MADRAS
AGRICULTURAL DEPARTMENT

YEAR BOOK

1920-21

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1921

PREFACE

THERE was no issue of the Year Book for the year 1920 as sufficient material was not collected in that year. The present Year Book, therefore, covers both 1920 and 1921.

MADRAS,
16*th May* 1921.

A. D. STUART,
Director of Agriculture.

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YEAR BOOK, 1920-21.

NATADA NARARIA, MOORE (*Lep. E.I. Co., p.* 415 ; *Fauna of India, Lepidoptera, Vol. I, p.* 381)

By E. BALLARD, Esq., and M.R.Ry. Rao Sahib Y. RAMACHANDRA RAO.

Food plants *Pithecolobium dulce.*

While sorting and arranging the cage slips from the Insectary, I came across the following notes on the life history of Natada nararia. Our attention was called to this insect by the fact that the larvæ were defoliating a hedge (*Pithecolobium dulce*) which surrounded the Gas works on the College Estate.

As it was to the aesthetic interest of the community that the hedge should be saved more important problems were for the moment set aside and our attention concentrated on this Limacodid.

In the *Fauna of India*, Vol. I, p. 382, Sir George Hampson gives the following description of the adult :—

"Pall brownish ocherous. Fore wing with basal two-thirds redder and bordered outwardly by a dark brown somewhat diffuse curved line.

"The form 'Signata' from Ceylon has the fore wing more or less suffused with brown, sometimes with a conspicuous black dot at end of cell." Exp. ♂ 12–20, ♀ 22 mm.

He gives the following localities :—

Dharmsala, Mhow, Nilgiris, Ceylon,

NOTES ON NATADA NARARIA.

By E. BALLARD, Esq., and M.R.Ry. Rao Sahib Y. RAMACHANDRA RAO.

Egg.—Pale yellow, elliptical, flat, resembling a young Lecanium, 1·25 mm., laid singly on both sides of the leaves and on the sides of cage.

Number laid.—Female in cage "A" laid 158 (15th January 1914); she was then put into "B" and laid 21 more, transferred to "E" and laid 20 more, transferred to "F" and laid no more and died, i.e., between dates 14th/15th January 1914 and 17th/18th January 1914, she laid 158 + 20 + 21 = 199.

Another cage "C", 16th/17th January 1914, laid 73. Transferred to "D" morning of 20th January 1914, found dead having laid 8 more eggs, 73 + 8 = 81.

Cage X, 17th January 1914, moths in cop. put in 17th/18th January 1914. Laid 18 eggs. Male removed, transferred to "Y", 18th/19th January 1914, laid 14 eggs. Transferred to "Z." Morning of 20th found dead. Total 27 eggs.

Moths emerging 19th January 1914 on 20th January 1914 were put into four cages, 17 eggs were laid including a chain of 9 attached to a dead moth. By 24th all moths were dead.

Cage 6—a pair put in 21st January 1914 and on 21st/22nd January 1914 three chains of eggs were laid with hairs adhering. Fifty-six eggs in all. Moths were transferred to cage 7. By 23rd January 1914 53 eggs were laid and was dead. ♀ transferred and laid 48 eggs. ♀ transferred laid 12 more. ♀ transferred 2 more (26th January 1914)—27/28th January 1914 2 more. 29th January 1914 moth found dead, i.e., between 21st January 1914 and 29th January 1914 laid 153.

Time taken to hatch—

Eggs laid 15th/16th January 1914, hatched out by 8-30 a.m., on morning 21st January 1914, remainder of these had hatched by 22nd January 1914—5 to 6 days.

Eggs laid on night 16th/17th January 1914, some hatched 21st January 1914, others 22nd January 1914—4 to 5 days.

Eggs laid on night 17th/18th January 1914, hatched 23rd January 1914 a.m.—5 days.

'Cage X—eggs laid on night 17th/18th January 1914, hatched 23rd January 1914 a.m. 5 days.

Cage 7—eggs laid on night 18th/19th January 1914, hatched 24th January 1914 a.m.—5 days.

Short description of egg.—Egg has been already described as flattened scale-like object, pale yellow colour. On the second day after being laid the yolk appears to be concentrated at the sides of the egg and a clear kidney-shaped space appears in the middle.

Third day, this space is larger, yolk is more concentrated, embryo is seen clearly.

Fourth day, red patch appears at one end of the embryo and the edges of the clear area are becoming opaque.

Fifth day, two dark eye-like spots appeared, behind these an oblique red brown patch ; the red patch had deepened and formed a semi-circular band at one pole.

Larval life.—Larva just hatched rather less than 1 mm. in length. Colour yellow brown with two red brown stripes on dorsal surface of IV, V, VI, VII segments. Larva is beset with spiniferous processes placed in four rows, 2 lateral, 2 sub-dorsal.

The spines are bifid at the tip. The head is hidden by the projecting prothoracic shield and the anterior spines. It is strongly mandibulate and has singularly large eyes. Prolegs absent and replaced by the foot typical of Limacodids.

After first moult which takes place in 48 hours from the time of hatching the larva is 1·4 mm. in length. The colour bands have deepened and concen trated. Spiniferous tubercles are quite a different shape. Central spine is not bifid and there are two circles of strong dark spines surround ing base of central spine.

In another 48 hours larva moults again. It is now 2·2 mm. long. Colour is greener, dorso-lateral colour band deeper in colour and more concentrated.

Next moult (48 hours) length 3 mm. Dorsal spiniferous tubercles are white with black spines. First three lateral spines white, tubercles black, anal tubercles have black spines, others colourless.

When 5·5 mm. in length body is green above with dorsal stripe of anterior one-third greenish bordered by pink and yellow streak, post. two-third purplish bordered by yellow, it is constricted in two places by the yellow encroaching upon the purple dividing it into three parts. Tubercles have several rows of spines : terminal spines long and white (pale) three anterior tubercles darker.

Full-grown larva, 8—11 mm. in length.

General ground colour apple green. Three anterior spiniferous processes rose colour or, and more usually, bright crimson.

Running fore and aft a pair of bright yellow streaks placed latero-dorsally along the bases of

the latero-dorsal rows of processes placed between the two rows of latero-dorsal processes are three lozenge-shaped patches of bright crimson between segs. I and III, V, VI and on VII. Lozenges are separated by green, or by dilations of the yellow, streaks. There is faint mid-dorsal narrow yellow streak. This is the average typical specimen.

In some the crimson patch occupies the greater part of the mid-dorsal area—the three lozenges forming one stripe and extending forward along the yellow streaks and enclosing a median green patch joining with the red of the anterior tubercles. In others again the two posterior lozenges coalesce leaving the anterior one separate. Again two red spots mark the position which should have been held by the lozenges. The remainder of the space being green. Finally some show no trace of red lozenge shaped patches, the larva is entirely green except for a pair of latero-dorsal yellow stripes.

The cocoon is spherical and kept in place between the leaflets by a tangle of silk threads.

The pupa is 6 mm. in length stout and roughly oval. Eyes are prominent, wing rudiments plainly seen and extending to eighth abdominal segment. They are separated medianally by leg rudiments. Between eyes is a broadened cross ridge of chitin. Posterior end is blunt and thickened.

The moth has already been described. It possesses the rather quaint habit of sitting up like a "begging" dog.

One unfertilized moth lived in the laboratory, 21st to 25th January 1914; fertilized moths lived from 4 to 9 days. The average life appeared to be 5 days, but this was under laboratory conditions and the actual life in nature might be longer.

Characteristic life history notes.

Eggs laid—7th/8th March 1914.

Hatched—11th/12th March 1914. Spines bifid at tip ; larvæ did not feed, had appearance to naked eye of transparent ovid bodies with purplish nucleus (8 mm.).

I moult—12th/13th March 1914, by 11 a.m. in most cases. Period 12/14 larvæ were feeding on parenchyma and leaving veins (1·4 mm.).

II moult—17th/18th March 1914, one moulted before others and was feeding on 18th morning.

Twentieth, both larvæ feeding on parenchyma by 11 a.m. On 21st both were about to moult (2·2 mm.).

III moult—21st/22nd March 1914, moulted and feeding by morning of 22nd March 1914 ; length 3·2 mm.

IV moult—24th and 25th March 1914. 24th March 1914, one was about to moult. 25th March 1914 other about to moult.

V moult—30th and 31st March 1914, one larva died. Survivor was of the green variety with only very faint pink colouration.

8th April 1914, found to have pupated.

20th/21st April 1914, moth emerged.

Total length of life from egg to moth, 44 days

Total life from egg to pupa, 31 days.

Other egg periods were very constant at 4 days.

Larval life, 31 days.

Pupal periods, 14 to 16 days.

This may be taken as typical, others showed as above. The larva is parasitised by an unnamed Braconid.

SUGARCANE IN SOUTH KANARA

BY M. GOVINDA KIDAVU,

Assistant Director of Agriculture, VII Circle.

"Saccharum officinarum" or the common sugarcane seems to have been under cultivation in this district for long time past. But whether it is indigenous to this district or was introduced by some enterprising cultivator in times gone by, is not clear. But the cultivation of this as well as most of the other industrial or money-crops is in the hands of the comparatively poor Roman Catholic Christians of the district, whereas the indigenous agricultural population belongs to the Bhunt class. But for the purpose of our article the only relevant fact is that sugarcane has long been under cultivation in this district and that it is not a recent introduction. We are now concerned more with its future than the past.

The cultivation was till recently confined to the coast taluks, Kasaragod, Mangalore, Udipi and Coondapur, but it is now extending inwards. The crop is largely cultivated along the banks of rivers and perennial streams or channels and also on small islets at the mouths of the large rivers. Seven varieties of canes, namely, (1) Balla or Rastali—white thin cane ; (2) Dusa Kabbu or Striped cane ; (3) Karikabbu or red thin cane ; (4) Bedru or Hulla—reed cane ; (5) Red Mauritius ; (6) B. 208 ; (7) B. 147, are now met with ; of which the last three varieties have been introduced by the Agricultural department. Though sugarcane has been growing in the district for the last many years yet, the fact that it could be made to produce jaggery on a commercially profitable scale seems to

have been realized by the local ryots only comparatively recently. Much of the cane grown was being utilized as such for chewing because most of the ryots who grow sugarcane were, as stated before, very poor and lived a hand to mouth existence by selling a few canes every day, and using up only what remained for milling and making into jaggery at the end of the season. Jaggery making was thus not done on any commerical scale except in a few places where there were some professional jaggery makers.

Buchanan's description of the cultivation of the cane crop in South Kanara written in 1801 showed that it was well manured and that the price of jaggery then was high enough. Evidently the cultivation had degenerated and the area decreased considerably. Since the advent of the Agricultural department, it was found on inquiry by a departmental officer that the following among others were the chief causes for the deterioration in cultivation and decrease in the area :—

(1) Inadequate manuring and faulty methods of cultivation.

(2) The diseased and otherwise unsatisfactory growth of canes as result of No. 1.

(3) The decreasing price of jaggery.

(4) The damage done by jackals, etc.

(5) The difficulty of getting fuel for the manufacture of jaggery.

(6) The primitive methods of milling and jaggery making.

(7) The inadequate return for the trouble bestowed—a natural consequence of the existence of all the above conditions.

At about this time the Agricultural Department grew a trial crop of sugarcane on the newly opened experimental station at Taliparamba. "The cultivation being new to these parts the methods adopted were all suggested by experience of cane growing in the east coast. The growth of this crop exceeded all expectations and was as good as the heaviest crop on the east coast. The varieties tried were Red and Striped Mauritius."

The difference between the tall thick canes growing at the Agricultural Station and the sickly stunted ones grown in the South Kanara district was very marked indeed. It was, therefore, decided to make a trial with these varieties in a few places of the district where cane cultivation is carried on. Accordingly, a few sets were distributed through the District Agricultural Association of South Kanara. The growth of these, though good, was nothing when compared to the canes of the Government Farm. The fault was due to bad drainage and inadequate manuring. One of the officers of the Agricultural department then made an extensive tour of the district visiting some of the chief centres of sugarcane cultivation and induced a few ryots in different parts of the district to grow experimental plots of Red Mauritius cane. Special care was also taken to make them follow the same methods of cultivation as practised at the Agricultural Station and the result was found to be excellent. Great difficulty was, of course, at first experienced in inducing people to grow this new variety of cane.

In parts where there were professional jaggery makers who enjoy the lion's share of the profits of the cultivation and yet to whom the cane growers

were greatly indebted, it was easier to work through these men, than deal with the tenants directly. With the introduction of the new variety, it was found easy to improve the methods of cultivation, even in the local canes. Consequently it was possible to produce as good canes in these parts also as were grown on the Taliparamba Farm, by adopting a system of wider planting, adequate manuring and proper drainage.

This variety became more and more popular year after year and there was corresponding increase in the area cultivated. Thus this industry whose future was almost despaired of only a few years back, was resuscitated as it were, and it is no exaggeration to say that the newly introduced Red Mauritius cane has supplanted the local canes in more than 90 per cent of the total area. This variety has been admitted by all cultivators to yield as much again as the best local variety. This fact was brought home to the minds of the sceptic ryots by experimental milling of their own local canes and of the introduced varieties. The introduced varieties also found to withstand the ravages of jackals, because combined with thickness, it possesses a very hard rind. Before the introduction of this new variety thick canes were confined to the islands in the back waters, for if grown on the main land considerable damage was being done by jackals, after the introduction of the Red Mauritius canes, the cultivation has extended to the interior also. It has completely replaced the local hard rinded cane "Karikabbu."

Now with the introduction of this new variety, it was found that improvements had to be effected in the old methods of extracting juice and

manufacturing jaggery. The old wooden mills can never extract even half the amount of juice from these thick hard canes. Iron mills had therefore to be introduced. Once again the professional jaggery makers came to the rescue. A couple of these men were induced to try these mills, and the actual working thoroughly convinced them that these were much more efficient in that, they extracted more juice and that in a comparatively shorter time than the wooden mills. The introduction of big iron pans and the construction of furnaces for boiling jaggery followed closely on the heels of the iron mills. The old pans were too small for working with the iron mills, and the hearth had no draught. This caused great wastage of fuel not to say the waste of heat.

In 1911, an officer of the Agricultural Department once again visited the large cane growing areas and held practical demonstrations in jaggery making on improved lines for the first time. It is needless to say that the improvements commended themselves very favourably to the local people. Since then these methods have been largely adopted by most of the professional jaggery makers as well as by many individual cultivators who mill their own canes and prepare the jaggery themselves and considerably increased their profits, the bulk of which went to the professional jaggery makers before the advent of the department.

The poverty of the individual cane growers, the smallness of the area cropped by each and the high rent levied by the land owner aggravated the difficulties of the department in pushing on with this work. However, the result was encouraging. In the district the total area under canes in 1907,

just when the work was begun was 1,775 acres, but it has increased to 3,000 acres according to the last year's crop report. Ninety per cent of the area is estimated to be under the introduced varieties. The experimental milling conducted some time ago with Red Mauritius sugarcane showed an increased profit of Rs. 200 per acre over the local canes under the old system of jaggery making.

Under these encouraging circumstances one may pertinently ask why the local canes have not as yet been completely replaced by the Red Mauritius variety. The fact is that even now there is a large demand for a cane fit for chewing for which the Red Mauritius canes are not quite suited. Again the local canes accustomed to close-planting for the last many years do not tiller much. They ripen almost uniformly towards the end of the monsoon when jaggery is always scarce and consequently fetch higher price. These soft-rinded canes are much in demand at that time. There is every probability therefore that there will always be a demand for local canes, even though the greater bulk of the crop will be Red Mauritius. Rastali and Dase Kabbu varieties which are used for chewing are gradually being replaced by the two Barbadoes varieties, namely, B. 208 and B. 147, recently introduced by the department.

But everything is not yet as it ought to be. Even though the introduction of this variety is of comparatively later date, signs are even now not wanting, especially in the early introduced tracts, to show, that there is a general tendency to revert to the old methods of cultivation. As a result of this, the variety is deteriorating. The canes are gradually getting thinner and more stunted and if

timely care is not taken to improve the methods of cultivation, the old story will have to be repeated.

The following defects are still lingering in most of the cane areas and it is to the interest of all concerned that they should be removed as early as possible :—

(1) Adequate attention is not being paid to drainage. Ill drained lands will never produce good canes. On the other hand these encourage all sorts of unhealthy and diseased conditions which are detrimental to the growth of canes. Where there is difficulty of drainage deep trenches should be made between each row of canes and these should be connected to a deeper trench to drain off the excess water. Water should never be allowed to stagnate on the land.

(2) Manuring is another most essential thing if the crop is to be profitable. Even if the lands be fairly rich, manuring cannot be dispensed with. Fish manure which can be had at a comparatively cheap rate in this district, all along the coast, has been found to give excellent results. An application of 1 ton of sundried sardine with an equal quantity of ashes must be enough for an acre. This may be applied in three equal doses, one at the time of planting and the two later ones, at equal intervals of about a month after planting. Manuring is said to lengthen the ripening period of canes, but this difficulty can be overcome by earlier planting which is also found by experience to produce better canes.

(3) *After cultivation.*—The canes after planting receive practically no attention till the time of cutting except a few irrigation. But this should

not be. The field should be kept as clean of weeds as possible. The weeds take away both the manure and moisture from the soil which would otherwise be of great use to the canes. The canes should also be thrashed and exposed to the sun. This is said to improve the quality of jaggery. Occasional deepening of the trenches and earthing up of canes will ensure better drainage and prevent the canes being blown over by wind.

The above suggestions are not difficult to carry out and will, if properly done, result in the better growth of canes and consequent increased outturn of jaggery.

Although the main theme of our articles has been the improvement of the sugarcane cultivation of this district, it will not, I hope, be out of place to mention here, that this work of popularizing the Red Mauritius canes has indirectly paved the way for other and perhaps more important lines of district work such as green manuring, economic planting of paddy.

LIVESTOCK OF THE FARM

By Mr. R. C. BROADFOOT, N.D.A., C.D.A. (Hons.),
Superintendent, Central Farm.

An important adjunct to the Central Farm and one which is capable of profitable expansion is the Dairy Herd which was founded early in the history of the farm with the intention of providing a safe and pure milk supply to residents on the estate. That it has achieved its aim cannot be denied if one refers to the wonderful health and freedom

from contagious diseases of the residents of the Agricultural College Colony. The herd was founded in 1907 by the selection of three cows from the old Saidapet Farm, but as the Agricultural College expanded and the estate population grew likewise the dairy operations had to be extended and the herd increased. This was done mainly by purchasing animals from outside so that at present the herd consists of about sixty cows of various pure and cross-breeds. Although primarily intended for the purpose of supplying milk to the estate, some measure of success was achieved in breeding and early in 1918 the College herd had, in addition to some good specimens of the country breeds, also some good half-bred cattle—the progeny of Looper —a Jersey bull which is still spoken of with reverence by the older farm coolies.

Unfortunately Rinderpest—that dread scourge of the Indian cattle breeder—broke out in the herd and in the course of a very brief period swept away a large proportion of the best of the herd including practically all the cross-breds. The herd has not yet recovered from this setback as regards its breeding value, but the commercial milk production has been maintained by the purchase of milking animals locally. It is unfortunate that so few of the farm-bred animals have come into milk, otherwise a brighter picture could have been represented. As it is, the herd is yielding well and at the present time when milk is usually scarce both on the farm and in the district the dairy is able to make full supply to all residents on the Estate. At the present time (August) 66 per cent of the dairy cows are in milk, a proportion rarely attained.

GRAPH NO. I.

The above graph shows the number of animals in milk during the years ending May 1918, 1919 and 1920. As will be seen the number has kept more uniform during 1919–20 than in the previous two years.

GRAPH NO. II.

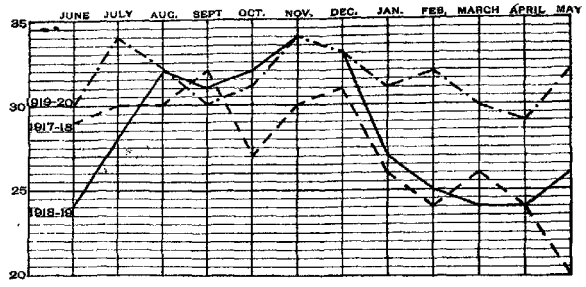
This shows the yield of milk in the years ending May 1918, 1919 and 1920. The general average throughout the year 1919–20 has been higher than in the previous years, although in September 1919 the yield was low owing to a scarcity of green fodder at a critical period.

GRAPH NO. III.

This shows the yield during the lactation of typical animals in the dairy herd. The graph is interesting as showing the steady increase during the first to second or third months after calving and thereafter the decline until the end of the lactation. Nizambi, a pure Delhi buffalo of a good type, shows a gradual rise for three months and afterwards a rapid fall during the remaining period of her 9 months' lactation. Sivappi, a cross-bred cow with Australian blood, maintained a steady yield up to 6 months out of a total of 8 months' lactation, when she was allowed to dry off being advanced in pregnancy. The other cows are country animals and show nothing exceptional except the long lactation and gradual decline towards the end in the case of Malli. Rambha is one of the poorer types and the graph shows pretty clearly the difference which exists between individual animals.

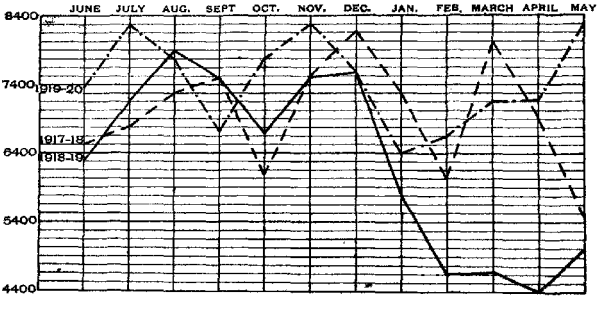
GRAPH No. I

Number of cows in the years 1917-18, 1918-19, & 1919-20.



GRAPH No. II

Yield of milk from the farm herd in 1917-18, 1918-19 & 1919-20.



GRAPH No. III

Monthly yields of cows

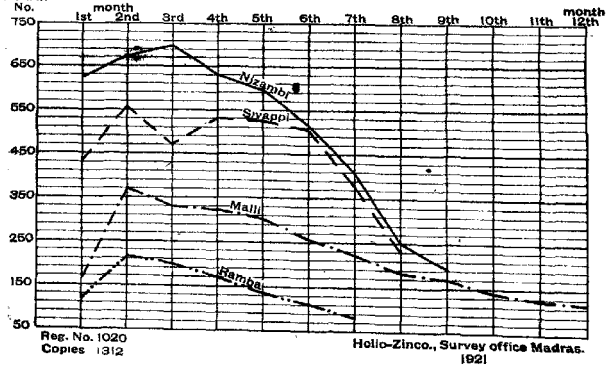


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TABLE No. IV.

List of 20 of the best cows in the herd in order of merit in 1919-20.

Number.	Names.	Breed.	Age.	Yield of milk.	No. of days in milk.
			YEARS.	LB	
1	Ida	Half-bred Australian	...	6,857	435
2	Dora	Nellore Jersey .	6	5,956	839
3	Rose	Cross-bred Jersey.	13	5,671	334
4	Brindle	Nellore Australian.	10	4,852	304
5	Nizambi (Buffalo).	Delhi . .	9	4,457	288
6	Julia	Half-bred English.	13	3,933	306
7	Rebecca	Half-bred Kerry ..	11	3,583	272
8	Sivappi	Cross-bred ..	9	3,556	226
9	Badrakshi ...	Nellore X Kangayam	7	3,525	308
10	Rani . ..	Kangayam	5	2,872	374
11	Kaikeyi	Nellore	8	2,742	300
12	Ammi	Country	9	2,530	225
13	Malli	Cross-bred English.	8	2,523	319
14	Sakuntala .	Kangayam	5	2,463	367
15	Buffalo No 17 ...	Country .. .	10	2,390	406
16	Thambai ..	Nellore X Kangayam.	7	2,149	228
17	Badami	Do	10	2,085	221
18	Vemba	Nellore ...	9	2,045	218
19	Buffalo No 20 ...	Country	8	1,964	300
20	Ammai	Do.	13	1,804	252

Table No. IV gives general information about the 20 best yielding animals in the herd. The figures given in column 5 represent the yield during the last completed lactation and column 6 shows the number of days in milk. It needs no other proof to show the advantage of cross-bred stock for milk production and this combined with the more regular breeding periods should encourage their extension on the Central Farm especially now that a method exists in protecting such animals from rinderpest.

A PRELIMINARY INVESTIGATION OF THE "POLLU" DISEASE OF PEPPER IN NORTH MALABAR IN 1918

BY T. V. RAMAKRISHNA AYYAR,

Assistant Entomologist,

ASSISTED BY MESSRS. L. A. MULIYIL AND P. SUSAINATHAN,
ASSISTANTS TO THE GOVERNMENT ENTOMOLOGIST.

Ever since it was first studied the pepper in parts of North Malabar has been found to be subject to some damage which is locally called "*Pollu*" and which has been affecting the proper outturn of the crop often considerably. With the idea of investigating this disease which had not received any serious attention for some long time, work was begun at the beginning of June 1918 and was continued for one whole season at the Taliparamba Farm. The following is the report of the work done in this connexion during the pepper season 1918–19. As the report only covers the work done during one season it has not been possible to get at definite results or conclusions. This paper merely records an account of the preliminary investigations.

2. *What is Pollu.*—The term "*Pollu*" as applied to pepper in Malayalam literally means a hollow seedless shrunken berry. From the time berries appear on the pepper vines on to the period when they get thoroughly ripe and are about to be harvested (and this period roughly runs from August to January), due to one cause or other some of the berries in spikes or whole or portions of the spikes do not develop properly. Some of them drop down half ripe while some remain on the spikes all through the season and get shrunk and

turn dark in colour very early. The immature spikes that drop down are not abandoned as useless but are all gathered from time to time and dried. Finally when the pepper crop is harvested and the whole of it dried, the sound berries are separated from the seedless dry berries and to this latter lot are added the gatherings of the fallen spikes which have accumulated during the season. This latter including the whole lot of undeveloped seedless pepper of the whole season is separated and is known as the "*Pollu*" as contrasted with healthy pepper. This pepper chaff has certainly a market value but a very low one compared to the sound pepper.

3. *Some factors that cause Pollu.*—So far as observations have been made "*Pollu*" appears to be undoubtedly due to more than one factor. The following appear to be the chief factors in this direction :—

(*a*) *Weather conditions.*—Sudden changes in the weather are found to cause undeveloped spikes to drop in numbers. This appears especially to be the case during the months of September-October when the seasonal variations in some years are very marked. A long spell of fine weather followed by heavy showers, vagaries of the monsoons, strong winds, and in fact, every marked change in the weather appears to affect the growing tender pepper spikes very appreciably.

(*b*) *Insect damage.*—The grub of a small beetle is found boring into the growing berries ; the grub eats up the inner contents and the berries thus attacked turn dark brown and become "*Pollu.*" Most of these remain on the spikes all through the season.

(*c*) *Other causes.*—Besides the above two, certain other factors have also been noted to bring about the "*Pollu*" condition. These are—

(i) Early in the season, by August-September, all or many of the berries in some spikes of pepper exhibit a peculiar spotted appearance, green berries showing characteristic brown s: on the surface. In some cases instead of these spots, the berries are found split at the distal region by the formation of one or two brownish shallow grooves on the surface. It appears as though the spots later become grooves and cause the splitting of the berries. Such spotted and split berries do not appear to develop into healthy berries; such spikes gradually dry up, many of the berries remaining attached to them as chaff. This sort of damage has absolutely nothing to do with insect attack. This factor contributing to *Pollu* we may call "the berry split" or "Berry spot" of pepper.

(ii) Many a time in bad weather whole vines with their load of healthy spikes are damaged due to the breakage of the standards, or the fall of dry branches; and this also adds a small quota towards the "*Pollu*" since many of the spikes in the fallen vines are crushed or shed.

(iii) In the case of the variety of pepper called "*Udaramkotta*" it is found that the development of the berries in the spikes is not at all uniform; some are very small and do not develop at all while only a few attain proper maturity. All these ill-developed berries are added to the *Pollu* during harvest time.

(iv) Some of the spikes develop at an early stage a uniform pale sickly yellow colour and the berries gradually dry up.

The above are the different factors noted so far which contribute to what is generally known as the *Pollu* disease of pepper. As stated above all these shed, and immature spikes of the season are taken into consideration at harvest time and reckoned as

The following is a short note by Mr. S. R. Venkatakrishna Mudaliyar, one of the Assistants in Mycology, who was working on some pepper diseases on the farm during the season :—

POLLU DISEASE ON PEPPER.

"The term 'Polla' or 'Pollai' means hollow in Malabar and is used in connexion with pepper berries when they are hollow. Specimens showing typical 'Polla' can be seen at this part of the year to a small extent. A pepper spike showing 'Polla' always shows two or three dry hollow dark berries (whereas the rest of the berries are green), containing the excreta of a grub of an insect which is being studied by the Government Entomologist. The presence of the Government Entomologist at the Taliparamba Farm was availed of in this connexion and all cases of so-called 'Polla' specimens were studied. Besides the above disease there are three instances in which insect does not seem to play any part :—

"(1) The spike as a whole falls down even while it is green and turns brown and becomes hollow. This appears to be connected with seasonal variations.

"(2) Spotted berries are seen on a spike. The spots begin to appear at the stylar region. Some berries turn yellow and become hollow.

"(3) Berries there are that show a splitting at the stylar region. This symptom is very prominent in Wynaad-Chenakodi in plot 11-A."

4. *Relative importance of these factors and the estimate of* "*Pollu.*"—So far as our observations go to show, it has been found that the most important factor that plays a very good part in causing "*Pollu*" is that of "Seasonal variations." I have seen cases where after a heavy storm in October large quantities of shed spikes containing half-developed healthy berries have been gathered as "*Pollu.*" From the records of the last season's harvest at the Taliparamba Farm just received, it is found that the proportion of "*Pollu*" to healthy pepper by weight was only 1·48 per cent. Of course it may be said that this year was a very good and favourable year. All the same it is evident that after all "*Pollu*" (which also has its own money value) is not as serious as it often appears or is pictured to be. And the blame for this comparatively small percentage of "*Pollu*" has to be divided between the various known causes detailed above. From this it can be judged how insignificant a part is played by insect agency. We are unable to estimate the proportion of insect damage to the total "*Pollu*" at more than 5 per cent on the whole. It is therefore evident that it is incorrect to put down the insect factor as the sole cause of "*Pollu*" as is sometimes done. This is also clear from the mycological note quoted above. The investigations carried on during the past season were solely confined to the factor of insect damage and the results of the season's work in that direction are detailed below.

5. *The Pollu Insect.*—The insect contributing its share for the "*Pollu*" is a small active flea beetle of the family "Chrysomelidae." It has since been identified as *Longitarsus nigripennis, Mots.* Though over a dozen species of *Longitarsus* including this species have been noted from India not one of these has ever been recorded as Even the record of the locality of this sp... by the original describer Motschulsky is not clear ; it is simply recorded as "from India." The species of this genus are very small in size, never more than three millemetres in length, and the posterior legs are very stout. This thickening of the hind legs helps these creatures to jump long distances ; their saltatorial powers appear to be much more developed than flight with wings. This species *Longitarsus nigripennis* is 2·5 mm. in length. The head is small in size and is more or less covered over by the prominent prothorax. The antennæ are comparatively long and the eyes prominent. The femora of the last pair of legs are extraordinarily stout compared to the small size of the insect. The head and thorax are of a pale fulvous yellow colour when fresh; in dry specimens this appears reddish brown. The elytra are bluish black. The antennæ and legs are of a pale brownish colour but the swollen hind femora are bluish brown. The eyes are dark.

6. *Nature of the damage done by the insect.*—The damage done to growing pepper berries by this beetle consists in the larva or grub of this insect boring into the berries and eating up the inner contents, thus causing "*Pollu*" or hollowness.

The external indication of such an attack on the growing pepper vine is generally the presence

of a group of two to four darkish berries in a spike of pepper, the rest of the spike being healthy and green. Infested berries are commonly found in groups of two, three or four. An examination of one of these blackened berries will disclose a short stout pale white grub or evidence of its work. Generally only one of these three or four berries shows the grub and this is explained by the fact that this one grub is responsible for the damage to all the three or four berries in the group,—the larva feeding on the inner contents of the berries one after the other. Not more than four berries are attacked, by one grub before it is full fed. At the initial stages of infestation one has to examine the spikes more carefully to find berries that are just getting attacked, since at the beginning the berry that is first attacked simply shows a pale sickly yellowish surface and a minute hole through which excrement might be seen thrown out ; the characteristic dark colour of berries begins to show itself only when the grub has finished with one berry and has entered the second. In certain cases another phenomenon is noted in infested pepper berries, and that is the darkening of the whole distal portion of a spike. This happens when the grub, in tunnelling through one berry to another, encroaches on the main stem of the spike and scoops out a good portion of it ; this damage to the stalk at the middle arrests the flow of nutrition to the distal portion and the berries beyond this spot turn black and do not ripen, although they remain attached to the spike almost throughout the season showing a pale dark colour (see plate II-4). From this last feature alone it may be

possible in a way to judge the proportion of insect caused "*Pollu*" to the total "*Pollu*" of the season.

7. *Distribution of the Pollu beetle.*—Almost all the important pepper tracts of North Malabar were visited and it is found that the sub-montane region —the low-lying forest region between the ghats and the coast—is the home of the insect. It is not very common along the coastal "*parambas*" and it is pretty rare up the ghats in the Wynaad. The beetle is very commonly found in pepper plantations some miles away from the coast, and especially in the hill region noted above. The tracts similar to the one where the Taliparamba Farm is situated and parts of the Kurumbranad taluk approaching Kuttiyadi ghat may be taken as typical of this tract.

8. *Varieties of pepper attacked.*—In this respect observations were confined only to the Taliparamba Farm and the surrounding villages. Of the three varieties of pepper the variety called "*Kallu valli*" appears to be somewhat resistant to the attack of the insect, while the other two "*Balamkotta*" and "*Udaramkotta*" are equally subject to the attacks of the pest. The immunity of the former is probably due to the comparative hardness of that variety of berry.

9. *Life history and habits of the insect.*—Observations made so far go to show that the eggs are laid singly by the parent beetle. Before the eggs are laid the parent beetle makes test holes on the berries probably to see whether the spot is suitable for egg-laying and often the egg is finally laid only after a few of these trial holes are made ; such holes leave a scar on the growing berry in a few cases. Each egg is carefully thrust and glued to

the tissue just underneath the skin of the green pepper berry, commonly near its attachment to the stalk ; only one egg is generally deposited in each berry. To find out the egg one has to very carefully remove the berry skin in very thin slices. The egg is ovoid in shape and measures 1·5 mm. in length ; it has a pale brownish colour. It has not yet been possible to get the eggs hatched out in captivity though several methods were tried. The grub is pale to cream white in colour. A full fed grub is short and stout, slightly depressed dorsventrally-convex above and concave below. Length 2·5 mm. Head and prothorax black. Three pairs of dark thoracic legs. The grub goes on growing by feeding on the inner contents of two, or three berries for about 40 or 50 days after which it stops feeding and drops down into the soil to pupate. It goes down into the soil two to three inches and before the final moult to assume the chrysalis stage builds an oval cocoon of soil around itself. The pupa is pale white in colour. In this condition it remains for ten days (the period noted in captivity). After this period the adult form is assumed, but the beetle remains in that condition for a day or two in the soil and comes out only after these one or two days, which period is apparently necessary for the insect to get its body hard and become active itself.

The adult readily and voraciously feeds on the tender pepper leaves biting numerous small holes in them.

10. *Seasonal history.*—The investigations in this direction, though incomplete, tend to show that the beetle passes through two broods in the year. The first generation of adult beetles begins early

in October while the second generation emerges by January. There is however no clear period between these two, as there is a sort of overlapping of the generations during the pepper season from July to February. It is believed that the beetle æstivates in the adult condition all through the summer until the pepper vines flower and begin to bear berries the following season. A visit to the Taliparamba Farm in March 1919 has more or less confirmed this view. Beetles were found in fair numbers feeding on the pepper leaves. Of course further observations are necessary before one can assert that there is no third generation during the summer, passed, perhaps, in some wild shrub as an alternate food plant.

11. *Alternative food plants and natural enemies.*—Till now no natural enemies of either parasitic or predatory habits have been noted on the beetle; nor has any alternate food plant in which the pest might breed been noted although bushes bearing berries like pepper, such as *lantana*, etc., were examined. Further work has to be done in this direction.

12. *Effect of soil and weather conditions.*—From a comparison of the different plots in the same tract in the sub-montane region it appears that the beetle is found to prefer vines in plots which are shady, very moist and with fair facilities for the drainage of the soil. The adult beetle always loves very shady nooks. As is shown by the habits of the pupa in captivity, a good deal of moisture is required with drainage; it does not thrive in a miry soil where there is not sufficient drainage. Nor can the pupa thrive in soils exposed to the Sun. These habits of the insect possibly account

for the presence of "Insect Pollu" in Blocks I and II as compared to Block III of the Taliparamba Farm. Very probably this is also the reason for the absence or scarcity of the pest in the coastal *parambas*, where the soils are comparatively dry and not so cool and shady as the sub-montane tracts.

13. *Some control experiments.*—Though the main attempts in the preliminary investigations were directed to the proper detection, identification and the study of the life history and habits of the pest, a few experiments were tried in the shape of preventive measures on the Taliparamba Farm where the Assistant Director of Agriculture, VII Circle, was kind enough to place a few plots at our disposal for this purpose. These experiments consisted of :—

(1) Spraying the vines with arsenical mixtures to prevent the beetle feeding on the leaves or laying eggs on the berries or to act as a deterrent.

(2) Hœing the soil with the idea that this may expose the pupæ in it and kill them.

(3) Pruning of old shoots, picking of old leaves, dry standards, etc. This is simply as a sort of plant sanitation to keep off vermin by clean cultivation.

Application of arsenicals was found rather impracticable as it was found difficult to give the application uniformly to the vines top to bottom. Besides, it was found that in the ordinary proportions used for all plants Paris green injures the foliage of pepper to some extent. One noteworthy fact however was that in the plots where Paris green, Bordeau mixture and Lead arsenate were applied there was no trace of the "*Pollu*" beetle

infestation. This, I believe, is more due to the open and dry condition of these plots compared to the others in Blocks Nos. I and II of the farm. The spraying experiments were also vitiated by the appearance of a fungus disease (leaf spot) in these and adjacent plots. In the light of experience and the knowledge latterly gained regarding the life history and habits of the insect it appears spraying is not only impracticable but unnecessary.

The hœing of the soil around the vines was carried on in plots 59 and 61 in May-June. This again was done with an imperfect knowledge of the habits of the beetle with the idea that the pupæ would be in the soil during this period ; but later knowledge has shown that the pupæ are found in September and December for the first and second generations respectively. However, it was found that "Pollu beetle" attack was extremely rare in these plots also. In this connexion it may be interesting to quote the remarks on this subject by the Deputy Director and the Assistant Director of the circle in their joint report on the work of the Taliparamba agricultural station for the year 1918-19 during which period these preliminary investigations were carried out :—

"The yield obtained (during the season) is the highest yet recorded since the station was opened."

It is also satisfactory to note "that Block III of the farm has yielded the best," the block where we carried out our measures and about which the Assistant Director had serious apprehensions regarding the effect of these on the vines. In the same report, on page 4 under "Disease" may also be found a correct idea of the Pollu disease and the

part played by insect agency—a thing greatly misunderstood till now.

14. *Possible control methods.*—The knowledge gained of the life history and habits noted till now goes to show that the most vulnerable stage in the life history of the insect which can be tackled successfully is the "*pupa*" stage. As for the other stages preventives in the shape of sprays, deterrents, etc., may be employed against the adult beetle. But the insect is extremely small and active, and thorough spraying of the vines is found impracticable especially in large areas. With regard to the other stages *egg* and *borer*, nothing can possibly be done on a large scale as both are found inside the berries. In the very early stages, however, portions of spikes showing distinct borer attack may be clipped and destroyed to check the multiplication of the pest.

The method that can be adopted against the pupa is the hœing of the soil, especially round the vines, during the time when the pupa is in the soil. The pupa is in the soil twice during the season; once during the latter part of September and again by the end of November.

During these periods the hœing of the soil especially in plots which are generally badly infested would reduce the pest considerably. It is also possible that reduction of shade in very close and shady plots may also be of use in checking the infestation, as the insect is found partial to such plots.

15. *Conclusion.*—The most important results of the season's work include the main foundation on which control methods depend.

These are—

(1) A knowledge of the "Pollu" disease, its causes, nature and extent.

(2) The identification of the "Pollu" flea beetle and the working out of the main points in its life history and habits.

As stated in the beginning the investigations have still to be carried on and there are some more important and interesting points in the life history of the insect to be studied. These include (1) the incubation period of the egg, (2) the condition of the insect during the off-season (February to June), (3) natural enemies of the insect, if any, (4) alternate food plants, if any.

THE POULTRY FLOCK

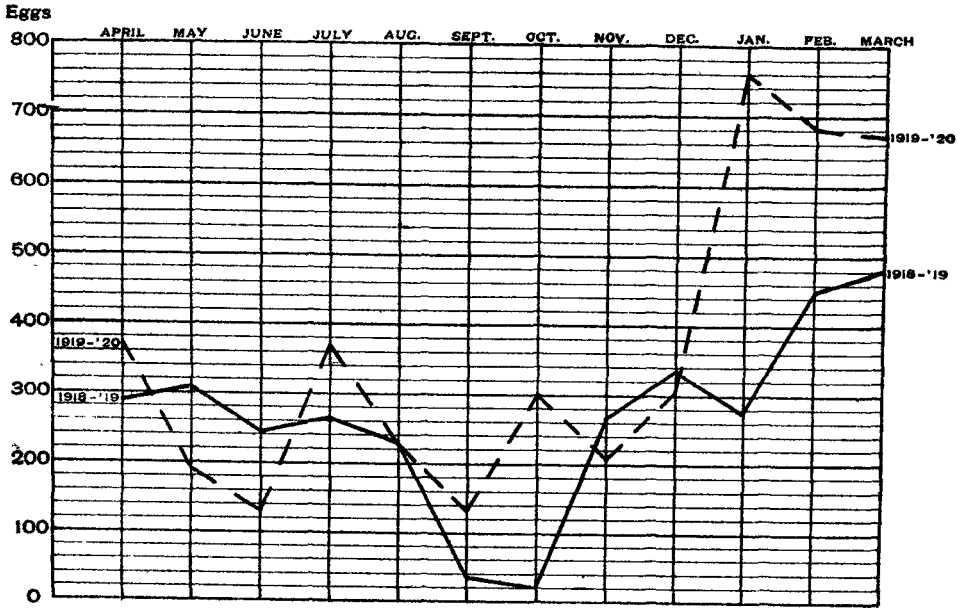
BY Mr. R. C. BROADFOOT, N.D.A., C.D.A. (HONS.),
Superintendent, Central Farm.

Poultry farming does not usually receive much attention from ryots but there is no doubt this could be undertaken by ryots as a profitable and interesting side line to arable farming and the following short note is intended to awaken interest by showing what has been done on the Central Farm in this promising venture :—

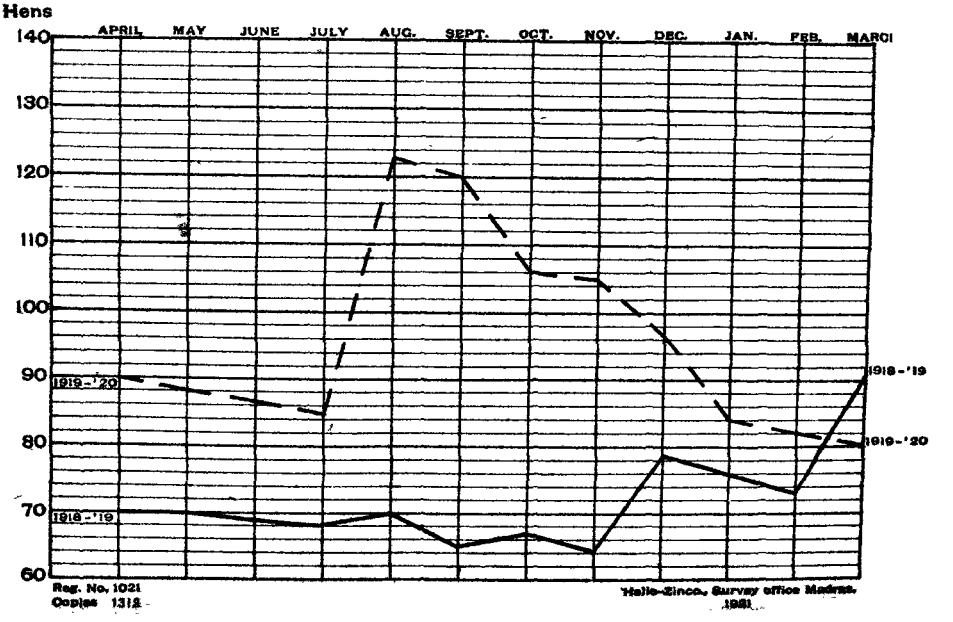
The poultry flock was started with the intention of eliminating waste, by turning to account all the grains, etc., which fell in and around the farm yard and for this purpose a few ordinary country fowls were procured and allowed to roam at will over the farm yard. Later, pure broad white Leghorn cockerels were introduced and from the resulting crosses the majority of the

present flock has been built up. The result of this experiment has been fully justified and the cross-bred hens may be classed as good utility fowls much more productive than the ordinary country breeds. The appended graphs show the progress achieved during the last two years. Not only has the egg yield greatly increased but the fame of the fowls has spread abroad and there has been a good demand for hatching eggs and pens of breeding fowls. Cockerels have been supplied when available but it has been considered the wisest policy to retain all the young hens and pullets on the farm. Leghorn fowls have been found to do quite well on the farm and except for occasional outbreaks of fowl cholera no difficulty has been experienced, the cross-bred fowls appearing as hardy as the country fowls. In addition to the fruits of their industry the fowls receive some waste paddy or broken cholam grain. This has been found necessary for the periods between harvests when fallen grains are scanty. The poultry also do useful work in the loose boxes and manure pits picking up weed seeds and grub larva and our immunity from fly pests is no doubt largely due to the watchfulness of the fowls. Difficulty is always experienced in getting broody hens with the result that the hatching season is much prolonged and the results not quite so good as one could wish. To obviate this difficulty in future an incubator for hatching has been obtained and hatching experiments will be carried out. If these are successful one of the main difficulties experienced in the past will be overcome and the future becomes more hopeful for profitable expansion. Poultry exhibits have been sent from

1918-'19; 1919-'20 No. of eggs



1918-'19; 1919-'20 No. of hens



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the farm to Ootacamund Poultry Show during the last three years and several prizes have been won.

The poultry flock also includes Turkeys and Guinea fowls and although these lend variety to the flock these are not likely to prove as profitable nor as fascinating as the ordinary fowls. In addition to their value for students' demonstration, the poultry flock gives the farm an economic farming appearance and in the cold season one might easily confuse the Farm yard with that of a Western Homestead.

EXPERIMENTS IN GRASSHOPPER CONTROL BY POISONED BAIT IN SOUTH INDIA

FOREWORD BY E. BALLARD, B.A., F.E.S.,
Government Entomologist.

I was led to investigate the possibility of using bait for the control of grasshopper attacks in 1914 owing to the widespread and serious damage done by the Deccan Grasshopper *Colemania sphenarioides, Bol.* in the Ceded Districts. Bagging and dry weather ploughing had been suggested as remedies for this pest, but the first is impracticable owing to the high winds which prevail during the season when *C. sphenarioides* is active and the ground is too hard for ploughing and the country plough unable to deal with it at the time when ploughing should be done.

The first experiments were made with baits made up according to the original Texas formula with the difference that rice bran was used instead of wheat bran and limes were substituted for lemons.

Experiments on the Central Farm at Coimbatore with this bait were very successful. Seventy-five per cent to 85 per cent of the hoppers in a given area were killed and moreover the bait proved to have a superior attractive power to young cholam [1] which was growing in the experimental plots at the time.

The most striking feature of the 1919 experiments is in my opinion the discovery of the attractive power of Terpinol. In 1914 we had very successful results with mango juice as the flavour for the bait and when experiments were re-started in 1919, I consulted the Agricultural Chemist on the subject of Ethers found in fruit which smelt like mangoes. He kindly supplied me with a selection of terpenes of which Terpinol was one.

It is obvious that any such Ether of which only a few drops are required is much more easily handled than fruit and the preparation of the bait is much simplified. Most forms of fruit in South India are difficult to obtain in bulk and are expensive.

Once a really dependable bait is found its use would generally be required over thousands of acres at a time, and a sufficient quantity of fruit for so large an area would be next to impossible to obtain. The success of Terpinol gives distinct hope that a good fruit substitute is within the bounds of possibility.

One most important point which has also to be solved is whether any substitute can be used for rice bran. Saw-dust was tried but without success ; but it was not tried in conjunction with Terpinol.

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[1] Andropogon sorghum.

The present experiments dealt with in the following paper had to be discontinued owing to the pressure of other work but it is hoped to be able to take them up again at an early date ; in the meantime what has been done is of sufficient interest to be recorded.

EXPERIMENTS IN GRASSHOPPER CONTROL BY POISONED BAIT IN SOUTH INDIA.

By JOHN A MULIYIL, B.A.,

Assistant to the Government Entomologist.

The experiments recorded in this note are but a continuation of those started by the Government Entomologist in 1914 and they are still being pursued under his guidance.

The control of grasshoppers by means of poisoned baits has received and continues to receive a great deal of attention at the hands of Agricultural and Entomological associations in the United States of America,[1] and a few of the initial experiments noted here have been performed in the light of those conducted by these associations.

In the year 1914 poisoned bait was first tried at the Central Farm, Coimbatore, on the hopper *Chrotogonus saussurei, Bol.*, with much success (75 to 90 per cent of the hoppers being killed). These experiments paved the way for the Deccan Grasshopper Campaign of 1914-15. Reports were received about Deccan Grasshopper *Colemania sphenarioides, Bol.*, which for some years had been doing great damage to cereal crops in Bellary and Kurnool

[1] Journal of Economic Entomology—
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districts It was decided to try the bait on this. Five different sets of experiments were conducted with the bait which consisted of rice bran, jaggery syrup, paris green and limes. The first set was tried in a field where Korra,[1] Cotton and Cholam[2] were under cultivation. Within this field a space of about one cent was enclosed with cloth supported by stakes driven into the ground. A large number of hoppers were collected and put into the enclosed area and the bait was thrown broadcast. Leaving a wide margin for the number of hoppers that might have escaped from the enclosure, the number of hoppers killed was deplorably poor. It was also observed that the bait had no special attraction for the hopper. They fed on the bait only incidentally.

The second experiment was tried in a non-cereal plot. A space of about half a cent was enclosed in a castor field and a large number of hoppers were put within the space. It should be stated here, that the hoppers in the enclosure were nearly starving as they were in a non-cereal plot ; hence they readily took to the bait. About 3,000 dead ones were picked up but this number is only 20 per cent of the total number put in the enclosure and the results are therefore not much in favour of the bait.

The third experiment was similar to the first, but it was observed that if the bait happened to be on the windward side the scent was easily taken up by the hoppers, but on the lee-ward side the bait was not easily noticed. It was also observed that when the choice lay between a particle of bran-mash and a fresh Korra plant, the latter was almost invariably found more attractive. In this case also the number of dead hoppers picked, was only 20

[1] Setaria italica (Italian millet) [2] Andropogon sorghum

per cent of the total enclosed within the area marked out.

The bait used in experiment No. 4 had as one of its ingredients finely minced cholam leaves. It was added on the assumption that it would supply the peculiar cholam odour to the bait. This mixture, though it had a greener colour than the baits used on previous occasions, did not exhibit any superiority as far as its attractive powers were concerned. Yet another experiment was conducted on the same lines with slight modifications, with the same results.

The general results of the foregoing experiments can be summed up as follows :—

The bait had some attraction for the hopper, but it was limited in its action for it exerted no power beyond a radius of an inch or an inch and a half. Given the choice between a cereal plant and the bait, the former was invariably preferred. If the bait is decidedly an attractive one it is said that the hoppers should jostle against one another for obtaining possession of the bait. Such a degree of strength is claimed for the bait in the United States of America.

That grasshoppers do not feed on any bait that is cast in the field, is a fact borne out by the results of previous experiments. They too exercise a certain amount of judgment in the selection of their food and they are decidedly partial to some. In the majority of cases the choice of food is perhaps based upon the agreeableness of the odour emitted by the stuff ; and the taking in of it, upon the taste thereof.

The present set of experiments started in August 1919 had for its end the determination of the relative

proportions in which the various ingredients of the bait should be taken and above all the choice of a fruit or an essence which when mixed with the bait increased its attractiveness (by attractiveness is meant the power of the bait to draw the hoppers to it) not forgetting the cost or avilability of such a fruit or essence. This necessarily involves a long and varied series of experiments and what are recorded are but a few tried till now.

The components, the relative proportions in which they are taken, and the mode of preparation of the bait are some of the points which now needs consideration. Rice bran, Paris green (a double acetate and arsenate of copper), molasses or jaggery and some fruit or essence, generally enter into the composition of the bait. Every one of these serves a definite purpose. Paris green is the poison in the bait. It is comparatively cheap and a very small quantity is enough for one lethal dose. Jaggery sweetens the bait while emitting a peculiar odour of its own which to some extent serves to attract the hopper. Fruits like oranges, limes and bananas have a strong odour and the addition of any one of these or of any essence prepared out of such fruits increases the attractiveness of the bait to a remarkable degree. It is the magnet that draws the hopper to the bait. Often a handful of common salt is also added to make the bait taste better. With regard to the relative proportions of the component parts, the formula adopted in Montana[1] (United States of America) was followed with some alterations. One pound of Paris green and six to ten pounds of jaggery for every 25 lb. of bran was

[1] University of Montana, bulletin of February 1918, Circular No. 76.

the formula generally followed. Alterations were made now and then but not till each set was given at least three trials.

When preparing the bait the actual quantity of each ingredient required is carefully weighed and taken. Paris green and bran are first put in a bucket and well mixed till the bran assumes a light green colour. Jaggery is then taken and dissolved in a small quantity of water till the liquid is of the consistency of honey. The mixture of bran and Paris green is now thrown into this dissolved jaggery and the whole thing is well mixed up, occasionally adding a little water till the whole mass becomes almost semi-solid. To this mass is now added the particular fruit or essence which is under trial. If it is a fruit, it must be well chopped or minced before it is added to the bait. The final touch is given by the addition of a handful of common salt. The bait is now ready for use.

To come back to the experiments, the first set of experiments were conducted in a small plot selected for the purpose where just then the hoppers were busy nibbling away leaves of Zinnia seedlings and the tender blades of sprouting grass. As the plot selected was rather small only 2½ lb. of the bait was prepared. Lime was a fruit put to the test. One and half limes were well minced and mixed up with the bait. Four experiments were conducted with this bait :—

(1) The bait was put in small balls all over the plot.

(2) The bait was distributed in small mounds.

(3) The bait was put in long rows.

(4) The bait was thrown broadcast all over the plot.

In experiment No. 3 a distance of 5 feet between two adjacent rows was maintained to enable the observer to walk through without disturbing the hoppers. Of the four modes employed, the last was found most economical and successful. Half the usual quantity of bait used was found sufficient and this is a fact to be borne in mind when the question of cost is taken. The results of the experiments are given in table A.

TABLE A (Fruit tested, lime).

Experiment.	Number of hoppers found feeding or near about.	Number of hoppers picked up dead.
Bait used in balls	16	2
Do. put in mounds	15	3
Do. in rows	13	2
Do. thrown broadcast	18	6

Another series of experiments were conducted in this plot substituting bananas for limes. (Four small plantains per two pounds of bait.) The result of the experiments are given in table B.

TABLE B.

Experiments	Number of hoppers found feeding or near about.	Number of hoppers picked up dead
Bait put broadcast	20	8
Do. do.	21	7
Do. in rows	13	4

The decrease on the third day is not merely due to the difference in the way in which the bait was offered, but also to the fact that hoppers were getting fewer in the plot. The success of an

experiment cannot always be judged from the number of dead ones picked up. If the poison is well mixed up in the bait, every one of the grasshoppers that feed on it takes in an amount of poison sufficient to kill it. A hopper which takes in a lethal dose of poison avoids light, retreats to shady nooks and corners and generally takes shelter under clods of earth or dry leaves. Very often dead hoppers were picked up from such places. Under such circumstances it is not always possible to get at dead ones. The ever busy ants associated with the lazy hoppers even in fables put in their appearance and carry away the dead ones and often only what escapes their attention are picked by the observer. A considerable decrease in the number of hoppers in any selected place can be taken as an indication of success.

Yet another series of experiments were conducted in this plot and this time the fruit tested was ripe tomato. The results obtained were very poor.

On the 9th of September another small plot was selected in a different part of the estate. As the results of previous experiments were in favour of bananas this fruit was given a few more trials. Apart from its power of attracting grasshoppers it has also other points in its favour—(1) it is pretty cheap ; (2) it is almost always available. On many a day the inclemency of the weather interfered with the work and fresh bait had to be used often, where the old bait would have sufficed. It may with advantage be mentioned here that the bait will continue to do its work for three or even four days. Only if the bait becomes perfectly dry, it needs renewal. The results of the experiments are given in Table C.

TABLE C.

Bait put broadcast	Number of hoppers found feeding or near about.	Number of dead ones picked and snatched from ants.
First day	21	Nil. (Bait washed away by rain.)
Second day (fresh bait) ...	44	17
Third day (old bait)	19	19
Fourth day (fresh bait) ...	20	21
Fifth day (old bait)	16	9
Sixth day (do.)	18	11

In these as well as in the following experiments, the bait, to save time and expense, was thrown broadcast. One more trial was given to tomato and on this occasion too as on the previous one the results were rather poor.

Two more experiments were performed in this plot and on both the occasions instead of a fruit, Aniseed oil was tried at the rate of 30 mm. to a pound of the bait. The results were fairly good.

TABLE D.

Bait thrown broadcast	Number found feeding or near about	Number picked up dead and snatched from ants.
First day	16	12
Second day	12	12

As these experiments were done soon after those recorded in Table C, it cannot be definitely stated whether the mortality among the hoppers was caused by the bait containing Aniseed oil or plantains. Baited or rather poisoned hoppers sometimes remain for five or six days even before

they succumb to the deadly effects of the poison. So there is a likelihood that some of the hoppers perished as a result of the previous experiments.

From the 22nd of September experiments were continued in the cotton plots attached to the Insectary where a large number of hoppers were found feeding on the leaves and tender shoots of young Cambodia cotton plants. Here for the first time was put to test, Terpinol, an essence with a particularly strong smell. The results of experiments conducted in 1914 with mango juice as one of the ingredients of the bait were exceptionally good. Terpinol has an odour very much alike to that of mangoes. Hence the addition of this particular essence to the bait. Even at the very start the results obtained were very favourable. From 15 to 20 drops of the essence was used for every pound of the bait. The bait was thrown broadcast and the results obtained are given in Table E.

TABLE E.

Experiment.	Number of hoppers attracted.	Number of dead ones picked and snatched from ants.
1	15	18
2	27	22
3	20	6
4	21	10
5	17	5
6	22	7
7	11	12

Experiments 5, 6 and 7 were conducted in the Botanical Gardens where hoppers were feeding on vegetable seedlings. Experiments in the Botanical Gardens were continued but instead of Terpinol, another essence Carvene was used. Another

change was also made—the bait on two occasions was used without jaggery syrup. The results were not very gratifying. But the essence has a pretty strong and fairly agreeable smell, and before it is finally set aside as an essence useless for the purpose for which it was tried it should be given a few more trials.

All the foregoing experiments without a single exception were carried on within the Central Agricultural Farm, but the following few were conducted in the compound of the Police Recruits' Training School, at Coimbatore. A report was received from the Principal of the school that some insects were feeding on the leaves of certain rare plants like Blue-gum and Lemon-scented gum. On investigation it was found that grasshoppers were the perpetrators of the mischief, especially, the species *Chrotogonus saussurei, Bol.* As the report was sent with the hope that some remedial measures would be adopted, the work done there could not be of a purely experimental nature. So Terpinol was used once more in the preparation of the bait. The effect of using this was so marked that in a few days the seedlings were quite free and there was no necessity to continue the experiments. A considerable number of dead hoppers were picked up daily by a couple of recruits who assisted me in my work. It can be stated without hesitation that Terpinol when mixed with the bait has a considerable power of attracting the hoppers to the bait.

Just another series of experiments remain to be recorded and these too were tried in the Insectary cotton plots. At this time there were kept in the Insectary a dozen Pomelos which were affected

with fruit flies. Permission was obtained for taking a few of these fruits to test their power of attracting grasshoppers when mixed with the bait. Three experiments were done and on each occasion one Pomelo was added to every three pounds of the bait. The results obtained were by far better than those obtained with limes or tomatos. One noteworthy feature of these experiments which needs mention is this—that *Orthacris ramakrishnai*, *Bol.*, and *O. acuticeps*, *Bol.*, the wingless grasshoppers commonly found here which are closely allied to the well-known Deccan Grasshopper *Colemania sphenarioides*, took a great liking to this bait. They formed the majority among the dead ones picked up.

With regard to the various species attracted almost all common species found here have been found amongst the dead ones. But *Chrotogonus saussurei*, *Bol.*, *Aeolopus tamulus*, *Fabr.*, *A. indicus*, *Bol.*, *Atractomorpha crenulata*, *Fabr.* and *Catantops indicus*, *Bol.*, are those which have a special liking for the bait.

As has been stated at the beginning of this note, it is too early to arrive at any definite conclusion. But this much can be said that Terpinol when mixed with poison bait has a considerable power of attracting grasshoppers. It remains to be seen whether it will be allowed to hold this position permanently. In the course of experiments to be carried on in future, some other essence or fruit cheaper and stronger than Terpinol may be secured. But till then let Terpinol take the lead.

ON THE PRESENCE OF AN EPHELIS AND A BALANSIA ON A COMMON FODDER-GRASS, CENTRAL FARM, COIMBATORE.

By M.R.Ry. S. SUNDARARAMAN, M.A.,
Acting Government Mycologist.

On the surface of leaves of Panicum distachyum is noticed a thin greyish-white membranous covering which is uneven in thickness and thrown into folds. The plants that exhibit these symptoms do not present any healthy appearance. Their growth is arrested. Very often, the shoots are enclosed inside the leaf-sheaths. Very seldom is there any development of the parts of the inflorescence from a cluster of infected plants. The buds from an affected plant present an external appearance of being healthy but a cross section of one of these shows fungus to be abundant between the different parts of the undeveloped leaf and of flower-bud. The fungus develops within the bud and forms a white sticky covering on the surface. The different parts of the leaf-bud and flower-bud are found closely bound together by fungus strands preventing them from growing, and the fungus masses are dense that they cause as it were a strangulation to the further growth of leaves and flowers.

The fungus attacks apparently very young inflorescence or young leaves. Rough cross sections of a diseased leaf-bud and flower-bud show that the individual flowers of the branched panicle are bound together to the main axis by the development of fungus tissue between them. There is a pseudo-parenchymatous tissue of thickly interwoven mycelium mingled with parts of the host tissue, i.e., of the leaf and of the flower-bud. The hyphae are seen penetrating the leaves, the stem,

glumes, ovaries and other parts of flowers. The surface region was found to be made up of numerous flat disc shaped or cup shaped structures resembling some forms of Pezzizales producing numerous branched conidiophores, each with clusters of needle shaped spores 19·2—33·2μ and average 24·5μ from 50 spore measurements. This fungus is Ephelis which is referred to by some authors as the conidial stage of Balansia, one of the Hypocreales of the Ascomycetes group.

While searching among the grasses for the study of the above characters,a few plants(Panicum distachyum) more or less in the advanced stages of growth were noticed with black stromatoid, horn-shaped bodies protruding from the regions of the nodes in places where normal buds and shoots arise. These "bodies" had a coarse and rough exterior, black in colour outside and whitish within. When wet they are soft and fleshy and when dry horny and brittle. They are obovate more or less cylindrical, tapering at the tip, 4—10 mm. in length. The surface was minutely punctate with slightly projecting ostioles of the perithecia which are immersed in the stroma. Sections of these stromatoid bodies showed layers composed of pseudoparenchymatous tissue made up of thick interwoven masses of hyphae with the disintegrated remnants of leaves, axils, glumes and floral parts of the host plants. The perithecia are immersed in the stroma, ovate to flask shaped, ostiolate. The wall of the perithecium is not distinct from the adjoining portions of the stroma except by its closely interwoven structure. The asci are cylindrical slightly curved, club shaped with a tapering pedicel very fragile a-paraphysate

95-189μ, spores filiform as long as the ascus itself. extremely slender and measure 38-105μ.

REPORT ON MY TOUR TO COCHIN-CHINA, CAMBODIA, THE FEDERATED MALAY STATES AND CEYLON

By H. C. SAMPSON, Esq.,
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I left Coimbatore on the afternoon of February 7th en route to Colombo. I had booked my passage by the Messageries Maritime S.S. "Paul Lecat" which was due to sail on the 9th, but on arrival at Colombo ascertained that she had not been signalled and was not likely to leave till the 12th owing to engine trouble. During my stay at Colombo I met an engineer at the Hotel, who had been to the motor tractor trials in Lincoln, England, for his firm. He mentioned two tractors which he thought most suitable for eastern conditions, viz., The "Sanderson Tractors," Elstow, Bedford. Price £510 at the Lincoln trials. This is driven by a two cylinder oil engine and not by a petrol motor. The Glascow farm tractor. This has a three wheel drive, 25 B.H.P. Runs on petrol, but can be arranged to run on kerosene, if necessary. Price £420 at the Lincoln motor trials. The latter would probably not suit our conditions on account of the front centre wheel which would make it difficult to get it about along country cart-tracks.

I arrived at Saigon at about midday on the 20th February to find that the Chinese new year holidays had just commenced and that everything had stopped till these were over. On the following day I called on the British Consul who told me what

arrangements he had made about my deputation. I had, owing to the holidays, to remain in Saigon till I had my passport viséd and took the opportunity to call on the officers at the newly started research institute. Here I met Mr. Vieillard who is the Economic Botanist working on rice. I handed over to him several samples of South Indian paddy, which they had asked for and which I had brought with me. His work has largely been up to the present, the botanical study of the delta varieties of Cochin-China. He took me to his small station which is just outside Saigon, but unfortunately I was just too late to see the crops as the harvest had been completed the week previously.

I also met the officer in charge of Mycological and Entomological work. M. Chevalier, the head of the Institute, I did not meet as he was in Europe on leave. I did not see as much as I should have liked to, as the Institute was in course of construction and the work was being carried on in the meantime in temporary quarters.

I left by river steamer for Pnom Penh, the capital of Cambodia, on the evening of 28th February arriving at my destination on the morning of the 1st of March. The journey up gave one some idea of the vast size of both the delta and the river. The lower portions of the delta are evidently low lying for even at this, the middle of the dry season, the river level was little below that of the country around. Most of the rice crop had already been harvested and though the population did not seem to be at all dense a very large area of the land was under cultivation. The branch of the river up which we went was in many places over a quarter of a mile wide and I gather that

some of the other branches were considerably greater. It was up one of these other branches that the rice station was situated, but I did not visit it as the crops there had all been harvested.

Higher up the river the banks were considerably steeper. Much of this also had been under rice and as a second crop the land near the river was being cropped with tobacco. Watering was done by pots carried from the river. Very little cotton was to be seen on the deltaic banks of the river and then only in the neighbourhood of Pnom Penh.

Pnom Penh was a wonderful sight in the early morning sun as we approached. The palace grounds and pagodas stood out against the sky with their golden minarets and brightly coloured tiled roofs. The pagodas are, I imagine, very similar to those in Siam and Burma only the points of the eaves and gables are very much longer. The roofing of the palace was done with green, yellow and blue glazed tiles arranged in geometrical patterns and borders.

I called on the Resident Superior of the Protectorate in the morning of my arrival and from there his Secretary took me to the Agricultural Department's office, where the Inspector-General of Agriculture for Indo-China was in camp. I learnt from him that M. Flacourt, the Chief Agricultural Officer of Cambodia, was away on leave to Europe.

However he said that he would arrange a tour programme for me and let me know later. In the afternoon he took me round the king of Cambodia's palace and grounds. The throne room was wonderfully decorated and much of the interior roof decoration was familiar to me, being Hindu in origin. Hanuman, Garudan and various other

names connected with Hindu mythology being used even here.

The "Silver pagoda" was well worth seeing. It so gets its name from the fact that the floor is paved with silver tiles. This contained a life size standing Buddha said to be of solid gold.

There was also what was in my opinion what was still more wonderful a Jade Buddha about half life size cut out of a solid piece of jade—a beautiful green with a shade of purple reflected through it.

From here we went to a silk factory owned by a French company and saw the whole process of killing the cocoons and of the reeling of the silk. The cocoons were killed in a large retort by means of steam which did not damage the cocoons. The factory was quite up to date and seemed to be very well run. The growing of silk was, I was informed, a local industry, which was a surprise to me seeing that the climate was very much like that of the plains of Southern India, which is too hot for the local Indian silk worm to live. Certainly the air was moister being so close to the river. The Cambodian women are said to be very expert at reeling and about half of the hands employed were local labour. The rest were women brought from Tonkin mainly for the purpose of being trained.

The people of Cambodia are a race which are quite different to any that I saw. I should say that they contain a considerable admixture of Dravidian blood. They are much darker than the people of Cochin-China, who are purely or largely Mongolian and are quite different in their mode of dress. Both men and women wear clothes very

similar to the people of this country except that he cloths are brightly coloured and usually of silk. The men and women dress alike. Both wear a dhotie. The women however wear a extra cloth to cover the breasts much in the same way as is worn by Badaga women. All have coarse black hair which is kept cut short.

On the following day I went by launch down the river for about five miles to Keash Kandal where is the only ginning factory working in the country. This was formerly owned by a European company, but now belonged to a Chinaman. It was quite a small place fitted up with eight saw gins, and the requisite baling presses. In addition to this there was machinery for the extraction of cotton-seed oil and for the manufacture of soap. The factory was not at work when we visited it, though there was a fair quantity of kappas coming in. This is all brought down the river either by country craft or river steamer. All of it was packed loose in ordinary sacks and was very damp when delivered. There were large drying floors for drying kappas before being ginned and here I was able to examine the kappas. This was very uneven and contained a large proportion of undeveloped seed. On the return journey to Pnom Penh we stopped at a timber factory. This before the war was engaged in the export trade of timber, but since the export had stopped they were turning their attention to the manufacture of wooden houses, furniture, etc. The chief timber in use was a very fine "pitch pine" which was floated down the river, from goodness knows where, possibly from the Tibetan frontier.

Pnom Penh is situated where the delta commences to branch. The main river is the Mekong which comes down from the north. Another branch comes down from the great lake. This is really a syphon and only flows when the Mekong is falling. When the Mekong is in flood then the water backs up this branch and fills the great lake and the streams which fill it. It is then navigable for river steamers (from July till December).

In the evening I drove out to Oudong, which is the burial place of the kings of Cambodia, some forty kilometers out of Pnom Penh. The road outran alongside of the branch of the river which connects with the great lake. Except along the immediate banks of the river there was little sign of cultivation as in the rainy season when the river is in flood most of the country is submerged. Oudong itself is a low range of hills rising out of this submerged plain. There is no town there. A few Chinese shops along the roadside and a few houses occupied by Buddhist priests or Bonzes as they are called. These latter are again a distinct race to the people of the country and appear to be of the same origin as the Saivite Brahman of South India if one can judge by the features. It is possible that they are the descendants of the Hindu priests, who came over to this country with the Tamil conquerers who founded the Khimir Kingdom. The tombs of the kings were on the crest of the hill and were in various stages of preservation. There was also a large pagoda here with a sitting Buddha some seventy feet in height. There was also a relic of Hinduism in the shape of a stone bull which was kept in a tiled shed and which

was still worshipped if one could judge by the joss-sticks surrounding it.

We left Pnom Penh on the 3rd of March for a tour up the river to the part where cotton is largely grown. The "We" consisted of M. Badetty, the Inspector-General of Agriculture, M. Bramel, the President of the Chamber of Commerce at Pnom Penh and Director of the Societe Cottonier, who have a large concession of land for the development of cotton cultivation on the red soils. M. Jeannerat, who had come out on the steamer with me on a mission to write a book on the Hindu ruins in Cambodia in English. He acted as interpreter when necessary. We saw cotton grown on the banks of the Mekong all the way up from Pnom Penh to Kompong Chiam. Most of these were on the actual banks of the river which were very high especially higher up the river. I measured the level of the river at Kompong Chiam with what was marked as the flood-level and there was a difference of about forty-five feet, the river being here quite a quarter of a mile wide. We landed at a few places on the way up to see the crop and as far as I could make out cultivation very seldom penetrated more than a couple of hundred years from the river and most of it was on the actual slopes.

The crops were very disappointing from the point of view of making any selection. Sowing is very carefully done, each hill being spaced about two feet apart, but at each place there were several plants, as many as twelve, in the neighbourhood of Pnom Penh where the soil was a fine silt and even as far up as Kompong Chiam where the silt deposit was much coarser there were five or six plants.

The plants were not well grown as after-cultivation was very perfunctory.

It was impossible therefore to select any plants for the shape of the plant and the strength of the stem on account of their restricted growth. The kappas also had suffered from the same cause and many of the bolls were not well developed, while as it was towards the close of the picking season a large majority of them were attacked by "boll-worms" of different kinds.

We stopped with the resident at Kompong Chiam and from here made an expedition to the concession of the Societe Cottonier which was about 20 kilometers distant at a place called Chup. The first half of the way was along a new road which was under construction. The country behind the river seems to be very much lower than the actual banks and is therefore submerged in the rainy season. The road therefore ran along a high embankment. After about a third of the way we crossed a stream where a reinforced concrete bridge was in course of construction. The French seem to excel in this work and it is very plentifully used for bridges, water towers, etc. Here we came to deciduous scrub forest growing on what appeared to be a shallow black cotton soil. At about two-thirds of the way the ground began to rise very slightly and we came to the red soil. Here the character of the country changed and the low deciduous forest gave place to very high forest mostly evergreen and mostly soft wood consisting chiefly of Ficus sp. The concession consisted of 18,000 hectares of this red soil, which I understand is volcanic in origin and therefore likely to prove very rich when once brought under regular

cultivation. The clearing, where work had been started, was some 400 hectares, where the trees had all been felled and burnt, though here and there were the stumps of giant banyans which it was impossible either to fire or remove. Some fifty hectares this year had been sown with Cambodia cotton, but it was not doing at all well. The land was not yet "tamed" as the cultivator of India would say and it is probable that for an annual crop such as this the effect of burning such large areas of timber and soil might render the soil too caustic. Practically no crop had been gathered and what there was was very badly stained chiefly with "boll-worm." This, I discovered, was present on perennial kidney cotton which was found growing on a small native clearing and it is probable that this was the source of infection. The crop, however, was thoroughly unhealthy and large areas of it were covered with red spider.

I have no doubt that in time when this land is brought under regular arable farming methods it will crop very well. It was the most wonderful virgin forest that I have ever seen and apparently a wonderful country for big game. Three Rhinoceros had been shot on the concession and there were plenty of tracks of wild elephant on the road cut.

On returning to Kompong Chiam, we motored out towards the east for some fifteen kilometers and from there rode across country about twenty kilometers to a forest village called Krabou. The country was very similar to that which we went through on the way to Chup except that there were more signs of habitation and small areas of rice cultivation. We passed several herds of

village cattle in the low forest quite nice looking animals all of them a fawn colour and much of the type and size of the Kangayam cattle of Coimbatore. Krabou is situated on another area of red soil similar to that at Chup. The village itself was quite a small one and though the people looked prosperous enough their houses seemed very primitive. These, as is the case with all those belonging to the Cambodians, were built on piles and the space underneath was used for keeping pigs, poultry, carts and other appliances.

We halted in rather a better class building of this type which was a sort of halting place for officials visiting the village. Here the cotton crop grown on the small station run by the administration was stored. The station itself was quite small and quite close to the village and as far as I could gather, had been started with the idea of popularising Cambodia cotton on these red soils. Many of the people of the village had grown this and their crops are very good. It was, however, all in the neighbourhood of the village itself and grown apparently on old clearings where crops of bananas, pineapples, etc., had been cultivated in previous years. The ground was therefore broken in, unlike the new clearings seen at Chup.

It was a pity that M. Flacourt was not present at the work done here had been in his charge and the cotton grown on the small demonstration farm was very much superior in quality to that grown by the villagers. There were two selections which as far as I could gather from the Annamite subordinate in charge were "bulk selections" made by M. Flacourt. The cotton was sown in the same way as is done by the natives along the banks of

the river, except that the distance between the hills was about a metre and there were only three or four plants at a hill. There was no comparison between the cotton grown on these red soils and that which I saw grown along the banks of the Mekong. Here the plants were seven to eight feet in height with strong woody stems and had evidently carried a very heavy crop of cotton, much heavier than the Annamite in charge could account for which was a ridiculous figure which worked out at about 120 lb. of kappas per acre. The cotton itself was of excellent quality. A long silky staple and a very fair twist. It seemed however to lock ginning outturn. Unfortunately my visit was just too late to see the season crop, the picking of which was about over and what was left on the field was mostly attacked by boll-worm. The same was the case with the villagers crops. I however obtained samples of the season pickings of both selections as well as some of the ordinary crop which I have since handed over to the Government Economic Botanist (Cotton). These I carefully went over afterwards on my return to Pnom Penh and discarded all that showed possibility of "boll-worm" infection as I had no wish to introduce fresh species of these into India. As far as I could, I sorted these not into separate locks so that when sown it would be possible to get several plants from the same parent in the first year.

How far the quality of this cotton was due to soil conditions and how far to improvement by selection remains to be seen. It was impossible for me to select for shape of plant owing to the system of planting and, on this red soil, all the plants that I saw had well developed wood. Even

if such selection had been possible it would have been impossible to obtain seed of the plants selected as the season was already advanced and picking was nearly over.

Many of the village headmen came in from the neighbouring villages to see the Resident, who among other things had come out here to meet the growers of cotton. Each year there is a big tamasha where medals presented by the King of Cambodia to growers of cotton are given away. This is to encourage the introduction of this crop on the red soil where it is a new crop. Many of these headmen were wearing medals which they had obtained in previous years and seemed very proud of them. I was asked to stop and see this tamasha but it would have prolonged my stay unnecessarily in the country. This apparently has done some good, but till these people learn more of ordinary arable farming methods it is difficult to see that any permanent advance can be made. At present as far as I could see when a crop of cotton was over the land was allowed to go back to jungle again until it was required for some other crop at some future date.

On our return from here we passed some old Hindu temples "Vat Nokor" near Kompong Chiam and I drove out one evening to see them. The style of architecture somewhat resembles that of South India. The administration have taken charge of this and are keeping it in repair. A portion of it is still used as a Buddhist shrine. There were some very fine carved "Garudans" at the entrance of the temple. The basis of the building was laterite and this was faced with a fine sandstone which was extremely well carved.

This I am told is only one of many such temples dotted about the country which seems to point to the power and extent of this old Dravidian kingdom of the Khmers.

I heard from M. Badetty that he intended shortly to go down to the Coast to Kampot which is the centre of the pepper industry in Indo-China and he said that he would arrange for me to accompany him, if I could wait a few days. So I availed myself of this opportunity to go and see the ancient city of Ankor. I also had the opportunity of accompanying young M. Jeannerat who had acted as interpreter to me on the previous trip and who was then on his way to this place. As he was only 17 years old and new to the country I think that the authorities were glad that some one could accompany him as the ordinary route to these ruins was closed for the year.

We set off by car to Battembang which is some 280 kilometres from Pnom Penh and which we reached at five in the same evening. From here we had to travel all night by sampan down a creak to the great lake and the next day we crossed it so arriving within six miles of the ruins. At a place called Bak proah, we called on the Cambodian Governor of this Province. The rest of the journey was done on horseback. The creak down which we had to travel was very thickly populated by a fishing and trading population, most of whom seemed to live in their sampans or junks as the case might be. The whole way down the banks were lined with fish traps and all the way down were signs of manufacturing preserved fish. Most of this was either salted and dried or else it was smoked and dried over a fire. The fishing season

for these was just about over and the only fish which I saw being caught were "murral" which were kept alive in cages and sold as fresh fish. The place was alive both with fish and with numerous kinds of water birds, carmorants, divers, stalks, flamingoes, egrets, maribouts, and pelicans. The air was also full of kites which were feeding on fish offal the commonest of which seemed to be the "Brahmini kite." Many of the boats had different kinds of water fowl kept in cages presumably for food. In the lake itself there were several fishing villages built on poles and quite a long distance from the shore. There appears also to be quite an industry in fish oil as there were the remains of furnaces all along the banks both of these rivers and the Mekong where I was told that fish oil was extracted.

The country round the ruins was quite different to anything that I had seen. There was a fairly swift flowing stream here which was being used for the irrigation of the holdings along side. These rather reminded one of the West Coast, being mixed arecanut and coconut gardens. Irrigation was done by means of a water wheel. The stream was dammed up to raise the level and increase the strength of the current through a small opening where the base of the paddle wheel revolved in a wooden frame. The force of the current against the paddles revolved the wheel. On the perimeter of the wheel were fastened bamboo joints which filled when in the water and emptied at the highest point into a wooden trough connected to an irrigation channel. There was thus a continuous flow of water to the garden.

I also saw here a very ingenious mill for husking rice. This was made of split rattan, fine canal clay and hard wood. The lower part of the mill looked like a shallow cup in a saucer only both were woven in one piece out of split rattan. In the centre of the cup was a strong wooden pin or axle the cup was filled with this canal silt up to the brim. Into this were let in strips of very hard wood and the clay was shaped so as to make an angular groove. A woven rattan cap fitted onto this, the upper portion of which was a hopper to receive the paddy and the lower portion was filled with the same silt and pieces of hard wood to make the upper mill stone. In the centre was a block of hard wood with a hole in the centre. This hole allows the paddy to get down to the faces of the mill stones and at the same time fits loosely onto the pin or axle in the lower millstone. There is a cross piece of wood which is fixed through the middle of the upper millstone at each end of which is hole. A bent stick works in this to revolve the upper stone. The other end of this bent stick is attached to a bar suspended from above by two ropes and the man working the mill swings this to and fro, thus revolving the upper part of the mill. The hopper above held about ten Madras measures, and most of the paddy is husked in the first passage through the mill which may take about five minutes. I believe that the mill is Chinese in origin as I heard afterwards that the same type of mill is used by the Chinese in the Federated Malay States.

Any detailed description of the Hindu ruins would take too long to describe and already several works have been published on the subject. The

largest of the ruins is known as Ankor Vat and is situated outside the old city walls of what was the town of Ankor Tom. The temple is rectangular in shape and has been surrounded by a moat, which at the present day is used for paddy cultivation. Within this are terraces each of which are raised some 35—40 feet above the lower one. The highest is quite small and is "the Holy of Holies." The lowest is surrounded by a gallery on the walls of which the whole story of the "Ramayana" is said to be carved. The carving is most wonderful. Nothing grotesque or obscene is to be seen. This is said to have been completed in the 14th century at the time when the Khmer kingdom is said to have been overthrown. One extraordinary thing about such skilled builders and architects is that they seemed to have been unaware of the principles of the arch. The steps also from one terrace to the next were very steep and narrow. The old town of Ankor Tom was to my mind much more interesting than the more modern temple of Ankor Vat. This is surrounded by a city wall and is square in shape. In the centre of each side is a large elephant gate, and across the town measures some three to four kilometres. The French administration have taken over the charge of these ruins and an officer of the Public Works Department is stationed here, not only to look after the ruins and prevent their falling further into decay, but also to open up other buildings which are at present grown over with high forest. The temples here show all different styles of architecture. The oldest is said to be the temple of Bayon. Here each of the towers of the temple are shaped like human heads. Round the walls of this there is a gallery

where scenes representing seafights between the Chinese (?), Malays (?) and the conquerors of the country (?) are carved. This is said to have been completed in the ninth century. I saw one of the finest of these temples which was in the process of being cleared of forest growth. The trees were all soft wood trees—mainly of the ficus family and their roots had been mainly responsible for pulling down the walls of the buildings. Great roots as thick as one's body were to be seen running along the floors of the galleries searching out for a crevice in the stone work. The entrance to this temple was guarded by large stone lions which might have been carved in South India so much did they resemble the carved lions which one sees here whether ancient or modern. The Naga seemed to form one of the most prominent forms of decoration and wherever a balustrade of stone was built the body of the snake formed the top of the balustrade ending in the erect head of the seven-headed cobra. In the more modern of these ruins were evident traces of Buddhist influence and it is probable that the conquerors of this kingdom were Buddhists of a kind, since in some of the temples every image even small figures in the carved scroll work of the pillars had been chipped out. All the carving was done in a fine freestone except in what was said to have been the king's palace. Here there was a small private temple built solely of laterite. It may be that the laterite was merely the basis of this and the outside had been removed. In a small museum maintained here were some excellent carvings, etc., including some very fine specimens of the lingam.

I have mentioned such detail as this as I think there can be no doubt that this work is in some way connected with Southern India and there is no doubt that these ruins are one of the wonders of the world and should be more fully known by the people of Southern India. They certainly have been visited by many Tamils since in several places I notice Tamil names written on the walls The written Cambodian language also seems to be closely connected with Tamil. Many of the letters appear to be similar. So also the mode of writing the vowel sounds. In the spoken language I could not, however, note any resemblance. At the right season of the year the journey to these ruins is an easy matter. A river steamer service takes one from Saigon within five days right to the ruins. All meals are provided on these boats as well as sleeping berths. This is from July on to December. After that the waters of the lake subside and the steamers cannot go up to the lake. There is a rest-house under European management at the ruins.

The journey back to Battembang was very tedious. The creek down which we had come, had fallen in level very considerably since I had come down three days before and in many places the water was so shallow that even a small sampan could not find sufficient draught and this had to be hauled over such shallow places. My provisions just held out, and I was able to relieve my thirst with water melons which were grown in considerable quantities on the silt-laden land along the banks of the creek. These were specially good varieties and I brought back some of the seed which is now being tried on the West Coast here.

I got back from Battembang in a day (280 kilometres). I travelled in the front seat of a Chinese-owned car of which there were regular services running. The back seat was occupied by some eight to ten people including two cleaners. The numbers varied as the journey progressed by picking up and dropping passengers. I had no idea till then how many people could be made to fit into a car. When the congestion was too great the cleaners would climb out and sit on the front mudguards. Bundles and bedding were hung round on lamp brackets and anywhere else where there were hooks. The car which was a pre-war French car did the journey at an average of 45 kilometres to the hour, which speaks well for the roads which were everywhere perfect. On one journey we averaged 60 kilometres an hour for about 100 kilometres. These were all maintained by the Public Works Department who had special gangs employed on the roads with travelling carts in which the workmen could sleep. Where the roads were under thorough repair there were continuous lines of road metal stacked for miles in wattle fences waiting till the steam roller came there. Besides this there were permanent way men for patch repairs. Nowhere were the roads wider than was necessary and usually they were lined with avenue trees planted close up to the road and so pruned as to give a high top shade in the heat of the day, at the same time allowing the air to circulate so as to dry the road after rain. Many different kinds of trees were planted for this purpose but unfortunately I could not find out their names. The only one which I knew was the

tamarind, which looked very unfamiliar when trained up with a long straight clean bole.

I left Pnom Penh again with M. Badetty on the 21st March for Kampot, where we called on the Resident to find out from him where we could best see the pepper cultivation and who could show us this. Pepper here all has to pay an export duty and the Resident has to know exactly where it is grown as well as the area. From here we went on the same evening to Kep a sea-side sanatorium which has lately been opened up. The best pepper cultivation centred round this place and the whole of it is in the hands of Chinese settlers. In all there is not more than three thousand families of these settlers and the area which each grows is quite small yet this small area supplies more than enough to supply the whole requirements of France. There is also a certain amount of this crop grown on the island of Phu Choc, which lie off the coast here.

The following is an account of the cultivation as carried on. It is of great interest as it is entirely different to that of our West Coast.

The soil selected for this cultivation is a slightly elevated land, either wet land or just above the level of the wet land. The texture of the soil is a fine loam and is of light colour. The greatest attention is paid to drainage and this is artificially improved by raising the level some four feet or more above that of surrounding fields by carrying soil to it. Ridges are then formed along the contour in such a way that the furrows have a very gentle slope thus no water at all is allowed ever to stand on the surface of the soil. If necessary these furrows are stepped, the steps being built up with

dry stone. From crest to crest of the ridges the distance is 6½ feet and the height of the ridge from the top of the crest to the bottom of the furrow is about one foot. Posts are planted along the crests of these ridges 6½ feet apart. Each post is about thirteen feet in e ngtn, three feet are sunk into the ground and about ten feet are above ground. These are of special timber which will not rot nor will it be attacked by white ants. Three different trees are used for these posts, but the only one, which I was familiar with, was the "Irul" Xylia dolabriformis, which is the name tree as is used for pepper crops on our West Coast.

The variety of pepper grown is quite different to that grown in India and is probably a different species. It never forms runners like our West Coast varieties do and the branches and internodes are stiff and short and stand out like our "Utherankotta" variety.

Whereas in Malabar only the runners are used for cuttings, here the ordinary bearing part of the vine is used and this cutting is cut right down to the old wood. The side branches of that part of the cutting which is to be below ground are removed and the length of the below ground portion is from 15—18 inches consisting of some eight to ten internodes. The part to be above ground may have three or four branches which are not removed, and the main stem may have some four or five well formed internodes. Two or three of such cuttings are planted close up against the post. Planting is usually done in March-April, i.e., at the commencement of the hot weather, and the cuttings are shaded till they establish themselves. Before planting a hole is dug at one side of the

standard and the soil removed is mixed with about 2 lb. of prawn skins. If necessary the cuttings are watered. This is done by boring a hole in the ground in the vicinity of the standard and filling this with water. Surface watering is never done.

Subsequent cultivation consists of hoeing and weeding three or four times a year, though in none of the gardens visited were any weeds to be seen. So probably this was rather to preserve the soil mulch.

The vine commences to bear in the following year, though to no great extent. In three years it gives a good crop and in five to six years it has completely covered the pole. After that it may continue for 25—30 years. If the post fails the vine is carefully removed, a new post is planted and the vine replaced.

Although the vines seem to have a very strong aerial root attachment which concentrates in clusters at the nodes, the vines are very carefully tied. The bast from the bark of some tree is used and the vines are tied every three or four inches.

Each year at the commencement of the rains each vine receives about 2 lb. of prawn skins. This is buried in a trench at one side of the vine one year and on the other side the next.

This species of pepper gives two crops a year. One in March which flowers in November and the other in August which flowers in May. The heaviest crop is the March picking, which was in progress at the time of my visit. At this picking each vine is said to give about 4 lb. of dried pepper, but judging by the crop on the vines this is an under estimate as I have never seen such heavy crops.

Harvesting commences when the berries commence to turn red, but most of those seen on the vines were red ripe. This is dried for two or three days on a drying floor when the berries are removed from the stem by the feet of men treading them out. It is then winnowed in a winnowing machine, which is very much like the European machine to separate the light pepper.

White pepper is also made by grinding off the fruit coat, but the best white pepper is collected in the surroundings of the garden by women and children from the droppings of birds which feed on the ripe berries. The white pepper is either disgorged or passes through the bird after the fleshy part of the fruit is taken.

I have brought a few of these "white peppers" back with me. I did not like to take cuttings or plants as there are two serious pests on the crop, which are unknown in Malabar; one is a meally scale and the other is unlike anything in the insect line that I know. I believe it has been described in the scientific publications of Saigon, which are received in the Agricultural College Library.

We stopped at the "bungalow" at Kep as well as at Kampot on our return. The "bungalow" in these mufassal stations take the place of hotels, cafés, and clubs and are used both by visitors and residents. Both these were under European management and both had water laid on to all the rooms and were either lit by electric light or acetylene gas.

From here we went up the coast towards the Siam border where there was more pepper to be seen. This was a fine stretch of country with sparse cultivation of paddy and a few houses along

the creaks. Many places were splendidly suited for coconuts, though others were too low-lying. Most of the stretch of country was covered with forest—high forest—where the drainage was good and low backwater type of forest where this was bad. The road was in course of being constructed and was to connect up with the coast road being made by the Siamese. This would provide land communication with Bangkok.

The following day we went up the mountain at the back of Kampot where a hill station is being made to be called Popokville. Here there was an acclimatization station, where all kinds of European fruit and vegetables were being grown. A very fine ghat road had been made and this had just reached the crest of the hill where the town was being built. All the labour employed on the road was jail labour, which under supervision seemed to be very efficient. In fact jail labour was used in all the towns for watering and cleaning the streets, and for any public works where skilled labour was not required.

From here we returned to Pnom Penh on March 24th, 146 kilometres in 2½ hours.

On the 26th I left for Saigon and on the 28th left Saigon for Singapore, having secured a passage on a rice boat. I arrived at Singapore on March the 31st morning and spent the rest of the day trying to get into an hotel. All were full, however, but finally I managed to get into a hotel five miles out of the town. I had tried to get up to Kuala Lumpur, but found that there was no room either on the train or on the passenger steamer which plied up the coast as the Easter holidays had commenced and there was a cricket match at

Kuala Lumpur between the colony and the Federated Malay States.

I had therefore to stop in Singapore till the 2nd of April and spent the time going round the various shipping offices trying to secure a berth to Colombo but with no definite result. On the 3rd I arrived at Kuala Lumpur to find that the hotels were full. I managed to get a room for the day at one hotel and in the evening secured a bedroom at the other the station hotel which is run very well by the State railway. There was nothing doing over the Easter week end. The Director of Agriculture was away, but Mr. Spring, the Agriculturist, arranged to take me round.

On the 5th we visited two estates, both of them rubber. One of them had their own staff of experts with laboratories and research station. Most of the work of the department had till last year been devoted to rubber, but the scarcity of food grains had impelled them to take an interest in this side of agriculture. I saw some of the ragi crops grown from seed supplied by the Madras Agricultural Department. These gave one a good idea of the fertility of the land. I do not think I have ever seen this plant grow so luxuriously even on land which is heavily manured and irrigated. It looked as if this were likely to become a weed so readily did it grow. The new ordinance passed last year makes it necessary that every estate should grow one quarter of its areas under food stuffs, and naturally there were different ways in which this was interpreted. In some places sweet potatoes were grown. Not that the tubers were collected, but to form a cover crop to keep down weeds. In young coconuts this was useful also as

a counter attraction for pig, which often damage young trees. Another estate I heard of had planted ragi on 500 acres, but the plants were spaced four feet apart. In other cases estate managers had really given the matter their attention and some of them were already growing sufficient ragi to feed their labour.

On the 6th Mr. Spring and myself set out for Taluk Anson taking the train to Port Swettenham and from there intending to go by steamer. On arrival however we found that the steamer had been cancelled so we had to return to Kuala Lumpur and go by train the next day. From Taluk Anson we went by car and launch to Sapintas a coconut estate recently purchased by the Government as an experimental station. This was situated about eight miles up the Birham river. The planting was about six years old where planting had been done and most of the trees were in bearing. A very stiff clay soil for the most part and where there was not clay on the surface there was peat. The trees on the peat had grown very well but had no root hold and none of the trees were growing erect. Some of them were almost horizontal. Most of the work consisted in planting up fresh areas and some five hundred acres had been planted that year. From here we went down the river the same night where we anchored till morning and then went out to sea round to the other branch of the river. Here we visited the Began, Datong and Arcadia Estates. The oldest plantations on the former were some 14 years old. Arcadia was much younger and the oldest plantings were made in 1912. Here some of the 1916 plantings were already coming into bearing.

From here we returned to Kuala Lumpur from where I went on short tour with Mr. Jack, the Economic Botanist, to see the coconut estates in Selangor. Mr. Jack is just starting work on this crop. We visited "Carey Island coconut estates," "Dusan Durian rubber estates" where there were about 900 acres of coconuts and from here on to Tumbuk ("Selangor coconuts"). On our return journey we motored through a large Dutch and Danish estates of 7,000 acres the whole of which had been planted within a period of 15 months. It was quite young only 15 months old, but the trees were as big as four year old trees in South India. Though my tour here was limited to time, I was able to see what were stated to be some of the best estates in Porak and Selangor.

One thing to be noticed about the coconuts of the Federated Malay States is the extraordinary rapidity with which the trees come into bearing. It is a pity, however, that so much of the area is planted on land where adequate drainage is impossible. If only the same care were taken to select land for this crop as is taken in the case of rubber there is no doubt, in my mind, that this could compete successfully with that crop and be a very much more certain proposition than many of the present coconut estates where adequate drainage is impossible. People seem to be carried away by the remarkable early development of the crop but forget that this fertility is merely that of the surface soil if the land cannot be adequately drained.

All that I saw of this crop confirmed the conclusion which I had already formed in India

of the requirements of the coconut as far as soil conditions were concerned.

I arrived in Singapore on the 12th April and spent the next two days in trying to get a passage. This I finally secured on the Messagerie Maritime steamer, "Paul Lucat," the same boat as that in which I had sailed to Saigon. We left Singapore on the 15th afternoon and arrived in Colombo on the 20th. I took the opportunity to visit some of the coconut factories here for coir, dissicated coconuts and oil, but unfortunately the markets were very dull at the time and none of these seemed to be working. I also visited an estate at Horrikelly some 40 miles north of Colombo in the Chulai district. Here the soil conditions were very much like our West Coast. Though the trees were fairly old the management was good. This was the first estate that I saw here, cultivation was regularly done and the records maintained on the estate showed clearly the value of this operation to the coconut crop.

I left Kandy on the 28th and reached Coimbatore on the morning of the 1st of May and took over charge on the 3rd.

SOME TEMPERATURE EXPERIMENTS IN BUTTER MAKING

By Mr. R. CHOKKALINGAM,
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Temperature is an important consideration in butter making. When churning is done at the right temperature, butter is obtained in the form of good grains; when these are washed properly

and worked carefully with a butter worker, the finished product will have the characteristic granular structure with a desirable degree of hardness and it will keep well for some reasonable time.

2. Various authorities describe various temperatures as being most suitable under various conditions but the limit of variation is generally between 50° and 66° F.

3. In the College Dairy, the temperature at the time of butter making is generally from 72° to 78° F. except in cold season when it goes below 70° F. It is found that when churning is done at these ordinary daily temperatures, the butter produced is of inferior quality on account of its greasiness and the large amount of butter milk contained in it, both of which do not allow the product to be kept long. A certain quantity of ice has to be used in order to lower the temperature and thus improve the quality of the butter. Ordinarily the churning temperature is brought down to something like 60° or 62° F.; but this does not always give good results, and an attempt was made to find out the proper churning temperature with the following aims : (1) to study the temperature at which breaking stage takes place and the time taken for the same, (2) to see at what churning temperature, good grains of uniform size can be attained and the time taken till the final stage.

4. The experiment was conducted during September and October, when the room temperatures while churning were between 74° and 76° F. throughout. Trials were made from 50° to 64° in the churn and as far as possible, the contents of the churn were kept almost uniform in quantity

and the rate of revolutions was fairly constant in all cases. Limited quantities of 4 to 5 lb. of cream were churned in the small churn so that the temperatures may be conveniently controlled. The following table No. 1 gives particulars regarding the amount of cream, water and ice used :—

TABLE 1.

Quantity of cream churned.	Temperature of dairy	Temperature of water.	Temperature of cream.	Ice taken	Water added (quantity).	Temperature of iced water.	Churning temperature	Time when churning commenced	Time at breaking stage.	Temperature at breaking stage	Ice taken.	Water used	Temperature of iced water.	Resulting temperature.	Time.	Time when churning was finished.	Temperature when churning was finished.
LB.	° F.	°	°	LB	LB.	°	° F.			°	LB.	LB.	°	°			°
4	76	74	76	4	7	32	50	7–50	8–10	62	3	6	32	50	8–20	10–0	66
4	76	72	78	3	7	36	52	7–30	7–48	62	3	7	36	52	7–55	9–5	62
4	74	74	76	3	5	34	54	7–37	8–10	64	2	5	40	54	8–10	9–5	66
4	76	75	78	2	8	44	56	8–52	9–5	64	1	6	48	56	9–25	10–15	68
4	76	74	78	1½	6	44	58	7–50	8–2	66	1½	4	40	58	8–17	8–47	66
4	76	74	78	2	4	40	60	8–26	8–35	66	1	4	48	60	8–42	9–0	66
4	74	73	78	2	8	46	62	8–24	8–33	66	1	5	48	62	8–40	9–15	66
5	76	73	78	1	4	46	64	7–15	7–23	70	1	4	46	64	7–30	7–45	65

5. *Results*—(1) *Temperature at breaking stage.*—It is found that at higher temperatures, the only factor that is required for the collection of butter is a certain amount of agitation ; but in the case of low temperatures such as 50° or 52° F., it seems necessary that a certain temperature also should be reached before the breaking stage is got. Temperatures taken at intervals during churning show

that in the case of low churning temperatures, the cream did not break until 62° F. was reached. Table (No. 2) below gives temperatures at breaking stage for different churning temperatures :—

TABLE 2.

Starting temperature.	50° F.	52°	54°	56°	58°	60°	62°	64°
Temperature at breaking stage.	62°	62°	64°	64°	66°	68°	68°	70°

These data show that when churning was started at 50° F., the breaking stage was obtained after a rise of 12°, whereas when the starting temperature was 64° F., the cream breaks at 70° F. with a rise of 6° only. At higher temperatures than these, the difference between the starting temperature and that at the breaking stage very rarely exceeds 2° and even this is not necessary for breaking but it is only incidental during the process of agitation of the contents.

(2) *Time taken to break.*—This varies with the different temperatures of churning ; the lower the temperature the longer the time taken. This is indicated by the following table (No. 3) :—

TABLE 3.

Churning temperature.	50° F.	52°	54°	56°	58°	60°	62°	64°
Time taken for breaking.	20 mts.	18 mts.	16 mts.	13 mts.	12 mts.	9 mts.	9 mts.	8 mts.

(3) *Size of grains.*—In the case of low temperatures of 50° and 52° F. the grains obtained were of the size of mustard seed and were quite uniform. In the case of 54° the grains obtained were slightly bigger than mustard seed but smaller than the

smallest cholam grain. 56° F. produced very good grains of the size of the small cholam and they were quite uniform. By churning at 58° and 60° F. the results obtained were almost identical; grains were not uniform but were as big as cholam. Churning at 62° and 64° produced irregular grains which had a tendency to unite.

(4) *Structure of grains.*—Starting from 50° up to 60° grains obtained were globular and individual grains could be distinguished, but in the case of higher temperatures, the very first stage of grain formation showed a greasy appearance.

(5) *Time taken for complete formation of grains.*—The lower the temperature the more prolonged is the churning. This was very much pronounced in the case of 50° and 52°, where the formation of grains was not at all perceptible until 60° F. was reached. Up to 56° F., the churning process was a tedious one but above that, the collection of butter was much quicker. The following table gives the time taken from the breaking stage to the finishing up of churning.

TABLE 4.

Churning temperature.	50° F.	52°	54°	56°	58°	60°	62°	64°
Time taken from breaking stage up to the final stage	100 mts	70 mts.	55 mts.	50 mts.	30 mts	15 mts.	28 mts.	18 mts.

(6) *Interpretation of results.*—(*a*) Churning temperatures below 56° F. here do not seem to be of any practical value because (1) the time taken is too long; in the case of 50° F., two hours and ten minutes were required and for 52° F., one hour and thirty-five minutes were necessary just to finish

up the process. (2) The quantity of ice to be used is great and the results are not worth the expenditure; for churning 4 lb. of cream at 50° F., 7 lb. of ice costing 14 annas was spent and for 52° and 54° F., 6 lb. and 5 lb. of ice costing 12 annas and 10 annas respectively, had to be spent excluding the ice required for washing. This was the minimum quantity necessary. The amount of butter produced, was only $2\frac{1}{4}$ to $2\frac{1}{2}$ lb. and for this quantity 10 to 14 annas is not worth spending. (3) The capacity of the churn is unnecessarily lowered as a large quantity of iced water has to be added to bring down the temperature. A larger quantity of cream can be churned at higher temperatures without increasing the total contents of the churn as less iced water will be sufficient.

(*b*) Churning at 56° F. produced good results. The time taken was just over one hour and the grains formed were quite uniform and fairly big and not at all greasy. The quantity of ice used was also small as only 3 lb. was spent. This temperature can be recommended here for obtaining best results.

(*c*) Temperatures 58° and 60° F. appear convenient for ordinary purposes and these need not be considered as too high. These produce good sized grains, but the only defect is that the grains are not uniform. The time taken is very short and the expenditure on ice is very little, considering the quality of butter produced which is granular and sufficiently hard.

(*d*) Temperatures 62° and above must be condemned if good results are expected as the butter obtained is soft and greasy and does not keep long.

A trail was made to find out if it would be possible to obtain good grains with smaller quantities of ice. 8 lb. of cream was churned at 62° F.; at breaking stage the starting temperature was brought back by adding iced water. Then, just when the grains began to collect, the temperature was reduced to 60° F. and at a latter stage to 58° F., very good grains of uniformly big size were obtained. Time taken was only 55 minutes for the whole operation and the quantity of ice used was 4½ lb. on the whole. This is convenient as only a small quantity of ice is necessary; the time taken is not long and the results produced were very good.

(7) Incidentally, the fat-contents in butter-milk obtained at various churning temperatures were tested. The following is the table showing results of analysis of butter-milk :—

TABLE 5.

Churning temperature.	50° F	52° F	54° F	60° F	64° F	74° F	78° F
Per cent of fat in butter-milk.	0·1	0·1	0·1	0·2	0·3	0·5	1·0

It is found that as the churning temperature is raised the loss of fat in butter-milk becomes greater. This loss can be reduced to the minimum by churning cream at a low temperature but the cost of ice used will be much more than that of the extra butter obtainable; but a low temperature improves the quality of butter considerably and this will more than repay the cost of ice. For instance, when 40 lb. of cream was churned at 78° F, 60 lb. of butter-milk containing 1 per cent fat was obtained. From this quantity of butter-milk,

10 oz. of butter costing about 12 annas can be obtained. For this, ice costing about Rs. 4 must be used for churning at a reasonably low temperature. If this amount is spent the value of the whole produce is much increased on account of the improved quality, and in addition, we will gain the 12 annas worth of butter; in other words, by churning at a low temperature the quality of butter is improved and the loss of fat in butter-milk is reduced to the minimum.

(8) *Summary.*—Under the conditions described above in paragraph 4, temperatures below 56° F for churning are not of practical value because of the large amount of ice and energy expended. (2) When churning is done at 56° F, very good uniform and fairly big sized grains can be obtained and this may be recommended as the best under our conditions. (3) 58° and 60° F are satisfactory for ordinary purposes as the time taken as well as the cost is very little and the butter is of good quality. (4) Churning temperatures about 60° F produce only inferior butter. (5) By lowering temperatures at intervals during churning, good results can be obtained even at higher churning temperatures; and by this means the quantity of ice can be minimised. (6) The higher the churning temperature the more the loss of fat in butter-milk.

THE MANGO IN ALAMANDA

A PRELIMINARY STUDY

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There is no place more noted for mangoes than Alamanda in the district of Vizagapatam. It is a

village of about hundred houses inhabited mainly by a class of people known as the Razus belonging to the Kshatria caste and claiming relationship with the old ruling princes of Vizianagaram. The village is about 27 miles from Waltair and 15 from Vizianagaram on the Bengal-Nagpur Railway. A large trade in mangoes centres round the place in the busy season every year and one cannot but be impressed by the excellent varieties of fruits grown in the locality, the care with which the gardens are managed and the expert knowledge which the cultivators possess regarding the culture and improvement of this most important fruit which is rightly considered to be the fruit *par excellence* of India.

Soil and Climate.—The soil is gravelly and bright red in colour and owing to the lack of moisture in the surface is free from grasses and weeds of a persistent nature. The porous nature of the soil faciltitates quick drainage. The rainfall amounts to about 35 to 40 inches and is distributed fairly uniformly throughout the year. The climate is hot and moist and is the one very well suited for the mango.

Varieties.—The number of varieties is very large at least about 50 being common. Some of these are exhibited with their names. It is interesting to see that the people are quite conversant with these and identify even the rarer ones by means of the shapes and sizes of the fruits. The names of several of them have interesting histories of their own, one named the Yandrusu (the Mulgoa of Madras) after one Andrews, probably John Andrews, who was the first Chief-in-Council of the District in 1769; another Hamilton after an

Englishman of that name resident at Bombay from whom a missionary named Dawson introduced the variety many years ago ; the Collectormanu, meaning the collector tree which is the Bangaloora of Madras, a collector having been responsible for its introduction ; and the Nayuduchettu after one Sanyasunaidu. The pre-eminent fruits of the place are, however, the Razumanu and the Swarnarekha both named by a previous Raja of Vizianagaram. The former of these has a most delicious taste being full of juice with little or no fibre and is appreciated for sucking. It is oblong in shape characterised by two slight prominences on the left side near the apex which go to distinguish it from any other type. Of the Swarnarekha there are two sorts, one with larger bulky fruits and the other about half its size, these being respectively known as the Pedda (large) and Chinna (small) Swarnarekhas. The fruits of both are coloured deep red with light golden yellow whence the Telugu name. A parent tree about 60 years old of the smaller Swarnarekha still exists in the place treated with certain amount of veneration. The origin of this is uncertain but it is believed that it arose from a seed sown by an itinerant mendicant (Bhairagi). It is also thought that when the larger Swarnarekha was introduced from Polaypalli (Bimilipatam taluk) some 60 years ago the seed of it gave rise to the smaller Swarnarekha which became the parent of all the later Swarnarekhas. However this may be, there is no doubt that the Chinnaswarnarekha is by far the most common variety which is prized for its many excellent qualities, viz., the ease with which the grafts could be raised, their heavy bearing and the great demand for this fruit both in

the nearer and distant markets. It is a distinctly superior fruit the best known of all mangoes in Alamanda except probably the Razumanu.

Botanical Characters.—The characters that are of the greatest help in the identification of the varieties are to be found in the shape, size and colour of the fruit, the prominence of the beaks and the oblique or flat nature of the base. The vegetative characters are difficult to establish except when they are fairly decisive as, for instance, in the case of the Hamilton which has small leaves whence the local name Sannakulu meaning the small leaved, or the Ganneru with leaves small and narrow resembling those of Thevetia neriifolia (Ganneru) or Chennapatnampeddakulu meaning long-leaved Madras corresponding to the Walajah Pasand of Madras one of the bulky fruits. It may also be noticed that in the case of some fruits the insertion with the fruit stalk is distinctly swollen and may be advantageous in resisting wind. This is the case with Ganneru a sweet variety referred to above and another less known type known as the Beach Bombay. The Swarnarekhas are oval and slightly beaked ; in Swanthami and Kolankagoa the beaks are pronounced ; Goa has a double protuberance ; Banganapalle and Bhulokasundari are of an oblique nature the former being compressed whereas the latter is more rounded ; the Razumanu, as stated before has two slight prominences on the left side near the apex. Hamilton belongs to the rounded class and also the Nayuduchettu, Yandrusu, Goa and Asalovva all of them considered to be of a superior quality especially the first and the last. In these the fruits are, as a rule, broader than long the differences being found in

the presence or absence of depressions near the bottom and apex. For example, the Hamilton is perfectly rounded whereas the Nayudu fruit has a deep pit near the base and the Asalovva both at the base and apex. Of the smaller fruits the Thondakayamanu (literally resembling Cephalandra fruits) is kidney shaped and has a delicious taste. The Jivantu is a peculiar variety strongly smacking of turpentine owing to the resinous ducts apparent in the mesocarp just beneath the rind.

Grafting.—The art of grafting appears to have been in practice for at least 60 or 70 years. Originally introduced in the private gardens of the Maharajah of Vizianagaram some of the rarer varieties were guarded jealously for the exclusive use of the palace and the seeds of these were, it is said, drilled and damaged before being thrown away with the object of preventing their propagation elsewhere. It is stated that some of the grafts were stealthily brought later on to Alamanda in carts under the disguise of Purda women by some of the garden owners.

The method of grafting is mainly that of inarching in which art the gardeners have become perfectly familiar. Special nurseries of stocks are always kept ready for the purpose being 30×25 feet and containing over ten thousand seedlings about twelve months old. The seedlings are transferred to pots at this stage and are allowed to remain in large numbers under the shade of the mango trees where they are watered and looked after for some time till they are fit to be used. There is no fixed time for grafting but the rainy season is generally avoided. The materials and

tools employed are of the simplest sort, a long table knife, a large skein of Gogu fibre (Hibiscus cannabinus) coiled round a wooden frame and a narrow strip of cloth greased with bees wax and rolled into a bit being all that is required. The scions are selected from a small grafted plant not more than a few years old which is specially set apart for the purpose and round this a large earthen mound is raised to serve as a platform for elevating the stocks. A large number of stocks may thus be seen buried in the mound at one time and this is a very convenient practice since it ensures the simultaneous watering of all the grafts till they are ready for removal. The use of a single small graft for grafting on a large number of stocks may appear defective in many respects as it may lessen the vigour of the scions but it is the only method which could be resorted to for propagation on a large scale to supply outside demands for grafts. Grafted trees in bearing several years old are also sometimes made use of when they happen to be rare varieties and the thorough acquaintance displayed by the gardeners in these matters shows how the ryots could perfect a method when they are convinced of its extreme advantages. In the process of inarching the shoot of the stock is kept or removed according to the nature of the scion used and the whole operation does not demand more than a few minutes. An expert gardener may in this way graft 100 to 150 stocks a day the percentage of successful grafts being rarely below 90. About four months' time is allowed for the grafts to be united and after they are transferred to the soil and get established the plants often begin to bear the same year but the

flowers are removed in the first year to promote vegetative growth.

Keeping qualities.—The success of the mango trade depends a great deal on its keeping qualities. Of the finer first rate varieties the Banganapalle is said to last for about 25 days after removal from the tree and stands transport well whereas the Swarnarekha keeps only for 7 to 14 days. We were also able to gather that out of the Swarnarekhas and Banganapalles sent to England for trial only 15% of the former and 40% of the latter retained their good qualities. This is not a high percentage and trade with distant countries will not therefore be attended with encouraging results unless more satisfactory methods of preserving them are evolved.

Trade.—The busiest season is from April to June. The sale in fruits amounts in a normal year to about Rs. 75,000 though the last season brought only a "half-crop." The trade is chiefly with some of the North Indian towns like Calcutta, Kuttack, Midnapur, Baleswaram, Buddrack and rarely with Madras. It may be remarked in this connexion that the crude way of packing, namely, filling the baskets with 50 to 100 fruits and consigning them to their fate, is the greatest drawback in the trade and improved methods must certainly be made known to both the growers and the traders. But this is a matter which involves questions of cost, greater railway facilities, etc., which cannot be entered into here.

The prices range from Rs. 3 to Rs. 6 per 100 according to the nature of the variety, the Razumanu and Goa, for instance, selling at Rs. 3, the Chinnaswarnarekha and the Hamilton at Rs. 4,

the Banganapalle and Yandrusu at Rs. 5, the Peddaswarnarekha and Nayudu at Rs. 6. Some of the bulky fruits which are in demand for pickles also sell at the higher rates.

To the trade in fruits must also be added the sale of graft plants which are sent in several thousands every year to distant places.

Other fruits.—Next only in importance to Mango is the Sapota (Achras sapota) which is grown on a limited scale and has become well acclimatised in the district. Five or six varieties are grown and they are productive throughout the year. Their propagation is by grafting and the stocks used are those of a quite different plant, viz., Mimusops hexandra (Palai). The Rose apple Eugenia jambos grafted on stocks of E. Jambolana is also grown to a less extent.

PRESERVATION OF CUT CANES

By M.R.Ry. K. KRISHNAMURTI RAO,

Acting Assistant Government Sugarcane Expert.

During last year, on a very small scale, experiments were conducted to see how best canes could be preserved without much loss and they gave indications that canes kept in a cool, shaded place and occasionally sprinkled with water could be kept for a pretty long period with only slight loss of sugar. To see how long the local variety (Poovan) under the local climatic conditions could be kept without much deterioration and loss and

also to compare the changes in its composition the following experiment was undertaken.

Taking advantage of the main harvesting and crushing season in the neighbourhood, 400 canes of the Poovan variety were purchased with the help of Mr. Kesava Ayyar, Supervisor in charge of the Sugarcane crushing installation, Pallapalaiyam village. These were divided into 40 bundles of 10 canes each. These were then divided into two lots A and B. Lot A was kept in the laboratory on a small quantity of cane trash, 4 bundles over 4 bundles, and after covering the whole lot with some more cane trash, water was sprinkled. This spraying of water was done every day. Lot B was kept exposed on a platform in the seedling house. One bundle from each lot was analysed every day. The results of analyses of all the bundles of these two lots are tabulated in pages 95 and 96.

The meteorological records of the period during which the experiment was conducted will be found on page 97.

From an examination of the results of analyses of Lot A cane bundles, it may be observed that deterioration in the case of canes kept under shade and sprayed with water is so slight that, even after 20 days after harvest, the juice gave over 84 purity, and the jaggery obtained from it was of a fairly good quality. So, if there should be a breakdown in a cane crushing installation or if a ryot urgently wants his canes cut and land cleared, losses can be minimised by making arrangements to store canes in a cool place and to have them sprayed with water.

The percentage of jaggery to cane or juice could not be determined ; for, the quantity of juice was so small and even out of this, some quantity

had to be utilized for analytical and for tasting purposes—to see if the juice is drinkable. But it is not seen why the percentage should be in any way much less than usual, seeing that the weight of cane and the percentage of juice to cane are practically the same and the total solids only slightly less than before. (Vide consolidated statement given on page 94.)

The cane bundles which were arranged at the bottom and consequently had more water on them, had given out large amount of adventitious roots and the buds were slightly shooting.

Where rooting was advanced it will be seen from the analytical sheet (page 94) that glucose contents were not high but rather slightly lower than when there was not so much rooting—mainly due to utilization of glucose by the roots for their growth.

The juices from about the eighth day get gradually darker, less agreeable to drink on account of the slight amount of putrefaction setting in and also get slightly more sour.

The fermentation and the putrefaction both start from the bottom of the cane. Putrefaction was more and acidity less in the cane bundles of lot A than that of lot B cane bundles.

On the 19th day after cutting the cane bundles of both lots A and B were analysed for acidity and they gave the following results :—

Lot A.	100 cc. juice of the bottom half of cane consumed.	10·2 cc.	N/10 alkali (KOH)
Do.	top half (100 cc.).	9·6 cc.	do.
Lot B.	bottom half (100 cc.) ...	18·2 cc.	do.
Do.	top half (100 cc.) ...	16·8 cc.	do.

On the 20th day, lot A. bundles were also analysed.

In Bottom 1/3rd 100 cc. juice required 12·8 cc. alkali.
In Middle 1/3rd 100 cc. juice required, 11·6 cc. alkali.
In Top 1/3rd 100 cc. juice required 11·4 cc. alkali.

This was done just to show that there is more acidity at the bottom.

From an examination of the results of analyses of lot B cane bundles, it may be inferred—

(1) The deterioration in the exposed canes is rather marked and begins as early as the 3rd day (vide statement on page 96). It will be seen that the glucose contents increase steadily day by day. Other results, though they do not show such regularity yet show an increase in the total solids and decrease in sucrose and purity.

(2) The change appears to be mainly inversion; for, the cane juice even on the 19th day after cutting was drinkable. Acidity occurs to a certain extent.

On account of this high glucose content in the juice it is not possible to make either gur or jaggery out of this. But it is suggested that such juices might be profitably converted into syrup.

(3) The acidity is more in the bottom joints in this lot also, as already noted.

(4) The colour of the juices was far better than that of lot A canes.

(5) The statement given on page 94 shows that there has been no dryage in lot A canes, while the dryage in the lot B canes was 9 per cent on an average of all the days; while if we take the

average in the bundles of the last three days (18th, 20th), it is as high as 18·2 per cent.

This consolidated statement gives, at a glance, the rise in the total solids, the glucose and the glucose ratio and a regular fall in the sucrose and purity contents of the lot B canes.

My thanks are due to M.R.Ry. Rao Sahib T. S. Venkatraman, Acting Government Sugarcane Expert, for the facilities given for conducting this experiment.

Consolidated analytical statement comparing the changes in the canes exposed and in those kept in the laboratory and sprayed daily

Date of analysis.	Days after harvest of cane.	Number of canes per bundle.	*B Lot (canes exposed). Orignal weight of cane.	Weight of cane on the date of analysis.	Weight of juice obtained.	Percentage of juice to cane	Total solids per cent (corrected).	Sucrose per cent.	Glucose per cent	Glucose ratio	Co-efficient of purity	†A Lot (canes kept in shade and sprayed in the water). Original weight of cane.	Weight of canes on the date of analysis.	Weight of juice obtained.	Percentage of juice to cane.	Total solids per cent (corrected).	Sucrose per cent	Glucose per cent.	Glucose ratio.	Co-efficient of purity.	Remarks.
			LB.		LB.							LB.	LB.	LB.							
Oct. 1920. 5th and 6th.	Average analysis of 4 bundles of canes before the experiment			...	...	...	18 92	16·62	0·81	4 9	87·8	...	...	...	...	18·92	16·62	0·81	4·9	87·8	
7th to 9th.	3 to 5 days ...	10	37·0	37	24¾	66·9	19 60	15·85	1·24	12 2	80·9	38·5	40 0	27·0	67·5	18·39	15·76	0·90	5 7	85·7	
10th to 12th.	6 to 8 days ...	10	34 0	32½	22	66·3	20 64	15·72	3 20	20 4	76 2	37·7	37 8	25·3	67·0	19 44	16·79	1·24	7·4	86·4	
13th to 15th.	9 to 11 days ..	10	40·0	38½	25	65·5	21 10	14 17	5·36	37·1	67 2	33·7	33·9	22·6	66 7	19·44	16 08	1·71	10·6	82·7	
16th to 18th	12 to 14 days ..	10	36 0	32	20½	64 1	21 55	13 35	6 32	47·3	61 9	39·3	39·5	26 4	66 9	18 55	15·40	1·65	10 7	83·0	
19th to 21st.	15 to 17 days ...	10	36·7	31	20	64·5	22 82	13 24	7·81	58 1	58 0	41·3	41 0	27 9	68 0	19·54	16·56	1 47	8·9	84·7	
22nd to 24th.	18 to 20 days ..	10	34·0	27½	18	64 7	23·34	13 38	8·78	65 8	57 3	43·3	43 3	29·5	67 9	18·03	15·39	1·11	7·2	85·5	
	Average ...	...	36·3	33 1	21·7	65·(	21 51	14·28	5·57	39·0	66·4	39 0	39·3	26·4	67·4	18 90	16·00	1·35	8 4	84·3	

* From the above, it will be seen that there is a steady increase in the total solids, glucose, and glucose ratio of the B lot canes and a decrease in the sucrose and the purity contents.

† In the A lot canes, sucrose is less than when first analysed only by 0·62 per cent and the purity by 3·5. The glucose has risen only by 0·54 per cent. There has been no loss in the weight of canes. The results in this series are rather irregular, due mainly to variations in sampling.

Result of Sugarcane juice analysis of the cane bundles of A lot (i.e.) of canes kept in a cool place and sprayed daily with water from the 7th to the 24th October 1920.

Days after harvest.	Date of analysis.	Original weight of canes.*	No. of canes cut.	Weight of canes crushed.†	Weight of juice obtained.	Percentage of juice to cane.	Brix (corrected) per cent	Sucrose per cent	Glucose per cent	Glucose ratio.	Co-efficient of purity.	Remarks.
				LB	LB.							
1st & 2nd	5th & 6th	Average analysis.					18 92	16·62	0·81	4·9	87·8	
3rd	7th	39	10	41½	27½	66·3	17 94	15 27	0 62	4 1	85 1	
4th	8th	43	10	44¾	31	72 1	17·98	14·48	2 0	13 8	80·5	Abnormal Two canes appeared affected with disease
5th	9th	38	10	38½	26½	68 8	18·84	16 24	1·18	7 3	86 2	
6th	10th	43	10	45½	29½	67·8	19 51	16 79	1 25	7·4	86 0	
7th	11th	33	10	33	21½	65 2	18 70	16·39	1 00	6 1	87 6	
8th	12th	37	10	37	25	67 6	20 11	17 19	1·47	8·60	85·50	
9th	13th	35	10	35	23½	66 5	20·03	16 79	1 61	9 6	83 8	Juice getting slightly darker.
10th	14th	30	10	30½	20½	67 8	19 05	15 84	1 61	10·2	83·1	Do.
11th	15th	36	10	36½	24	65 8	19 25	15 61	1 92	12 30	81·1	Juice—slight decomposition set in.
12th	16th	41	10	42	27½	64 9	18.32	15 14	1·85	12·2	82·6	Do.
13th‡	17th	40	10	40	27½	68 7	18 77	15·44	1·67	10 8	82·3	Juice—slight decomposition slight rooting in canes
14th	18th	37	10	36½	24½	67 1	18·55	15 61	1·43	9 2	84 2	Do.
15th	19th	38	10	38	25½	67 1	19 09	16·17	1·35	8 3	84 7	Juice putrid decomposition and slight rooting in canes
16th	20th	43	10	43	29·4	68 4	19·82	16·65	1·65	9·9	84 0	Do.
17th	21st	43	10	42	28·8	68·7	19·71	16 86	1·43	8·6	85·5	Do.
18th	22nd	47	10	46½	32	68·1	18 27	15 52	1·11	7 2	84·9	Juice putrid decomposition and more rooting in canes
19th	23rd	42	10	42	28½	67·5	18·70	16 23	0 94	5 8	86 8	Juice badly decomposition and badly rooting in canes
20th	24th	41	10	41½	28	67 5	17·13	14·41	1 28	8 9	84 1	Do

On the 5th of October 1920, canes were cut at Pallapalaiyam village and were carted to the Cane Breeding Station on the 6th An average analysis of 4 bundles of 10 canes each done on the 5th and 6th is also given below—

* Weighed in a big weighing machine at the sugarcane installation itself

† Weighed in a smaller weighing machine at the cane breeding station.

‡ From the 13th, uncrushed portions of megass were fed once more to the mill.

Remarks—From the above it will be seen that even on the 20th day after harvest, canes still gave good purity and were capable of giving fair quality jaggery.

Result of Sugarcane juice analysis of cane bundles of B lot (i.e.) of canes kept exposed from the 7th to the 24th Oct. 1920.

Days after harvest.	Date of analysis.	*Original weight of canes.	No. of canes cut.	† Weight of canes crushed.	Weight of juice obtained.	Percentage of juice to cane.	Brix (corrected) per cent.	Sucrose per cent.	Glucose per cent.	Glucose ratio.	Co-efficient of purity.	Remarks.
1st 2nd	Oct. 1920. Average analysis.			LB.	LB.			18·92	16·62	0·81	4·9	87·8
3rd	7th	..	10	40¾	27	67·5	19·07	15·48	1 59 ‡	10·3	81·2	
4th	8th		10	42½	28¼	66·7	19·55	16·15	1·85	11 5	82·6	
5th	9th	..	10	28	19	67·8	20 18	15 93	2 38	14·9	78 9	
6th	10th	...	10	33½	22½	67·2	20·31	16·41	2·50	15·2	80·8	
7th	11th	...	10	30¼	20	65·6	20 88	16 22	2 94	18 1	77·7	
8th	12th	...	10	35½	23½	66·2	20 72	14 53	4·16	28·6	70·1	
9th	13th	..	10	38	25	65·8	21·83	15·08	5·26	34·9	69 1	
10th	14th	...	10	42	27½	65·5	20 42	13·51	5·26	38·9	66·2	
11th	15th	...	10	35¼	23	65·2	21·03	13·92	5 56	39·9	66·2	
12th	16th	.	10	34½	22	63·8	21 84	13·98	6 06	43 3	64·0	
13th	17th	...	10	31	20½	66·1	22 19	14·17	6·25	44·1	63·9	
14th	18th	...	10	30½	19	62·3	20·63	11·91	6·66	55·9	57·7	
15th	19th	.	10	33	21	63·6	21·88	12·09	7·42	61·4	55·3	
16th	20th	...	10	36	23	64·5	24 20	14·01	8 00	57·1	57·9	
17th	21st	...	10	25½	16	62 5	22 39	13 63	8·00	58·7	60 9	
18th	22nd	..	10	22½	15	64·4	23 29	13 50	8·52	63·1	58·0	
19th	23rd		10	27	17	63·5	23 49	13 98	8·52	60·9	59·5	
20th	24th		10	34	22	64·7	23·24	12·67	9·30	73 5	54·5	

On the 5th of October 1920, canes were cut at Pallapalaiyam village and were carted to the Cane Breeding Station on the 6th. An average composition of 4 bundles of 10 canes is also given below.

* Weighed in a big weighing machine at the sugarcane crushing installation itself.

† Weighed in a small weighing machine at the breeding station.

‡ Attention is particularly invited to the steady increase in the glucose content of these cane bundles.

A copy of the Meteorological records for the period (5th to 24th October 1920) during which this experiment was conducted.

Date.	Observation at 8 a m on date shows				Previous 24 hours.			Laboratory temperature at the time of working.	Rainfall at the Cane Breeding Station	Remarks
	Barometric pressure.	Shade Temperature.	Humidity saturation.	Wind velocity per hour.	Wind velocity per hour.	Maximum shade temperature.	Minimum shade temperature.			
	INCHES			MILES	MILES					
5th	28 311	77 2	80·1	2	3·8	86 5	71·6	Not noted	0 07	Cloudy
6th	28 389	75·5	82·8	5	6·2	84·0	71·6			,,
7th	28·426	75·4	80 8	Calm	6 6	82 5	71·1		0 04	,,
8th	28·443	77·0	76·0	,,	3 4	82 5	70 6	86	..	
9th	28·507	76 0	82	,,	3·4	89·8	72·0	84	..	Cloudy.
10th	28·489	79·0	80	,,	3 4	87 0	66·8	80	.	
11th	28 449	79·0	74	3	3·0	89·5	68 0	80		
12th	28·446	80 0	71	Calm.	2 5	90·2	69·2	90	..	
13th	28·494	79 6	74·6	.	3·0	91·6	67 5	89	0 15	
14th	28 507	77 6	78 8	1	2·8	92·2	70·3	88	0·25	
15th	28·469	77 0	76 8	2	2·4	91 0	67 2	90	..	
16th	28·498	78·3	78	6	3	91 1	72·5	89	...	
17th	28 498	78 0	70	Calm.	3·4	91·6	67·6	82	..	
18th	28 474	77 8	74	2	3·4	92·6	68 0	89	.	
19th	28·496	78·8	73·2	1	3 5	91 0	70·1	89	..	
20th	28 525	80·5	73	2	3 1	94·0	72 8	89	..	
21st	28 511	80·1	69·3	2	3 9	92·6	70·1	82		
22nd	28·539	77 8	82	Calm.	4·1	92·0	71·5	82	0·05	Cloudy.
23rd	28·534	79 8	77·8	3	3 3	88·5	71 2	82	0 05	,,
24th	28·588	77 1	82	3	5·1	91·5	70 0	82	drizzle	

IRRIGATION WATER FOR SUGARCANE CULTIVATION

BY M.R.RY. K. KRISHNAMURTI RAO,
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One of the first difficulties experienced on the newly acquired land for the Sugarcane Breeding Station was the reluctance with which the canes grew therein. The acquisition of such an area though more than amply justified by the free flowering of both the thick and thin canes of the farm a great desideratum in the work of breeding

at the station was thus somewhat of a disadvantage at first. The thick canes died out and even the thin ones put up but a poor show in the first few years of the station. An investigation soon disclosed the fact that the land had been neglected and mishandled by the previous owners and it needed an elaborate scheme of land improvement before the thin canes could be grown with ease. The improvement has, however, been so thorough and in recent years the crops have been so luxuriant that in some cases the usual manuring had to be cut down to check the growth and allow the canes to ripen.

A study of the methods adopted is an interesting one by itself, but in the present note it is proposed to detail such factors as bear on the quality of the water used in irrigation by the previous owners.

An analyses of the well waters at the station and in the neighbourhood showed the desirability of irrigating canes from the best well on the farm and an arrangement was soon made by which all the area which was to grow cane was to be irrigated only from this well; not only when cane is actually grown on the area but also when other incidental crops are sown for rotation purposes.

Analyses of well waters at Cane Breeding Station.

(In 100,000 parts of water.)

—	Carbonates.	Sulphates.	Chlorides.	Total
Well No. 1 ...	11·4	7·4	24·9	43·7
" 2 ...	53·0	31·5	93·9	178·4
" 3 ...	...	60·0	155·3	215·3
" 4 ...	16·4	57·8	153·2	227·4
" 5 .	not being used at all			
" 6 ..	12·2	59·7	175·3	247·2

Analyses of some well waters from places where sugarcane is successfully grown.

Particulars.	Injurious salts in 100,000 parts of water			
	Sodium carbonate.	Sodium and Mag. Sulphate	Chlorides.	Total
Singanallur village.				
Palni Nayakan's 5 mhote well ..	7·9	7·3	33·9	49·1
Kasturi Nayakan's well water	..	12·9	55·1	68·0
Sundara Nayakan's well		6·4	34·9	41·3
† Rangaswami Nayakan's well.	..	41·7	96·5	138·2
Samakulam Agraharam village ‡				
Appu Ayyar's well No. 1	6·4	2·7	8·2	17·3
Venkatrama Ayya's well	3·6	3·7	8·2	15·5
† Kuppu Ayyar's well .. .	.	16·9	72·5	89·4

* Notes on well waters with special reference to sugarcane irrigation, by K. Krishnamurti Rao, pages 15—29, Vol II, the Journal of the Madras Agricultural Students' Union

† Considered not quite good for cane cultivation by the ryots.

‡ Ryots of Samakulam Agraharam claim that their jaggery is sweeter and superior to that of Singanallur ryots.

This in conjunction with the soil improvement has produced many beneficial results :—

(1) The soils and sub-soils of the station appear to have changed for the better as the following figures of recent analyses show :—

Particulars.	Previous analyses, 1912.		Recent analyses, 1918.	
	Chlorine.	Total injurious salts.	Chlorine.	Total injurious salts.
Block 1	0·017	0·031	0·008	0·016
Do. 2 ..	0·057	0·073	0·014	0·033
Do. 3	0·117	0·198	0·019	0·066
Do. 4	0·080	0·166	0·023	0·067
Do. 5*	0·070	0·163	0·011	0·047
Do. 6	0·030	0·096	Under pasture and not analysed	
Do. 7* ...	0·024	0·080	0·015	0·066
Do. 8	0·062	0·144	Not under cane ; still being irrigated with well No. 6 ; not analysed.	

* Parts of blocks 5 and 7 are liable to be inundated with the tank water

(2) The brownish, soft earth which used to form on the sides and tops of ridges in abundance was very much lessened.

(3) The thick tropical canes which formerly refused to grow, grew fairly well and the thin North Indian canes much more vigorously than before.

Still, the results obtained, have not been as one would wish them to be. The thick canes do not yet yield heavy crops and the thin canes while leaving nothing to be desired in respect of growth, yield only a poor quality jaggery which in many cases runs to liquid. The samples of jaggeries obtained during the year 1916–17 and 1917–18 were examined with respect to the nature of cane (thick or thin) from which they were obtained and the field on which the canes were grown. The only samples of jaggery that were passable or of fair quality were obtained from thick cane varieties and thick seedlings. Mungo group * gave only 3 passable jaggeries. All the other jaggeries obtained from thin seedlings and varieties other than those included in the mungo group and in fields other than those mentioned below, were not satisfactory.

Field No. 9 is our best field, being lowest in chlorine content. Field No. 24 though it contains rather a high percentage of sodium carbonate has only small quantities of chlorine. It seemed probable that one of the chief determining factors in the successful raising of canes which would yield good jaggery was the chlorine content of the soil.†

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* A group of dwarf sweet canes chiefly found in the United Provinces, Bengal, Bihar and Orissa.

† Effect of salinity on the growth and composition of cane by K Krishnamurti Rao, Indian Science Congress Special number, 1919, of Agricultural Journal of India.

In accordance with the suggestion made by M.R.Ry. T. V. Rajagopala Achariyar Avargal, Assistant-Professor of Agriculture, attempts were made this year to obtain brown sugar from the juices after converting them into rab as is done in North India. The *massecuite* or rab was allowed to ripen for over a fortnight and centrifuged in a butter drying centrifugal machine. The percentage of raw sugar obtained was roughly only 0·6 to 3·3 on cane and the colour of this except in one or two samples was not good. As it was considered that analyses of the molasses resulting from these rabs might be useful, some of these were analysed with the following results :—

Sucrose.	Glucose.	Moisture.	Total ash.	SO_3.	Cl.	K_2O.
PER CENT	PER CENT.	PER CENT.	PER CENT	PER CENT.	PER CENT.	PER CENT.
55·0	6·6	27·5	5·4	0 57	1·3	2·34
51·6	9·7	26·4	6·3	0·63	1·6	2·86
53·5	5 0	27 0	6·8	0·73	1·6	...
47·5	14·1		6·9	0·63	1 7	2 90
52·2	7·3	26 4	6·5	0·64	1·6	..
Rough average 52·0	8·5	26·8	6·4	0·64	1·56	2 70

For the sake of comparison, some analyses of final cane molasses by Prinsen Geerligs are given below—

* Composition of some final cane molasses.

Particulars	Sample numbers.					
	Two per cent	Six per cent	Four per cent.	Seven per cent	Ten per cent	Average.
Solid matter	81 95	80 44	·75 7	81·4	83·6	
Water	18 0	19 5	14·3	18·0	16·0	
Sucrose	25·3	30 0	35 7	37·0	37 4	...
Reducing sugars ..	34·9	31 6	22·1	18·5	25·9	...
Gum	1 3	1 1	1 5	2 0	0·7	...
Ash . .	7 1	6·0	9·1	9·6	8·0	7·96
Organic non-sugar ..	14·6	13 3	18 8	16·3	12 5	.

* Page 34, *International Sugar Journal*, 1920.

Particulars	Sample numbers.					
	Two per cent.	Six per cent	Four per cent.	Seven per cent.	Ten per cent.	Average
Soda	Small quantities about (0 25)					
Potash	2·3	1·7	3 6	3·9	3·0	..
Chlorine ..	0 3	0·3	0·5	0·3	1·0	0·48
Sulphuric acid ...	0·7	1·0	0·5	1·1	1·6	
Carbonic acid	1·7	1·0	2·3	1 9	1·0	.

On comparing the two, it is seen that our molasses contain much higher quantities of sucrose and moisture, but much lower quantities of glucose than the other. Again, the percentage of chlorine on the ash of our molasses is very high being 24 (1·56 of chlorine in 6·4 of total ash) wheras Geerlig's results give only a chlorine percentage of 6 (0·48 of chlorine in 8 of total ash) only one-fourth of the amount present in our molasses. The failure to obtain jaggery of good keeping quality would therefore again appear to be due to the presence of an excessive proportion of chlorine in the juices.

We have said above that the sugarcane fields are not now irrigated by saline water and that the chlorine contents of our soils, at least of the surface soils, have consequently been very much lessened. It was possible, however, that the sub-soil still contained excess of injurious salts to which the poor quality of the jaggery was due. Attention was accordingly next directed to an examination of the deeper layers of the station soils.

While digging weed pits in the farm, it was observed that at a depth of 1½ feet to 2½ feet from the surface, a greyish dark coloured layer of about 2 to 3 feet thickness was met with. This layer was found to be hard and offered much resistance while

working with the spade so that crowbars had to be used.

A rough sketch in section and description of one of the weed pits is attached in the end.

The peculiar appearance of the sub-soil suggested a closer examination of the same. Analysed for chlorides, some of these hard soils gave the following results :—

Particulars.	Chlorides in	
	Surface layer.	Middle hard layer.
Field No. 16 Pit A ..	0·015	0·120
Do. 16 Pit B ...	0·015	0·076
Do 16 Pit C ...	0 018	0·071
Do 13 Pit ...	0·035	0·064
Do. 24 Pit	0·022	0·064
Average ...	0·021	0·079

The more remarkable feature of the subsoil was, however, its poor capacity for drainage. Under the guidance of Dr. R. V. Norris, the Government Agricultural Chemist, experiments were conducted to determine the relative draining capacities of our soils and the results are noted below.

Determination of the permeability of Cane Breeding Station soils.

Description.	Quantity of water that passed through in a noted time.	Percolation rate, i.e., water that passed in one hour. Soil col. 15 cms. Water head 40 cms.
Field No. 13 Pit—		
First layer	1,015 cc. in 16¼ hours.	62·5 cc. per hour.
Second layer	Water was kept at a height of 40 cms, as in other cases over the soil column of 15 cms for 24 hours. Only one-third of the column became wet during the time.	
Third layer	285 cc. in 21¼ hours.	13·4 cc. per hour.

Description	Quantity of water that passed through in a noted time.	Percolation rate, i.e., water that passed in one hour. Soil col 15 cms. Water head 40 cms.
Field No. 18 Pit—		
First layer	115 cc. in 2 hours	57 5 cc
Second layer	Impervious as in Field No 13. Water was allowed to stand at the usual height for 16 hours, but could wet only about one-third of the soil column	
Third layer	322 cc. in 16¼ hours.	19·8 cc. per hour
Field No. 24 Pit—		
First layer	420 cc in 4½ hours	93·3 cc. per hour.
Second layer ..	6·5 cc in 6 hours ...	1 1 cc. do.
Third layer	72 cc. in 3 hours .	24·0 cc do.

The following figures in respect of a few dry land soils in the neighbourhood are given for purp oses of comparison :—

Ukkilipalayam Pit—		
First layer	1,090 cc in 5 hours	218 cc. per hour.
Second layer	300 cc in 4¼ „ ..	70·6 cc. „
Third layer.	155 cc. in 4 „	38·8 cc. „
Fourth layer ...	360 cc. in 4 „ ..	90·0 cc. „
Lingaigoundanur Pit—		
First layer	1,250 cc. in 3½ hours.	344·3 cc. per hour.
Second layer ...	570 cc in 4 „	142·5 cc „
Third layer . . .	700 cc. in 5½ „	127 3 cc. „
Fourth layer	815 cc in 5¼ „	155 0 cc „
Vadavalli Pit—		
First layer	2,080 cc. in 2½ hours.	924 5 cc. per hour.
Second layer . .	410 cc in 1¼ „	273·3 cc. „
Third layer... ...	405 cc. in 3½ „	101·2 cc „
Fourth layer	1,200 cc in 4⅘	248·3 cc. „
Sand	3,000 cc. in 15 minutes	12·000 cc. per hour.
(The sand was passed through a 2 m.m. sieve just like ordinary soil samples)		

It will thus be seen that the hard layer underlying the surface soil, besides being charged with a considerable quantity of saline matter, forms an impervious pan itself, effectively preventing drainage and the washing out of the salts injurious to

sugarcane. Besides, sodium chloride has been found to have the most toxic effect on soil bacteria (vide "Soil Science," 1918, Vol. VI, pages 463–477), the combined effect of these features being seen in the poor growth of thick canes and in the bad quality jaggery obtained from thin canes.

The existence of a hard pan below the surface soil naturally leads to a consideration of its cause.

Discussion about the possible causes for this hard pan.—It is well known that in all cultivated lands, whether rainfed or irrigated, constant ploughing to a uniform depth, season after season and year after year would naturally produce a more compact layer of soil below the plough with a diminished drainage capacity. Such a condition may also be due to the natural disintegration of subsoils being less than the surface soil or to the clayey portion of the surface soil finding its way to the subsoil. A pan formed in this manner is generally reclaimable and is not harmful; nay, in rare cases (vide page 223, "Agriculture," Vol. I, by Storer) even beneficial effects have accrued in as much as this increases the water retaining power of some soils and at the same time is not too stiff to prevent drainage. But in lands such as ours, constant irrigation with brackish water must have tended to make an ordinary plough pan into an alkaline pan, the reclamation of which is extremely difficult of accomplishment. Though traceable in a general way to brackish water, the formation of such pans is far from having found a satisfactory explanation.

Literature.—According to an investigation published in "University of California publications in Agricultural Sciences" 1916, Vol. I, No. 10, page 338,

it is stated that the Davis clay loam soil to which surface applications of solutions of NaC_l, Na_2SO_4, and Na_2CO_3 had been made, became very impervious to water, difficult to cultivate, and manifested the characteristics of a high degree of diffusion, although these salts have been shown to exercise flocculating powers on suspensions of this soil, etc. The diffusion in soil treated as described above seems to be closely associated with the direct addition of sodium to or with the absorption of sodium by the soil, thereby producing a new silicate complex of a colloidal character in the soil, etc." A. D. Hall on page 245 of his "Soil" describes the effect of sodium chloride on the texture of soils as "due to the attack of the sodium chloride upon the double silicates of the soil, lime in particular, being displaced by soda. The result is the deflocculation of the clay which will not settle down for many weeks when suspended in water." In another place (page 285) Hall says "Many clay soils, especially when undrained, possess a great tendency to accumulate hydrated ferric oxide.

This deposit sometimes forms a serious obstacle to cultivation and requires to be broken up with a crowbar or a subsoil plough before any deep rooting crop can be properly grown. Its origin is perhaps not entirely explained as yet. The respective shares of the iron bacteria of Winogradsky or the purely chemical actions of solution and reduction by the organic matter and carbonic acid followed by a re-deposit on evaporation is a matter requiring further investigation. The formation of the material is only noticed in clays very poor in calcium carbonate and liable to water logging through insufficient percolation."

SUMMARY.

(*a*) Sodium chloride in irrigation water is the most harmful for sugarcane cultivation. Anything over 75 parts of it in 100,000 parts of water is not desirable.

(*b*) Its evil effects persist for a long time as seen from the failure to obtain good jaggery from thin canes even after stoppage of saline water irrigation. Analyses of some molasses obtained from thin cane juices showed that they contained large amounts of chlorides.

(*c*) Saline water irrigation, besides injuring the chemical composition of soil, appear to impair its physical condition also. A hard impervious pan is formed especially in soils that are clayey and that do not contain much lime.

I am indebted to Dr. C. A. Barber, C.I.E., and M.R.Ry. Rao Sahib T. S. Venkataraman Avargal, B.A., for valuable suggestions and to my colleague M.R.Ry. G. Ganapati Ayyar, B.A., for his willing help in carrying out several of the analyses.

THE FEEDING VALUE OF COTTON SEED

BY ROLAND V. NORRIS, D.SC.,
Government Agricultural Chemist.

There appears to be a somewhat widespread belief that Cambodia cotton seed is of inferior feeding value compared with seed from other strains of cotton. This belief found expression at the last Agricultural Conference held at Coimbatore when several speakers asked for information on this point. A series of analyses of different

varieties of cotton seed has accordingly been made, the results of which are tabulated below. While the number of samples examined is much too small to permit of any sweeping statements, the figures obtained afford no evidence that Cambodia seed is in any way inferior to other types in regard to feeding value. The analytical figures are quoted in full in Table I and summarized in Table II. The significance of these figures will, however, be made clearer by a reference to Table III which shows the percentage of *digestible nutrients*, calculated from Kellner's digestion co-efficients, in each type of seed analysed and the nutritive ratios and starch equivalents of the samples.

Nutritive Ratio.—The nutritive ratio expresses the ratio between the digestible protein of the food and the digestible nitrogen-free constituents (carbohydrate, fibre and fat). A high nutritive ratio therefore indicates a relatively high proportion of digestible protein—the most expensive item of a ration and is to that extent an index of the relative value of different foods of the same type. From this standpoint, it will be seen that the Cambodia and Westerns samples are equal in value and have both given rather better figures than any of the other types of seed.

Starch Equivalent.—This figure indicates the value of a food for heat or energy production compared with starch as a standard. A high starch equivalent denotes therefore a high capacity of energy production. In this case Westerns seed gave a slightly better result than the four other types which were all approximately equal in value. The difference, however, is too slight to be of any

real significance considering the small number of samples examined.

The results, therefore, so far as they go, indicate that Cambodia seed *of average quality* is fully equal in feeding value to other types of cotton seed. It is probable therefore that the prejudice against Cambodia is due to the use of inferior samples of seed derived from plants badly attached with boll worm or other pests. Such seed is usually of a bad colour and will undoubtedly give poor analytical results.

TABLE I.

Analyses of Cotton Seed.

Serial number.	Laboratory number.	Nature of sample.	Moisture.	Ash.	Fat.	Crude fibre.	Carbohydrate	Crude protein.	True protein (albuminoids)	Nitrogen.	Phosphoric acid	Potash.	Remarks
			Per cent	Per cent	Per cent	Per cent.	Per cent.	Per cent	Per cent	Per cent	Per cent.	Per cent	
1	8/21	Cambodia ...	9·92	4 51	15·90	22 68	28 09	18·90	18 73	3 02	1 09	1 27	From Negapatam.
2	9/21	,, ...	8 83	4 44	15·98	26 10	25·67	18·98	16·71	2 97	1 05	1·22	,, Nidāmangalam.
3	10/21	,, ..	8·93	4·51	16·30	22·15	29 21	18 90	18 64	3 02	1·11	1·23	,, Koradacherri.
4	11/21	,, ...	9 07	4·33	16·10	25·20	25 00	20·30	20·24	3·25	1 02	1 22	,, Māyavaram
5	178/13	,, .	7·65	4 14	20·45	16·99	29·08	21·69	21·63	3 47	1·37	1·05	,, Tuticorin.
6	480/12	,, ...	7·61	4 19	18·69	26 88	24·57	18 06	18 06	2 89	1·39	1·89	,, Trichinopoly.
7	481/12	,,	8 29	3 85	16·33	25 29	29 68	16·56	16·56	2 65	1·16	0·80	,, Tuticorin
		Average for Cambodia.	8 61	4 28	17·11	23·61	27 33	19·19	18·65	3 07	...	..	
8	467/20	Northerns ...	9·55	4 06	19 80	19 55	27·79	19 25	18·03	3·08	1 14	1·16	Strain N-14 from Nandyal.
9	220/11	,, ...	7 49	3 26	19·81	24·73	25 71	19·00	17·37	3 04	...	...	From Nandyal.
		Average for Northerns.	8 52	3 66	19·805	22·14	26·75	19·12	17·70	3 06	..	..	
10	466/20	Westerns ...	8·60	3·84	17 49	16·75	33·54	19·78	18 49	3·16	0·78	1·29	H. 25 from Hagari.
11	306/09	Tinnevellies ..	8·76	3·41	17·40	22 84	29 78	17·81	16·25	2·85	. .	...	
12	16/21	Uppam	9 30	3·91	21·50	20 75	27 30	17·24	14·53	2·76	0·93	1·74	From Coimbatore.
13	37/10	,, ...	8 04	3 55	14 80	29·00	28 73	15·88	15·25	2·54	...	...	,,
14	39/10	,, ...	8 19	3·34	16 66	23 22	32·12	16·47	16·06	2·63		...	,,
15	38/10	,, ...	8·21	3 68	14·90	24·53	33·12	15·56	13·31	2·49	...	...	,,
		Average for Uppam.	8·43	3·62	16·96	24·37	30 32	16·29	14·79	2·60	...	...	

TABLE II.

Abstract of Table I.

—	Moisture.	Ash.	Fat.	Crude Fibre.	Carbo hydrate.	Crude protein.	True protein.	Remarks.
Cambodia ...	8·61	4·28	17·11	23 61	27·33	19·19	18·65	Average of 7 analyses.
Northerns .	8·52	3 66	19 805	22·14	26·75	19 12	17·70	Do. 2.
Westerns ...	8 60	3·84	17·49	16 75	33·54	19·78	18·49	Single analysis.
Tinnevellies.	8·76	3 41	17·40	22 84	29 78	17·81	16 25	Do.
Uppam ...	8·43	3·62	16·96	24·37	30·32	16·29	14·79	Average of 4 analyses.

TABLE III.

Analyses of Cotton Seed.

—	Digestible nutrients.			Nutritive ratio. N/R.	Starch equivalent.	Remarks.
	Fat	Carbohydrate and fibre.	True protein			
	per cent.		per cent.	per cent.		
Cambodia ...	14·89	31 60	11 67	1/5·5	78·2	Calculated on Kellner's Digestion co-efficients for ruminants.
Northerns ..	17·23	30·20	11·08	1/6 0	82·0	
Westerns ...	15·22	29 50	11·57	1/5·4	77 1	
Tinnevellies.	15·14	32·25	10 17	1/6·4	78·1	
Uppam ...	14·76	33·68	9 26	1/7·2	77·4	

HELMINTHOSPORIUM DISEASE ON "RICE" (ORYZA SATIVA)

BY M.R.RY. S. SUNDARARAMAN,

Acting Government Mycologist.

Reports were received during the months of August and September from the Tahsildars of Narasapur and Bhīmavaram, Kistna district, that a disease locally known as "Yerrathegulu" was

causing serious damage to paddy crop in several villages. The investigation of the disease was taken up. When the localities were inspected there were several plants showing attack by "stem-borer," and "silver-shoot" disease, known locally as "Kodu." Both these were caused by some insects. While carrying on this investigation, in certain fields where the growth was very poor there was also a disease forming leaf-spots in which the fungus "Helminthosporium" was present.

In fields growing vigorously very few plants showed the disease. It was severe in low-lying tracts and in crops subject to submersion under water during the rains when the fields could not be easily drained. In the localities mentioned there was heavy rain during the last half of October and the first week of November in 1919. In several places it was a blight in nurseries. Wherever observed, the disease has been found to affect young plants and plants weakened by bad drainage and overflooding. A combination of high humidity and temperature seems very favourable to the spread of the disease. Some indications or difference in varietal resistance have been observed ; but this requires verification.

Diseased spots were seen on leaves, leaf-sheaths and glumes. On leaves the disease showed itself by small oval spots with greyish—white central portion. In this central portion smoky black areas are seen which, on scraping, were found to show dark—brown hyphæ and spores. Diseased spots appeared on both sides of the leaves. They either remain single and isolated or may join together to form large discoloured areas. When a large number of these diseased spots occur together

that portion of the leaf appears yellow and if several of the leaves are affected in this manner the whole field presents an yellowish red appearance from a distance and hence, the people mistake this yellow disease for "Yerrathegalu," or red disease. These symptoms can easily be distinguished on close inspection from those suffering either from "root-disease" or from "stem-borer" attack or "silver-shoot" disease. In most cases it is generally found affecting plants in the nurseries where the disease spreads very rapidly from plant to plant. Weather conditions are the prominent factors for its spread. Continued heavy rains with cloudy and muggy weather are found to be favourable for the development and spread of this Helminthosporium disease. In advanced stages the ear-heads also are affected. Dark, brown spots appear on the glumes. The grains inside the glumes shrivel up and are discoloured. But most grains remain unaffected and it, therefore, appears to be purely local infection from diseased leaves. Even in severe cases few grains are attacked, portions of the spikelets remain unaffected and the grains mature without any disease whatever.

The mycelium of this fungus is found in sections of leaves to ramify through the intercellular space in the mesophyll tissue of the leaf. Groups of hyphæ were also noticed in sections breaking through the upper epidermis and also through the stomata bearing tawny conidial clusters and spores.

The fungus was brought into pure culture and pure culture inoculations on plants raised under sterile conditions were successful in developing typical disease symptoms.

Further work on the investigation of this disease is in progress and will form the subject of a paper I am preparing.

EFFECT OF QUALITY OF SEEDLINGS ON YIELD OF PADDY

By F. R. PARNELL, Esq.,
Government Economic Botanist.

In conducting variety tests for yield in paddy care is necessary to ensure that the seedlings of the different lots shall be as nearly alike as possible. In the trials carried out on the Paddy Breeding Station all the seed-beds for one series of strips are given the same treatment, are of the same size and shape and are sown at the same rate. In spite of this they are not always as uniform as could be desired. Some of the differences are legitimate, e.g., variations in the type of seedling produced by different strains; others, on the other hand, ought to be avoided, e.g., differences in thickness of stand due to differences in germination or variation in the size of seed and consequently of the number of seeds sown.

In order to obtain some idea of the effect on yield that may be caused by variations in seedlings some definite experiments were conducted. Two series of strips were grown for testing the yield from—

I. different types of seedlings selected from one seed-bed,

II. seedlings raised in differently treated seed-beds.

As the results of these preliminary experiments are of some general interest they are recorded here.

I. From a seed-bed of No. 24, that had been sown for non-experimental purposes and without special care, three types of seedlings were selected :—

(*a*) *Tillered.*—All with three tillers, taken from the edges of the plots where the stand was thin.

(*N.B.*—This condition should not be confused with that of old seedlings that have started to run to head.)

(*b*) *Single strong.*—All single shoots but thick and strong.

(*c*) *Single weak.*—All single shoots and sound but thin.

These were planted in alternating strips, 40′ × 4′, repeated four times in each of two plots. The seedlings were planted singly 6″ apart each way. For some time after planting no rain was received, it was very hot and the conditions were rather less favourable than normal though the plots were irrigated and never allowed to dry up.

The *tillered* lots established themselves quickly and went ahead almost at once. The *single strong* lots took longer to establish themselves and went back distinctly before going forward. The *single weak* lots did badly for some time and recovered very slowly : a few seedlings died shortly after planting but were replaced in order to eliminate as far as possible variations in yield due to different numbers of surviving plants. The differences between the three types became gradually less marked during later growth but were still visible at flowering ; moreover the tillered lots flowered a few days earlier than the others.

The grain yields are given in the following table in 10 gram units :—

Plot		Tillered.	Single strong.	Single weak.
B 5a	1	672	579	501
	2	655	506	453
	3	593	494	417
	4	618	452	395
B 6a	1	719	508	483
	2	570	490	373
	3	600	415	403
	4	622	489	494
Total		5,049	3,933	3,519
Relative		*143*	*112*	*100*

The differences between the three types are very marked, probably rather more so than they would be in a more favourable season. If seedlings of the tillered type could be raised ordinarily it would very greatly increase the crop, but the area of seed-bed required would probably be prohibitive. It is by no means impracticable, however, to raise seedlings of the single strong type. They were distinctly better than are ordinarily obtained where the rate of sowing is 1 M.M. to 1 cent of seed-bed, and it is probable that it would be good practice to reduce this seed-rate still further. The single weak type would compare favourably with the seedlings ordinarily raised by cultivators.

II. Four seed-beds were raised as below, the same seed, local Tulukka Samba, being used for all :—

	Manuring.	Seed-rate per cent.
(*a*)	10,000 lb. green leaf per acre.	1 M.M
(*b*)	Do. do.	3 ,,
(*c*)	Nil.	1 ,,
(*d*)	Nil.	3 ,,

Conditions, both for the seed-beds and after planting, were rather unfavourable. There was little difference visible at the time of planting though the manured lots were rather a better colour than the unmanured. They were planted in strips in the same manner as those described above and gave the following results :—

Plot.		Thick.		Thin.	
		Manure.	Nil.	Manure	Nil.
E 4 a	1	542	588	613	624
	2	562	588	623	628
E 4 b	1	575	540	654	616
	2	520	540	631	595
E 4 c	1	546	550	629	618
	2	528	546	610	620
E 4 d	1	468	505	603	560
	2	503	477	587	538
Total ...		4,244	4,334	4,950	4,799
Relative ...		*98*	*100*	*114*	*111*

It is obvious that manuring the seed-bed has had little or no effect on the yield, whereas the thinner sowing is decidedly better than the thick.

As already noted the conditions generally were rather unfavourable and the differences, in both experiments, may be greater than they would be in a normal year. Somewhat similar experiments will be continued for several years and any possible effect of the season will then be visible.

ANALYSES OF VARIETIES OF RICE

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In 1919 owing to the scarcity of foodgrains in Ganjām and neighbouring districts rice was imported in large quantities from Burma, Bengal and Orissa as well as from the Kistna Delta. A collection of 26 varieties made by the Deputy Director of Agriculture, I Circle, Cocanada, was forwarded for analysis and the results obtained are tabulated below. It will be seen that there was a very marked difference in the food value of these varieties. While the best sample contained over 11 per cent of "Crude Protein" with a nutritive ratio of 1 : 8, the worst had only half the above protein content and a nutritive ratio of 1 : 17. The average figure for crude protein in all the samples examined was 7·89. The nutritive ratio calculated on the average results was 1 : 11·4.

Analyses of Varieties of Rice.

Name of variety.	Source from which derived.	Laboratory Number.	Moisture.	Ash.	Crude protein.	Crude fibre.	Fat.	Carbohydrates.	Albuminoids.
Budama, White ...	Gōdāvari ...	534	10·67	0·74	6·54	0·28	0·71	81 06	6 53
Gutikusuma ...	Kistna .	535	10·41	0·83	6·91	0 29	0 70	80·86	6·66
Iswasakora ...	Nellore ..	536	11 06	0 85	8·08	0 27	0·95	78 79	7·49
Kesara .	Kistna ..	537	10·81	0·88	6 39	0 30	0·67	80·95	6 26
Kristnakatukalu ...	Do. ..	538	10 12	1 08	6 51	0 52	0 65	81 22	6·50
Poombalai	South India.	539	9 76	1·35	11 61	0·25	0·45	76 58	10 94
Ratnachudi . .	Ganjām ...	540	9·92	1·04	7·29	0 42	1·23	80 10	7 04
Swarnalu ...	Gōdāvari .	541	11·12	1·29	10 38	0 58	2·24	74·39	9 83
Uttirkar ...	South India.	542	10 52	1·06	7 63	0·32	1 86	78 61	7·44
Avasara Samba ..	Do	543	11 56	1·15	7·71	0 24	1 25	78·09	7 42
Velladam .	Gōdāvari .	544	11 30	0·69	5·61	0 15	0 96	81·29	4 36
Gilama ...	Do. .	545	10 96	0 86	6 39	0 18	1 13	80·48	6 11
Sanna Atragada ..	Kistna ...	546	11·13	1·35	6·23	0·11	1 35	79 93	5 92
Atragada ...	Do.	547	10 21	0·94	7·85	0 30	0 99	79·71	7 56
Rasangi ..	Gōdāvari ..	548	10·09	0·91	7·39	0·27	0 80	80 54	6 39
Thurpusanna Akkullu ..	Do. ...	549	9·89	1·22	8·64	0 40	0 91	78 94	6 14
Akkullu ..	Do. ...	550	9 94	1·41	7·23	0 35	0 68	80·09	6·53
Kanaka Sompu .	Ganjām .	551	11 61	0·78	7·11	0 14	0 99	79·37	6·29
Dalwa .	Gōdāvari ..	552	9·81	0·98	9·97	0 28	1·25	77 71	8·08
Garikisanna Vari ...	Do .	553	9 32	0 84	10·32	0·12	1 12	78·28	9 28
Metta Budagalu .	Ganjām ..	554	9·45	1·12	8 92	0 12	1 12	79·27	8 09
Pishanam ...	Kistna ..	555	10·10	0·97	8·07	0 30	1 05	79 51	7 91
Konamani No. 7 .	Gōdāvari	556	10 21	1 20	7·31	0·29	0 99	80 00	6·80
Local Konamani ...	Do. .	557	10·32	1 23	8 65	0·41	1 28	78 11	8 11
Punasa Konamani ...	Do. .	558	9·18	0 98	9·10	0 38	0 92	79·44	8 56
Budama, Black ...	Do. ...	559	9·24	1 31	7 92	0·32	0 91	80·50	6·10

Abstracts of results obtained.

	Maximum.	Minimum.	Average.
Fat	2·24	0 45	1 04
Crude protein	11·61	5·61	7·89
Carbohydrates	81·29	74 39	79 35
Crude fibre	0 58	0 11	0·29
Albuminoids	10·94	4·36	7·21

NOTE ON THE TRIALS WITH NITROLIM AS A FERTILIZER FOR PADDY AND OTHER CROPS

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The chief crop on which Nitrolim or Calcium Cyanamide was tried was paddy, and the results obtained on the different farms are tabulated in the annexed statement.

During the three years' trials at Samalkota (1916–17 to 1918–19) the cyanamide plots gave slightly higher yields than unmanured plots. On the Manganallur Farm the results were against cyanamide in 1916–17 but in 1917–18 and 1918–19 they were in favour of it as against "no manure." In combination with green leaf the results, when compared with those of green leaf alone, were favourable in 1916–17 and 1917–18 but slightly unfavourable in 1918–19, but on the Manganallur Farm the result was unfavourable in all the three years. In combination with superphosphate cyanamide gave a slightly better yield than superphosphate alone in 1918–19. On the Nandyal Farm, though a slightly higher yield was obtained from the cyanamide plots the result was unfavourable when cyanamide *plus* green manure *plus* super were tried against the latter two alone. On the Central Farm the result was favourable in 1919–20 and unfavourable in 1918–19.

The results are thus favourable in some cases and unfavourable in others. In most cases, however, the result whether positive or negative cannot be said to be conclusive as the trials were made in only single or duplicate plots. In only one case (Central Farm—1919–20) was the difference

between manured and unmanured plots beyond the range of probable error (30 : 1 chance) and in this case the result was in favour of cyanamide.

The failure of the manure to give higher or adequately higher yields than "no manure" or other manures is traceable in some cases to the manure being applied on the surface while the young crop is standing or just before planting or sowing, resulting in the plants being burnt up. In others it appears to be due to the growth being too luxuriant to yield a good crop. The burning action may be prevented by applying the manure some time before planting or sowing (two days' time has been found sufficient on the Central Farm) and working it into the soil so that the roots of the plants do not come in direct contact with the manure. Overluxuriance of the crop may be prevented by applying the manure in small dozes.

In fact, in the trials referred to above, 1 cwt. of the manure gave better results than two cwts. With these precautions and in combination with a phosphatic manure whenever necessary, it may, from the results so far at hand, be hoped that cyanamide may advantageously be used for paddy.

Of the other crops on which this manure was tried and appreciably higher yield than in the unmanured plots was obtained from fodder cholam on the Koilpatti Farm in 1918–19. The results were inconclusive with Tenai and Ragi on the Central Farm.

Statement showing results of cyanamide experiments on the various farms.

Serial number.	Name of crop and variety.	Farm.	Year	Yield with no manure or manured other than cyanamide.			Yield with cyanamide with or without other manures.			Interval between manuring and sowing or planting.	Remarks.
				——	Grain per acre	Straw per acre	——	Grain per acre	Straw per acre		
					LB.	LB.		LB.	LB.		
1	Paddy-Palagummasari.	Samalkota ...	1916-17	No manure ...	2,497	5,489	Cyanamide 2 cwt. ..	2,772	6,507	Nil.	Average of 4 plots.
2	Do.	Do. ...	1917-18	Do. ...	1,706	4,266	Do. .	1,763	5,056	Do.	Do.
3	Do.	Do ...	1918-19	Do. ...	3,109	6,792	Do. ..	3,177	7,504	Do.	Do.
4	Paddy-Red Samba.	Manganallur.	1916-17	Do ..	2,860	3,230	Do. ...	2,580	2,960	Do.	
5	Do.	Do.	1917-18	Do. ...	1,685	1,885	Do. ...	1,830	2,040	Do.	
6	Do.	Do.	1918-19	Do. ...	795	1,490	Do. ...	930	1,615	Do.	
7	Paddy-Poombalai.	Central Farm.	1918-19	Do. ..	3,786	4,896	Do. ..	3,352	3,840	4-11 days.	
8	Do.	Do.	1919-20	Do. ...	3,786	...	Do. 1 cwt. ...	4,644	...	2 days.	
9	Paddy-Second crop (Vankalu).	Nandyal ...	1918-19	Do. .	872	...	Do 2 cwt. ...	881	...	1 day	
10	Paddy-Red Samba.	Manganallur.	1916-17	Ammonium sulphate 212 lb.	2,765	3,265	Cyanamide 2 cwt. + green leaf 4,000 lb.	2,525	2,935	Nil.	
11	Do.	Do.	1917-18	Do.	2,075	2,360	Do.	2,500	2,845	Do.	
12	Do.	Do.	1918-19	Do.	1,105	2,090	Do.	1,040	1,930	Do.	
13	Do.	Do.	1916-17	Green leaf 4,000 lb.	2,825	3,375	Green leaf 2,000 lb. + 112 lb. Cyanamide	2,420	2,705	Do.	
14	Do.	Do.	1917-18	Do.	2,050	2,335	Do.	1.995	2,260	Do.	
15	Do.	Do.	1918-19	Do.	905	1,715	Do	895	1,630	Do.	
16	Paddy-Palagummasari.	Samalkota ...	1916-17	Do.	2,283	5,885	Cyanamide 2 cwt. + 4,000 lb. green leaf.	2,647	6,638	Do	

17	Do.	Do. ...	1917–18	Do.	1,704	5,225	Do.	1,929	6,322	Do.
18	Do.	Do. ...	1918–19	Do.	3,379	7,163	Do.	3,227	7,546	Do.
19	Paddy-Kuruvai.	Manganallur.	1918–19	No manure ...	1,410	332	Cyanamide 2 cwt. + 250 lb. Super.	1,710	3,830	Do.
20	Paddy-Ottadan.	Do.	1918–19	Do. ...	630	1,200	Cyanamide 1 cwt. + 250 lb. Super.	730	1,280	Do.
21	Do.	Do	1918–19	Super 250 lb. ...	710	1,350	Cyanamide 2 cwt + 250 lb Super.	760	1,470	Do.
22	Paddy-Kuruvai.	Do.	1918–19	Do. ...	1,620	3,950	Do.	1,710	3,830	Do.
23	Paddy-First crop.	Nandyal' ...	1918–19	Green leaf and super.	3,584	3,338	Cyanamide 1 cwt. + green leaf + Super	3,086	3,048	1 to 3 days.
24	Paddy-Second crop.	Do. ...	1918–19	Do.	1,214	1,907	Do.	1,141	1,771	1 day.
25	Do	Do. ...	1918–19	Fish guano ...	905	..	Cyanamide	881	..	Do.
26	Chollam (Periya Manjal).	Koilpatti	1918–19	No manure ..	..	6,142	Do 2 cwt. ...	...	9,384	Nil.
27	Do.	Do. ...	1918–19	...	...	...	Cyanamide 2 cwt. + 5 Cwt. fish guano.	...	10,528	Do.
28	Tenai	Central Farm.	1918–19	No manure ...	707	773	Cyanamide 1 cwt. ...	663	810	Do.
29	Do	Do.	1919–20	Do. ...	700	...	Do. ...	840	...	42 days.
30	Ragi	Do.	1919–20	Do. ...	2,728	...	Do. ...	2,332	...	6 days.