is democratically elected, the production and price policies are rigidly determined by the state, leaving the collective farmer a mere merchant or a specialised worker without any individuality. From the long period point of view agriculture must thrive as a way of life, and mechanized agriculture cannot serve that end.

Still India needs large-scale farming in the short period, and farms much bigger than what they are today in the long period. The solution is cooperative farming It would be difficult to persuade the tenants to pool up their lands or give them up in exchange for shares in the cooperative farming societies. So, to begin with, it would be better to form cooperative supply societies for seeds, manures and implements. Then benefits of cooperative farming should be demonstrated by organizing crop farming societies with new lands brought under the plough. Such farming society may be assigned 100 acres of land with occupying rights and the state may waive the revenue and give free grants for purchase of implements and free water for cultivation for a few years as an inducement. Subletting, mortgage and subdivision rights may be allowed to the farming society with limits to the minimum area. The land should be mortgaged only to cooperative institutions and not to individuals. The society may first carry on cultivation employing members as paid workers and shares of profit. Later on lands may be allotted to the members, five acres a-piece, on occupancy basis, and the members may be helped and guided in all matters of production and distribution. Cooperation of enlightened land owners and educated youths hailing from rural areas will help to make the scheme a success Development of land mortgage banks to help the revival and running of cottage and small scale industries as alternative employment for those rendered landless by compulsory consolidation or cooperative farming will solve many of the incidental problems and make the whole scheme a success.

A. K. N.

Large-scale application of mercury for prevention of insect pests in stored food grains. *K. K. Dole. Cur. Sci. Vol. 14, No. 2, February '45.)* In large-scale experiments conducted at Kirloskarwadi (Satara District, Bombay Presidency) 408 bags of different grains, Jowar gram, wheat and dhal, were treated with mercury dust and stored for a period of five months along with 1500 bags of infested grain. At the end of this period it was found that the treated grains had been quite satisfactorily preserved. It should be pointed out that mercury is effective mainly against eggs and small larvae and that in cases where the grain is infested with a pest whose adults cause much damage, it would be desirable to supplement the mercury by some method for the elimination of these insects.

Gleanings



The Oestroscope—A Simple Device for Testing for Oestrus in Cows. (*G. W. Scott Blair, M. A., D. Sc., F. R. I. C. National Institute for Research in Dairying, Shinscld Reading*) Much valuable time is sometimes wasted in getting cows and heifers in calf because of failure to recognize the symptoms of heat, especially in the winter months. It has long been known that the mucous secretion from the cervix which comes down into the vagina and is sometimes even to be seen hanging from the vulva, is not only much more plentiful in season but has a peculiar kind of elasticity at this time.

Scott Blair, Folley, Malpress and Coppen have made use of this property in the design of a simple instrument called an oestroscope which consists of a narrow glass tube (A) with a small side tube (B) near one end, which is ~~joined to a hypodermic~~ syringe.

The mucus, which is carefully taken by hand from the upper vagina is roughly mixed by squeezing between two glass plates, and a little is sucked, by means of the hypodermic into the tube (A) so as to fill it, the tube (B) being kept closed with the thumb. The excess is removed from the end of (A) so that a column 10 cm. long (as shown on the scale) is left in the tube, which is then laid down flat.

The mucus is then slowly pushed out of the tube by means of the syringe keeping (B) closed with the thumb, until the end of the column reaches the point, marked 7 cm. on the scale, the 3 cm. of mucus so displaced forming a blob which hangs freely at the end of the tube. At this point, the thumb is released from (B) and if the animal is in season the mucus will flow back so as to refill or nearly to refill the tube. If she is not in season the amount of recoil is small or negligible (not more than ½ cm.) unless she is just coming in or out of season when a partial recoil will take place. It is not possible to tell from a single test whether oestrus is just past or not yet fully reached, and in such cases the test should be repeated an hour or two later.

The test is done very simply (it is easily carried out in the cowshed) and takes less than two minutes to complete, but since care is needed in taking samples from the vagina of the cow, especially in young animals it is suggested that those anxious to use the method should first discuss the matter with their veterinary practitioner. The method has now been used continuously for four years and is completely reliable. (*The Journal of the Ministry of Agriculture, Vol. LI No. 10, January, 1945.*)

Hybrid bees may be next. (*Condensed from Farm Journal and Farmer's Wife.*) Since honey first was sweet, queen bees and drones have mated high in the air on the wing, and all of man's attempts to control bee-breeding were foiled until recently, when artificial insemination, became practicable. Now hybrid strains of bees, developed along the same lines as hybrid seed corn, are in the making.

Queen bees may be (are being) "self-fertilized," just as corn is "selfed" in producing seed. A drone is hatched from an unfertilized egg, and when the dam (or queen-mother) of a drone is impregnated with sperm from that drone (her son) the process is actual "selfing", since no other parent intervenes.

Accordingly, true-hybrid bees are possible, and now are being produced in at least three apiaries in the United States. One is maintained by the University of Wisconsin, a second by the *Usda* Division of Bee Culture at Baton Rouge, Louisian, and the third at Alfred University at Alfred, New York.

William C. Roberts, of Madison, Wisconsin, is one of the leading experimenters in this field. He had devised and constructed a delicate syringe from a plastic material. (Syringes have been fashioned of glass and steel, with fine points that are likely to break when handled by a novice or nervous inseminator). The technique of artificially inseminating a queen bee seems fairly simple, but great skill and experience is required because of the tender tissues and organs involved.

The queen is held in a tapering hollow galss tube with an adjustable stopper, with her abdomen protruding. This is fastened in the field of a microscope, through which the operator watches as he adjusts tiny instruments to hold open the vaginal orifice for injection of the sperm. The syringe is steadied by a pivoted holder.

The sperm is obtained by dropping the drone into a chloroform bottle where he emitted sperm as he died. Some squeezing of the dead insect was necessary to expel all of the sperm.

But artificial insemination has not taken all of the bugs out of bee-breeding; in fact, some new ones have appeared. For instance, although the transmission of sperm from male to female has been accomplished successfully, it appears to cause a delay in egg-laying. When queens mate naturally they lay eggs within a couple of days, but when they are mated artificially they wait three weeks or more before they start to lay.

The broad objective of artificial insemination of bees is to develop better strains. Possibly a strain with hybrid vigour soon will be developed. Specifically, the experimenters hope to build bees with (1) a high degree of disease resistance; (2) bees that will, cap the comb in one color, preferably white; (3) bees that are fairly "gentle"; (4) bees that don't swarm too easily; (5) bees that are prolific and industrious; (6) bees that are active pollinators.

There are other desirable characteristics including consistent marking by color or other identification, so that they may be recognized readily as possessing certain traits. In short, bee-breeders hope to fix the good points in a bee and then make her tag herself.

The job isn't nearly finished yet, but is well on the way, thanks to men like Roberts at Madison, Otto Mackensen at Baton Rouge, L. R. Watson at Alfred, New York, and J. I. Hambilton of the USDA Experiment Station at Beltsville, Maryland.

Here are some definite figures on just how much honey-bees step up production of legume seed.

In Ohio it was found that bees increased clover seed production 15 times when they had complete coverage. There was a direct relationship between seed yields and honey-bee population.

Pennsylvania researchers went a step further. They found that red clover grown inside bee cages averaged 50 seeds per head. That grown in the open field averaged about 30 seeds per head, and clover in cages where bees and other insects were kept out less than I seed per head.

The Pennsylvania folks found that bees show preference for some clover strains over others, probably because blossoms of some clovers contain more nectar than others. They also observed that some bees "worked" red clover exclusively, while others gave their full attention to alsike.

If you wish to grow clover seed, and have no hives of honey-bees near your field, you might be able to persuade a commercial bee-keeper to move some bees to your farm by offering "free rent." (*Farmers' Digest, Vol. 8, No. 6, 1944.*)

The increase of B vitamins in germinating seeds. (*P. R. Burkholder and I. Mcveigh Natl. Acad. Sci. Proc., 28 (1942), No. 10, pp. 440—446 figs. 2*). Significant increases in concentration of ribboflavin, niacin, biotin, and pyridoxine during germination are reported for many kinds of seeds. If the value of germinated seeds is to be judged by their vitamin content, it appears that the common use of spreuted seeds in the diets of orientals rests on a sound nutritional basis. (*Experiment Station Record, March 1943, No. 3, Volume 88. Page 313.*)

Variation in ascorbic acid and dry matter content of cowpea plants at different times of day, *M. E. Reid. (U. S. D. A. et al.). (Bul. Torrey Bot. Club, 69 (1942) No. 7, pp. 522—527*). Progressive increases in ascorbic acid and dry matter were found to occur from the beginning of the daily light period and to continue during the day, depending on the carbohydrate-synthesizing power in the tissues. Plants grown under high illumination and much-limited food supply tended to have relatively large reserves of starch and sugars and low carbohydrate-synthesizing ability. Under favourable light such plants tended to have their maximum vitamin C values early in the day. Plants subjected to prolonged periods of cloudy weather, and especially with an abundant supply of mineral nutrients available tended to have low vitamin C values and a low supply of starch and sugars. These results suggest that for best vitamin C values harvesting of vegetables should be done not beford midforenoon following generally clear weather. If it must be done after cloudy weather, collection should be made as late in the day as possible. (*Experiment Station Record, March 1943, No. 3, Vol. 88, Page 313.*)

Germination of cotton seed as affected by soil disturbance and machine placement of fertilizer, *H. P. Smith, M. H Byrom, and H. F. Morris (Texas Sta, Bul. 616 (1942), pp. 29, figs. 21*). Effects of machine placement of fertilizer and of soil disturbance on the germination of cottonseed were studied, 1936—40. See also an earlier note (*E. S. R. 78 p. 407*). The best germination and emergence were obtained when cottonseed were planted on a firm, undisturbed soil, and better stands were obtained with fertilizer placed 2 in. to the sides and 1 or 2 in. below the seed level. The highest yield was obtained at College Station when fertilizer was placed 2 in. to each side and 1 in. below seed level and at Nacogdoches when fertilizer was placed 2 in. to each side and 2 in. below the seed level, although fertilizer applied in any manner significantly increased yield at both stations.

Danger in improper use of fertilizers. (*Condensed from California cultivator, R. B. Stephenson.*) Commercial fertilizers supply essential nutrients for plant growth and, when properly used, yield increases are sometimes phenomenal. Wrongly used, on the other hand, commercial fertilizers may reduce crop yields, as perhaps some have found to their sorrow.

The first effect of a fertilizer may be noticeable in the speed of germination of the seed. Any appreciable concentration of soluble fertilizer in contact with seed may retard or completely inhibit germination. The Pennsylvania station in trials with corn, soybeans, tomatoes, potatoes, cucumbers, cabbage and radishes found that the quickest germination in every case was in unfertilized soil.

Some crops are very sensitive while others, such as potatoes, will tolerate a high concentration of fertilizer although the germination is slowed down. The reason for the difference in sensitivity is not known and, though the rate of germination is reduced for all crops with seed in contact with fertilized soil the final yield is usually greatest where rather liberal fertilization has been practised.

How to receive all the good and none of the evil effects from the use of fertilizers is important. The answer lies largely in the method of using the material and to a lesser extent, in the moisture conditions of the soil. With 30 per cent moisture the soil solution is only about half as concentrated as when the moisture drops to 15 per cent and the plants probably begin to show signs of wilting. An adequate moisture supply is necessary for the satisfactory use of fertilizer.

Much of the difficulty can be avoided by having the fertilizer placed in the soil a sufficient distance away from the seed, which is usually two inches or more To mix amounts of fertilizer with all the soil and plant seed immediately is a bad practice. The most effective method is to place part of the fertilizer in rills, or small furrows, two inches to the side and two inches deeper than the seed. With heavier rates of application rills of fertilizer in the bottom of the plow furrow have worked well. This places the major portion of fertilizer some six to ten inches down where the soil is always moist. A light application near the seeds starts early growth quickly.

The most effective fertilizer placement leaves strips of unfertilized soil not only between the seed and fertilizer, but also strips of unfertilized soil between the rills of fertilizer. The fertilizer is also deep enough so that the soil does not dry readily. This allows the roots easy access to soluble fertilizer while at the same time affording a zone of soil where roots may function without hindrance of a high concentration of the soil solution. By this means burning, which is the name given to fertilizer injury, is avoided.

To speed seed germination, on the other hand, an abundance of rotting organic matter may be provided Soil from under a rotting mulch produces both a higher percentage and a quicker seed germination, sometimes cutting the time nearly in half where poor soils have been mulched. The reason for this good effect of humus is not known, but the production of growth hormones by the rotting organic matter is a possible explanation. It is known that hormones are produced when organic matter rots in the soil.

All these observations sum up to a recommendation for the next use of commercial fertilizers. Heavy applications should be placed deeply, in rills or furrows, a safe distance from the seed or plant. Light applications are needed near the plant for early growth stimulation. Organic materials, particularly farm-yard manure or compost, used with the fertilizer on the same soil will increase the efficiency of the fertilizer and reduce the danger from burn. Frequent watering to prevent excessive drying of the fertilized soil also will reduce the danger from burn.

Once plants are well started in the soil, growth tolerance is greater than germination tolerance for fertilizer. This is one of the reasons for the practice of side dressing plants with soluble fertilizers at frequent intervals, sometimes nearly up to the time of final harvest A ton of sulphate of ammonia applied to an acre of soil at one time would probably cause serious crop burn. When applied in light side dressings at suitable intervals on tomatoes a phenomenal harvest resulted. A more concentrated fertilizer solution can be safely used for side dressing well established plants than may be used as a booster solution before the plants have a well developed root system.

The season of the year is also an important factor affecting the danger of fertilizer burn. In hot, dry weather only small amounts of fertilizer can be safely used at one application even when irrigation is practised. In the early season of moist, cool weather danger of burn is relatively much less. These well established facts lead to the conclusion that skill and experience are necessary

to use commercial fertilizer most effectively. When properly applied most dangers attendant upon their use can be avoided, with the prospect of a greatly increased harvest. (*Farmers' Digest, Vol. 8, January, 1945.*)

Broodiness in Poultry. Broody hens are sometimes used by small poultry-keepers and householders to hatch a few chickens, but to the commercial farmers who do all their hatching in the incubator, they are a nuisance.

Light breeds such as White Leghorns, Anconas, Minorcas, etc., seldom go broody, whereas in the heavy breeds such as Australorps, Rhode Island Reds, Light Sussex, etc., broodiness is usually fairly prevalent. This is probably why White Leghorn is the most popular breed with the large commercial poultry farmers. The work entailed in handling "broodies" certainly takes a great deal of time, and egg production of the flock is seriously affected in the meantime.

If broody hens are allowed to remain in the nests for several days they are much harder to "break off the cluck," and also quickly lose condition, which means a longer period out of production. They also cause overcrowding in the nests and an increase in the number of cracked and broken eggs.

Remove the hen immediately she becomes broody to a broody coop or spare pen in which there are no nests and where she can be fed and watered. She should be back into production again in ten days to a fortnight, but if allowed to remain on the nest, many weeks of production will be lost.

Some hens go broody only once in the year, others many times. It is advisable to mark persistent broodies with a colured leg band so that they can be culled out early and not used for breeding purposes. (*Journal of the Department of Agriculture, Vol. XLIII—Part 1, January, 1945, Page 29.*)

A controlled experiment in feeding wheat germ oil as a supplement to the normal ration of bulls used for artificial insemination, *G W. Salisbury, (Cornell Univ.) (Jour. Dairy Sci., 27 (1944), No. 7, pp. 551—562)* In a group of 20 bulls fed a regular ration over nearly a year, supplementing the ration of one-half of the bulls with 1 oz. of wheat-germ oil daily did not increase the fertility of sperm viability as contrasted with the other half, which received no wheat-germ oil. Data were recorded on the semen characteristics of the bulls and their breeding behaviour during the 3-month period before wheat-germ oil feeding and also while being fed the wheat-germ oil. The time that the bulls required for mating, from their approach to the "teaser" cow until the ejaculation, volume of ejaculate, number and motility of sperm, concentration of semen, and conceptions among the 3,681 artificial services of the wheat-germ-oil-fed bulls and the 4,565 services of the control bulls were recorded. The wheat-germ oil feeding did not prevent two bulls from decreasing in fertility to such low levels that they were withdrawn from use in artificial insemination. There was a highly significant decrease in the percentage of motile sperm during the early-spring months and highly significant monthly differences in sperm counts but no significant monthly differences in fertility were noted. Semen was collected from each bull approximately once each week. (*Experiment Station Record. Vol. 92, January 1945, Page 35.*)

Chemical Capons. By implanting pellets of stilbestrol beneath the skin of the neck of young roosters, a scientist at the University of California produced all the appearances of genuine capons in his experimental birds. Masculine characteristics were lost and quite phenomenal gains in weight were obtained.

Female birds so treated assumed male characteristics. Stilbestrol is a synthetically-made female sex hormone. The drug is absorbed very slowly, and necks of birds so treated must be discarded before they are offered for sale or eaten. Midwest veterinarians, in several instances, are distributing these pellets among poultry raisers specially selected. As yet, experimentation has not gone far enough to justify widespread application to home-owned flocks. The end advantage may be in effecting quick weight gains rather than actually in making true "Chemical capons." (*Farmers' Digest, Volume 8, January 1945*).

Tobacco Root as site of Production of Nicotine *K. Mothes and K. Hiske (Naturwiss., 1943, 31, 17—18).* Tomato shoots grafted on tobacco plants contain approx. the same proportion of nicotine as do normal tobacco shoots. Conversely, tobacco shoots grafted on tomato roots are practically free from nicotine. The fluid which exudes from the root of a flourishing tobacco plant when the stem is cut at the junction contains approx. 200 mg of nicotine per 100 c. c. Results indicate that the tobacco root is one of the chief sites of nicotine production and that nicotine is probably not essential for the growth of the tobacco plant. Nicotine (and other alkaloids) are possibly produced from simple N compounds, e. g., NH_3 by inter-action with products of carbohydrate decomp. *(British and Physiological Abstracts. December 1944.)*

Departmental Notifications

Postings and Transfers

Gazetted Service

Sri K. B. Viswanathan, Assistant in Paddy to officiate as Assistant Paddy Specialist vice Sri T. K. Balaji Rao granted leave; Sri C. Jagannatha Rao is posted, on the expiry of his leave, as Assistant Cotton Specialist, Narasaraopet, reverting Sri S. Sundaram to the Madras Agricultural Subordinate Service; on expiry of his leave on 5—6—45, Sri G. Venkatanarayana is reposted as Superintendent, A. R. S. Nileshwar vice Sri C. R. Seshadri transferred as Assistant Oil Seeds Specialist for research on groundnut, Tindivanam; on relief by Sri C. R. Seshadri, Sri M. Bhavani Shankar Rao will revert to the Madras Agricultural Subordinate Service; Sri M. Gopala Chettiar, Personal Assistant to the D. A. O., Pattukottai to officiate as D. A. O., Saidapet vice Sri M. Subramania Pillai transferred as D. A. O., Kurnool releiving Sri V. Satagopa Ayyangar posted as Assistant Marketing Officer, Madras, in the Madras Rice Mills Licensing Order Scheme.

Subordinate Service.

Sri M. K. Swaminatha Ayyar, A. D., Orthanad and Sri S. Mahadeva Ayyar, A. D., in charge of Vegetable Scheme, Trichinopoly are posted for investigating the scope for increased cultivation of Temple and Math lands in the districts of Tanjore, Trichy, Madura, Ramnad and Tinnevelly; Sri M. Rami Reddi, A. D., Markapur to be A. D., Allagadda; Sri M. Narasimha Reddy, F. M., A. R. S., Nandyal to be A. D., Dhone vice Sri N. Vasudeva Rao posted as A. D., Pattikonda; Sri K. V. Reddi Naidu, A. D., Bhimilipatam to be Marketing Asst. for purchase of cakes; Sri B. P. Samba Rao, A. D. Pithapur, is transferred to the Agri. College, Coimbatore in connection with vocational training of serving soldiers; Sri K. Ramanarayana Menon to be Marketing Asst., Madras; Sri M. L. Balasundaram, Asst. in Paddy, Rice Research Station, Buchireddipalayam, to be Asst. in Paddy, A. R. S., Maruteru; Sri J. Subramaniam, Asst. in Paddy, Rice Research Station, Buchireddipalam to be F. M., A. R. S., Maruteru vice Sri C. L. Venkatachalam, transferred as A. D., E. Godavari Dt.; Sri V. Muthuswami, A. D., Uthamapalayam to be A. D., Sriperumpudur vice Sri J. Vaidyanathan, transferred as A. D., Mayavaram; Sri T. Krishna Reddi, Personal Asst. to the D. A. O., Kurnool is posted, on return from leave, as Personal Asst. to the D. A. O., Cuddapah; Syed Ibrahim Sahib, Asst. in Paddy, Coimbatore, to be Asst. in charge of the Rice Research Station, Buchireddipalam vice Sri S. Ramachandra Rao transferred as Senior Science Asst., A. R. S., Maruteru; Sri P. Krishnaswami, Marketing Asst. for procurement of black gram from Bihar is posted back as Asst. in Millets, Coimbatore; Sri D. V. Ramana Rao, Tobacco Seed Production Scheme, Guntur to be A. D., Vinukonda; Sri A. Rama Doss, A. D., Tiruthuraipundi to be Personal Asst. to the D. A. O., Pattukottai; Sri K. Kuppumuthu, A. D., Mudukalathur to be A. D., Srivelliputhur vice Sri D. S. Subramania Ayyar transferred as A. D., Musiri, relieving Sri C. K. Gopala Krishnan posted as Temporary Additional Teaching Asst. in Agriculture, Coimbatore.

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