

The Madras Agricultural

Journal

1922 - July

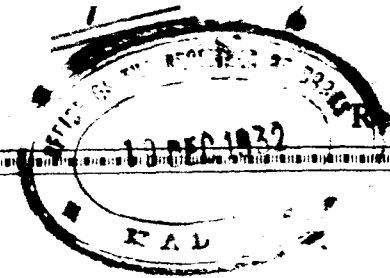
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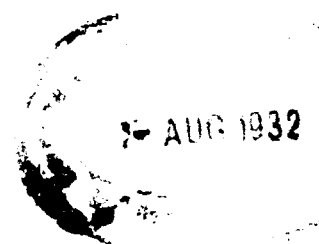


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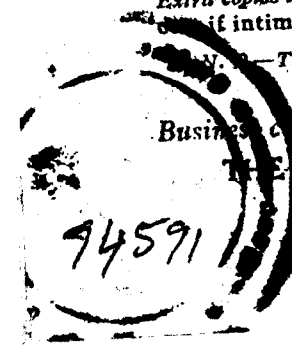
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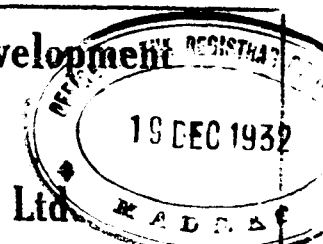
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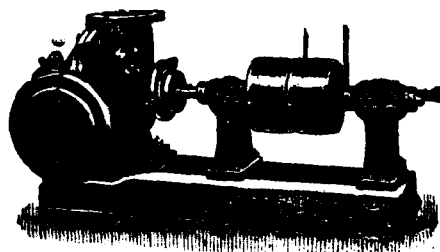
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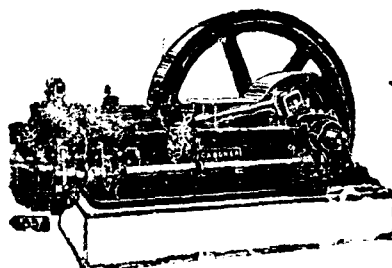
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PESTS OF GANJA (*Cannabis sativa*).*

By M. C. CHERIAN, B. A., B. Sc., D. I. C.

Madras Agricultural Department.

Introduction. As early as 1920 reports regarding pests of Ganja were received by the Government Entomologist, but it was only in 1927—28 it was found possible to take up the study of the different pests of this crop. One acre of Ganja worth about Rs. 5000/- grown for experimental purposes by the Agricultural Chemist, in the Central Farm, Coimbatore, in 1926—27 had to be destroyed due to the heavy damage caused by mites. The seriousness of the pest was at once understood and during the season 1927—28 the study of this and various other pests of Ganja was taken up by the writer. The present paper deals with the work done by him so far.

Cultivation of Ganja. Before dealing with the various pests of Ganja it would be necessary to make a few notes in regard to the cultivation of this crop. In the Madras Presidency Ganja is grown in three different centres, namely Santaravur in Guntur District, Santavasal † in North Arcot District, and Hosur in Salem District. Cultivation is carried out by a number of ryots under Government supervision. Seed is supplied free to the ryots by the Government. Sowing generally takes place in August-September after the preliminary ploughing and manuring. In Santaravur transplanting is practised while in Santavasal this is not the case.

* A paper read before the Indian Science Congress 1932.

† For the last two years Santavasal Centre has been dropped.

Ganja is a dioecious plant. This is the general rule but occasionally monoecious plants are also met with. For the preparation of Ganja cake, seeds have to be eliminated as far as possible. So the male plants are rogued out to prevent fertilisation of the flowers. The earlier the male plants are removed, the better, as there is then less chance of fertilisation taking place. The removal of male plants will also enable the female plants to get more nourishment from the soil.

The writer understands that the Ganja Botanist has been able to detect certain characters in the seedlings by which the male plants could be rogued out as early as 18-23 days after sowing, depending on the variety used and the method of cultivation practised. Till the elimination of monoecious plants by breeding new varieties, the monoecious plants also will have to be pulled out.

Harvesting of the crop takes place in January and continues till March. When the plants are mature all the lower leaves are shed and there remain only the flowers, bracts and smaller leaves. The plants are cut during nights and allowed to remain in the fields till next morning. They are then removed to the threshing floor for further drying. After eliminating the leaves, seeds and stalks, the flowery tips are placed in the sun for a short time for drying. These are then thrown into moulds $3\frac{1}{2}' \times 2\frac{1}{4}'$ and transferred to presses. After 24-36 hours the cakes are removed from the presses and cut into suitable sizes and allowed to dry. The average yield per acre is $2\frac{1}{2}$ - $3\frac{1}{2}$ maunds (1 maund = 82 lbs). The Ganja Botanist was able to get about 10 maunds per acre from one of his experimental plots in the Central Farm.

Pests of Ganja. The following pests noted so far are arranged according to their families.

Pests of Ganja.

No.	Common Name.	Scientific Name.	Family.	Order.
1.	Mites	<i>Tetranychus telarius</i> , Linn.	Tetranychidae	Acarina.
2.	Whiteants.	<i>Microtermes obesus</i> , R.	Termitidae	Isoptera
3.	Caterpillars.	<i>Chloridea obsoleta</i> , F.	Noctuidae	Lepidoptera
4.	do.	<i>Amyna octo</i> , G.	do.	do.
5.	do.	<i>Lophygma exigua</i> , H.	do.	do.
6.	do.	<i>Prodenia litura</i> , F.	do.	do.
7.	do.	<i>Euproctis fraterna</i> , M.	Lymantriidae	do.
8.	do.	<i>E. scintillans</i> , Wlk.	do.	do.
9.	Plant bugs.	<i>Dolycoris indicus</i> , Stal.	Pentatomidae	Rhynchota
10.	do.	<i>Nezara viridula</i> , Linn.	do.	do.
11.	do.	<i>Otinotus lignicola</i> , B.	Membracidae	do.
12.	do.	<i>Eurybrachys tomentosa</i> , F.	Fulgoridae	do.
13.	Plant lice	<i>Aphis gossypii</i> , G.	Aphididae	do.

14.	Thrips	<i>Heliothrips indicus</i> , B.	Thripidae	Thysanoptera
15.	Grasshoppers.	<i>Chrotogonus saussurei</i> , B.	Acridiidae	Orthoptera
16.	Ants.	<i>Solenopsis geminata</i> , F.	Formicidae	Hymenoptera
17.	Beetles.	<i>Epilachna dodecastigma</i> , Muls.	Coccinellidae	Coleoptera
18.	do.	<i>Xanthochelus superciliosus</i>	Curculionidae	do.
19.	do.	<i>Tribolium castaneum</i> , Hb.	Tenebrionidae	do.
20.	do.	<i>Silvanus surinamensis</i> , L.	Cucujidae	do.
21.	** Field rats	—	—	—

Of these, numbers 1, 2, 3, 4, 9 and 10 may be classed as major pests. Of the others, number 14 does some slight injury to the leaves of young plants. Numbers 19 and 20 affect stored Ganja cakes. A short account of the major pests and the control measures tried against them is given first. Short notes on the other pests are also given.

Major Pests.

1. **Tetranychus telarius**, L. This mite, the most important pest of ganja is a minute creature the adult measuring about .3 m.m. in length. It sucks plant sap with the aid of its piercing mouth parts. In cases of severe infestation the whole plant may dry up. The mites are generally found on the under-surface of the leaves. When the plants become mature they attack the spikes also. In the later stages of infestation the various portions of the plant will be found webbed together. In the earlier stages of infestation the under surface of the leaves will have to be searched for the presence of this pest, but in the later stages the leaves show discoloration and webbing is one of the sure symptoms of attack.

The loss due to mites has been estimated roughly to be about 30 to 50% of the crop. Cakes prepared from attacked plants are moreover not so good as those from mite-free plants. As stated before the damage to the Ganja crop in the Central Farm one year was so severe that the plants had to be destroyed. Perhaps the severity of the infestation may have been due to the fact that the crop was concentrated in an acre of land.

Mites have been noticed as early as 60 days after sowing, but they are generally seen in numbers only after $2\frac{1}{2}$ to 3 months after sowing. The appearance of the mites may probably have some relation to the formation of spikes on the plants.

The whole life cycle of the mite takes only 10-12 days. The maximum number of eggs for a female has not been worked out but one fresh female was recorded to have laid 157 eggs in 20 days from 11-2-29 to 3-3-29 the date on which it unfortunately happened to get drowned. Seeing that the life cycle is short and the egg laying capacity large, it is no wonder that they multiply in large numbers.

** The Ganja Botanist reports that in Hosur (1931) Field rats did considerable damage to seeds and seedlings at the time of sprouting.

and cause much damage to the plants unless checked in time. It is true that there are several natural enemies present such as certain lady-bird beetles and other insects but their powers in regard to the reduction of the pest are very limited. Again in the case of certain other pests by dealing with their alternate host plants, some relief is obtained. But this is not possible in this case for this mite has been noted on a variety of plants such as Agathi (*Sesbania grandiflora*), Castor (*Ricinus communis*), *Aristolochia* sp., mulberry (*Morus alba*), Daincha (*Sesbania aculeata*) and Jasmine (*Jasminum sambae*). Infestation from any one of these common plants is therefore quite easy.

Remedial Measures. Remedial measures against mites were attempted in three directions namely

- a. Varietal trials for mite resistance
- b. Seasonal trials
- c. Insecticidal trials

a) *Varietal trials.* Six varieties of Ganja were tried for mite resistance but none were found to be immune. Of those examined 'Pu-a' and 'Naogaon' showed only slight attack while 'Goribidnur' and 'Hosur' were the worst affected. 'Khandwa' and 'Almorah' were intermediate. In this connection it has to be mentioned that the two varieties which showed the least attack are unfortunately the worst from the spike point of view and one variety which is the best from the spike point of view (Goribidnur) is one of the worst affected by mites.

b) *Seasonal trials.* It is known that certain crops when sown earlier, are able to escape the attention of the pest to some extent. To ascertain whether it is so, in this case, the Ganja crop was grown in 1930 at 6 different periods at an interval of 15 days (20th July, 5th and 20th August, 5th and 20th September and 5th October) the normal period being the 20th August. It was found that the pest was equally severe in all the plots and that the last 2 plots did not come up properly perhaps due to the fact they were sown too late. The seasonal trials will have to be repeated to confirm results so far obtained.

c) *Insecticidal trials.* Various insecticides such as flowers of sulphur, 'Harola' (patent sulphur preparation), lime sulphur, fish oil rosin soap and fish oil soap were tried at different strengths and at different stages of plant growth. All these were found effective against the pest but chemical analysis showed that cakes prepared from plants treated with sulphur preparations contained sulphur in varying proportions and when these were tested by veteran smokers they gave their verdict against them. Cakes prepared from plants treated with fish oil rosin soap or fish oil soap (1lb in 6 gallons of water) have, however, passed the smoker's test successfully. Spraying, to be effective, has to be done in time as soon as the pest appears.

2. Chloridea Obsoleta, F. This caterpillar is found in large numbers feeding on leaves and capsules of the Ganja plant. The first report of this pest doing serious damage to Ganja was in 1920 from Santavasal. There was a similar attack of this caterpillar in 1925 from Santaravur. An examination of the latter crop by one of the Entomological staff showed the presence of these caterpillars on almost every plant. In certain plants the maximum number was as high as 35. In two days hundred caterpillars ate in captivity as much as two lb of leaves and shoots. The life history of the moth is as follows. Eggs are laid singly by the female moth on the leaves or shoots of the plant. They are pale yellow in colour and $\frac{1}{2}$ m.m. in size. Three moths laid in captivity 241, 627 and 1509 eggs respectively. The egg period is 3 days. The newly hatched caterpillars are $1\frac{1}{2}$ m.m. long and 0.2 m.m. broad and are pale yellow in colour with small dark hairs on warts. They first feed on the epidermis of the leaves and later on, on the whole leaves and capsules. As soon as the sun gets severe the caterpillars get down the plants and hide in cracks in the soil. When full-fed they pupate in the soil. The larval period is about 26–30 days, and the pupal period 12–14 days. The whole life cycle of a moth came to 41 days. The longevity of seven moths fed with jaggery water in captivity was 9, 11, 12, 13, 16, 17 and 18 days respectively.

Remedial Measures. Hand picking of caterpillars in the early stages of attack will give some relief. In a moderately attacked field in Santaravur, ten boys and girls collected from one acre of crop three ordinary bucketfuls of caterpillars. On the Central Farm, Coimbatore, the method of shaking the plants and killing the caterpillars which fall, down, once in ten days was found to be useful. This method reduced the number of not only these caterpillars but also of others and plant bugs.

As an experimental measure a dozen plants were dusted with Lead arsenate—one oz of the poison being mixed with 8 times the quantity of fine ash. Cakes prepared from these plants were analysed by the Government Agricultural Chemist and reported upon as follows.—

"100 grammes of Ganja cake from plants dusted with Lead arsenate contains only 8.3 milligrammes of Lead arsenate. This quantity is equivalent to 2 milligrammes of arsenic. The medical dose of arsenic is 2 milligrammes i.e. 100 grammes of Ganja cake contain only an amount of arsenic that is usually allowed as a medical dose".

3. Amyna octo. G. This is the first time that this pest is noted on Ganja. Sweet potato (*Ipomaea batatas*) jute and Lantana are other host plants. Eggs are laid singly by the female moth on the under surface of the leaves, generally 3 to 4 days after emergence.

They are pale white in colour and are circular, flattened at base and convex distally with tubular outgrowths and measure $\frac{1}{2}$ m.m. in diameter. The egg period is 3 to 4 days. Three females kept for egg laying laid 442, 393 and 388 eggs in 7, 12 and 7 days respectively. The maximum longevity of a moth came to 43 days. The newly hatched larvae are 2 m.m. long and pale green in colour. Short black hairs are seen all over the body. The warts on the head capsule have black dots and hairs. In the early stages the caterpillars feed by scraping the green matter from the upper surface of the leaves. During later stages they feed on the entire leaf. At this stage they have dark longitudinal lines and two dark crescents on the dorsal surface on each of the body segments. When full-fed they measure 25-27 m.m. in length. When about to pupate they assume a purple colour. The larval stage is 15-19 days. Pupation is generally in the soil. If they cannot find soil for pupation the caterpillars web together leaves and pupate inside. The pupae are deep brown in colour and measure $9\frac{1}{2}$ m.m. in length and 3 m.m. in breadth. The pupal period lasts 8-14 days. The whole life cycle is 26-37 days. Control measures are the same as those for Chloridea.

4. *Microtermes obesus*, R. This is also one of the major pests of the crop noted in the Central Farm, Coimbatore. The attack is generally noticed in grown up plants, the plants attacked being found to dry up. If such plants are pulled out the roots are all found to be eaten away and even the stems found hollowed out, sometimes even to their tips. Nothing can be done to save such plants at this stage. If however the attack is noticed in the earlier stages, relief can be given by irrigating with crude oil emulsion when the white ants will be driven away.

5. *Dolycoris indicus*, Stal. Of the bugs noticed on the crop this together with *Nezara viridula* is the most important. The bugs, both nymphs and adults, suck the plant sap. If found in very large numbers (in certain years this is the case) considerable damage will be done to the plants. The length of the life cycle of one specimen reared on Ganja came to 26 days, the egg period being 5 days and the nymphal period 21 days. There were five moults. Eggs are pale yellow in colour and laid in clusters and glued on to the leaves. Three such clusters examined showed 41, 35 and 35 eggs respectively.

6. *Nezara viridula*, Linn. These bugs in addition to sucking plant sap from the leaves are also found damaging the spikes. Eggs are laid in clusters and one such cluster contained 94 eggs.

Minor Pests.

A list of the minor pests, together with the nature of injury done to the plants is given below in a tabular form.

Minor Pests of Ganja.

No.	Name of pest.	Nature of injury.	Remarks.
1.	<i>Heliothrips indicus</i> , Bagnall.	Feeds on the plants by sucking the juice.	One year this was found doing certain amount of damage to young plants. This was checked by spraying Fish oil Rosin soap, at strength of 1 lb. in 10 gallons of water.
2.	<i>Prodenia litura</i> F.	Feeds on leaves and spikes.	Next to Chloridea and Amyne. The caterpillar is found in small numbers. Noticed on young plants.
3.	<i>Laphygma exigua</i> , H.	do.	
4.	<i>Euproctis fraterna</i> , Moore.	do.	Noticed occasionally.
5.	<i>E. Scintillans</i> , Wlk.	do.	do.
5-a.	<i>Otinotus lignicola</i> .	Sucks up plant sap.	do.
6.	<i>Eurybrachys tomentosa</i> , r.	do.	Contact insecticide such as F. O. R. S. is useful against the pest.
7.	<i>Chrotogonus saussurei</i> , B.	This grasshopper attacks seedlings.	No remedy known except killing by mechanical means.
8.	<i>Solenopsis geminata</i> , F.	Damage done by biting buds of young seedlings and making tunnels in the soil near their roots.	Some repellents such as Crude Oil Emulsion may be tried.
9.	<i>Epilachna dodecastigma</i> , M.	Feeds on leaves.	Found only on two or three occasions.
10.	<i>Xanthochelus superciliosus</i> , F.	do.	A few weevils were collected once.
11.	<i>Tribolium castaneum</i> , Hbst.	Feeds on Ganja cakes in store houses.	Collected by Mr Reddi, Ganja Botanist from Bangalore.
12.	<i>Silvanus surinamensis</i> , L.	do.	do.

Acknowledgments. In conclusion the writer wishes to thank Rao Sahib Y. Ramachandra Rao, Govt. Entomologist (now Deputy Locust Entomologist) for advice in the course of this work, Rao Bahadur B. Viswa Nath, Government Agricultural Chemist, for analysing the samples of Ganja cakes sent to him and Mr C. M. Ranga Reddi, Ganja Botanist, for facilities rendered in connection with the remedial measures for mites.

A NOTE ON CITRUS CULTIVATION AT PALACOLE, GODAVARY DISTRICT.

By P. LAKSHMINARAYANA,

Assistant Agricultural Demonstrator, Narasapur.

Citrus gardens are raised in and around Palacole in about 10 villages: Viz. (1) Palacole (2) Konteru (3) Gaggipurru, (4) Gummulur, (5) Digamorrur, (6) Kaza, (7) Vadlavanipalem, (8) Vedangipalem, (9) Kapavaram, (10) Valamaru, (11) Kommuchikkala, etc. The cultivators are mostly local Kapus, Thelagas, but of late other communities, viz. Kshatriyas, Thurpu kapus and Settibaligis, are taking to it.

2. **Citrus Varieties.**—There are many varieties. The chief among them in this locality are:—

- i. *Citrus aurantium*—Country Orange
- ii. *Citrus sinensis*—Batavian Orange
- iii. *Citrus decumana*—Pomelo
- iv. *Citrus medica*—Var. *acida*—Sour Lime.
- v. *Citrus medica*—Citron.
- vi. *Citrus medica*—Variety—Limonum—Lemon
- and vii. Seville Orange.

Of the above varieties, only three are being cultivated locally on a large scale, the names of which are given below in order of their importance:—

- i. *Citrus medica*—variety—*acida*—lime. ii. *Citrus sinensis*—Batavian orange. and iii. *Citrus decumana*—Pomelo.

3. **Selection of site**—High level lands free from salinity are most suitable. There should be good facilities for irrigation and drainage.

For successful growth of the orange, shelter is required to act as wind breaks both in rainy and summer seasons. For this purpose, coconuts are planted in this locality all round at a distance of 6 yards. About 50 coconut trees can be planted round an acre garden. Coconuts are not usually planted where there is a saltpan underneath, as in such localities full grown trees in yield may die suddenly. The system of planting coconuts all round is a source of good income. Fifty trees planted like this round a garden will usually yield more than one acre of coconut garden, the reason being that the manuring and irrigations given to citrus trees are taken advantage of by these. Three year old coconut seedlings are planted which usually commence bearing after 5 years. These fifty trees will ultimately yield on the average about 5,000 to 7,000 coconuts per annum which will fetch about Rs. 200 in normal times. The yield of coconut trees planted round in citrus gardens in black clay soils is considered to be heavy.

4. **Soils.**—The soil of citrus gardens may be classified under four heads. (i) *Pati soils* (Old village sites). In these soils heavy watering is required. There will not be much vegetative growth. The yield of fruit is heavy. The rind will be thin and the fruit heavy but less sweet. Watering is to be done once a week. The life of the garden is comparatively short.

ii. *Black clay soils.* The trees will have good vegetative growth very soon. Low yields, thick rind, light fruits and medium sweetness are the characteristics of the produce of this soil. Watering is required once in 10 days. The life of the garden is medium.

iii. *Red loams.* This is intermediate between (i) and (ii). Fruit is very sweet, moderate-sized, (smaller than that in *pati* soils), smooth and of good colour. The life of the garden is long. In soils where lime is present in large quantities, the fruits will be slightly sour.

iv. *Sandy loams.* As at Dosakayalapalli, very heavy waterings are required. The surface may appear to have dried up, but there will be moisture below. The trees put on good vegetative growth and begin to yield soon. The fruits are of medium sweetness.

Citrus trees succeed best on well drained soils of a rather open nature.

A good admixture of sand seems to be an essential condition. The trees thrive most where this sandy soil is mixed up with either red or black ferruginous earth. It is also necessary for success that the soil should be capable of retaining a good deal of moisture.

Sticky heavy soils, through which water does not easily percolate should be avoided, and also those which are extremely dry, unless they can be irrigated. Again, damp and wet soils and those underlaid with hard pans should not be chosen for citrus cultivation.

5. **Seed selection.**—Seeds are taken out of mature fruits from medium-aged trees in September and October. A medium age in the case of lime is about 30 years and in the case of Batavian orange and Pomeles about 40 years. These seed fruits are procured from strong growing, healthy trees; all immature and poorly developed seeds should be discarded. Care should be taken to sow the seeds as fresh as possible. If seeds are allowed to become too dry, the cotyledons separate and germination will be poor. So, unless they are to be planted immediately, they should be preserved in damp sand or earth, but in any case for not more than a week or two, after which period, the seeds are said to be useless. Care should be taken to see that seeds are not damaged by insects and ants. Usually, baskets are tied to 'Batavians' while on the tree, and such fruits should not be used for seed purposes, as they are usually insufficiently ripe. The seeds are usually dried in the shade for 2 or 3 days before being sown.

6. **Seed beds, Sowing and Management:**—Good high level ground is selected and a nursery is prepared. The earth to a depth of about 9 inches is prepared by turning over with mamhatties 4 or 5 times and a fine tilth is obtained. If deficient in plant-food, a little well decomposed farm yard manure and silt is applied to the bed and worked into the soil, two to three weeks before planting the seed. Beds are formed into convenient sizes—say $3\frac{1}{2} \times 2\frac{1}{2}$ yards or about 9 square yards. When the beds are properly levelled the dry seeds are spread over them and are then covered over with finely powdered soil to a depth of an inch. Before sowing, care must be taken to see that the soil is either naturally moist enough to insure proper germination of the seed or made and kept so by watering. These seeds are generally sown in October and November. After sowing, the ground is covered over with plantain and other leaves, the covering being removed in the evening and some water sprinkled over the surface. This process goes on till the seeds germinate which generally takes 20 to 30 days. Some do this sprinkling of water on alternate days. In any case, water should not stand and remain in the bed. Usually under favourable conditions four to five weeks may be allowed for the seedlings to get above the ground. After 20 to 30 days, water is to be sprinkled over twice a week for about a fortnight. Afterwards, water is allowed to flow freely into the beds and drained away immediately.

The seed should be planted thick, at a depth of $\frac{3}{4}$ to 1 inch and the ground should be moist at the time of planting, to secure the best results.

In a bed, say $3\frac{1}{2} \times 2\frac{1}{2}$ yards = 9 sq. yds, the following are the requirements of fruit for seed purposes:—

- i. Lime:— 500 lime fruits are required. Each fruit contains 10 to 15 seeds. About 500 good seedlings can be obtained.
- ii. Batavians:— 100 fruits are required. Each fruit contains 20 to 25 seeds. About 500 good seedlings can be obtained.
- iii. Pomelo:— 50 fruits are required. Each fruit contains about 25 seeds. About 750 good seedlings may be obtained.

Weeds should not be allowed to grow. Irrigations are to be given according to requirements, and the seed beds should be carefully watched for insects.

Usually the seedbeds are given some shade. The shaded seed bed has its drawbacks. Some consider that the better method is to provide ample irrigation and grow the seedlings in the open. It has been found best to water by sprinkling and to keep the soil and plants reasonably moist at and immediately following the germination of the seed.

The seedlings are left over in this first seed bed for about two years. In the second year (in the first seed bed) some apply a small quantity of a mixture of well decomposed farm yard manure and

tank silt. This makes the soil of the bed somewhat loose and dry to facilitate removal of seedlings for planting in the second nursery.

In the 3rd year during September and October the seedlings are transplanted into a second nursery. By this time, the seedlings will be about a quarter of an inch or so in diameter at the ground. The second nursery should be cultivated thoroughly before transplanting. The earth is turned over with mamhatties four or five times in fifteen days and well decomposed farm yard manure and tank silt are applied and worked in; after which the land is levelled and beds are formed, as in the seed nursery. The seed nursery is watered thoroughly just before removing the seedlings. In removing the seedlings from the seed bed the hand hoe is driven down to a depth of 8 to 10 inches and the seedlings lifted out. The top and roots are sometimes trimmed back before planting. This pruning induces a well branched and well developed root system. These seedlings are then planted in the second nursery and placed 8 or 9 inches apart; some give one foot spacing every way. About 50 seedlings are planted in a bed of $3\frac{1}{2} \times 2\frac{1}{2}$ yds. or 9 sq. yds.

It is reported that in the neighbourhood of Tenali, ryots always put in the plants *obliquely*. The reason is that new and straight shoots are given off near the root, and the original oblique one withers away. Then the leading root-shoot is left, which grows more vigorously and forms the future tree. After planting irrigations are given twice a week for about a month and afterwards once in 5 days till the rainy season, afterwards once a week. No manure is applied after planting the seedlings in the second nursery. It is merely kept free of weeds. Here the seedlings are allowed to remain for an year or two. By this time, they grow to a height of 4 or 5 feet. They are then finally planted out.

Gardeners in the neighbourhood of Palacole object to the system of oblique planting, and they say that root-shoots are not good yielders. No doubt the root shoots come up when thus planted, but the trees from such shoots will not develop fully. Such trees are said to come to bearing early, but die early on account of the branches dying back. As many root shoots are allowed to grow from each plant none of them develop properly and the yield is on the whole poorer.

7. **Cost of seedlings:**— Two year old seedlings from the first nursery are sold as follows:—

- (1) Lime:— at Rs. 2—8—0 to Rs 3—0—0 per 100 seedlings.
- (2) Batavian orange at Rs. 5 per 100 seedlings.
- (3) Pomelo at Rs. 2 per 100 seedlings.

Usually 3 to 5 years' old seedlings are selected for permanent planting in gardens and prices normally are as follows:—

	4th year.	5th year.
(1) Lime seedlings	Rs. 30 per 100	Rs. 45 per 100.
(2) Batavian orange seedlings	at Rs. 50 per 100	„ 100 „
(3) Pomelo seedlings	Rs. 25	„ 40 „

8. **Preparation of ground for planting:**— The land for planting should be in a high level where water will not stagnate even in the heavy rainy season. Cattle are penned for 5 or 6 months and the land is well ploughed and levelled. Circular pits are dug for all varieties:—

(1) Lime	... 2 feet depth and 2 feet diameter.
(2) Batavian	... 2 „ 3 „
(3) Pomelo	... 2 „ 3 „

The pits are filled with a mixture of well decomposed farm yard manure and tank silt at the rate of 2 to 4 baskets per pit. The digging of pits is usually given on contract at the rate of Rs. 10 per 125 pits or at about 12 pits per rupee. Manure mixture costs annas eight per cart load of 20 baskets.

At about the same time as the citrus seedlings are planted, coconut seedlings are put down all round for shelter as already referred to. Plantain suckers, about 75 pairs to an acre, are also planted in the interspaces. This crop of plantains is allowed to grow for three years.

9. **Season for Planting:** Planting is done from the commencement of rains to the end of January but the best time for putting in the seedlings is during the rainy season in October—November. Some plant in the months of December—January also.

10. **Lifting seedlings:**—The system adopted in lifting seedlings is to remove them with a ball of earth about their roots and then encasing this ball of earth in a Palmyra basket. The best results are obtained if the seedlings are removed with earth about 10 inches in diameter and 12 inches deep.

11. **Spacing:**—The following spacings are adopted with advantage for the several varieties:—

- Lime 8 yards apart—75 plants to an acre.
- Country Orange. 10 yds. apart—50 plants to an acre.
- Batavian Orange—8 yds. apart—75 plants to an acre.
- Pomelo 8 „ 75 „
- Coconuts all round 6 „ 50 „
- Plantains in the first 3 years 8 yds. apart 75 pairs to an acre

12. **Planting:**—Seedlings are never set deeper than they stand in the nursery. It is even considered advisable to place them higher rather than lower, to allow for settling. They do not thrive, if planted too deep. They are planted perpendicularly and the pits are filled up with earth around the sides. Planting in pits is given on

contract at Rs. 2-8-0 per 100 pits. Hand watering on the day of planting costs Rs. 1-4-0 per 100 pits (2 pots per pit). The system of putting manure into pits before planting is said to be advantageous in promoting root action and aiding the plants in establishing themselves in the new sites.

13. **Irrigation:**—After planting, pot watering is given once in two days for about a month (2 pots per plant); afterwards twice a week up to the rainy season. In all about 14 waterings will be required up to the rainy season and this costs about Rs. 28/- per acre.

Afterwards flow irrigations are given. Circular beds are made round each tree for the purpose of irrigation during the dry reason. This is small at first but enlarged in diameter as the tree develops.

Annually, irrigations are given for 6 months from the month of (December to June) at one irrigation per week ($6 \times 4 = 24$) but irrigation is stopped for two weeks when in bearing gardens the trees are in flower, usually between December and February, so that bearing gardens receive only 22 irrigations on the average per annum, costing Rs. 40/- per acre.

14. **After-cultivation:** From the time of planting onwards, good gardeners get the whole of the ground dug over, once a year, the object being to keep a loose open surface.

Weeds and grass are kept down and the surface of the beds around the trees are stirred as frequently as possible. This operation is usually done by the watchman as a matter of routine. But if the garden is foul with weeds, extra labour is employed.

15. **Manures and Manuring:**—The gardeners realize that manured fruit trees produce better, sweeter and finer fruit than the unmanured trees. Well decayed cowdung and black tank and canal silt are considered the best manure for citrus trees. Refuse of various sorts are also applied; but they are slow in action. They, however, improve the texture of the soil; rubbish of all kinds and ashes act in the same way. In applying these manures, one or two inches of the surface soil of the bed is loosened and thrown aside. The manure is then spread over the surface, dug into the soil, and the whole is immediately covered over with the same soil which has been thrown aside. Frequent and copious waterings are given soon after manuring. For the first ten years, manure is applied once in two years, silt and farm yard manure mixed in equal proportions being used. In the first five years after planting, manure is applied at the rate of 4 to 5 baskets per tree. From the 6th to the 10th year, manure is applied at the rate of one cart-load (20 to 25 baskets) per tree.

After 10 years, 400 to 500 cart-loads of manure is applied to an acre of the garden (75 plants) once every 3 or 4 years.

The cost of manure mixture delivered at the garden may be put down at Rs. 0-8-0 per cart load.

In the first 5 years after planting, manure is applied, all round the tree to a distance of $1\frac{1}{2}$ yards to 2 yards.

From the 6th to 10th year, the distance of $1\frac{1}{2}$ to 2 yds. round the tree is left and manure applied only beyond this distance to a width of $2\frac{1}{2}$ to 4 yds.

After 10 years, the whole garden is manured, leaving portions manured in the first two periods, round the trunk.

Whatever manure is applied, it should not touch directly, either the trunk or the roots. The roots should not be cut or exposed when dug for manuring. As a result of irrigation, the root system will make use of the manure. **October to December when the trees shed their leaves is considered the best time for applying manures.** After the trees begin to put forth fresh vegetation just after shedding the old leaves, no manure should be applied. For Lime trees, especially, manuring in the rainy season i.e., in Chitta Karthi (approximately 9th to 22nd of October) is considered beneficial. As a result of this, trees flower for the third time and yield heavy crops from December 15th to March 15th when prices are at their maximum.

For all citrus varieties from the time flower buds begin to appear until the fruit sets, irrigation may be withheld for about two weeks or light irrigation given once in 10 days. Afterwards, irrigations may be given once a week.

Tank and canal silt improves vegetative growth. Farm yard manure improves both the vegetative growth and the yield. Back yard refuse and Municipal rubbish if applied without decomposing, are harmful but when applied after being well decomposed, the trees give heavy yields. The life of the tree is however shortened on account of these manures being more subject to gummosis and other diseases.

It is reported that gardeners near Tenali and Jagarlamudi (Guntur District) apply castor cake and groundnut cake at 500 lbs. per acre per application twice a year. They do not dig round the tree. Frequent and heavy waterings are given. The effect is immediate and lasts only for 3 months.

Some gardeners apply green sunhemp and cover with earth or farm yard manure and tank silt. Irrigation is to be given immediately and at intervals of five days up to one month, afterwards, once a week. The trees thus treated put on good vegetative growth and yield well.

Manuring especially for lime trees is profitable. The trees begin to bear early and yields two or three crops almost every year. There is great demand for limes all over India.

16. Period taken for the commencement of flowering and fruiting: i. Lime trees begin to yield from 3 to 5 years after planting

ii. Country Orange trees	5 to 7	"	"
iii. Batavian Orange trees	7 to 10	"	"
iv. Pomeloes	"	"	"

Season for flowering and harvest are as follows:—

	Flowering.	Harvesting.
i. Lime	1st crop December--January, April, May, June. 2nd " April to June--September, October & November. 3rd " October--November, December to February.	
ii. Batavian Orange.	1st crop. December to February. 2nd crop May to July.	September to November. December to February.
iii. Pomelo.	1st crop / 2nd crop)	As for Batavian Orange.

17. Yield:— In the case of Batavian and Pomelo gardens, where two crops are obtained, the yield is reduced by about 25 per cent.

If only one crop a year is obtained, each Batavian Orange tree gives 100 fruits on an acre and if two crops a year are obtained each tree gives in the first crop 50 and in the 2nd 25 giving a total of 75 fruits, which is 25 % less.

In the case of limes, the three harvests are as follows:—

1st crop.	1000 fruits
2nd "	500 "
3rd "	200 "

18. Harvesting and Gathering:— The fruit is usually picked by hand with the stalk by which fresh twigs come up from above. For export trade, only three quarters ripe fruits are harvested and so the trees put on fresh shoots and flowers giving heavy yields. If the fruits are allowed to ripen fully on the trees, the yields lessen.

19. Basketing:— This is done for Batavians and country oranges. Small baskets of palmyra leaves are prepared and tied to the fruits. The cost of 100 baskets is Rs. 0-3-0, and the cost of tying 100 baskets is Rs. 0-2-0. Basketing hastens the development of yellow colour. So the fruits can be harvested earlier, thereby the vigour of the tree is not completely lost. Basketing also prevents trouble from fruit moth.

Basket fruit is pale yellow and less sweet than the naturally ripened fruit for want of the sun's rays.

20. Rat damage and traps:— From the time the trees begin to put on fresh vegetation and flowering, till the fruits are harvested, there is rat trouble. From the month of December to November the rats are caught four times. Of these two catches are done from the

time flowering commences till the young fruit forms. *Panchamas* have rat traps, made of bamboo of their own. About Rs. 3 will be the expenditure for catching rats per acre per annum.

21. **Pruning**:— Before the trees begin to bear, fresh, young, long shoots come from the bottom. These are removed. Every year before autumn the trees are pruned of dead and weak branches. Ordinary knives are used. Secat and pruning saws are not in use.

22. **Insect pests and fungus diseases**:—

- (a) Insect pests:
 - (i) Leaf-eating caterpillars in nurseries and on young twigs.
 - (ii) Borers on stem.
 - (iii) Fruit moth.
- (b) Fungus diseases:
 - (i) Gum diseases.
 - (ii) Scab.
 - (iii) Sooty mould on leaves.

23. **Life of gardens and fruit-bearing**:— Old trees bear large crops. Whatever may their age, they never grow to a greater girth than 3 feet or about one foot in diameter or to a greater height than 20 feet. The full life of citrus gardens cannot definitely be put down to any fixed period as it depends on soil and treatment etc. In good soil, citrus gardens remain in full bearing for about 50 years and in an average soil between 30 to 40 years.

24. **Yields per acre per annum**:—

- i. Lime gardens:— Up to 300,000 (three lakhs) of fruit may be obtained but on average the yield may be put at 150,000.
- ii. Batavian Orange:— About 20,000 fruits may be obtained per acre.
- iii. Pomeños:— Under good conditions, 8,000 small pomeños will be harvested per acre.

PADDY CULTIVATION AT HOSPET AND THE DEPARTMENTAL INFLUENCE

By K. SANJEEVA SHETTY, B.Sc., Ag.

Agricultural Demonstrator, Hospet.

Of the four "Western Taluks" in the Bellary District, Hospet is the northern-most and is the smallest taluk in the District. It is the only Taluk in Bellary which is fairly well protected in all seasons from famine, its wet lands being irrigated by the channels of the Tungabhadra. The channels (so the history goes) were built by an officer (called Mudda) of the redoubtable historic figure, King Krishna Deva (1509—1530) of the world famous Vijayanagar Dynasty, and it is averred with truism that "the position of the anicuts have been chosen with great judgment and the channels have been formed with consummate skill."

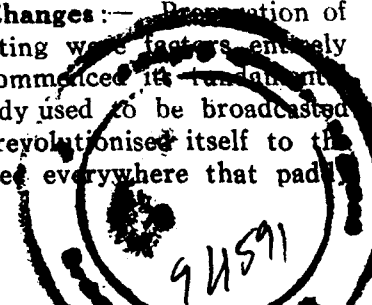
There are about 14000 to 15000 acres of wet lands in this Taluk irrigated by these channels and paddy occupies not less than 7000 acres.

The Local Varieties. Among the various local paddy varieties *Gowri-sanna*, *Sepai*, and *Siranga* were the most popular and widely grown in this tract. *Gowrisanna* is a fine variety and *Sepai* a coarse one, both of six months' duration and sown in July as first crop. *Siranga* is a four month crop and is raised as second crop in September. These varieties appear as anachronisms at present and have been almost superseded by the departmental strain, GEB. 24, which was introduced by the Agricultural Department and is now spreading spontaneously like a conflagration. It occupies nearly 95 % of the total area under paddy, which is a sufficient testimony to the individuality of this variety. Further, it is also gratifying to note that this variety covers a large area in the Gangavathi taluk of the Nizam's Dominions on the other bank of the river Thungabhadra.

The superiority of GEB. 24 for fineness of rice, high yield, and disease and drought resistance is acclaimed by all. A few still grow *Sepai* as they seem to have developed a taste for a coarse variety and find that GEB. 24 is tasteless. Evidently these are accustomed from a long time to eat coarse grains like *chulam*, *thenai* and *cumbu* and a fine rice cannot very much appeal to them as it does to one who eats with measure and prefers a variety suitable to the table.

Local Practices and Subsequent Changes:— The introduction of nursery, raising of seedlings and transplanting were factors entirely novel to the people until the department commenced its fundamental work on this line about 15 years ago. Paddy used to be broadcasted in all the fields, and the whole system has revolutionised itself to the present condition. It is rejoicing now to see everywhere that paddy

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is transplanted (in many cases single-seedlings) from seedlings got from a thin sown nursery.

The Role of Green Manure in paddy cultivation:— Invariably a green manure crop precedes the paddy crop, and when we say that the area under paddy is 7000 acres the extent under green manure necessarily means almost the same area. Thus a green manure crop of *Daincha* (*Sesbania aculeata*) or sun-hemp (*Crotalaria juncea*) or green gram or gingelly is a certainty. The raising of green manure crop is not an innovation but a practice continuing from ancient days.

The Truth Behind the Growing of Green Manure Crops:— *Daincha* is grown on a very small scale in alkaline soils whereas Sunn-hemp occupies a major area. Green gram is grown because the seed is obtained cheap in villages whereas sunn-hemp has to be bought from outside, but the growing of gingelly as green manure has a story behind it. The ryots believe that sunn-hemp benefits only the paddy crop and not the sugarcane that follows it next year as opposed to gingelly which does not so much help the paddy but is of use to the sugarcane crop which the ryot values most. Though the useful effects of sunn-hemp to paddy cannot be gainsaid, yet it is a matter for investigation as to how far the gingelly crop influences the growth and output of the cane. It may be that gingelly being a non-leguminous crop and an oil seed, takes a longer time to get completely decomposed in the soil and hence a good portion of it may remain available to the cane crop; but what strikes at its very face is that gingelly is preferred by some, as the seeds are cheap and easily available requiring very little irrigation and not eaten by stray cattle.

Rotation:— Paddy after sugarcane forms the usual and general rotation in the locality which accounts for the area under cane, which is approximately equal to that of paddy. This again explains how the area under cane under individuals is very much higher than anywhere else in the presidency. Plantain may come in occasionally in the rotation, and paddy for two years and cane for the third year is also followed by a few.

Preparatory Cultivation:— Paddy lands at Hospet are all uneven, and very little attention is paid by the ryot for levelling and increasing the size of the plot. The beds are as a rule 3 to 5 yards square.

Early in the month of May the fields are divided into fairly big plots just to facilitate irrigation. The lands are then irrigated and allowed to dry up to an optimum condition (2 or 3 days) when 15 to 20 seers of sunn-hemp or 4 to 5 seers of gingelly are sown broadcast and the seeds are covered by ploughing the land once with a plough (in the case of gingelly it is sown when there is water in the field and is not covered with any implement). The land is again irrigated and left for 3 days and irrigated again. Then it is irrigated once in 10 or 15

days and the green manure crop is ready in about 45 to 60 days. When the green manure crop has grown sufficiently, it is either ploughed in or pulled out and trampled in and beds of convenient sizes are formed by men working with *mammatties*. It is allowed to decompose for 5 to 6 days when the bunds are trimmed and the plots puddled again. The beds are levelled with *mammatties*, bunds are rectified by women (who are preferred to men, as they do this work better than men being a work requiring a continually stooping posture). The land is then ready for transplanting.

Preparation of Seed Bed: (a) When the green manure crop is about a month old (early June) it is ploughed into the soil where the nursery is to be prepared. It is allowed to rot for a week, the soil puddled again, beds formed and seeds are sown broadcast at the rate of 6 to 15 seers in about 6 to 10 cents of land sufficient to plant an acre.

(b) Preparation of the seed. The required quantity of seed is soaked in water for a night and then placed in a basket covered with paddy straw or *lakkai* leaves or *margossa* leaves and weighted with stones, to increase the temperature. The next night it is soaked again and the day following it is sown broadcast in the prepared seed-beds. The day next to the sowing of the seeds the nursery is slowly irrigated, but subsequently allowed to dry till slight cracking appears on the surface of the soil. Then it is irrigated daily and drained for about 12 days when the seeds would have germinated completely and subsequently the water is allowed to stand continuously. The seedlings get ready in about 25 to 35 days. Usually no manuring is done to the nursery except a top dressing of ammonium sulphate which is at times given to induce vigorous growth.

Transplantation:— This is done in July—August. The seedlings are pulled out and transplanted in the main field. After planting very little water is allowed to the bed for a week to force the seedlings to strike fresh roots, but subsequently they are irrigated daily.

Aftercultivation:— Two weedings are generally given. The first one is done within 20 days or one month after planting. It is called *Halegante* in Canarese (meaning the removal of old clumps of grass). The second weeding is done a month and a half later or a month before the flowering of the plants. It is called *Tiru-kalevu* (weeding again.) Roguing is not as a rule attended to. The ripening of the crop is watched by the ryot who looks to the earheads for guidance and when he finds that the grains in the spikes at the base of the ears are hard, he stops irrigating the land and allows the fields to dry.

Harvesting. When the land is dry the crop is harvested and left in the land in loose sheaves. After two days of drying the sheaves are bundled and stacked in the thrashing floor and thrashed at convenience.

Thrashing is done by beating the bundles on a hard prepared floor (cow-dung smeared) and any grain left in the straw is separated by cattle-threshing—spreading the bundles and letting cattle to walk round over them in packs. The loose straw is bundled into head loads and stacked. Winnowing is done with the help of the prevailing winds after which the seeds are dried, measured, bagged, transported and stored.

Yield: GEB. 24 Paddy gives an average yield of 30 to 35 gudies (one gudy weighs roughly 120 lbs.), or nearly 3600 to 4200 lbs., as against Sepai which yields on an average 20 to 25 gudies or 2400 to 3000 lbs.

General: The soils of almost all the wet lands of Hospet are black cotton soils and it is interesting to note that a soil of this nature under swamp conditions yields as much as 3000 to 5000 lbs. of grain per acre.

Many a ryot still does adopt clump planting or planting 2 to 4 seedlings in a hole and in such cases the seed rate is as high as 15 seers or 25 lbs. As a rule, about 8 seers are sown.

Recently, better attention is being paid by many ryots to levelling of the plots and increasing their size. A basal dressing of superphosphate at 1 cwt. per acre has been found to be very useful for a paddy crop and the ryots at Hospet have fully realised the benefits of artificial fertilisers for increased crop production. A sale of nearly 25,000 to 30,000 rupees worth of ammonium sulphate and superphosphate is effected in Hospet taluk and the idea of using quick acting manures in conjunction with green manures, farm yard manure or oil cakes is rapidly gaining ground and there has not been a greater blessing to the ryot than the introduction of GEB. 21 paddy.

Cultivation sheet for an acre.

Preparatory Cultivation:—			
Ploughing twice 6 pairs @ 8 as.	Rs.	us.	ps.
	3	0	0
Forming crossbunds 8 men @ 4 as.	2	0	0
Levelling twice 6 men @ 4 as. and 6 women @ 3 as.	2	10	0
Trimming and renovating bunds 3 men @ 6 as. and 3 women @ 4 as.	1	14	0
Total.....	9	8	0
Manures and Manuring:			
Irrigating the lands to sow Green Manure Seed ¼ @ 4 as.	0	1	0
Forming bunds to facilitate irrigation 6 men @ 4 as.	1	8	0
Cost of 20 seers of sunnhemp seeds @ 8 seers per Re.	2	8	0
Covering seeds 3 pairs @ 8 as per pair	1	8	0
Total.....	5	9	0
Seeds and Sowing:—			
Preparatory cultivation for 10 cents	1	8	0
Cost of 10 seers of paddy seeds	0	10	0
Pulling seedlings and transplanting 32 women @ 3 as.	6	0	0
Total.....	8	2	0

After cultivation		8	5	0
1st weeding 10 women @ 3 as.		1	14	0
2nd weeding 10 women @ 3 as.		1	14	0
Total.		3	12	0
Harvesting, thrashing &c.				
Harvesting, transporting, thrashing and winnowing paid in kind,				
2¼ gudies of paddy @ Rs. 4 per gudi.		10	0	0
Cooly for irrigating an acre ¼ gudi		2	0	0
Total cost of cultivation	Grand Total.	38	15	0
Yield.				
Cost of 35 gudies at 4 Rs. per gudi		140	0	0
Assessment per acre.		14	3	6
Lease for the land. 12 gudies		48	0	0
Profit for the land-lord if he cultivates the land himself Rs. 140. Deduct (38—15—0 & 14—3—6)		86	13	6
Profits for the tenants if leased out 140 (deduct 38—15—0 & 48—0—0)		53	1	0
Profit for the land-lord if he leases out the land 48—0—0. Deduct Assessment of 14—3—6)		33	12	6
Cost of land at present per acre.		1000	0	0.

N. B. The cost of cultivation may vary slightly from place to place & from year to year. Coolies employed for pulling the seedlings & transplanting an acre were as high as 50 to 60 in the beginning when they were just beginning to learn this new kind of work. It has now improved and practically only ¼ the amount of labour is employed, which is still a high figure.

The cost of paddy straw (3000—4000 lb.) which is omitted, valued at Rs. 10— may be added in each case.

CULTIVATION OF TURMERIC (1) IN GUNTUR DISTRICT

By K. V. Seshagiri Rao, Assist. Agl. Demonstrator.

Just as paddy occupies the largest area among the cereals, turmeric covers the first place among the condiments in the Kistna delta comprising Tenali and Repalli taluks of the Guntur District. It is considered sacred by Hindus as without it no religious ceremony can be performed. Every Indian kitchen stocks turmeric in one form or another to give both taste and colour to the food. It occupies an important place in Ayurvedic Medicine and the last but not the least of its uses is as a dye for various articles. All these put together go to show that there is a continuous demand for turmeric and ryots who have got facilities for its cultivation, therefore, make it a point to include it in their list of crops every year.

Turmeric occupies an area of nearly 5000 acres grown mostly under canal irrigation and a little under wells. Though grown on a small scale for nearly a century, it is said to be an introduced crop brought

(1) *Curcuma longa*.

from Cuddapah District. The area under this crop began to increase with the introduction of canal system and it increased by leaps and bounds from the year 1903. This crop is grown all along the Repalli canal bank close to the Kistna from Revendrapad in the Tenali taluk at one end to Anantavaram at the other end in the Repalli taluk where in the years long gone by the Kistna made its way leaving behind rich silt and sand making the soil light. It is also raised in the bed of the Tungabhadra once a tributary of the Kistna—commencing from Revendrapad at one end to Vetapalam at the other end in the Tenali taluk. The soil, is a light mixture and very fertile.

In almost every place where turmeric is grown sand is struck at a depth of 6 to 9 feet and beautiful fresh water at a depth of 20 to 30 feet. The survey of the soil description therefore goes to show that it is best suited for turmeric cultivation as such soil is quite essential for the development of the under-ground rhizomes.

While lowering the level of the land for paddy cultivation some of it had to be raised ranging from one to three feet and it is in such bits of land that most of it is grown. In some places it is grown in the original land—where mostly well irrigation is given though some area is irrigated by the canal water.

Season. The crop is a heavy feeder occupying the land for nearly nine months from July to March.

Preparatory cultivation. In the hot weather months the ryots will be busy carting clods of earth dug from the neighbouring silted wetland. Generally 20 to 30 cart loads of earth are spread over an acre of land. In places where this is not possible the ryots remove clods of surface soil from the adjacent field and spread them. This the ryots call *gaddaveyuta* in Telugu. This top soil which is rich in plant food becomes richer by the action of the weathering agencies. This operation, therefore, not only facilitates the raising of the level and making the soil loose for the easy and healthy growth of rhizomes but also adds to the richness of the soil.

Manures and Manuring. The ryot pays great attention to this operation. He liberally manures other crops when he has turmeric in his cropping scheme. He folds his cattle in the hot summer months in the field itself shifting them in a systematic manner thus covering the whole area. Cattle-penning is practised during the summer months. In addition he also adds sheep manure by sheep penning if he can have it. Besides these he adds 20 to 30 cart loads of farm yard manure. If the growth is not satisfactory he gives the crop a dressing of groundnut and castor-cake at the rate of 500–600 lbs. per acre.

Seeds and Sowing. As a rule only the mother rhizomes (cut into two length-wise) are sown. About ten years ago, the bed-system was in vogue where sowing was done in furrows behind the plough at 2500

to 3000 lbs. per acre and this system is still prevalent in some parts. Most of the area is now sown in ridges $1\frac{1}{2}$ feet apart in which case the rhizomes are sown in every alternate row behind the plough. The seed rate is therefore reduced by nearly half.

Aftercultivation. In the bed system of sowing no other inter-cultivation except weeding is done. In the ridge sown crop besides weeding round the plants inter-cultivation is done once or twice between the lines which helps to earth up the crop and to allow easy irrigation.

Irrigation. From the time of sowing till November no irrigation is given except when there is drought. From November onwards the crop receives about ten irrigations till its harvest in March at intervals of about 15 days. If it is well irrigation it is done by baling out water by *mhote* buckets and if it is canal irrigation it is done either by gravity, flow or by baling water with swing baskets. Here and there we now see oil engines with centrifugal pumps or Archimedian screws at work irrigating the crop.

Rotation. Turmeric is as a rule rotated with a mixture of red gram and maize or dry paddy and red gram which do not receive any manure at all as the residual effect of the manure applied to the previous turmeric crop is quite ample for them. Since sugar-cane is now coming to importance turmeric is followed by sugar-cane both being long duration crops and heavy feeders. The two-year rotation is seldom strictly observed as the turmeric crop is to be found here and there even in the succeeding crop of maize and red gram. It may therefore be said that the turmeric crop occupies the land every year. Sometimes oranges or plantains are planted in the standing crop of turmeric the former to replace the turmeric after 7 years while the latter remains in the field for 4 years. Evidently this short rotation makes the land sick as is proved by the fact that the average yield of 12 candies per acre in the past has come down to 6 candies per acre in recent years even though the same agricultural practices are being continued. It would be well if the turmeric crop is rotated every four years.

Pests and diseases. This crop is subject to two fungoid diseases namely *Tataku* or *Lambadi tegulu* and the other *Pogachuru tegulu*. The appearance of the former does not seriously interfere with the yield of the crop but *pogachuru tegulu* does some damage as the coating of sooty mould reduces transpiration and formation of food. The crop is also subject to the attack of the root grubs in some years. If good seed free from the attack of these grubs is sown the crop is also free. Hence the selection of seed is very important.

Preservation of seed. The central rhizomes round or ovoid in shape are separated from the fingers and heaped in convenient sizes

under shady trees and covered over with turmeric leaves in a thick layer to prevent sun and rain acting on them.

Harvesting-Curing etc. In the ninth month all the leaves wither and fall level to the ground and this is a sign that the crop is ready for harvest. Ten or twelve days before harvest the last irrigation is given to facilitate easy lifting of the rhizomes. The general practice of lifting is to plough the land with the country plough and engage women to collect the rhizomes from behind the plough. Here and there there is the practice of lifting the crop by means of crow bars. Lifting, collecting, cleaning and heaping over, the next operation that the ryots attend to is curing. Till five or six years ago, curing was being done in earthen pots. Curing is the process of boiling the green rhizomes in water for about half an hour till they become soft to the touch and spreading them in thin layers on the ground to completely dry up and then removing the dust from the rhizomes before storage. A batch of 50 pots with rhizomes and sufficient water to boil them will be placed in a line over a long narrow pit one foot wide and $1\frac{1}{2}$ feet deep; 15 or 16 men at the rate of three pots per head look after boiling and five more men attend to other works as spreading the stuff, drying up, and adding water to pots whenever necessary. Four tons of fuel would boil in a day 60 candies of green stuff which when dry would come to 15 candies. At this rate the cost for every candy of cured stuff would come to Rs. 6/-. This was considered to be a laborious and risky work besides being a heavy item of expenditure. From 1924 or 1925 curing was begun to be done in mhoie—bucket shaped receptacles. A small pit is dug and cart axles are placed over it to form four seats for the four buckets. Four men do 16 to 18 boilings per day which would come to 6 candies of cured stuff consuming $1\frac{1}{4}$ cart loads of red gram stalks costing Rs. 12/-. The hire on the four pans per day comes to Rs. 4-8-0 i. e. for every candy of cured stuff they charge Rs. 0-12-0 i. e. for every boiling Rs. 0-4-0. Thus on the whole, for a day's work the expenditure would come to Rs. 19-8-0 and thus for a putty of cured stuff an expenditure of Rs. 3-4-0 is to be incurred. This is the rate when the weather is favourable. When the weather is unfavourable i. e. when there are heavy winds the same quantity of fuel will suffice to get only $4\frac{1}{2}$ candies of cured stuff because of the wastage of heat in which case the expenditure would rise to Rs. 4-4-0 for every candy of cured stuff. On an average therefore it comes to Rs. 3-12-0. Those ryots who cannot afford to get red gram stalks have necessarily to go in for casuarina or babul or some other fuel which costs Rs. 24-0-0 per ton. This would boil 8 candies in a day and therefore the charges on fuel alone come to Rs. 3/- per candy. In addition the ryot has to meet a further expenditure of eight annas for labour and twelve annas for hire of pans so that the total expenditure per candy of cured stuff comes to Rs. 4-4-0. By discontinuing curing in mud pots and taking to iron pans, the average gain per candy works at Rs. 2-4-0.

While this was being done all over the tract one ryot Mr. Challa-palli Zangaiah, village mu-siff, Revendrapadu, with the help of Rev. Haaf the then American Missionary there, made one pan of the following description.

The outer pan is $4\frac{1}{2} \times 4\frac{1}{2} \times 2$ ft. It has a lid on the top which is in two parts and hinged in the centre so as to open from both the sides for the easy removal of the inner pans containing turmeric. The inner pans are four in number each $1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{2}$ ft. The sheets all round and at bottom contain small holes for the entrance of water from outside and for the escape of dirt and water at the time of their lift. The distance from pan to pan all round will be six inches which is occupied by water. The outer tank is fixed up once for all and will not be removed till all the turmeric boiling is over. About 70 pots of water is put into it and kept at boiling point through-out.

The small pans inside are placed in dishes each two feet square and three inches deep which are intended for the accumulation of dirt and every morning they are removed, cleaned and placed again. Just below these dishes a flat iron frame is placed inside the tank to create space for the boiling of water.

As an experiment a Sindewahi furnace was constructed by the efforts of the Agricultural department for boiling turmeric and red gram stalks and babul bush were used as fuel. The charcoal filled up the furnace and due to choking the furnace did not work properly and the work therefore suffered a great deal. The ryot continued to work it without the grating and the central wall using the same fuel and he was able to work as follows.

The boiling begins every morning at 6 a.m and closes at 6 p.m. Four coolies work at the furnace. Eighteen to twenty boilings at $\frac{1}{2}$ candy per boiling are done per day, about 10 candies being thus cured daily. The fuel consumed per day will be about a cart load weighing $\frac{3}{4}$ ton of red gram stalks costing Rs. 8 and so for every candy of cured turmeric Rs. 0-13-0 worth of fuel is burnt. For preparing ten candies of cured stuff the cost comes to Rs. 11-13-0. Thus for a candy it comes to Rs. 1-3-0. Taking the cost of the boiling set to be Rs. 200 and the working season to be a month when 300 candies can be cured the interest and the depreciation on it per candy comes to 3 annas. Thus Rs. 1-6-0 will be the cost for making a candy of cured turmeric. Finding the advantages of such boiling four more boiling outfits came into operation. During 1929 the Agricultural department again entered into the field to try the cheapest method of curing. Groundnut crop is being grown in this tract for the last 7 or 8 years and the area is increasing year by year. Most of the groundnut is being shelled in the local factories of Tenali, Chebrole, Duggirala, Mangalagiri, Guntur etc. and the husk was lying idle in mountainous heaps. The owners of factories not knowing the method of disposing

it off were ready to allow anybody to take it away for the mere asking. At this juncture the department went to their rescue and a large quantity of groundnut husk was carted by the ryots. The department this time constructed a slightly modified Sindewahi furnace in which the length of the grating was increased from 20 inches to 32 inches, the central wall was shifted a few inches away from the centre towards the smoke passage and the smoke passage was covered at the top by 3 inches thus keeping the bottom of the passage in level with the bottom of the furnace. The objects of doing these modifications were (1) to take the flame right into the centre so as to allow water to boil all over (2) to allow free draught of air and (3) to allow ash to easily drop down into the ash pit below, thus keeping the furnace free from choking. Groundnut husk was the main fuel used but now and then turmeric leaves to form a bed for the husk was burnt. One cart load of husk was sufficient for a day's work. In later stages one cart load of husk was charged at 8 annas. Thus for every candy of cured stuff 1 anna worth of husk fuel was burnt. Taking the cost of labour and the interest and depreciation on the set into consideration the total amount spent on a candy of cured turmeric comes to 9 annas.

The following tabular statement gives the amount spent on fuel alone under the various methods of boiling so far described on the total quantity of turmeric produced in the two taluks.

System of boiling	Nature of fuel used	Quantity of turmeric (cured)	Amount spent for 1 candy of cured stuff on fuel alone	Total amount spent on the total produce	Nature of furnace used	Cost per candy cured including labour etc	Total amount spent on the total produce including labour etc.
mud pots	Red gram stalk, babul bush or casuarina	30,000 candies	5-0-0	150000-0-0	long narrow pit local	6-0-0	180000-0-0
Iron pans	Do.	Do.	2-9-0	67875-0-0	Ordinary pit-local	3-12-0	11250-0-0
Retangular pans	Red gram stalk & babul bush	Do.	0-13-0	24400-0-	Sinde-wahi without grating & central wall	1-6-0	41250-0-0
Do.	Ground-nut husk	Do.	0-1-0	1875-0-0	Modified sinde-wahi furnace (32" grating etc.)	0-9-0	16875-0-0

Preservation and marketing of turmeric. Immediately after curing it is well dried and cleaned and sold away if there is a ready market. If the market is dull it is preserved in pits dug in a high level place where no moisture can be had and covered over by a thick layer of earth and kept under thorough anaerobic condition. For every six months to one year it is removed, sun dried and again put in pits for further preservation. In this way the stuff is kept for any number of years until a good price is on the market.

In 1908 finding that there was a good demand for turmeric and that the area was on the gradual increase a factory for polishing and also to purchase from ryots and supply the demand from elsewhere was established by one Mr. Nimmagadda Sangaiah and Sons at Duggirala. Even before establishing the factory Mr. Nimmagadda Sangaiah was a regular trader in turmeric and he is still continuing to be so. Duggirala therefore has become the chief trading centre of turmeric and some more factories were established a few years back.

Generally the price would be at its minimum during March-April; the season for the turmeric from the fields to be ready in the market would be at its maximum from October to February by which time half the produce of the tract would have been exported. The markets to which turmeric is exported are the Punjab, Agra, Delhi, Cawnpore, Calcutta, and Bombay. For unpolished stuff there will be demand from Cawnpore and Calcutta firms and the rest of the firms invariably require polished stuff. The standard price at which it can generally be sold cannot positively be stated as there is fluctuation every minute, hour and day. It has therefore become a matter of gambling. The traders who are now the ryots purchase from their brother ryots and stock it until they get a good price with their mouths wide open to readily swallow any profit they can get in this gambling. It is only the favoured few that could come up.

The price in the beginning of turmeric cultivation was ranging from Rs. 20/- to Rs. 25/- and it gradually rose up to Rs. 30/-, Rs. 35/- and Rs. 40/- and maintained so till 1921. In 1921 it went up to Rs. 70/- and 1922, 1923, 1924 it went up to Rs. 151/-, Rs. 216/- and Rs. 180/- respectively on account of demand from Germany and in subsequent years it came down even to Rs. 31/-. So 1922, 1923 and 1924 were the years when the traders were raised aloft and the subsequent ones were the years when they were thrown to the ground and hurled in the dust never to rise again. Thus rich ryot traders have become insolvents. But the actual cultivators so far in general are alright as they dispose of the stuff at their earliest convenience.

Statement of ruling prices of turmeric at the Duggirala market from 1921 to 1928.

Year	maxi- num	mini- mum	Months											
			Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1921	70	42	...	...	...	42	...	...	...	...	70	...	...	...
1922	150	42	...	...	...	62 to 66	78	...	91 to 93	97 to 99	102 to 100	108 to 115	...	151
1923	216	85	165	120 to 85	114 to 117	102 to 106	118 to 166	151 to 154	160 to 164	182 to 203	198	200	210 to 216	211
1924	180	110	176	180	132	147	166	161	146	126	110	124	143	159
1925	75	44	...	...	...	...	75	...	66	...	...	46	44	54
1926	40	31	...	...	35	...	40	...	36	...	31	...	33	32
1927	46	32	32	40	41	46	44	43	37	38	38	43	37	40
1928	...	...	43	43	49	42 to 66	58 to 62	...	...	...	...	...	...	...

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Cultivation of Turmeric in Guntur District

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The price at the time of writing is Rs. 52. per candy.

Cost of cultivation of turmeric per acre.

- | | |
|--|-------------|
| 1. Ploughing 6 times (four pairs of cattle.) | Rs. 15-0-0 |
| 2. Cattle manure 20 cartloads. Rs. 40/- & sheep penning Rs. 20/- | } .. 60-0-0 |
| 3. Seeds five putties (set off for the same seed he gets for the next year.) | 50-0-0 |
| 4. Ploughing for sowing seed (2 pairs) | .. 5-0-0 |
| 5. Cutting and sowing rhizomes-12 women | .. 4-8-0 |
| 6. Weeding twice (20 women) | .. 6-4-0 |
| 7. Ploughing twice in rows (2 pairs) | .. 5-0-0 |
| 8. Irrigation 10 times-wells (if swing baskets Rs. 43. plus water rate Rs. 20/-) | } .. 60-0-0 |
| 9. Harvesting - ploughing 6 pairs Rs. 15- & 33 women Rs. 11- 4-0. | } .. 26-4-0 |
| 10. Boiling-4 men @. 0-12-0. | .. 3-0-0 |
| 11. Drying and cleaning-6 men | .. 3-0-0 |
| 12. Hire on pans at Rs. 0-12-0 per putti | .. 4-8-0 |
| 13. Fuel | .. 16-0-0 |

Total. Rs. 208-8-0

Taking the average yield to be 6 candies the price of it at the present rate would be Rs. 312. Thus the net profit that he gets is Rs. 103-8-0 per acre. The ryots take into calculation only items numbers 2, 5, 6, & part of 9, 10, 11, 12, and 13 which actually touch their pocket and which come to Rs. 68-8-0 while the rest of the items are out of account as they are the reward of personal labour. By making a cash expenditure of Rs. 68-8-0, they thus claim to get a net profit of Rs. 243-8-0.

FLAVOUR IN MILK *

By Professor R. H. LEITCH, M.A., B.Sc., N.D.A., N.D.D.

A characteristic of milk which more than any other commends itself to the discriminating consumer is flavour. Whether or not the high food value of milk is realised by the general public, a fine flavoured milk is universally appreciated. But if the flavour is displeasing, the milk will not be acceptable, no matter how excellent its keeping properties, how rich it may be in butter fat or how low its bacterial content. The public does not understand fully the real significance of chemical analysis or of bacterial counts, but it does appreciate flavour. Indeed, flavour controls all the other qualities of market milk, and it is a fact that milk is decisively rejected by the dealer or the consumer more often on account of a displeasing flavour than by reason of any other defect. An effective means of popularising milk would be to ensure that not only is it safe, rich and of good keeping qualities, but that it has a pleasing and attractive flavour.

In fresh milk of good quality, the sweetness is due to the milk sugar and the aromatic taste to the butter fat. The flavour of milk, however, while largely determined by these two components, is also influenced by certain of the milk salts, particularly the chlorides. It has recently been shown that the taste (as distinct from flavour) of milk (1) is in large measure associated with the finely dispersed and easily dialysable components, and that when these are removed, the remainder of the milk is relatively tasteless.

Practically all the components of milk are subject to degradation changes which affect its flavour adversely—the fat by oxidation and cleavage, the casein and albumin by proteolysis, the milk sugar by fermentation, and the ash by exaltation of some of its components. But even when such flavour defects are well defined, the casual factor is often difficult to determine; and yet until the origin of the fault is known, advice such as might lead to its elimination or control cannot be offered. Defective flavours in milk may arise from physiological effects; from the incidence of bovine ailments or disease; from the food supply of the lactating animal; from the direct absorption of taints from the environment; from bacterial infection of the milk at the time of or subsequent to its withdrawal from the udder; or from the effects of oxidation during storage. In some instances, contact of the milk with certain metals may lead to the development of an off-flavour.

It should be observed at the outset that the sense of taste is not equally developed in all persons, and that a milk which is sensibly off-flavoured and displeasing to one individual may call forth no adverse comment from another. Defective flavours which will be discussed

here are those which are sufficiently pronounced to be detected by the average citizen.

Physiological Effects. The relationship of the physiological health of the cow to the flavour of the milk secreted is as yet little known. If the milk of individual cows in the same herd (all receiving the same food and the same general treatment) be critically examined by a person with a keen sense of taste, it will often be found that while the majority of cows yield milk which is pleasing to the palate, some may give milk which has a flat and unattractive flavour. An examination of samples of milk of 536 cows supplying the University of California Farm Creamery revealed the fact that 68 (or 13%) of the cows, presumably in normal health, were producing milk which had an abnormal flavour. Roadhouse and Koestler (1) have observed a difference in the taste of the milk not only of individual cows in the same herd, but in different milkings of the same cow. The cause of such variations in the flavour of the milk of individual cows in full milk and in apparently normal health cannot be easily explained. It may have a physiological basis or it may be an inherited characteristic. Relative work in America (2) would appear to show that the ability to produce a good flavoured milk is an individual characteristic, and one investigator foresees the time when whole herds of cows giving milk of an agreeable flavour will be assembled, and efforts made to perpetuate this desirable characteristic by breeding and selection.

Milk secreted by the cow at the very beginning and at the extreme end of the lactation differs normally from milk produced throughout the rest of the milking period. Colostrum with its bitter fleshy taste and its thick slimy consistency does not come within the category of market milk, because of its obviously abnormal character, but it is different with the milk of cows approaching the end of the lactation. After the ninth or tenth month, the milk sugar which hitherto has been maintained fairly constant begins to decline and at the same time the chloride of the ash increases in amount. The net effect of this is that the milk acquires rather a sharp salty taste. Sometimes the milk of cows in advanced lactation is rancid and, when swallowed, produces a burning sensation in the back of the throat, the rancidity being due to the splitting of the butter fat by a lipase enzyme present in the milk. The rancidity usually develops in the milk within a few hours of its withdrawal from the cow. Sweetened condensed milk may also become rancid if through accident or error small amounts of such milk in the unheated state are made part of the batch. Rice (3) has found that as little as 0.3% milk containing lipase can induce rancidity in the condensed product.

A disturbed metabolic condition of the cow known in South-west Scotland as "staw" is responsible for a peculiar odour and flavour in

* Reprinted from the *Scottish Journal of Agriculture*, Vol. XV, No. 2.

milk. The milk as it is withdrawn from the udder has a strong penetrating smell suggesting a phenolic or medicinal odour; the taste is distinctive and disagreeable. Staw and its associated effects generally occur early in the lactation, usually about three to four weeks after calving. A change of feeding and careful veterinary treatment will usually rid the cow of the undesirable affliction.

A fishy flavour in milk apparently arising from a disturbed metabolic condition and recalling the effects of staw is reported by Harding, Rogers and Smith (4) to have occurred in the milk of an isolated cow in the dairy herd. The milk had a rank disagreeable odour and taste as though it had been in close proximity to herring or other fish. The fishy odour was easily detectable at milking and did not appear to increase on standing. There was not discernible ailment or lesion of the cow and the physical appearance of the milk was normal. The off-flavour could not be shown to be caused by any bacteria present in the milk, nor by the foods, which were fed alike to all the cows in the herd. Nor was it due to any objectionable weed at pasture. A similar case of fishy flavour in the milk of a cow kept for family use was reported by Griffiths in 1899.

Off-flavours perceptible in newly drawn milk are often due to indigestion and dyspepsia in the cow. Experimental evidence shows that a prolonged and systematic deficiency of calcium and phosphorus in the food supply is also responsible for deterioration in the flavour of milk.

Pathological Effects. Udder infections which are much more common than is generally supposed are perhaps the most common cause of unpleasant flavours in milk. Mastitis (garget) nearly always induces a disagreeable taste. Indeed whenever an off-flavour is encountered in the milk of any individual herd, a careful physical examination should immediately be made of the udders of all the producing cows. Such an examination may reveal an infected quarter in one or more cows, and if the pathological milk is withheld, the troublesome flavour will usually disappear. It sometimes happens, however, that a clinical examination reveals no unusual feature; the udder may not be hard or painful; the physical appearance of the milk may be unaltered, and yet the milk is obviously bad flavoured. Such a circumstance is possible when one or more of the cows in the herd is suffering from a mild catarrh of the udder caused by micrococci. While a "weedy" flavour is easy to recognise in the milk of individual cows, it is much more difficult to appreciate when the affected milk is mixed or diluted with a considerable volume of normal milk. The taste of the mixed milk may simply suggest a staleness, "something not quite right." Reference in such cases must be made to the milk of the individual cows.

Many professional investigators are averse to tasting such suspected milk because of the presence in it of pathogenic organisms, and hence the simple and effective method of locating the source of the offending flavour (i. e. in the milk of individual animals) is often neglected. Here, however, some guidance may be got from a microscopic examination of the milk, especially with reference to its leucocyte content. The presence of leucocytes in greatly increased numbers is suggestive of a derangement of the milk gland. Confirmatory evidence will be furnished by the alizarol test, by the catalase test or by the blood agar plate, and appropriate cultural methods will usually reveal the pathogenic organism. Even when a cow recovers from an attack of garget, the flavour of the milk from the quarter which was affected is inferior to that of the unaffected quarters; usually it is salty to the taste. Peculiar odours occasionally accompany the disagreeable taste of "weedy" milk; sometimes the aroma suggests dough; sometimes it is fruitlike, suggesting pears.

Effect of Foods on Flavour of Milk. The effect of specific foods on the flavour of milk and cream for butter-making has been frequently determined, but less attention has been given by experimenters to the effect of foods on the flavour of market milk. According to Kellner (5) foods which improve the taste of milk are good meadow grass, carrots, oats, rice meal. Hay of good quality and malt combs would also appear to have a beneficial effect. On the other hand, rape cake, on account of the frequent presence in it of mustard seeds, is a risky food, imparting as it often does, an astringent and disagreeable taste, especially marked in the cream. On occasion, inferior samples of earthen cake are productive of a rancid odour and taste. Mouldy cakes and meals are also unsafe to use, not only because they have an adverse effect on the flavour of the milk, but also because they prejudicially affect the health of the cow.

Flat unattractive flavours which occur frequently in milk in late winter and early spring are often the result of the long continued use of certain concentrates under stall fed conditions..... Beet pulp, beet slices and beet tops are foods which are commonly believed to induce bad flavours in milk. On the continent it has been found that beet tops may impart a putrid taste and smell to milk especially when the leaves are partly decomposed. Post (6) states that the offensive odour and taste of milk and butter, prevalent in the months of October and November in the beet growing districts of Holland where beet tops are used for cattle food, are due to tri-methylamine, obviously derived from betaine present in the food. Lucas (7) confirms the experience of others that the feeding of sugar beet tops has a bad effect on the flavour of milk.

In South-West Scotland, an off-flavour (sometimes reported oily and sometimes metallic) in milk has been attributed to the feeding of

beet pulp The condition of the beet pulp is of some moment. Beet pulp of high acetic acid content has a tendency to cause digestive disturbances—a circumstance which may indirectly affect the flavour of the milk. Neutralisation of the acid by the sulphate or carbonate of lime has been stated by American investigators (8) to be of some benefit in eliminating the harmful effects of the acid.

Silage is sometimes a source of trouble. In America, where it is principally made from the maize (corn) plant, silage is regarded as a palatable and wholesome food for dairy cows. Yet according to Lucas (7) a silage flavour is not uncommon in market milk, and in a survey made at the University of Illinois Experiment Station, about 60 % of the consumers preferred milk carrying a silage flavour. The investigations of the United States Dept. of Agriculture (2) have shown that flavour imparted by corn silage is either very materially reduced or altogether eliminated by feeding the silage after milking time. Silage which is supplied to the cows within an hour of milking is so quickly absorbed that its taint is discernible in the newly drawn milk. Silage made from leguminous plants is much more liable to taint milk, and as a general rule it should be avoided in the feeding of dairy cows whose milk is sold for direct consumption. Alfalfa (lucerne) often produces a poor, ill smelling silage. Clover silage has a strong odour, and imparts a distinct food flavour to milk, even when as little as 5 lbs. is fed daily. Mouldy and decomposed silage is unsafe food for cows, and when given in amounts from 5 to 15 pounds per head daily, imparts a strong flavour and odour to milk, sometimes resembling garlic. A silage flavour may be considerably diminished by effective aeration of the newly drawn milk.

The indiscriminate use of roots not infrequently leads to undesirable flavours and odours in milk. Turnips and swedes, supplied in large quantities and especially when fed before milking, may cause a "turnip flavour" in milk. The taste is more pronounced if the turnips are partially rotted or have young secondary growth on the crowns. Cabbages may produce a similar effect, especially if slightly decayed. A turnip taste is seldom observed if the roots are supplied after milking (or at least 3 to 4 hours in advance of milking time). As in the case of silage, aeration of the newly drawn milk reduces abnormal odours and flavours resulting from the feeding of turnips and cabbages. The taint induced by the unskilful use of roots is more pronounced in cream than in milk, and for this reason a strong turnip flavour is not uncommon in farm made butter during the winter months—when whole milk or raw cream is used as the primary material. The turnip taint is also a frequent source of trouble in New Zealand dairying.

The turnip taint is not simply an effect consequent on the feeding of roots; other factors appear to be involved. According to Orla

Jensen (10) bacteria play a part in the development of the characteristic turnip flavour. The parent substance from which the taint is developed is a glucoside (present in cruciferous) plants which passes into the milk from the roots eaten by the cows. This glucoside is broken down by the action of certain liquifying bacteria which gain access to the milk, and which are derived either from faecal contamination or from a polluted water supply. These facts emphasise the importance of clean milk production. A turnip taint is less frequently observed in clean high grade milk than in milk produced under less carefully controlled conditions.

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ABSTRACTS

Effect of Methods of Grazing on the Yield of Lucerne.—H. W. Turpin. (*Forming in South Africa*, Vol. VII, 1932, pp. 59—60). In certain districts in South Africa and also largely in Argentine, Lucerne is grazed as pasture, especially by sheep, pigs and horses. The writer has carried out experiments to test the validity of the arguments generally brought forward against this custom, viz., (a) That it causes "hoven" (a bloat) in ruminants and (b) that the crop will soon be destroyed if closely pastured. The experiments show that Lucerne can be used for grazing purposes, bearing the following points in mind:—(1) Lucerne should not be grazed during the growth of the first spring crop—at any rate before the 10% bloom stage. (2) Lucerne can be grazed without serious injury to the crop, if hay crops alternate with grazed crops, but care should be taken to see that the first crop in the season is cut for hay. (3) Graze off crops rapidly by using small paddocks or larger numbers of animals in preference to larger camps and fewer stock. For example, if the lucerne takes 35 days to reach 10% bloom after being cut, have two sets of 5 camps in one of which the camps are each grazed down in rotation in about a week, while in the other the camps are cut for hay, so that the first camp will have 35 days' growth before being cut for hay or being grazed, as the case may be. This is preferable from the point of view of effect on the lucerne to 3 camps on one of which the stock are grazed continuously for 35 days, while the other two are allowed to grow to provide the next grazing and hay crops. (4) A stand of lucerne younger than 2 years should only be grazed very lightly if at all.

(C. N.)

A. Feeding Experiment to compare the merits of Single and Mixed Fodders:—Chanda Singh and Des Raj. (*Agri. & Livestock in India*, 1932, Vol. 2, pp. 23-3). In order to determine whether mixed roughage is superior to single roughages, observations were made with three groups of heifers receiving respectively ragi straw, hay and a mixture of these two fodders. Concentrates and green fodder were fed to all alike, in proportion to their live weights (450 to 530 lbs.). It was found that the hay group consumed more fodder (roughage 8.04 lbs. total dry matter 12.62 lb.), than the ragi straw group (roughage 6.62 lb., and total dry matter 11.21 lb.), while the group on mixed fodder consumed scarcely more fodder than the mean of the other two (roughage 7.58 lb., total dry matter 11.16 lb.). Therefore, mixing of fodder, in the present instance, has not yielded an appreciable advantage. The live weight increases during 100 days were similar, being 77, 80 and 86 lbs. per head for ragi straw, mixed ration and hay respectively. The lower amount of ragi straw injected by the heifers, is attributed to the fact that it swells considerably more (about $1\frac{1}{2}$ times) than hay, when moistened with water.

(C. N.)

The preservation of manure under arid climatic conditions:—Watenpaugh, H. N. (Bull. No. 19) of the New Mexico Agri. Expt. Stn.) The author has compared the following systems of preserving barnyard manure, in respect of loss of organic matter and conservation of nitrogen, viz. (a) Manure in a loose pile, (b) manure tramped into a compact pile, (c) manure tramped in a compact pile and kept wet, (d) manure tramped in a dirt pit, (e) manure tramped in a dirt pit and kept wet, and (f) manure spread in a thin layer on the ground. After 110 days of storage, the resulting manure was analysed for nitrogen and ammonia soluble organic matter, and actual manurial value compared by applications to plots growing cotton. It was found that the best preservation of manure is dependent on two factors, viz. (1) the wet manure should be compacted upon storage to avoid excessive rise of temperature and loss of organic matter which occur in treatments (a) and (f) above; (2) as little surface as possible should be exposed to climatic conditions (arid). When the manure is applied several weeks before planting, yields of seed cotton depend on (1) the amount of disintegration without much loss of organic matter, and (2) the amount of nitrogen conserved. Optimum conservation of both nitrogen and organic matter was obtained with horse manure containing about 5% moisture, by storing it for about 3 months in a dirt pit where it is compacted by trampling. Manure tramped in a compact pile and kept wet (treatment c) also gave good results.

(C. N.)

Gleanings.

Chromosome Studies and Plant Breeding.—The breeding of plants with the object of obtaining new and improved varieties is at best a slow and laborious process, with chances of success by no means assured. Any means of prediction of the probable results of a cross would be of immense value, and Dr. Darlington shows in a series of eight papers how far this object may be attained by previous knowledge of the cytology of the forms to be crossed.

The author passes to the practical view of the question with the minimum of technical detail, and shows how very closely the behaviour of plants in breeding can be correlated with their visible chromosome behaviour. He gives us the picture of a fertile germ cell as carrying a set of chromosomes, which must represent a complete and balanced set of characters, for in exceptional cases such germ cells are able to develop into a new plant without fertilisation. Normally two sets of chromosomes come together at fertilisation and remain associated throughout vegetative growth until germ cells are formed again. In this latter process, an

exact pairing of like chromosomes, which afterwards separate; one of each pair passing to each daughter nucleus, is usually associated with the production of fertile germ cells. Irregularity in this pairing frequently results in the production of unbalanced sets of characters in the germ cells, with loss or great reduction in fertility. This is a fundamental point in breeding, where the value of the hybrid depends on seed fertility, as in the case of the cereals, cherries and plums.

On the other hand, crossing between plants with different chromosome numbers, which result in sterile hybrids may have advantages when the plant is required for ornamental purposes and can be propagated vegetatively.

Another interesting fact which has emerged from comparatively recent cytological work is that related species of plants often have either the same chromosome number or some multiple of some basic number; that is, they are naturally occurring 'polyploids'. Work on plants in cultivation and under cytological observation has brought forward facts which are most suggestive as to a possible way in which species may have been derived from one another. This is illustrated by the cross between *Primula floribunda* and *Primula verticillata*, which results in a sterile hybrid. Occasional fertile seeds are, however, produced, and they give rise to plants with hybrid characters, but differing in being fertile and breeding true. Such seedlings known as *P. kewensis* are found to contain twice the anticipated number of chromosomes, and as each parental set has been doubled in such plants, exact pairing is again possible with the passage of two complete balanced sets to each daughter nucleus. The relative numbers of chromosomes in naturally occurring species suggests that hybridisation, followed by restoration of fertility by polyploids is one possible method of their origin.

These and many other problems are dealt with fully in these papers. Although, as Dr. Darlington points out, the knowledge gained by a preliminary chromosome investigation cannot control the results obtained by a cross, it may be of great value in directing the activities of the plant breeder into lines which have some hope of success. (*Gardeners' Chronicle*, Vol. 90, Nos. 2332-2347, 1931; abstract in *Nature*.)

The utility of cane sugar in mortar:—In a paper presented before the Sugar Division of the American Chem. Society, recently, Drs. Gerald J. Cox and John Metschl of Mellon Institute of Industrial Research, Pittsburgh, discussed their current investigation of the value of cane sugar in strengthening lime-sand mortar. Such an application of sugar is not new, as it is believed that the Romans made use of such materials in mortars that have certainly stood the test of time. Also, in sugar-growing countries, it is known that sugar has been employed to increase the strength of mortar.

Drs. Cox and Metschl found that there is very good reason for the empirical practice of "Sweetening" mortar. From their experiments they ascertained that mortar which contains sugar equal to 6% of the quicklime content has a tensile strength 60% greater than that of mortar containing no sugar. Further tests are planned of compression strength, setting time and durability as influenced by cane sugar.

The process of mixing the sugar with the mortar is quite simple. The sugar is dissolved in part of the gaging water and mixed in with the sand and lime. The sugar must not be mixed with the lime before slaking.

With the present low price of sugar, the 5 or 6 lbs. of sugar necessary for 100 lbs. of lime is only a small addition to the cost of laying bricks or plastering a wall. (*Scientific American*, 1st June 1932.)

Sterilising Milk with Sound Waves. Milk and similar liquids may some day be sterilized by subjection to a "terrific squeak" instead of by heat treatment. This possibility is visioned as a result of experiments by Dr. Leslie A. Chambers and Prof. Newton Gaines of Texas Christian University at Fort Worth, Texas. The apparatus which they have constructed and used in their Laboratories averaged a kill of 80 % of all bacteria present in various samples of milk, and in a few samples it produced complete sterilization. A nickel tube is caused to vibrate intensely and at a high rate by being placed in a rapidly alternating magnetic field controlled by mechanism, similar to that used in radio broad-casting. This causes the tube to "sing" with an exceedingly high pitched audible note. Partially immersed in water or other liquid its intense sound waves are very destructive to bacteria and other small organisms.... The laboratory model was of sufficient size to allow continuous treatment of milk at the rate of 100 quartz an hour; but the nature of the apparatus is such that the capacity may be expanded almost without limit.

With the co-operation of a local commercial milk concern, the apparatus was tested on a large number of samples of grade A. milk, with initial bacterial counts varying from 8000 to 30,000 per c. c. A few samples of pasteurised milk showing 3000 to 5000 counts were also tested with results indicating that the vibration treatment destroys germs not affected by pasteurization temperatures. The germs count in all cases, showed an average reduction of 80 % and in a few samples all germs were killed.

The sound-wave treatment, however, does not destroy bacterial spores; but such spores are also immune to pasteurization. Fortunately for both methods, the real trouble-making germs in milk are not spore formers.

Other liquids that may eventually be treated by the new method include certain dietary products, commercial alcohol, fruit juices, and delicate sera for use in medicine—in general, products that require a radical reduction in germ count, if possible, without heating.

(Science Service in "Scientific American" June 1932).

Potash from Sunflowers in Russia. The manufacture of potash from the ash of Sunflowers was carried on in Russia as far back as the 16th century. It was produced in considerable quantities, averaging about 20,000 tons annually before the World War. The main centres for this type of Potash are in the Caucasus and the Ukraine, where sunflowers are cultivated on a large scale. It is free from Iron and contains a negligible percentage of Sodium Salt. Until recently production was carried on in a rather primitive manner, but in 1930 two large plants with modern equipment started operations. Through the discovery of large deposits of mineral Potash in the Urals in 1926, Russia now ranks as the world's second largest Potash producer.

("Economic Review of the Soviet Union" in Chemical News, May 20, 1932).

The Indian Mango. "The fruit has been declared to be 'one of the most potent, if not the most potent, known natural source of vitamin C.' It has been recently studied at the Lister Institute for Preventive Medicine, London, by some of the leading Vitamin authorities in Britain Dr. Solomon Zilva and Miss Edith Perry. In a report just published by the Empire Marketing Board, they state that the Indian Mango, and particularly the variety called "Alfonso" is an extremely rich source of the Vitamin which protects against scurvy, and is also rich in Vitamin A, the anti-infective substance found in butter, milk, eggs, codliver oil etc. The "Alfonso" variety contains about six times as much Vitamin C as the most potent apple known, and about 30 to 40 times as much as the Cox's Orange Pipin, which may be considered its proto-type as regards palatability among eating apples." (Mysore Economic Journal, June 1932).

Normal Temperature of Animals. (Taken from the Queensland Agricultural Journal, March 1932).

	Degrees Fahrenheit,		Degrees Fahrenheit,
Horse ...	99.5 to 100.0	Dog ...	99.2 to 102.0
Ox ...	100.0 to 101.5	Rabbit ...	100.85 to 102.0
Sheep ...	101.0 to 103.0	Cat ...	100.4
Goat ...	101.0 to 103.0	Fowl average	103.0 to 106.0
Pig (adult)	101.0 to 102.6	Small birds	104.6 to 106.0
Pig (young)	102.6 to 104.0		

The "small" temperature of an animal as taken with a clinical thermometer is an index of the heat of the blood, and this, even in healthy animals, varies within certain limits. The normal temperature is raised slightly after a meal, during rumination, lactation or pregnancy. Work also raises it, and exercise much as when pigs are driven at a rate faster than that at which they are accustomed to move. The temperature of the same animal is always higher in the evening than in the morning. Young animals have a slightly higher normal temperature than old ones, and animals of anxious and restless temperament a higher one than sluggish or sleepy animals.

The temperature of the pig is taken by means of a clinical thermometer inserted into the back passage (the anus) and held there for not less than sixty seconds, and for preference, a longer period. Care should be taken to "set" the thermometer before use, that is to see that the mercury is a good deal below the line of normal temperature of the animal's body. Care in handling is emphasised.

Normal respirations of the pig are about 15 respirations per minute. Normal pulse is about 75 beats per minute. The pulse can be taken on the inside of the fore leg.

Notes and Comments

I. Work of the Agricultural Demonstrators:—For the past two years the work of the agricultural demonstrators who form the fundamental units of the department and the chief media of contact between it and the farmers has been on a more or less standardized type. Though every one of the present demonstrators is given the jurisdiction of one taluq, his main work according to the present arrangement is practically confined only to two or three centres fixed for him in each taluq. While we refrain from remarking on the merits or otherwise of this scheme, in view of the conflicting opinions we have been receiving recently on this arrangement both from farmers and the departmental men, we think it is not too early now to review the matter and judge of the efficacy or otherwise of this arrangement and settle something definitely for the future. We have no doubt that there will be arguments both for and against the present system. We would therefore invite the opinions of the departmental officers and our other readers who may be able to remark on this subject in our correspondence columns; we hope the superior officers will kindly permit their

subordinates to give expression to their actual experiences with regard to this matter. We need hardly add that the popularity and success of the department and its work depend a great deal on the proper methods of propaganda work that our demonstrators are directed to carry out.

II. The revised syllabus for the B. Sc. Ag. Degree Examination:

This note is in continuation of one in our March issue where we made a short reference to this subject. With the beginning of the new College year from this month the revised syllabus for candidates prosecuting their agricultural studies for the B. Sc. Degree of the University of Madras comes into force. Some of the conspicuous changes effected are: There are to be three University examinations, one at the end of each year of the course. During the first year freshmen students are given a course in the fundamentals of the basic science subjects which make up what we call the science of Agriculture, viz., Chemistry, Botany and Zoology and they are examined in these subjects at the end of the year. At the end of the 2nd year another examination is held on Agricultural Botany, Agricultural Zoology, Agricultural Engineering and the Plant Husbandry portion of agriculture, these being the subjects taught during the second year. During the 3rd year the subjects taught are Agricultural Chemistry, Animal Hygiene, the Animal Husbandry aspects of Agriculture and Agricultural Economics including farm management, and the final degree examination is held on these subjects. While there is no doubt that the subjects for the course are arranged in their proper sequence and suitability, it cannot be denied that there is no provision made for specialising in any subject and we are constrained to consider this as a serious drawback. We are aware that one or two members of the Syllabus Revision Committee, who were in fact the prime movers in the Board of Studies for a change in the syllabus, were very strongly in favour of some provision being made for specialisation during the 3rd year of the course and tried their best to get something done in that direction but without success. It is our opinion that by the time a candidate qualifies himself for the degree he must not only gain a fairly good knowledge of all subjects, but should receive sufficient training and help to carry on advanced work in some special branch of agriculture. The absence of this latter is evidently the reason why among so many of the diplomates and graduates who have gone out of the College, there are very few, so far as we know, who have taken to any special line of work on their own inclination or initiative; of course circumstances have driven many of them to do agricultural, chemical or botanical work, but that is quite a different thing, and this latter contingency often puts square men into round holes. This is certainly to be avoided. It is desirable that the graduate going out of this college should not only be a Jack of all trades in Agriculture, but should try to be a master of at least one of them.

III. Beekeeping as a cottage industry: In these days of unemployment and low wages, this industry of keeping bees and the production of honey offers a good avenue for young and old to add to their meagre incomes and means of livelihood. There is always a demand and good market for pure honey as compared with the bazaar stuff, which in many cases is neither honey nor good syrup; even the honey we get from the hills is usually mixed up with wax and insect juices. It is not every one, however, that can take to this fascinating work successfully; for unlike many other jobs, this work involves the handling of live insects and getting into touch with their habits and temper. We know many are by temperament absolutely unfit for such work; it is only those who have a natural inclination or who can easily train themselves for such work that can successfully engage in beekeeping; to such men the training is easy and quickly acquired. With regard to the kind of bees that may be selected, we understand from our Entomologist that it is better to domesticate the common Indian Bee (*Apis indica*) which is found everywhere in S. India, instead of getting foreign species at great expense and further risks. These latter may give more honey but they are unfortunately easily susceptible to some of the worst diseases bees are often subject to in other countries, and it is not improbable that by importing these foreign bees to new surroundings we are not only risking much, but might even import the bee diseases which are now said to be absent in India.

IV. Effect of retrenchment on Agricultural Education: We had occasion to remark in one of our earlier issues about some of the items of retrenchment effected recently in the Agricultural College. The financial difficulties which brought about such reductions have also unfortunately affected the rapid progress of agricultural education in some ways. Unlike as in the previous years applications for admission to the Agricultural College this year numbered only 180 as against more than 300 in the previous years; this is chiefly due to the recent introduction of college tuition fees and rent for lodgings, and this has kept away many a deserving but poor candidate from getting a course in agriculture as before. Though it may be argued why fees should not be levied in this college as in other professional institutions, like the Engineering and Medical Colleges, we feel that some special consideration has to be paid to agricultural training in view of the fact that, while it is not at present difficult for Engineers and Medical graduates to secure appointments or start private practice in their own lines, the time has not as yet arrived for the unfortunate agricultural graduates to stand on their own feet successfully. There are very few, if at all, among our agricultural graduates, who have taken to the practice of agriculture as an independent profession; nor do we know of any landed proprietors freely employing our men as farm managers or estate overseers. It is therefore unfortunate that the future aspirant

for an agricultural career is rather handicapped. Under the circumstances we would urge that some arrangements to give cheap and short courses in different aspects of agriculture may be made for those who wish to become practical farmers in their own way and are not anxious to get a costly University degree as a mere ornament with no future prospects. If we are not wrong we believe there is already a move on the part of the authorities in this direction.

V. Marketing of Produce: The progress and success of agriculture on satisfactory lines depend mainly on three or four important lines of endeavour. One is the development of technique in the matter of quantity, next the elevation of standards of quality, then the protection against plant and animal pests and above all good facilities for disposing of the produce at a reasonable profit. The reason for the existence of the first three efforts, in fact the reason for the existence of a farm itself is the opportunity to satisfactorily market the produce. In other words, it is within the field of marketing that we find the test of the success or failure of Agriculture. To produce where there is not a reasonably profitable market is certainly not worth while. There is no doubt that all our educated farmers and agricultural departments realise these important facts; but there is a good deal in the shape of marketing help which our small producers stand in need of, and it is up to the Co-operative and Agricultural Departments to afford all possible facilities to the small holder whenever necessary to find a ready and good market for his limited produce. Especially is this essential when the farmer is asked to grow new crops and take up novel industries. In the California State in America the Department of Agriculture maintains among its divisions, one called Division of Markets, the others being Divisions of Chemistry, Animal Industry and Plant Industry. The chief functions of this section of markets are (1) special marketing services on select commodities, (2) market information services, (3) grading for dairy and other animal foods and (4) administration of these activities—Legislation, Licenses, Proceedings, etc. Though it may not be possible for us to have such elaborate things, they show us how important this aspect of agriculture really is.

VI. Common Errors in Cotton Production: In a recently issued Bulletin of the United States Department of Agriculture on this subject the author gives an interesting and brief account of the common mistakes committed both in idea and practice by some cotton growers. It is not unlikely that some of these errors are made in India and the remarks might apply to Indian growers of cotton as well. Some of the causes which bring about the production of inferior cotton pointed out in this pamphlet are planting of poor seed, planting on price conjectures, changing the seed, planting too many varieties, failure to test varieties, misleading claims for varieties, propagation of hybrids, planting in unsuitable land, planting and thinning too early,

spacing too wide, picking too late, breeding insects in the off season, mixing seed at public gins, ginning too close and too wet or too dry. There is little doubt that the production of good cotton largely depends upon getting rid of the numerous errors in cultivation and production practices which are prevalent in the country and some of which have become long established customs often very difficult to mend.



Rao Sahib T. V. Rajagopalachariar,
Vice-Principal, Agricultural College,
Coimbatore—Retired.

M. R. Ry. RAO SAHIB T. V. RAJAGOPALACHARIAR, Avl.

On the 16th of June 1932 Rao Sahib T. V. Rajagopalachariar who was acting Vice Principal of the Agricultural College retired from Government employment after a continuous and very useful service of thirty years in the Madras Agricultural Department. In his retirement the department has lost the very valuable direct and active help of one who, with his long experience and sound knowledge of Agriculture, may be regarded as an authority on all agricultural matters in S. India.

Mr. Rajagopalachariar belongs to the Tinnevely District having been born in the village of Tirukkarungudi in the year 1877. After spending his early school days in Palamcottah, Tinnevely District, he joined the College of Agriculture, Saidapet and secured the diploma of the College in 1899. As was the recognised practice in those early days, he joined the Revenue Department and in the Office of the Board of Revenue, Revenue Settlement, Land Records and Agriculture. When under the commanding influence of Lord Curzon and Sir Denzil Ibbetson, the Agricultural Department all over India received a strong stimulus for expansion, Mr. Acharya found himself appointed as a Junior Agricultural Officer in the Madras Department. In this capacity he had the opportunity of visiting the agricultural tracts of Bombay and getting some training and gaining some experience in the different agricultural practices of the Bombay Presidency during the years 1903—1905. Returning from Bombay he worked as an Agricultural Inspector in Koilpatti and Coimbatore for two or three years. In the latter place where he worked as Farm Manager, even before the Agricultural College was opened, he acted as one of the pioneers in bringing the newly started Central Farm into working order during the years 1907—'08. In 1908 he once again got an opportunity of going out of this province and getting further experience; this was a deputation to the United Provinces to study the improved methods of sugar making at Cawnpore. Returning from the United Provinces he saw service in the N. Circars and the Ceded Districts. After thus equipping himself with the experience gained in the different tracts of this province and in two other provinces, he was drafted to the Agricultural College at Coimbatore as the senior agricultural teacher in 1919. In 1920 he was admitted to gazetted rank as Lecturer in

Agriculture. He continued in this capacity until two years ago when he was appointed to act as Vice Principal and it was in this position that he recently retired. He was Warden of the College Hostel for over 3 years and in that capacity and that of a teacher has helped to mould the character of successive batches of students for nearly 12 years. He has had his share of official reverses, and under ordinary circumstances he should have retired from a far higher position; but he was not one of those who have been very lucky to bask in the sunshine of official favours and rise like rockets. But such reverses did not in the least detract him from his keen enthusiasm and earnestness for agricultural work. In consideration, however, of the loyal service and good work done by him for over quarter of a century, Government was recently pleased to confer on him the title of Rao Sahib.

Both in his official and private capacities we have found in Mr. Rajagopalachariar a gentleman of very good parts. With his unostentatious and genial bearing and with his sound knowledge of agriculture and his keen appreciation of up-to-date scientific research, he commanded the regard and respect of every one who came into contact with him. Speaking of his unofficial activities, perhaps few outside the circle of his intimate friends and colleagues know that Mr. Acharya evinces keen interest in music and astrology and is a student of Sanskrit literature. He has been an ardent theosophist and was once Vice President of the local branch of the society. He has largely supported efforts in developing the religious, civic and social conscience of the residents of the College Estate in particular. He has been intimately connected with the Public Servants' Co-operative Society since he came to Coimbatore and he has been a Director and Vice President of the Society. He has been a prominent member of the Agricultural College Officers' Club for several years and at present, for a second time is Vice President of the Madras Agricultural Students' Union.

We need hardly add that unlike many an officer who retired from the department before him Mr. Acharya's experience and substantial knowledge will always remain an active and direct asset to the country; and we are also glad to note further that Mr. Acharya has arranged to settle down next door to the Agricultural College in Coimbatore and be ever ready to be of help in his own way to those who want it.

We earnestly hope and pray to the Almighty that Mr. Rajagopalachariar may be blessed with many years of well earned rest and further opportunities for good work and service to the country in the various lines of activities he has taken interest in. And it is needless to add that he carries with him the choicest good wishes of all the members of the Agricultural Department and especially those of the Agricultural Students' Union of which he is resident Vice President for the year.

(Editor).

Review.

A History of Applied Entomology by Dr. L. O. Howard, 1930.—Smithsonian Institute of Washington, U. S. A. Though in the words of the author the account may be somewhat anecdotal the publication is a very comprehensive volume on the rise and progress of Applied Entomology all over the world. The fact that such a famous man as Dr. L. O. Howard is the author will in itself be sufficient testimony to indicate how interesting and valuable the publication is sure to be for workers in the field of Entomology. It is only in the fitness of things that the author who has only recently retired from active service as Chief of the Bureau of Entomology, United States Department of Agriculture, after a long and remarkable service of more than fifty years and who is the accepted doyen among the Economic Entomologists of the present day, should put down in record a work of this nature which is evidently a summary of the author's accumulated notes and valuable experiences. No one else in our opinion would be so very competent to write such a history. It is needless to add how very interesting and helpful the information contained in the work will prove for workers in this line in all countries.

Though Applied Entomology (Economic Entomology) is a science of recent origin, compared to the other branches of Biology the growth of this particular branch of study "has been very rapid and its study is expanding like the traditional snow ball". "Its origin" in the words of Dr. Howard "has been so recent that there has been no demand for a historical record of its growth." The appearance of this work, therefore, is very timely and would supply to Entomologists all over the world in a nutshell facts and figures regarding the rise and progress of Economic Entomology from the earliest times to the present day.

After giving us an idea in the introductory chapter, of the chief motives that led him to prepare this volume the author deals with the subject in seven different parts. The first six of these deal with the rise and progress of Economic Entomology in the world, viz., (i) *N. America*, (ii) *Europe*, (iii) *Asia*, (iv) *Africa*, (v) *Australia*, and (vi) *Central & S. America with the West Indies*. The seventh part is devoted to the important subject of Medical Entomology, an interesting account of the numerous personal experiences of the author with famous workers in this line of study and finally to the various attempts made in different parts of the world in the biological methods of pest control by the study and utilisation of predatory and parasitic insects. The volume finally concludes with a series of 51 plates including the photographs of a galaxy of well-known workers in the field of Economic Entomology during the past one hundred years or more.

A glance through the first six parts will give one a very succinct account of the progress of the science in the different parts of the world and especially of the detailed knowledge and information the author has been able to collect from different corners of the world. The matter contained in these seven parts forms a mine of information on various aspects of Economic Entomology. It includes something about men, insecticides, well-known pests, legislation against pests, journals in Entomology, entomological societies, chief writers on the subject in different countries and various items of international work done by Institutions devoted to this subject in different parts of the world. In fact the publication very clearly and beautifully elaborates on the chief aims of the author laid down in his introduction, viz., 1. To impress on everybody the enormous importance of the study of insects—that this study is one of vital importance to humanity; 2. To show all entomologists that, no matter what aspect of the subject they are studying, they are doing work of vital importance and are greatly helping mankind—this in the effort to prevent all friction between museum and laboratory

men and economic workers; 3. To show the great body of scientific men the entomology and entomologists, including economic entomologists, are doing sound and important scientific work which should command their respect; 4. To bring about a solidarity among the entomologists of the world on the broad ground that the insect danger is one to all humanity regardless of national affiliation. We are gratified to find that in dealing with the work in various countries the author has not only not omitted to refer to the growth of this science in India but has been kind enough to remark with regard to entomological work that—“Madras stands out first among the provinces”—and refers to the filling up of the post of Government Entomologist by a *Native Entomologist*—Mr. (now Dr.) T. V. Ramakrishna Ayyar in 1914. Reference is also made to other Indians who became Entomologists later such as Messrs. Y. Ramachandra Rao, Afzal Hussain, Gosh and the late Dr. K. N. Kinnann of Mysore.

On the whole the publication contains plenty of information not only on the subject but also a good deal regarding the army of workers all over the world; and the series of photographs at the end besides giving an idea of the personalities of some of these pioneers in this science helps future workers to get inspirations in this field of science. We are only sorry that there is no photograph of the author which should have had its place as a frontispiece. We would suggest to every economic entomologist to possess a copy of this very valuable publication and there is no doubt that this work will be an ornament to any library of scientific books.

(Editor).

College News & Notes.

Students' Selection. 48 students have been selected for admission to the 1st year class consisting of 23 Brahmins, 18 Non-Brahmins, 4 Christians and 3 Moham-madans. Of the 43, 23 are from the Telugu districts, the rest being Tamils and Malayalees. There is also a waiting list to take from when any of the first selected ones does not turn up.

Students' Club. At a meeting of the club held on July 1, the following Office-bearers have been elected for the year 1932-33.

Games Secretary, T. S. Dakshinamoorthy, **Club Secretary,** V. S. Rangacharlu. **Hockey Captain,** T. Ramanjulu **Cricket Captain,** S. Varadarajan. **Football Captain,** N. Muthusamy. **Class III Representative,** N. Sriramreddy. **Class II Representative,** M. R. Devarajan. **Tennis Representative,** K. Radakrishna Rao.

Hockey Match. There was a friendly match on 25.5.32 between the College, students and the estate boy scouts. Though the latter were defeated by 3 goals, the youngsters put up a good fight and we are sure that with more practice they would considerably improve.

On Tuesday the 13th a Hockey team from St. George's Home, Kariy, Ootacamund, played a match with our College team. After a fast and exciting struggle, our College emerged victorious by one goal to love, scored in the first few minutes of the game.

Visitors. The Hon'ble Mr. P. T. Rajan, Bar-at-Law, Minister for Public Works was in our midst on 5th and 6th July along with Mr. S. V. Ramamoorthy, M. A. I. C. S., the Director of Agriculture.

General Body Meeting of the M. A. S. U. A General Body Meeting of the resident members of the Madras Agricultural Students' Union was held on Monday the 11th July, with the President Mr. C. Tadulingam Mudaliar in the chair, to consider the advisability of holding the College Day and Conference this year in view of the fact that the Director of Agriculture expressed it would not be possible for him—on account of financial reasons—to depute any mofussil officers to the Conference. After some discussion, the meeting resolved that on account of the

peculiar financial conditions of the present year, and in view of the fact that the last College Day was in December 1931, and that officers from the mofussil could not be deputed, the College Day and Conference be postponed to July 1933. The meeting also passed a resolution requesting the present Office-bearers, to continue in office till the next College Day.

Welcome to Freshers. A very pleasant function came off on Tuesday the 12th July in the Freeman Hall, when students of the II and III year gave a welcome to the freshmen of the first year. After tea, and a song by Mr. Subba Reddy the first years were introduced one by one to the audience, after which, welcome speeches were made by Mr. Sriramulu Reddy and Mr. R. V. Devarajan on behalf of III and II year students. Messrs. V. Muthuswamy Iyer and C. Narasimhachari for the lecturing staff, Rao Bahadur B. Viswanath on behalf of the tutors, Mr. H. Siva Rao as warden and Mr. M. R. Balakrishnan as Secretary of the Madras Agricultural Students' Union, also made speeches extending a hearty welcome to the new students. Mr. C. Tadulingam who presided, appealed in his concluding remarks, to all students to join the Madras Agricultural Students' Union which has been standing for the past 29 years for the promotion of an *esprit de corps* among its members.

Weather Review (JUNE—1932)

RAINFALL DATA

Division	Station	Actual for month	Departure from normal	Total since January 1st	Division	Station	Actual for month	Departure from normal	Total since January 1st
Circars	Gopalpore	0.3	-5.5	1.9	South	Negapatam	0.6	-0.7	8.2
	Berhampore *	...	...	...		Aduthurai *	0.6	-0.9	9.1
	Calingapatam	1.9	-2.9	7.5		Madura	1.7	+0.3	8.0
	Vizagapatam	1.3	-3.6	4.4		Koilpatti *	0.9	+0.4	9.0
	Anakapalli *	3.1	-2.9	9.1		Pamban	0	-0.1	4.1
	Maruteru *	2.5	-1.5	7.8		Palamkottah	0	-0.6	6.1
	Samalkota *	2.0	-2.7	4.2	West Coast	Trivandrum	2.9	-10.5	28.2
	Cocanada	3.3	-1.5	4.9		Cochin	2.6	-15.9	44.2
Ceded Dists	Masulipatam	3.3	-1.3	7.2		Pattambi *	10.6	-15.3	38.8
	Kurnool	2.5	-0.4	4.2		Calicut	17.5	-16.6	59.8
	Nandyal *	2.8	-1.8	6.8		Taliparamba *	25.1	-13.2	54.8
	Bellary	1.6	-0.3	3.0		Kasargode *	25.4	-11.0	48.5
	Hagari *	1.9	-1.2	4.5		Mangalore	31.5	-5.3	49.1
Carnatic	Cuddapah	1.2	-0.7	2.3	Mysore and Coorg	Bangalore	2.7	-6.2	11.0
	Nellore	0.4	-0.9	5.7		Mysore	0.6	-2.3	11.7
	Madras	1.1	-0.7	3.0		Mercara	14.9	-11.5	35.3
	Cuddalore	0.1	-1.4	5.9					
	Palur *	0.4	-0.6	6.0					
Central	Palakuppam *	2.3	-0.5	7.0	Hills.	Kodaikanal	1.1	-3.0	16.3
	Vellore	3.8	+1.4	8.0		Coonoor	1.0	-1.1	10.9
	Salem	4.5	+1.5	14.7		Nanjnad *	2.5	-6.0	16.3
	Hosur Cattle Farm *	2.9	+2.5	15.5		Kallar *	1.7	-0.1	16.4
	Coimbatore	0.6	-1.1	11.1		Ootacamund *	1.8	-3.2	12.4
	Coimbatore Res. Inst. *	0.9	-1.0	12.1					
	Trichinopoly	2.5	-1.1	12.9					

* Meteorological Stations of the Agricultural Department

General weather conditions.—The monsoon was generally weak over the peninsula during the month and rainfall was associated with thunderstorms. A depression formed at the head of the Bay on the 7th and moving into Deltaic Bengal gave heavy rainfall in that area till the 12th but failed to influence weather to any large extent in this Presidency. The Monsoon revived on the West Coast about the middle of the month but failed to penetrate inland and its activity was confined to the South Canara district. Scattered thunderstorms appeared in the south at the end of the month associated with pressure distribution characteristic of a very feeble monsoon.

Rainfall was below normal over the whole of the area with the exception of parts of the central districts where it was locally in excess. The defect was most marked on the West Coast and in the Circars.

Temperature was very high on the East Coast at the beginning of the month and was above normal almost throughout the month there, the area being a part of an area of high temperatures extending from the Circars coast northwestwards into the Punjab.

Masulipatam reported a maximum of 113° on the 2nd.

Weather Report for the Research Institute Observatory.

Report No. 6/32.

Absolute maximum in shade	...	...	93.00
Absolute minimum in shade	...	...	69.00
Mean maximum in shade	...	...	88.50
Mean minimum in shade	...	...	73.70
Total rainfall in the month	...	...	0.86"
Mean rainfall for June	...	...	1.83"
Departure from normal	...	...	0.97"
Heaviest fall in 24 hours	...	...	0.45"
Number of rainy days	...	...	2
Mean daily wind velocity	...	...	6.1 M. P. H.
Mean 8 hours wind velocity	...	...	9.4 M. P. H.
Mean Humidity at 8 hours	...	...	68.6%
Total hours of bright sunshine	...	...	225.8
Mean daily hours of bright sunshine	...	...	7.53

General weather conditions:

The weather during the greater part of the month was fine with a very weak monsoon.

Thunderstorms appeared towards the end of the month but rainfall was light

Temperature was generally normal.

P. V. R. & P. K. M.

Departmental Notifications.

Gazette Notifications:—C. Vijayaraghavan, Asst. to the M. S., Hagari, to officiate as Millets' Specialist from 29—5—32. M. Anandan, Superintendent A. R. S., Aduturai, l. a. p. without M. C. for one month and a half from 1st June 1932 or date of relief. T. K. Balaji Rao, Assistant, to be in full additional charge of duties of the Supdt., A. R. S., Aduturai. Rao Sahib C. K. Viraswami Ayya, Statistical Assistant to the Director of Agriculture, l. a. p. for 4 months from 13—6—32. K. Gopalakrishna Raju, D. D., III Circle, l. a. p. for 2 months from 20—5—32. Y. G. Kistna Rao Nayudu, D. A. O., Bellary to be D. A. O. in charge of III Circle vice K. Gopalakrishna Raju granted leave. C. V. Seshacharya, Offg. D. A. O., Kurnool, to officiate

as D. A. O. Bellary, vice Y. G. Kistna Rao Nayudu. I Circle:—Transfer—M. Chinna-swami Nayudu, F. M. Samalkota to district work in Peddapuram Taluk, with headquarters at Peddapuram. P. Laks minarayana, A. A. D. Narasapuram, l. a. p. for 15 days from 6—6—32. II Circle:—C. S. Gopalaswami Rao, Asst. in Mycology, l. a. p. for 15 days from 27—6—32. L. Narasimhachari, F. M. Guntur, extension of l. a. p. for one day on 25—6—32. III Circle:—N. Kesava Ayyangar, Asst., Hagari, l. a. p. for one month from 7—7—32. K. Balaji Rao, A. A. D. Seruguppa, l. a. p. for 3 months from 23—6—32 or date of relief. K. Ramanatha Ayyar should report for duty at Siruguppa after the expiry of leave. M. Vaidyanathan, F. M. Hagari, extension of l. a. p. for 15 days from 1—7—32 in continuation of leave already granted. IV Circle:—Transfers—M. K. Swaminatha Ayyar, A. D. Tirukoilur to Gudiyattam. V. Muthuswami Ayyar to Kalahasti Farm as F. M. to relieve V. Suryanarayana. S. Ramachandran, A. D. Tirupattur, posted to Polur for Pest Act Work for 2 months from July 1932. S. Muthuswami Ayyar, A. D. Gudiyattam should relieve Ramachandran by the 18th of June 1932. V. Suryanarayana, F. M. Kalahasti, l. a. p. on m. c. for 4 months from the date of relief. V Circle:—K. Sitarama Ayyar A. D. should join duty at Perambalur on the expiry of 6 months' leave granted to him. VI Circle:—P. Kannappa Pillai A. A. D. Nanganeri l. a. p. for 1 month without m. c. from 15—6—32. VII Circle:—K. Soopi Haji l. a. p. for 10 days from 27—6—32. VIII Circle:—P. V. Hanumantha Rao A. A. D. Kollegal l. a. p. for one month from date of relief. D. D. L. S.:—M. V. Narasimha Sastry, A. F. M. Livestock Research Section, Chintaladevi, l. a. p. for 2 months from 1—7—32. G. A. C's Section:—K. Veerabhadra Rao, assistant extension of l. a. p. for 2 days from 5—6—32. G. M's Section:—C. S. Krishnaswamy, assistant l. a. p. for 9 days from 22—6—32. P. S's Section:—N. Parthasarathy, assistant l. a. p. for 18 days from 13—6—32. C. V. Sankaranarayana Ayyar, Sub-assistant, extension of l. a. p. for 15 days from 16—6—32. M. K. Venkatasubramaniam, assistant l. a. p. for 23 days from 22—6—32. K. B. Viswanatham, assistant l. a. p. for 20 days from 22—6—32. Ch. V. Saravaya, assistant extension of l. a. p. for 23 days from 8—6—32. D. A's Office Orders:—John A. Muliyl extension of l. a. p. for 1½ months. Transfers:—R. Govindaramayya F. M. C. B. S. Coimbatore to V Circle. K. Krishnan, A. D. Turaiyur to be F. M. C. B. S. Coimbatore. C. Rangaswami Ayyangar A. D. in Mycology, III Circle on the expiry of 2 months leave to work under G. M. Coimbatore. His pay continues to be drawn under "Demonstration". If the services of a mycology assistant are required, the D. D. should apply to D. D. II Circle. Appointment:—Mohammed Moinuddin offg. upper subordinate, science section vice J. A. Muliyl till 15—6—32 will continue to officiate as upper subordinate from 16—6—32 vice C. Vijayaraghava Acharya, assistant, millets section on other duty. Transfer:—S. Madhava Rao, probationary upper subordinate under training, to the IV Circle, St. Thomas Mount.

ADDITIONS TO THE LIBRARY DURING MARCH, 1932.

A. Books.

(1) Russell E. J. *Soil Conditions and Plant growth*. (2) Howard A. and Wad Y. D., *The Waste Products of Agriculture, Their utilisation as humus*. (3) Ellis W. M. *Irrigation*. (4) Doyle K. D. *Agriculture and Irrigation in Continental and Tropical Climates*. (5) Copeland E. B. *The Coconut*. Revised edn. (6) Douglas C. E. *Rice, Its cultivation and preparation*. (7) Rutherford M. K. *Planters Note Book*, 9th edn. (8) Letif S. A. *Economic aspect of the Indian Rice Export Trade*. (9) Kesava Ayyangar S. *Economic investigations in the Hyderabad*. 1929—30 Vol. I. *General Survey*. (10) Penson T. H. *The economics of every day life* parts I and II. (11) Eckles C. H. *Dairy cattle and milk production*. revised edn. (12) Deshpande R. S. *Residential buildings suited*

o India. (13) Ekamjaram T. *Plant Studies*. (14) Mellor J. W. *A Comprehensive treatise on Inorganic and theoretical chemistry*, Vol. XI. (15) Hulstaert R. G. A. *Gene al Insectorum—Lepidoptera Rhopalocera—Fam. Danaidae Sub—Fam. Danoidinae and alluvinae Fasc. 193* (16) Hammond D. B. *Stories of the Scientific Discovery*. (17) *The Madras Stationery Manual*, 5th edition. Vol I text.

B. Reports and Publications.

Annual Reports for the year 1930—31. Agri. Dept, Central Provinces United Provinces, Royal Botanic Gardens, Calcutta. The National Institute of Agricultural Botany. Agricultural Dept. South Australia. Nigeria (1931) Experiment Stations of the Empire Cotton Growing Corporation (1931)—31. Guam Agricultural Experiment Station (1925—30). Hawaii Agricultural Experiment Station (1930). Connecticut Agricultural Experiment Station (with bulletins and circulars). Agri. Dept Bihar and Orissa 1930—31. Bihar and Orissa Agri. Exptl. Farms 1929—30. Agri. Dept. Gold Coast 1930—31. Indian Chemical Society 1931. Oklahoma Agri. Exptl. Stn. 1926—30. Alaska Agri. Exptl. Stations 1927, 1928, 1929. Mysore Agri. Dept. 1929—30. Imperial Sugar Cane Research Conference 1931. Indian Central Banking Enquiry Committee 1931 Pt. Majority Report Part II. Minority Report.

C. Bulletins, Memoirs etc.

(1) Bengal Industrial Dept. Bulletin 41. The Refining of Ghee. (2) Indian Meteorological Dept. Memoir Volume 24/8. The Lunar Atmospheric Tide at Bombay (1873—1922). (3) Imperial Economic Com. Report No. 20, The Wheat Situation 1931. (4) Leeds University Publications:— 167. Sugar beet growing in Yorkshire. 168. Production, production costs, sources of supply and methods of disposal of agricultural products 1921—1929. 169. Guide to experiments and demonstrations to Askham Bryan Farm, York. 170. Report on clean milking competition. 171. Experiments on the Fattening of sheep on roots. (5) Gold Coast Agricultural Department Bulletin 23. Year Book 1930. (6) Kenya Agri. Dept. Bull. 21 of 1931. Report on the 1931 Locust Invasion of Kenya. (7) Kenya Agri. Dept. Bull. No. 1 of 1932. The Growing of Wattle and Production of Wattle Bark in Kenya. No. 2 of 1932. The Poultry Industry, Egg marketing. (8) New South Wales Agri. Dept. Sci. B. 11:33. The control of Ked (Tick) in sheep. (9) Hawaii A. E. S. Bull. 62. Physical properties of Hawaii soils with special reference to colloidal fraction. 63. Physico-chemical properties of edible canna and potato starches. (10) Michigan A. E. S. Tech. Bull. 115. The Diagnosis of species of *Fusarium* by use of growth-inhibiting substances in the culture medium. (11) Porto Rico A. E. S. Bull. 33. Citrus culture in Porto Rico. (12) Terracing Experiments 1930—31. Hardy shrubs for the Penhandle landscape. Penhandle A. E. S. Pub. 31. (13) New Mexico A. E. S. Bull. 190. The preservation of manure under arid climatic conditions. (14) Minnesota A. E. S. Bull. 277. A study of taxation in Minnesota with particular reference to Assessments of Farm lands. Bull. 278. Trucking livestock to South St. Paul. Bull. 76. Black leg disease of potatoes in Minnesota. (15) Montero A. E. S. Exten. Bull. 111. Alfalfa seed. 114 Pastures bring profits. 237. An economic analysis of production problems in the flat-head irrigation project. (16) Iowa A. E. S. exp. Bull. 171. Weeds and their control. 172. Terracing to reduce erosion. (17) U. S. Agri. Dept. Bull. 1365. Development of flowers and bolls of Pima and Acala cotton in relation to branching. 1370. Sugarcane sirup manufacture. 274. Hot water as an insecticide for the Japanese beetle in soil and its effect on the roots of nursery plants. (18) Connecticut A. E. S. Bulletins:—321. Commercial fertilisers—Report for 1930. 322 Report of the Director for 1929—1930. 323. A preliminary study of the nonvolatile organic acids of tobacco leaves. 324. The chemical changes that occur during the curing of Connecticut shade grown tobacco. 325. Commercial feeding stuffs

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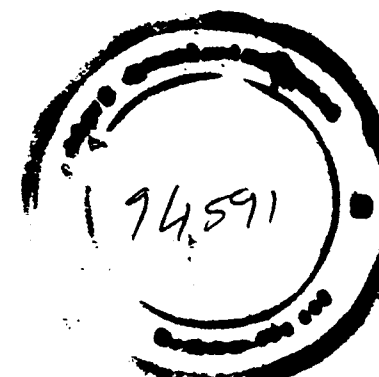
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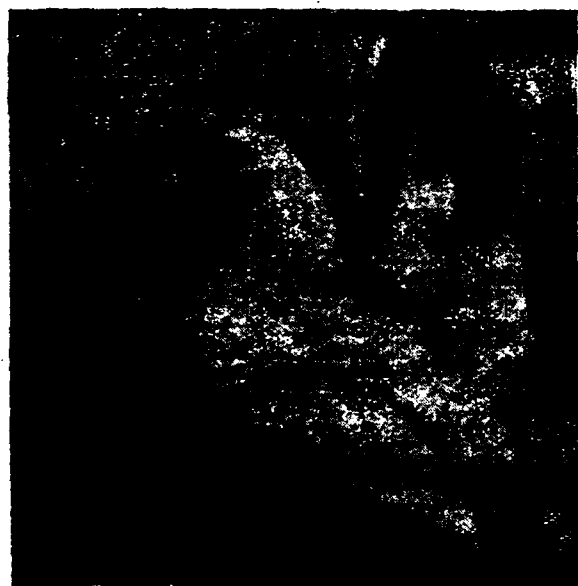
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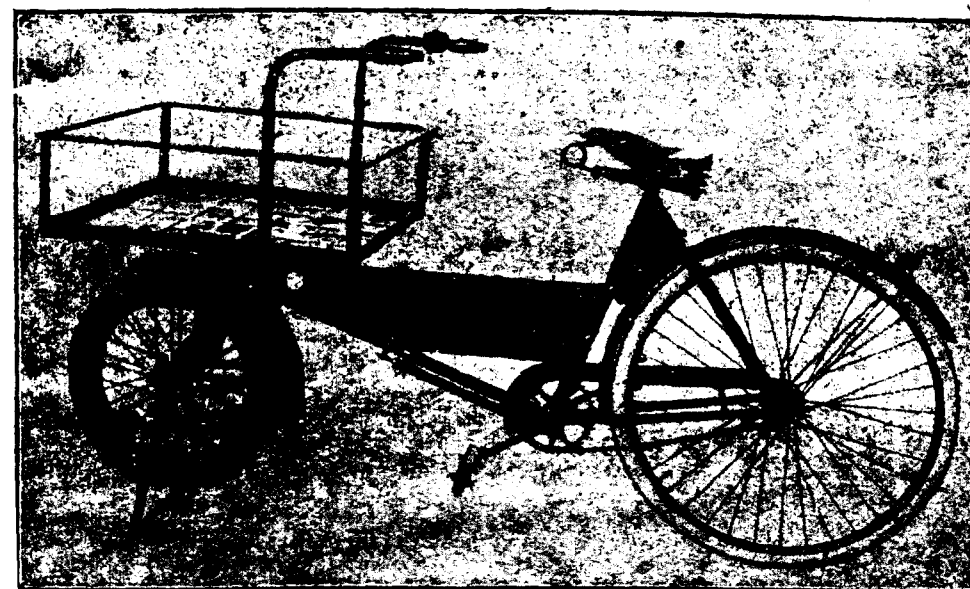
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