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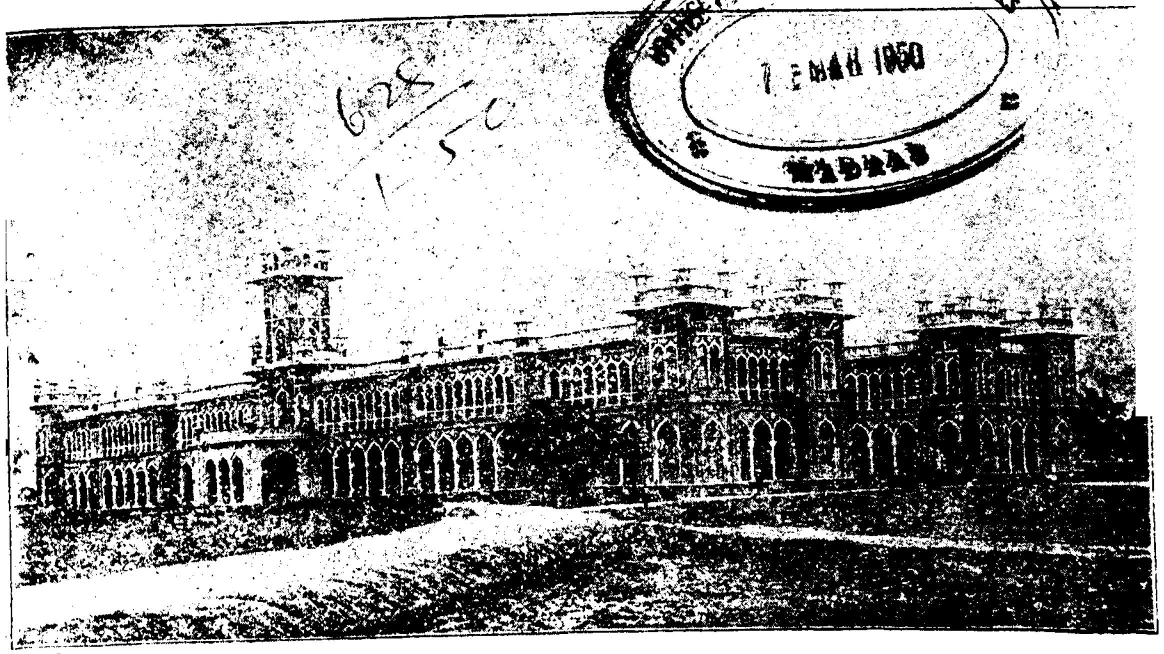

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# The Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXXVII February 1950 No. 2

## Editorial

**Tractors and trace elements:** The relation between trace elements and tractors might seem at first sight to be as remote as in "Darwin's" famous correlation between cats and clover, but it is none the less real, for all the seeming paradox. It is almost a truism nowadays to say that the Food Problem in India is a very acute and urgent one. All possible measures are being suggested and many of them also adopted, in order to get over the food shortage. Chief among those is the use of tractors and heavy ploughs to open up waste lands and bring them into cultivation. The other aspect is a more intensive cropping of the present area, with the aid of fertilizers, both organic and inorganic. The question of maintaining adequate levels of trace elements or micronutrients has a vital bearing on both these aspects in relation to improving our crop production.

When new land is broken up by means of tractors and heavy ploughs, a good portion of the subsoil is brought up to the surface. This 'raw' subsoil takes two or three seasons to get sufficiently weathered and support a good growth of crops. This inability to support plant growth is due to the fact that the food elements in the raw subsoil are not in an available form. Applications of the usual fertilizers like ammonium sulphate and superphosphate cannot improve this infertility, since most of the micronutrients, otherwise known as trace elements, are also in an unavailable form. And hence there is a need to recognize and determine in each case, the nature of the trace element dificiency which acts as a limiting factor in raising good crops from newly reclaimed land.

It has also to be admitted that supplying these micronutrients in suitable forms will become much more important in the future than it is to-day. Agriculture is now on a more intensive scale, and what might have been a sufficient supply of trace elements (like iron, manganese, copper or zinc) for a 1000 lb. crop of paddy is not sufficient when a 4,000 lb. crop is to be raised from the same area. With a wider and greater use of "high analysis" fertilizers manufactured from relatively pure salts there is also a corresponding need to keep the available amounts of other nutrients at adequate levels. Animal manures and other organic manures do provide a substantial insurance against trace elements deficiencies, but a widespread use of tractors for agricultural operations is bound to result in a lack of farmyard manure, thus aggravating the need for trace elements. From the point of view of the fertilizer industry, this potential need for the micro-nutrients is a factor to be reckoned with in good time, although at the present moment it is hardly in a position to suggest any practical measures. A great deal of scientific survey work is necessary, first to delimit areas where micro-nutrients deficiency exist and then to formulate remedial measures to rectify such deficiencies by adding the required elemets to the usual fertilizers that are applied to crops in these areas.

# The wild Gingelly of Malabar

## (*Sesamum orientale*, Linn. Var. *malabaricum*, Nar. var. nov.)

## *Sesamum orientale*, Linn. = *S. indicum*, Linn.

*By* 2914

C. M. JOHN, G. V. NARAYANA and C. R. SESHADRI
Oilseeds Section, Coimbatore

Sesame, *Til* or gingelly is an important oilseed and an article of food. It has been found in cultivation in the tropical countries, particularly in India and the Orient from very ancient times. All the cultivated forms and types come under the species *Sesamum indicum*, Linn. It is not known to have been found in the wild state by the earlier systematists. Hooker (1885) mentions three species of *Sesamum* of which *S. indicum*, Linn. is one. Gamble (1924) also has described the same three species as Hooker. Thiselton Dyer (1906) speaks of 17 species of *Sesamum* including *S. orientale*, Linn. But none of these authorities has mentioned any varieties of *S. indicum*, Linn. The species is very variable, growing as it does over a wide extent of the globe, for many centuries. Kashi Ram (1929) described 30 types of *Sesamum* occurring in India and Burma.

The Oilseeds section of the Department of Agriculture, Madras (Coimbatore) has been studying all available gingelly material collected or obtained from various places from 1930 onwards. In the collections maintained at the Groundnut Research Station, Tindivanam (S. Arcot, Madras) there is one distinct variety collected from the hills of Malabar. While the ordinary cultivated gingelly is found only in the fields, this variety is always found only on the uncultivated laterite hill tops of the west coast in a wild state and is always self sown. The seed which is quite distinct from any of the cultivated types of South India is not known to be collected or made use of by the people of the locality. The duration of the variety is about $4\frac{1}{2}$ months. It has one unique character namely that it can withstand even a rainfall of 750 inches during its life time and is not adversely affected by it while none of the cultivated types can grow well under heavy rain and are therefore never grown during the period of heavy rainfall. Therefore the wild variety was crossed with S. I. 263/3, S.I. 209/8 and S.I. 94/2 (selection from the local-Tindivanam) so as to evolve economically useful strains. The S. I. numbers refer to cultivated gingelly strains of the Tindivanam station. Three crosses namely X 30, X 35 and X 38 were produced. One economic selection from the $F_3$ progenies of X 38 was found to be the best and it is now the popular strain called TMV. 3 gingelly of the Department. It has done well both as a summer and also as a rainfed crop giving an increased yield of seed of 20 30 per cent. over the local type one of the original parents. The crossing work with the wild gingelly was started in 1934 and the new strain was first spotted out in 1941.

The wild gingelly is known to have been collected by systematists from time to time. The earliest specimen of the variety in the Madras Herbarium (Coimbatore) was collected as early as in 1884 at Trichur (Cochin). Subsequent collections were made in 1900 at Sullia in S. Kanara. Ichipalle Reserve Forest in Coimbatore District in 1924, Walayar—Malabar in 1929. Though the name wild gingelly "Kattu Ellu" was entered in some of the sheets in the Herbarium, they were all identified as *S. indicum*, Linn. Its habitat extends from Malabar to parts of Bombay and Central Provinces. As already mentioned the variety is unique in having very long duration and capacity to withstand very heavy rainfall; further the percentage of oil is only 32 as against 50% in most cultivated types. The seed characters also are quite different from those of cultivated types. Also it has been found gregariously in the wild state. Therefore, it is now described as a distinct variety. It freely crosses with other cultivated types of gingelly giving a high percentage of fertile hybrids. The chromosome number (2n) is 26 as in any type of gingelly.

Abraham (1945) reports that the wild sesame of Travancore though closely related to the cultivated sesamum in certain characters is quite distinct from *S. orientale*. His cytological investigations appear to have lent him support to the view that it is a new species hitherto undescribed and he has provisionally named it as *S. grandiflorum*. His hybrids of the wild sesame with *S. orientale* are said to be totally sterile. Therefore it is probable that the particular wild sesame of Travancore of which the writer mentions is different from that of Malabar. However Abraham's description of the Travancore wild sesame is not available for confirmation.

**Description of the wild gingelly from Malabar** *S. orientale*, Linn. Var. *malabaricum*. Nar.: An erect, shallow rooted, much branched annual herb, with conspicuous purple flowers, growing to a height of 2—5 feet, gregarious and met with in the wild state on the low laterite hills of Malabar and elsewhere from July to November every year. It has a life period of about $4\frac{1}{2}$ months. *Stem* green or tinged with purple, quadragonous with a longitudinal groove running the whole length of each side, pallucid gland dotted all over and hairy, hairs minutely gland tipped. *Leaves* heteromorphic, opposite, ex-stipulate long petioled towards the base. In well grown specimens petiole is 4 inches long and lamina $4'' \times 3\frac{1}{2}''$, ovate acute, shallowly or deeply three-lobed, margin distinctly or indistinctly dentate, upper surface darker green with impressed veins, lower surface paler, distinctly veined. The leaves get reduced in size towards the top where they are sub-opposite or alternate, subsessile and entire, lower surface conspicuously hairy and gland dotted like the stem. Glands rather sticky when not exposed to rain. *Flowers* purple, conspicuous, solitary in the axils of leaves, towards the tops of branches, very short pedicelled, with two yellow glands at the base; each gland with a narrow bract. *Calyx* about 1/5th inch long, deeply five lobed, lobes narrow pointed, very hairy, persistent. *Corolla* $\frac{3}{4}$—1 inch long light purple when open (in the mornings) and gradually becoming deeper in colour and dark purple when it withers in the afternoons; constricted at the base, gibbous, then expanding; limb 5-lobed, lobes broad, the middle lobe of the anterior half of the limb is always deep purple, longer than the rest by $\frac{1}{4}$ inch and acute while the others are obtuse; a dark purple crescent surrounds a blotch of yellow guide on the anterior side within the corolla tube. The guide leads to a deep yellow bar towards the base of the tube. The purple dots below the bar are very distinct and numerous; the corolla tube within is purple dotted all over. *Stamens* four, didynamous, each anther with a dark purple longitudinal line along the line of dehiscence; *Ovary*, superior, mounted on a glandular disc and two celled; *style* erect, long and stigma bifid. *Fruit*, erect, $\frac{3}{4}$ inch long, 4-loculed septicidally dehiscing, somewhat woody (4 sided); *capsule* longitudinally grooved on each side between rows of seeds, tip of fruit obtuse or rounded with an abrupt short acumination about 1/30 inch long. Number of seeds in a capsule about 64 in four, single rows. The number of fruits in a plant varies considerably and in a vigorous plant it may be as high as 300 or 400. *Seed* small, black, ovate, 1/10 inch long and 1/32 inch thick with two distinct faces or sides; each face is distinctly rugose and bounded by a raised sharp margin; border connecting the two sides of the seed is abrupt. Percentage of germination is low. Seed is rather bitter to taste.

This wild variety of Malabar does not fully conform to any of the descriptions of the 30 types of sesame given by Kashi Ram. The seed only resembles that of type 24 and the plant has the habit of type 25, but the corolla is different. Type 18 of Kashi Ram has the lowest oil content viz., 37.88% while the Malabar wild gingelly has the record of low percentage of 32 (ether extraction).

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# Some Lessons of the Bhagavadi Demonstration Farm


By

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(Received 23rd July 1949)


The Bhagavadi Demonstration farm represents a unique effort of the department and it is perhaps the only one of its kind. Its objective is not the straight one of modernising agriculture by translating the results of research to the ryots' stock of knowledge and practices; but merely to find out, in the words of the original, the reaction of the ryot to tested measures of improvement; and the methods adopted are not obtrusive, but are directed to a close observation from behind the screen, of the path of these improved methods and means of cultivation in the lands of a chosen population of ryots. This is obviously a technique seldom adopted for propaganda and although the farm is euphemistically named a demonstration farm, there is the least attempt to demonstrate. It should not be surprising that, for that very reason, the results are more revealing and the insight closer; for as is often said, none knows when the acorns giving rise to huge forest trees are sown in a forest, while, when a tree falls, the whole forest reverberates with the noise.



The Bhagavadi farm is an adjunct of the Agricultural Research Station located in the village of the same name and at a distance of about 5 miles from the present station. It consists of a compact area of about 170 acres in close neighbourhood of the village consisting of about 37 survey numbers and owned by thirtyone pattadars but cultivated by smaller number of ryots.

**Method:** The method adopted was simple and consisted of an oral or gentleman's agreement by which the ryots agreed to raise the ordinary *mungari* and *hingari* crops using irrigation water and following the practices adopted on the parent station at Siruguppa. In lieu thereof, Government undertook to supply irrigation water free of cess in the earlier years of the experiment. A small agricultural staff consisting of one demonstrator and a fieldman acted primarily as a liaison between the ryots and the Public Works Department for arranging on request for supply of irrigation water at required intervals and intensities and secondly as an adviser on irrigation, methods of agriculture and as an observer of the progress of operations and crop-growth on the farm. Records were maintained of every agricultural operation done on each field and the final yields obtained under irrigation enquired into and recorded.

Guidance was given in methods of irrigation of the deep black soils in respect of the following:—

(a) Preparation of the land for irrigation by levelling and terracing to a slope not exceeding 1 in 100.

(b) Summer ploughing for keeping down weeds immediately after the harvest of the crops.

(c) A more extended use of implements like buckscrapers, and bundformers.

(d) More intensive manuring of the lands by raising green manures.

(e) Use of improved strains tested for suitability under irrigation,

(f) Controlled and limited irrigation of dry crops at 2 inches in 14 days.

**Duration:** The work of the scheme on the above lines had been in progress since 1944 and the results of trials of four seasons are taken for the conclusions of this paper.

**Results:** The popularity and success in the irrigation of these dry lands can be gauged from the following statements.

**STATEMENT I.**

| Year | Area under Irrigation for Mungari crops | Area under Irrigation for Hingari crops | Garden land |
|---|---|---|---|
| 1. 1944–45 | 81·72 | 9·0 | 31·5 |
| 2. 1945–46 | 52·90 | 87·2 | 31·5 |
| 3. 1946–47 | 162·90 | 81·2 | 31·5 |
| 4. 1947–48 | 5·40 | 57·9 | 31·5 |

NOTE: The optimum irrigation of either *Munguri* or *Hingari* crops of the Demonstration **F**arm should bring an area of 360 acres per season.

It will be seen that irrigation is not very popular and that the particular sample of ryot population has put in only about 25% effort for obtaining maximum results of the use of water on their lands. The results of the four seasons, experiments may also be looked at from another angle and this is presented in statement II.

**STATEMENT II.**

| | Name of crop: Cotton | Jonna — | Korra | Wheat | Groundnut |
|---|---|---|---|---|---|
| 1. No. of ryots using for one season only | 7·0 | 6·0 | | 5·0 | 2·0 |
| ,, two do. | 6·0 | 7·0 | | 3·0 | 1·0 |
| ,, three do. | nil | nil | | nil | nil |
| ,, four do. | nil | 2·0 | | nil | nil |
| 2. Yield with per acre-Mean | 437 | 692 | 427 | 539 | 886 |
| Maximum | 887 | 1453 | 807 | 1320 | 1359 |
| Minimum | 84 | 77 | 82 | 64 | 509 |

It will be seen that only two of the 52 ryots used water consistently for all the seasons and that only for the *mnugari* jonna crop and that once in alternate years, the ryot is not likely to use irrigation water. But in the generality of cases where irrigation water had been used, the increase in yields was appreciable. This is reflected in the further observation made on the farm, that the cost of leasing land has increased four or five-fold since the advent of irrigation.

While the above analysis gives an estimate of the positive side of the effort at Bhagavadi, there is a great deal more that is of vital and far-reaching consequence that has not been achieved; in fact certain features of the recommendations have made practically no impression at all. The position in these respects during 1946–47 is typical of almost all seasons and is reproduced below:



| Blocks | Total area of the blocks | Preparatory cultivation: Deep ploughing in acres | Light ploughing in acres | Harrowing in acres | Manuring: Cattle manure in acres | Sheep penning in acres |
|---|---|---|---|---|---|---|
| Mungari (Mungari-Hingari rotation block) | 59·49 | 18·61 | 40·88 | 59·49 | 12·08 | 9·35 |
| Hingari (Hingari-Mungari rotation blocks) | 88·82 | 55·96 | 11 47 | 81·82 | 3·00 | 11·20 |
| Garden - land block | 32·04 | 23·42 | 8·28 | 31·70 | 12·21 | 16·24 |

It will be seen that the important experience and results of research on the agricultural research station are not incorporated in the ryots' practices at Bhagavadi. For example, the individual fields are still of the same size and their topography little changed after four years of working. The slope of the land is in places too steep for irrigation practies; nor has he adopted the tested practice of throwing the field into conveniently long and narrow beds.

(2) Manuring is still done at the low level of dry land regions only. The consequences of this has been of a serious character; the land becomes poorer with cropping due to exhaustion and loses its structure due to loss of its organic matter.

(3) The individual units of farming on the station is still as large as before there is thus no adequate appreciation of the primary needs of irrigation farming in respect of the labour and cattlewealth that may become necessary.

In short, the cultivation on the demonstration farm is still being done without a full appreciation of the change-over from dry to irrigation agriculture. The effects of this type of water utilisation would prove disastrous in a not very long period of time. Within half a dozen years of cropping, the unmanured areas of the Agricultural Research Station have given evidence of the exhaustion and loss of cropping power. Further, efficiency of irrigation under the uncontrolled conditions on dryland farming is bound to be low and with the limited quantity of water that is available, it will be found insufficient for the entire ayacuts estimated and localised in the earlier years and with increasing deterioration of the land, irrigation itself may become unpopular.

The position to which the Bhagavadi experiments lead us may be summed up as under.

(i) The use of irrigation water is generally believed in and welcomed (ii) its efficient use is unknown and the need for so doing is not appreciated. (iii) The reaction of the ryot is apparantly favourable but is anything other than what is needed by the newer conditions to come, in the wake of the present conditions.

**Discussion:** It should be interesting and instructive to speculate on the causes of the failure or the limited success in this effort. It will be necessary to have an idea of the background viz. the characteristics of the physical environment and of the population of the tract. The more important of these may be detailed.

The region is agriculturally an old country with a very ancient system of cultivation fairly well-settled practices and rigid ideas of seasons and crops.

2. A tract of precarious and uncertain rainfall, famines occurring once in five years and deficency in alternate years.

3. Thinly populated, with more of cultivable land per head than other similar regions, with predominantly dry systems of cultivation.

4. In normal seasons, the area is self-sufficient in respect of the major cereals and is protected against starvation during famine years by a system of famine relief. It is thus manned by a population that is ordinarily on famine doles. It is to such a region that water is made available. The question may be asked at this stage — at what level would it be best to give? and over what area? Whether 'protectively' in amounts just enough to ward off failure of crops in rainless or rain deficient years or "productively" with a view to develop the area and make the project remunerative.

These questions cannot be answered by demonstration farms or propaganda but only by a close integration of the characteristics of population and area concerned.

**SUMMARY.**

The Bhagavadi demonstration farm represents a unique effort of the department (i. e.) only one of its kind. Its object is to find out the reaction of the ryot when tested improvements of research were placed at his disposal and no kind of persuasive or compelling influence is brought to bear on him. Its lessons are therefore of interest in any enquiry into the difficulties of transferring research to practice.

The paper records the major experiences and results of the farm and it is pointed out that a close intergation of sociological studies of the ryot populations with the methods of advocacy is likely to produce better results.

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# Improvement of the "Patcha Jonna" or yellow Sorghums of the Cuddapah and Kurnool districts (Madras)

*By*

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and

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The "Patcha Jonna" (Yellow Sorghums) tract of the Nandyal valley is bounded on the North by the river Thungabhadra and extends beyond the river Pennar, in the South, while on the East and West it is bounded by the chains of the hills, "Nallamalais" and "Yerramalais" respectively. Jonna is the staple food crop of this tract, which comprises of Cuddapah and Kurnool districts; where normally 8,00,000 acres are anually sown under this crop. From the nutritional point of view, *jonna* is given a rank next to wheat and is considered better than rice on account of its protein and Vitamin B-1, contents. In forming "well balanced diet", the introduction of millet to a limited extent at the expense of the rice is found to satisfy all the essential food requirements.

Investigation on the "Patch Jonna" crop was taken up at the Agricultural Research Station, Nandyal with a view to evolve high yielding strains of good quality grain and straw suitable for the varying soils of this tract. In the earlier years, of the opening of this station (1906 — 1910) several varieties like "*Venna Mudda*", "*Chilta Patcha*". "*Zinkapuri*", "*Tella Jonna*" etc., were tried both in early and late seasons for yield tests. As a result of these observations it was finally decided to grow "*Cheruku Patcha Jonna*" (sweet stemmed sorghum) in September season. T-6., a selection from "*Cheruku Patcha Jonna*" was evolved in the year 1914 and was under distribution for nearly 20 years since 1920, in the entire "Patcha Jonna" area. It however failed to establish itself over the entire area and was found to survive in a few localised places where soil and climatic conditions suited the strain. From the year 1931, selection work was taken upon this station on an intensive scale. Nearly 5,000 selections were tried for grain yields for the last 15 years. As a result of these efforts there are now several valuable types which vary in duration, shape and nature of the earhead, sweetness of the stem and grain colour and grain size characters. The pick of these strains evolved on this station are tried under district trials in cultivator's lands in Cuddapah and

Kurnool districts for three or more seasons. These aspect of studying the suitability or otherwise of a strain to the locality, formed an important item of work of this station, as a first step towards the spread of a strain in this tract.

With a view to find out the reaction of sorghum strains evolved on this station to variations in soil in the Kurnool and Cuddapah districts, a detailed examination of the existing agricultural varieties and practices of the "Patcha Jonna" area was made. It is found that there exist many differences in the several agronomic aspects of raising this crop mainly due to soil and climatic variations. A detailed examination of the local varieties of *Jonna* crop grown in this area revealed that they vary widely though essentially they are all classified as "*Patcha Jonnas*" from the grain colour. The local varieties are the outcome of long continued natural selection and cultivation through generations. Such of those types as could adopt themseves to the variations in climate and soil fertility, survived in homogenous patches and finally settled down in their respective areas as eco-types. The entire area is broadly classified into five distinct zones, each of which differ in the nature of their soils, rainfall and other environmental factors, varieties grown and agronomic practices adopted. The particulars of these five zones are givan below :-

| Zone No | Taluks | Area in lakhs of acres | Name of Zonal vaioty |
|---|---|---|---|
| 1. Northern Zone | Kurnool and Nandikotkur | 1 | "Gundu Patcha Jonna" |
| 2. Western Zone | Dhone, Pattikonda and a portion of Kurnool | 1½ | "Mungari Patcha Jonna" |
| 3. Central Zone | Nandyal, Koilkuntla Siruvel, Jammalamadugu and a portion of Pulivendala | 3 | "Cheruku Patcha Jonna" |
| 4. Southern Zone | Proddatur, Cuddapah, portions of Pulivendala and Badovel | 1½ | "Oola Patcha Jonna" |
| 5. Eastern Zone | Markapur and Cumbum | ½ | "Punasa and pairu Jonna" |
| 6. Other scattered areas | | ½ | "Tella and Yerra Jonna" |
| | Total | 8 | lakhs of acres |

It was not possible to evolve a cosmopolitan strain to suit all the above zones. In the absence of regular substations for tackling the problems of these areas on a regional basis, it was decided in 1940 to take up the work for these five zones at the Agricultural Research Station, Nandyal itself consistent with the limitations of the staff and equipment provided on this station and pending further future expansion.



The material gathered from these zonal areas was worked up and tested on this station with the respective "Locals" as controls, with a view to assess the yielding behaviour of all the bio-types from the intial stages of trials. Such of the high yielding selections, which satisfied all the local requirements in this crop were taken back to their respective original areas for trial on ryots' lands. As a result of this, we have now on hand 9 strains under distribution in the several zones of this "Patch Jonna" tract. The details regarding these strains and the zones, wherein they are under distribution are given below :—

| Strain No. | Nature of stem | Duration in days | Panicle shape & compactness | Grain size & colours | Acre yield of Grain / Straw | Other details |
|---|---|---|---|---|---|---|
| No. 1 | Sweet Juicy | 115 | Compact cylindric | Bold Lustrous yellow | 650 / 1500 | Suitable soils to in Nandyal, Siruvel Koilkuntla and Jammalamadugu taluks. Gives 10% increase in grain yields over local. |
| No. 2 | Sweet Juicy | 115 | Compact oval | Bold yellow | 1000 / 2000 | Suitable to soils of Nandikotkur & portions of adjoining Kurnool, taluk where "Gundu Patcha Jonna" is grown. Gives 15% increase over local, |
| No. 3 | Pithy | 105 | Compact cylindric | Bold yellow | 700 / 1600 | Suitable to soils of medium and poor fertility in Proddatur and Pulivendale taluqs. Gives 10% increase over local. Escapes "Calacoris" attack by its earliness. |
| No. 4 | Pithy | 115 | Very compact oval & hard | Bold yellow | 800 / 2000 | Suitable to soils of rich fertility in Proddatur taluq. Gives 10% increase over local. |
| No. 5 | Pithy | 110 | Compact oval | Bold Good yellow | 600 / 1500 | Suitable to soils of Cuddapah taluq. Gives 15% increase over local. |
| No. 6 | Pithy | 110 | Very compact oval & hard | Bold yellow | 800 / 1600 | Suitable to soils of medium and rich fertility in Chagulamarri firka of Siruvel taluq. Gives 10% increase over local. |

| Strain No. | Nature of stem | Duration in days | Panicle shape & Compactness | Grain size & colours | Acre yild of Grain / Straw | Other details |
|---|---|---|---|---|---|---|
| No. 7 | Sweet Juicy | 115 | Compact oval | Bold yellow | 1000 / 1800 | Suitable to the rich soils of Polur, Balapanur village in Nandyal taluq whore "Gundu Patch Jonna" is grown. Gives 15% increase over local. |
| No. 8 | Pithy | 120 | Compact oval | Bold yellow | 600 / 1500 | Suitable to soils of rich fertility in the pithy area of Pulivendala taluk. Gives 10% increase over local. |
| N9. 9 | Sweet Juicy | 115 | Compact oval | Medium bold Good yellow | 600 / 1590 | Suitable to soils of rich fertility in the juicy aria of Pulivendala taluq. Gives 10% increase over local. |

There is still a large scope for effecting improvement both over the existing strains and over varieties from untapped areas. With the expansion of work at the Agricultural Research Station, Nandyal, in connection with each of these zones, a stage has now been reached when the work for these zonal areas cannot be continued on these lines as a permanent feature at this station with its limitations. Since the last two seasons, work on this station has been confined to the "juicy" zone, wherein this station is situated. The varieties from the other zones, when tried at Nandyal could not survive on this station in the majority of cases and hence it was not possible to work on them. In a similar manner the varieties bred at Nandyal from the "juicy" zone did not come up well in the other four zones. To overcome this difficulty, it has become necessary to institute local work in each of these zones, so that higher yielding strains may be evolved from each of them to obtain the maximum benefit from the same for these two important millet growing districts and thus help to lower the shortage in sorghum. In the case of the richer and more favoured crops like paddy, sugarcane etc., increase in yield can be obtained by the additional application of irrigation water and manure etc. But in the case of millets which are the main crops in dry lands and which occupy 40% of the cultivated area of the Presidency, no manuring and no watering is given to the bulk of these lands. The only way to improve crop yields in millets is by breeding high yielding strains and making them available to the cultivators.

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# Vellarimathan — a quick-growing cucurbit

*By*

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Baptala is situated in the central sandy belt in the east coast in the Guntur district. The water table in this coastal area is very high. The soils are mostly sandy and are of low fertility. Several crops like brinjal, chillies, amaranthus etc., are successfully raised with the aid of high doses of chemical and farmyard manures. A large collection of vegetables was made by the Department of Agriculture for the newly started College Botanic garden with a view to select the best suited for this locality. Among these, a vegetable collected from Malabar, locally known there as Vellarimathan was found to be the best in giving the highest yield in a very short time. Its colour, bulk and cheapness created a keen demand for this vegetable, in this locality. With a view to stimulate interest in the public and popularise this vegetable, a brief note on the morphology, culture, seasonal performance, response to ferttilizer treatments, composition etc., is presented here. The term Vellarimathan implies that it is an intermediate form between 'Vellari' or cucumber (*Cucumis sativus*, Linn) and Mathan or Pumpkin (*Cucurbitu maxima*, Duch). Dosa gummidi is a synonym in recent usage here. The external characters show a close resemblance to *Cucurbita maxima* Duch., and this is considered as a variety of pumpkin. But Krishnamurthy (1948) has reported that this has 36, as the 2n., chromosome number and this does not agree with the count of 40, 2n., chromosome number recorded for *Cucurbita maxima* by Bhaduri and Bose (1947), Whitaker (1933) and Mckay (1930). He opines that this is likely to be a variant obtained by selection. Its exact nomenclature, therefore, still needs confirmation.

**Morphology:** This is an annual medium herb trailing upto seven or eight feet. Leaves: Simple with indistinct lobes, slightly unequal halves, cordate base, bear no marking on veins but veins project prominently on the lower side. Stem: Ribbed, fistular, hispid, tendrils branched five-fid. Flowers: Monoecious, solitary, axillary and bright yellow. Male flowers: Calyx fused at the base with corolla, tips linear, filiform; Corolla, campanulate, five-fid, lobes broad and cuspidate; anthers connate, synandrous, much longer than filament. Female flowers: Calyx and corolla as above, style one, stigma, 3-lobed, sinuous; ovary inferior, 3-celled, parietal placentation. Fruit: Roughly cylindrical, spongy, non-flaring at fruit attachment, cream yellow with very sparse tubercles.

**Culture:** Cucurbit vegetables are generally raised in well-drained soils in river beds or in shallow soils. They give much bulk and are low-priced, palatable and find a wide use among all classes of people. Vellarimathan is a surface feeder and is eminently suitable for shallow, loamy or sandy soils of low fertility. It is raised in pits of $1\frac{1}{2}$ to 2 feet width and 9 inches deep filled with well rotten cattle manure or tank silt or compost. A spacing of 8 feet either way is adequate and in each pit 4 or 5 seeds can be sown. The root system is very shallow and does not penetrate over 12 inches depth in soil and deep pits are therefore are unnecessary. Daily hand watering can be done and very little after cultivation is necessary. In the young stages the seedlings are attached by red pumpkin beetles (*Aulocaphora* sp.) and dusting with gammexane is found very effective in controlling the pest. Bearing commences within 45 days of sowing and the average yield ranges from fifteen to twenty thousand pounds per acre. A net income of about Rs. 250 can be expected from an acre from this crop. The yield and duration of this crop are found to vary according to the season. For over two years this vegetable was raised at regular intervals in the Agricultural College Botanic garden and the data are presented below.

| Period of sowing | No. of days required for flowering from the date of sowing | Mean duration in days | Mean yield per acre, in lbs. | Monthly Mean temperature | |
|---|---|---|---|---|---|
| | | | | Max. | Min. |
| January | 35 | 105 | 18,500 | 83·7 | 66·7 |
| February | 37 | 105 | 87,25 | 87·9 | 70·6 |
| March | 40 | 120 | 4,000 | 89·6 | 72·2 |
| April | 42 | 125 | ... | 92·5 | 77·8 |
| May | ... | ... | ... | 101·7 | 83·6 |
| June | 40 | 118 | 11,000 | 102·8 | 83·8 |
| July | 38 | 110 | 23,000 | 94·8 | 76·3 |
| August | 38 | 100 | 16,875 | 94·2 | 79·6 |
| September | 37 | 100 | 16,000 | 89·4 | 77·5 |
| October | 28 | 95 | 14,875 | 94·5 | 76·5 |
| November | 32 | 109 | 13,875 | 84·2 | 74·0 |
| December | 35 | 105 | 18,875 | 82·8 | 64·4 |

Except in the month of May, when the crop succumbed to the heat wave, it did not fail to yield when sown in the other months. The low temperatures prevailing during December to February



seems to have accelerated flowering in the crops sown from October onwards. The flowering period lengthens as the temperature rises and in summer it is found to extend the duration of the crop considerably. Judged from this, it seems probable that the length of day as also the temperature have considerable influence on the duration of this crop.

**Effect of manures:** The average yield per plant in the unmanured ones was 4 lbs. 9 ozs. as against 5 lbs. 14 ozs. secured from plants raised with 50 lbs of farm yard manure. With an application of 100 lbs of farmyard manure per pit as much as 24 lbs. of fruits were obtained from a single plant. An acre yield of 26,000 lbs. has been recorded from a two-cent plot. This clearly indicates the cropping potentialities of this vegetable and its capacity to respond to manurial treatments.

**Nutritive value:** This is a heavy–yielding prolific vegetable giving good bulk. The composition of the fruit along with other cucurbits is furnished below in order to give an idea the comparitive nutritive value of each vegetable in this group.

**Percentage composition on dry basis.**

| Popular namo, with botanical namo | Moisture | Protein | Fat | Fibre | Mineral matter | Carbohydrate |
|---|---|---|---|---|---|---|
| 1. Vellarimathan (*Cucurbita sp.*) | 95·0 | 0·5 | 0·1 | 0·8 | 0·5 | 3·2 |
| 2. Ash gourd (*Benicasa cerifera*) | 96·0 | 3.6 | 0·1 | 1·2 | 1·8 | 16·0* |
| 3. Bitter gourd (*Momordica charantia*) | 92·4 | 1·6 | 0·2 | 0·8 | 0·8 | 4·2* |
| 4. Cucumber (*Cucumis sativus*) | 96·4 | 0·4 | 0·1 | ... | 0·3 | 2·8* |
| 5. Pumpkin *Cucurbia maxtma*) | 92·6 | 1·4 | 0·1 | ... | 0·6 | 5·3* |
| 6. Snake gourd (*Trichosanthes anguina*) | 95·4 | 0·5 | 0·3 | ... | 0·7 | 4·4* |
| 7. Ribben gourd (*Luffa acutangula*) | 95·4 | 0·5 | 0·1 | ... | 0·3 | 3·7* |

* From Health Bulletin No. 23 of the Nutrition Reserch Laboratory Coonoor, by R. Aykroyd.

It will be seen from the above table, that the composition of Vellarimathan is similar to the most popularly used, common vegetables like snake gourd and ribbed gourd. It can, therefore, at least occupy a similar position like these vegetables even if it is not very nutritious.

**Summary:** Vellarimathan – a cucurbit from Malabar is found to be a prolific, quick-growing vegetable suited for all seasons and soils of low fertility. Its high yield, easy digestibility and bulk are its noteworthy features. It is therefore recommended for wide cultivation in all parts of the province like the other cucurbits.

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# A note on chillies thrips control in seed-bed areas in Guntur district

*By*

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**Chilli Crop in Guntur:** There is an area of 67,415 acres under chillies in Guntur district, distributed over Guntur, Sattenapalli, Gurzala (Palnad) and Narasaraopet taluqs. Out of this, Guntur taluq claims an area of 40,000 acres. The crop is grown under rainfed conditions in the mid season, July to February. This is one of the most important commercial spice crops of this district and the income from an acre at present market rates, ranges from anything between Rs. 750/- to Rs. 1,000/-.

There are three or four insect pests on this crop and among them, the thrips *(Scirtothrips dorsalis,* Hood*)* is the most important one. It is known to appear since 1920 and is found throughout the



chilli area. Thrips occur in seed beds and as well as on the crop. They feed on the tender portions of the plant, scraping the surface tissues and sucking the plant sap. As a result the tender leaves curl up, get deformed and in bad cases wither. This is referred to as '*Madutha Tegulu*' (Leaf Curl) during the crinkled stage and as '*Koriri Tegulu*' (Burnt faggot) in extreme dried-up cases. These insects also feed sometimes on the flower buds which may drop off and on the tissues of fruits. However, serious damage is done only to the foliage. In heavy infections they cause wholesale destruction of the crop. The average loss may be anything between 30 to 50%. In previous years, the damage caused by thrips was so heavy that it was even thought that there might not be a chilli market at Guntur. The area under the crop dwindled considerably due to this pest.

The insects have alternate host plants like groundnut, cotton, castor, mango, beans and pomegranate which are also widely grown in this district. The dispersal of the pest from field to field is mainly by wind currents. The adult insect is a tiny creature about 1/25" long, yellowish brown in colour and elongate in shape. This has four wings with a narrow membrane surrounded by a broad fringe of hairs (the characteristic feature of order *Thysanoptera*). They have mouth parts adopted for lacerating the soft parts of the plants and sucking the sap, a stage intermediate between chewing and sucking types. Female thrips lay their eggs on the leaves and in four or five days the young ones hatch out and begin to feed on the tender shoots. They exhibit only a partial metamorphosis *(Heterometabola)* and the young ones resemble the adults in form with no wings. They become adults in six to seven days.

This year (1949) the thrips appeared very early in the nurseries. The seedlings which were already hard hit due to the continuous rains of August, could not survive the invasion of these tiny insects. The young leaves crinkled and began to dry up. The rains received may be expected to act against the pest by washing down the colonies from the foliage. But the thick stand of seedlings in the seed-beds and the overlapping of leaves prevented the rain from washing off the colonies from the foliage.

Hitherto control measures to check this pest were spraying tobacco decoction or dusting tobacco dust at the rate of six pounds to a cent of land. The present stringent excise-laws prevent the layman from purchasing and stocking tobacco leaves or refuse. It has become rather a difficult job to procure tobacco leaves, prepare the dust and stock it without the fear of loss of the nicotine content and distribute it through the Agricultural Department to the chilli growers. With the advent of new insecticides into the field of entomolgy, large-scale trials of Gammexane D. O. 25 have been made in Guntur taluk, dusting at the rate of one pound to a cent of nursery. The villages of Lalpuram, Guntur, Yenamadala, Yengalayapalem, Nallapad, Nallayapalem etc., in Guntur taluk where dustings were done intensively, have shown remarkable results. The pest almost disappeared within a week after dusting and the seedling became perfectly healthy and were quite fit for transplanting after the usual nursery period of fortyfive to fifty days. Gammexane is capable of producing more spectacular results than tobacco dust and wins the confidence the ryots immediately.

Ryots were convinced with the spectacular results and the efficacy of the chemical brought into the field by the Department. A novel method was adopted of dusting the chemical with ordinary flour sieves of fine mesh which are available in every house. Though the chemical has to be used at a higher dose with the sieve the work could be done with greater ease and without waiting for dusters to be got from the Department and passed on from ryot to ryot. The demand for the chemical which started from mere pounds immediately rose up to tons. A total quantity of nearly two tons was sold to ryots in Guntur taluq itself. This dust, covering more than forty acres of seed beds, made the seedlings suffice to transplant more than 2,200 acres, this means, we have covered half of the area of Guntur taluq and we hope that for the next season the whole area under chilli crop in this district would be treated with this insecticide. The villagers of Lalpuram, Mallayapalem, Kornepadu, Nallapadu, Vengalayapalem, Yenamadala, Kondaepudi, Thullur, Muthur, Tadikonde, Narakodur, Etukuru, Kovelamudi, Guntur, Budampadu etc., gave their whole-hearted co-operation and successfully carried through the campaign. In some villages where the ryots had not taken up dustings of chilli nurseries, the seedlings had completely failed and consequently sufficient seedlings were not available for planting the usual area. As a result of this, ryots had to purchase seedlings sufficient to plant an acre at the rate of Rs. 100 to Rs. 150/-. For want of seedlings, this year the crop was drilled in some villages.

The Departmental strain 308 (otherwise known as G. 1 chillies) has only a partial tolerance for attack by thrips and in years of heavy infestation, it has also to be dusted with gammexane to save the crop.



The gammexane dust supplied last year by the Imperial Chemical Industries (India) Limited was lacking in proper adhesion when used with transplanted crop. Agrocide at the rate of one ounce per gallon of water can be used wherever water is available for spraying, but for absolutely dry tracts, BHC will have to be continued with a proper diluent for easily sticking on to the leaves, especially on the under surface where thrips are found most. The manufacturers have been contacted for a suitable formulation for this.

**Economics:** To treat two cents of nursery area (seedlings to transplant one acre):—

| | | | |
|---|---|---|---|
| 1. | Cost of Gammexane 2·025—2 lb @ 7 annas per lb. | Rs. | 0—14—0 |
| 2. | Labour—½ Man @ Rs. 1—8—0 per day per man | Rs. | 0—12—0 |
| | Total | Rs. | 1—10—0 |

A sum of Rs. 1—10—0 would thus save a crop worth Rs. 50—0—0 assessing the damage at 50%.

To spray one acre of transplanted crop :—

| | | | |
|---|---|---|---|
| 1. | Cost of 3 lb. of Agrocide @ Rs. 2—10—0 per lb | Rs. | 7-14—0 |
| 2. | Labour for spraying, 3 men @ Rs. 1—8—0 per man per day | Rs. | 4—8—0 |
| | | Rs. | 12—6—0 |

The effect of this is the saving of a crop which would normally yield about 1,000 lb. per acre as against the 300 lb. which an affected crop would yield. The present price of chillies is high and a candy of 500 lb. is sold at Rs. 540/-. So the saving per acre would be Rs. 500/- with the present value for chillies.

# Fumigation of semolina at Madras

By

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In September and October 1948 two shipments of semolina (849 tons) were received from Australia and taken to the Provincial Reserve Storage at Madras. A further quantity of 550 tons was added to this stock in January 1949. The off-take of this commodity was very low at this period and the stocks had to remain in storage for a long time. The semolina was free from insects at the time of receipt but in the godowns it became infested within six weeks. The examination of the stocks in November showed the presence of flour beetles (*Tribolium castaneum*) ranging from 9 to 96 per pound sample in the various stocks. Stray *Rhizopertha dominica* beetles were recorded from 3 out of the 20 stacks examined. The insect population increased in January 1949 when the *Rhizopertha* beetles became more widespread. A further increase of both the insects was recorded in February and it was evident that the infestation would become more marked in subsequent months. The increase in insect population from November onwards was as below :

Increase in the temperature, due to insect activity developed in several stacks and it was necessary to take up some chemical treatment like fumigation to prevent deterioration.

The main draw backs in the fumigation of milled products appeared to be the greater absorption of the fumigant in the outer layers. The penetration of the fumigant inside the stacks which occurred mainly by diffusion and displacement of the air inside the chamber was very poor on account of the density of the flour. The fumigants was generally absorbed to some extent in the foodsuffs and the residues which were considerably higher in milled products than in whole grains might be harmful to the consumers.

Trial fumigations were conducted with Cyanogas 'A' dust and Killoptera (a mixture of ethylene dichloride and carbon tetrachloride 4 : 1) in wooden barrels each holding one bag (150 lbs.) of semolina. The barrels were made air tight by pasting strips of old news-paper along the joints. The dosages adopted were 3 pounds of cyanogas and 20 pounds of Killoptera for 1,000 c.ft. of space for an exposure of 48 hours. The required quantity of fumigants were calculated on the cubic capacity of the barrels and introduced before sealing the lid.



Samples were drawn with a sampling probe before and after fumigation from these bags both from the outer layers and from the centre of the bags. The insect population and its density in the outer and central portion of the bags were recorded. The percentage of mortality due to the effects of the fumigation was worked out taking into consideration the different species of insects, alive and dead, present in the samples before and after funigation. The results were as below :

| Details of stocks examined | | | Average insect population in one pound sample | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | November 1948 | | | | January 1949 | | | | February 1949 | | | |
| Particular of consignment | No. of stock | Number of bags and Fumigated in | Tri | Rhizo | Grubs | Total | Tri | Rhizo | Grubs | Total | Tri | Rhizo | Grubs | Total |
| New IV S.S. Dogola | 9 | 6,256 Feb. 1949 | 9 | 0 | 5 | 14 | 26 | 11 | 19 | 56 | 36 | 21 | 9 | 66 |
| Now V S.S. Casteldore | 11 | 7,296 April 1949 | 9 | 2 | 20 | 31 | 19 | 11 | 25 | 55 | ·39 | 34 | 25 | 98 |
| Now I S.S. Devanah | 7 | 6,905 May 1949 | | | | | | | | | *20 | 34 | 22 | 76 |

* Examined in April 1949 (Received in January 1949)

Fumigated samples were sent to the Government Analyst, King Institute, Guindy for the analysis of residues. In the case of Cyanogas, the residue was found to be below 5 parts per million. The analysis of Killoptera fumigated samples was not done for want of facilities. The Government Analyst was in favour of adopting Cyanogas fumigation since the degassing and the subsequent aeration would be easier and more complete than the other fumigant. It was therefore decided to fumigate the first batch of semolina bags with Cyanogas 'A' dust making suitable provisions to ensure greater degree of penetration of the fumigant and insect kill.

The big fumigation chamber in the Mint group of godowns was selected for the first fumigation. This chamber was 93′ long 32′ broad and 15′ high with eighteen gas inlet tubes distributed 6 on each side along the length and 3 on each side along the breadth of the chamber. 3,306 bags of semolina were transferred from Mint New IV into this chamber for fumigation.

The stacks inside the chamber were arranged in single file to a height of 8 tiers along the outer margins and 10 tiers around the pillars leaving sufficient space between the rows to provide for free access of the gas for every bag. The stacks arranged around the pillars were two deep and had two exposed faces — one in the space provided around the pillar and the other along the alleyways.

Passages were provided along the entire length and breadth of chamber facing the gas inlets. After the stacking was completed the bags were thoroughly brushed and the spillings collected. Samples were drawn from the different stacks and the insect infestation recorded. 48 samples were taken in all, 32 from individual stacks, 10 from stacks around the pillars, from the sides facing the pillars (as these faces would not be in direct line of Cyanogas dust) and 6 from the centre portions of the bags. The chamber was then closed and made gas-proof by pasting strips of newspaper. The gassing was commenced at 8 A.M. and completed by 2 P.M. on 25—2—1949. A higher dosage 196 lb. of Cyanogas 'A' dust at the rate of $4\frac{1}{2}$ lb. of the fumigant for 1,000 c.ft. of space was applied in this instance to ensure a greater degree of insect kill. The dust was introduced into the chamber with foot-pumps through all the 16 inlets in equal quantities. The chamber was opened after 48 hours on 27—2—1949 at 2 P.M. for degassing and after sufficient aeration, samples were drawn. A second series of 48 samples were drawn under the identical conditions as were drawn before fumigation and the insect population was compared with those of the first drawn samples. The fumigation resulted in the complete kill of adults and grubs of *Tribolium* and *Rhizopertha* beetles. Samples drawn after three days of natural aeration for analysis of residual HCN were declared to be fit for issue by the Government Analyst.

The introduction of Cyanogas left a coating of fine residual dust on the bags. After degassing the bags had to be brushed thoroughly to remove this dust. Though the brushing and the collection of spillings were done before and after fumigation considerable quantities of spillings got mixed up with the dust and the mixed sweepings had to be discarded. In order to avoid this wastage the application of the fumigant was modified in the second fumigation, which was done in the small fumigation chamber ($34' \times 24\frac{1}{4}' \times 13\frac{1}{2}'$) on 3—3—1949. 1375 bags of semolina were transferred from Mint New IV godown and arranged in single file as before. The Cyanogas 'A' dust was spread in thin layers over old news-papers spread on the floor all along the alleyways using gas masks during the operation. 50 pounds of Cyanogas 'A' dust was used at the rate of $3\frac{1}{4}$ lb. per 1,000 c.ft. of space. From the average of 8 samples it was seen that the insect kill was not as high as in the case of the first fumigation. All the adult *Rhizopertha* and 47% of *Tribolium* beetles were killed as a result of this fumigation. The effect on immature stages was not very significant.



The above two fumigations, involved transfer of bags to the fumigation chambers and an elaborate method of stacking. To avoid these, Methyl bromide, a fumigant reported to have remarkable penetrating qualities and which left no residual dust in the chamber or on the bags was tried in the third fumigation. This was conducted by Messrs. May & Baker (India) Ltd., Bombay on 27—3—1940 as a demonstration in the small fumigation chamber. 1650 bags of semolina were transferred from New IV godown and arranged in four stacks with central gangway dividing the stacks. The bags were stacked to a height of 14 tiers and 8 rows deep arranged in brickwise manner.

The fumigant was stored in a liquid form under pressure in a steel cylinder fitted with a delivery end and a stop-cock. On opening the stop-cock, the contents would be discharged in the form of a heavier than air gas which was pushed out of the cylinder by the pressure inside. The discharge into the chamber was made by connecting the delivery end of the cylinder to a rubber hose, leading into the chamber through one of the gas inlet openings. Inside the chamber this was carried over the nearest stack and fixed at the top of the stack with the other end pointing down towards the central space inside the chamber. The cylinder was counterpoised by weights on a beam scale and the required quantity 16 pounds (@ $1\frac{1}{2}$ lb. per 1,000 c.ft. of space) was let into the chamber by opening the stop-cock. The discharge was completed in 10 minutes. Degassing was commenced after 24 hours by opening the doors and windows from outside, taking care to see that the operator did not directly come in contact with the gas. The stocks were examined after it was found safe to enter the chamber by testing the gas concentration inside with a Tilley lamp. Samples were drawn from the peripheral and central layers of the bags and also from bags in the interior of the stacks. Eight samples were drawn before and after fumigation and the results of analysis compared. There were no live insects either adults or grubs in all the samples after fumigation. The penetration of the gas inside the bags and inside the stacks was very good. Samples of fumigated semolina were drawn at different periods after natural aeration and analysed for bromide residues by the Government Analyst. The analysis of samples drawn after 48 hours of degassing gave 89 parts per million of residual bromide expressed as potassium bromide. A fortnight later it was 58 parts per million after 48 days this came down to 24 parts per million.

The results of this fumigation indicated that methyl bromide was very effective as a fumigant in the case of semolina compared to the earlier fumigations with Cyanogas. This had also the advantage of greater ease in handling and did not leave any residual dust. Because of these advantages the next fumigation which was the fourth of the series was done on 15 4 1949 with Methyl bromide in Mint New V godown without shifting or restacking the bags. This godown had a dimension of 140' x 32' x 16½' walls and a gabled roofing (height of roof 10') covered with Mangalore tiles over flat tiles. The godown wss made air-tight by pasting strips of paper over the doorways and windows. The ventilators and skylights were covered with cardboards and pasted with strips of paper, 8,038 bags of semolina (540 tons) were fumigated using 105 pounds of Methyl bromide at 1 pound for 1,000 c.ft. of space for 24 hours. The gas was discharged into the godown from two points. The discharge in this case was completed in two hours. Within the first half hour the cylinder became ice cold due to the rapid evaporation inside and the delivery of the gas became very slow. To accelerate the discharge, the cylinder was heated from outside by burning small quantities of trash around it. Degassing was commenced on the next day. Samples drawn after fumigation revealed that there was a complete mortality of all adult beetles and grubs after fumigation. Samples drawn six weeks later for analysis of the residual bromide gave a residue of 24 parts per million.

The fifth and final fumigation of the series was done on 10 5 1949 in Mint New I godown having the same dimensions as New V. 7,618 bags (510 tons) of semolina received in January 1949 were fumigated in this godown. 35 pounds of Methyl bromide (the total quantity of Methyl bromide available) were discharged into the godown at one point. The exposure period for this fumigation was extended to 72 hours. The results obtained were not satisfactory. All the insects flying about in the godown and the insects infesting the surfaces of the bags were found killed. Samples drawn from inside the bags on analysis showed the presence of a large number of adults and grubs. The analysis for bromide residues gave 22 parts per million potassium bromide from samples drawn 48 hours after degassing and 17 parts per million from samples drawn 3 weeks later.

The result of the different fumigations and their comparative costs were as below :



**TABLE III.**

**Comparative cost of different fumigations.**

| Serial No. of fumigation | Number of bags | Fumigant used | Quantity in lbs. | Cost of fumigation in Rs. | Incidental charges in Rs. | Total per ton charges in Rs | Cost per ton in Rs. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| i | 3306 | Cyanogas 'A' dust. | 196 | 245 | 20 | 265 | 1-3-3 | Very effective. |
| II | 1375 | do. | 50 | 75 | 5 | 80 | 0-14-0 | Partially effective. |
| III | 1653 | Methyl Bromide | 16 | 32 | 5 | 37 | 0-5-5 | Very effective. |
| IV | 8038 | do. | 105 | 210 | 20 | 20 | 0-6-10 | do. |
| V | 7618 | do. | 35 | 70 | 20 | 90 | 0-2-10 | Partially effective. |

In the case of the first two fumigations, the cost of shifting and stacking worked out to approximately Rs. 1 4 - per ton. This was not necessary in the case of the last two fumigations done with Methyl bromide in the godowns I & V. In the third fumigation, done with Methyl bromide, the bags were shifted to the chamber and back but stacked in the normal way.

The total number of bags treated in all these fumigations were 20,337 bags. The fumigations resulted in the death of the beetles and their grubs in the bags. These dead insects had to be removed by screening before the stocks could be issued. Since the volume of stocks to be cleaned was considerable screening by manual labour was impracticable. The first 300 bags were cleaned at a rice mill situated 3 miles from the Mint godowns at a cost of Rs. 4 4 0 per ton. In addition transport loading and unloading charges to an extent of about Rs. 2 10 0 per ton was incurred. This was discontinued and a cleaning machine of the type of a tea drier with a 5 H.P. electric motor was installed in the godowns at a cost of Rs. 3,000 -. A sieve suitable for screening semolina was fitted up to this machine and the entire stocks were cleaned at a daily average of 400 bags. This resulted in a considerable saving in trasport and supervision charges and the wastage was reduced to the minimum.

There were differences in opinion regarding the permissible degree of bromide residue in the fumigated stocks. The Government Analyst, Guindy held that 15 parts per million of bromide residues expressed as potassium bromide was the permissible limit and to reduce the concentration of bromides in the fumigated stocks, the bromide fumigated stocks were diluted by mixing with non fumigated or Cyanogas fumigated stocks at the time of their cleaning.

Methyl bromide was a fumigant widely used in America and the Federal Bureau of Entomology and Plant Quarantine were recommending the use of this fumigant for grains and milled cereals at the rate of one to two pounds for 1,000 c.ft. of space for an exposure of 24 hours. Both the Federal Bureau of Entomology and Quarantine and the Food and Drug administration, Washington, were of opinion that the residues in wheat products when fumigated at the above concentrations did not result in a residue which would be a matter of concern from the stand-point of the enforcement of the Federal drug and Cosmetic Act. A residue of 37 parts per million would not be a matter of concern.

Milled products had not been subjected to fumigation so far in Madras. Of the above five fumigations, two with Cyanogas and three with Methyl bromide the latter had given comparatively better results from the point of view of insect kill, penetration, easier handling and low cost. The toxicity of the gas, its lack of warning odour in concentrations likely to be harmful and the absence of easy and reliable tests and the toxicity of the residues might require further examination. The evidence from literature on these aspects were abundantly in favour of its increased adoption.

**Acknowledgements:** I had the fullest measure of co-operation from my staff at Madras in arranging these fumigations. The demonstration of Methyl bromide fumigation was conducted by Sri B. K. Desai of May & Baker Ltd., Bombay who furnished some of the literature on the subject. The analysis for fumigant residues was done by the Government Analyst, Guindy who also gave his opinions on the toxicology of the different fumigants. The analysis of bromide residues of the first samples drawn from Methyl bromide fumigated lots was done by the Govenment Agricultural Chemist, Coimbatore. All the fumigations were reviewed by the Government Entomologist and the Assistant Entomologist (Civil Supplies), Coimbatore. My thanks are due to Mr. C. M. Packard of the Federal Bureau of Entomology and Plant Quarantine, and Mr. Ralph F. Kneeland, Jr. of the Food and Drug administration, Washington (D. C.) for their opinions on Methyl bromide residues and for the circulars No. 720 and 369 issued by the U. S. D. A. and the reprint on Bromide residues in foodstuffs by Edwin P. Laug Ind. Eng. Chem. Vol. 33 sent by them.



**TABLE I.**

**Comparative effects of Killoptera and Cyanogas A-dust**

| Details of samples examined | Average Insect population per pound sample | | | | | | | | | | | | Effect of fumigation on immature stages and adults Percentage of mortality | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Before Fumigation | | | | | | After Fumigation | | | | | | | | |
| | Tribolium | | Rhizopertha | | Grubs | | Tribolium | | Rhizopertha | | Grubs | | Tri | Rhizo | Grubs |
| | Alive | Dead | Alive | Dead | Alive | Dead | Alive | Dead | Alive | Dead | Alive | Dead | | | |
| Fumigated with "Killoptera" Average of 3 fumigation (5—2—1948) | | | | | | | | | | | | | | | |
| Outer portions of the bags ... | 40 | 9 | 17 | 9 | 11 | 1 | 4 | 52 | 6 | 36 | 8 | 11 | 73 | 51·1 | 49·6 |
| Central portions of the bags ... | 16 | | 9 | 12 | 21 | 1 | 4 | 16 | 4 | 3 | 12 | 9 | 50 | ... | 38·4 |
| Fumigated with "Cyanogas 'A' dust — Average of 3 fumigations (5-2-1948.) | | | | | | | | | | | | | | | |
| Outer portions of the bags ... | 25 | 9 | 25 | 6. | 18 | 2 | 5 | 27 | ... | 24 | 3 | 3 | 57·9 | 100 | 40·0 |
| Central portions of the bags ... | 26 | 24 | 3 | 2 | 9 | 1 | 7 | 18 | ... | 19 | 1 | 5 | 24·0 | 100 | 73·3 |

*Distribution of insects in outer and central portions* was 69·1% & 30·9%

**TABLE II.**

**Results of different fumigations**

| No. of samples | Details of samples Examined: Particulars | Average Insect population per pound sample: Before Fumigation: Tribolium Alive | Tribolium Dead | Rhizopertha Alive | Rhizopertha Dead | Grubs Alive | Grubs Dead | After Fumigation: Tribolium Alive | Tribolium Dead | Rhizopertha Alive | Rhizopertha Dead | Grubs Alive | Grubs Dead | Effect of Fumigation on adults and immature stages % age of mortality: Tri | Rhizo | Grubs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **First Fumigation :—** Big Fumigation Chamber-Cyanogas @ 4½ lbs per 1000 cft. of space for 48 hours. 3306 bags 25—2—1949 | | | | | | | | | | | | | | | |
| 32 | Drawn from peripheral layers from 32 stocks ... | 18 | ... | 20 | 19 | 25 | ... | ... | All | ... | All | ... | ... | 100 | 100 | 100 |
| 10 | Drawn from around the pillars ... | 19 | 4 | 15 | 13 | 29 | ... | ... | All | ... | All | ... | ... | 100 | 100 | 100 |
| 6 | Drawn from centre of bags ... | 17 | 6 | 40 | 24 | 21 | ... | ... | All | ... | All | ... | ... | 100 | 100 | 100 |
| | **Second Fumigation :** Small Fumigation Chamber-Cyanogas @ 3¾ lbs. per 1000 cft. for 48 hours 1375 bags 3—3—1949 | | | | | | | | | | | | | | | |
| 8 | Average of 8 samples ... | 12 | 4 | 26 | 14 | ... | ... | 12 | 22 | ... | 40 | ... | ... | 47·1 | 109 | .. |
| | **Third Fumigation :—** Small Fumigation Chamber-Methyl Bromide @ 1-1.5 lbs. per 1000 cft. of space for 24 hrs 1650 bags 27-3-49 | | | | | | | | | | | | | | | |
| 4 | Drawn from peripheral layer from stocks ... | 20 | 5 | 54 | 32 | 19 | ... | ... | All | ... | All | .. | ... | 100 | 100 | 100 |
| 2 | Drawn from top layers in pheripheral layers ... | 11 | 1 | 24 | 12 | 5 | ... | ... | 11 | ... | All | ... | ... | 100 | 100 | 100 |
| 2 | Drawn from top layers from centre of bags ... | 4 | ... | 18 | ... | 4 | ... | ... | 11 | ... | 11 | ... | ... | 100 | 100 | 100 |
| | **Fourth Fumigation :—** Mint and New V Methyl Bromide @ 1 lb. for 1000 cft. of space for 24 hours 8038 bags 15—4—1949 | | | | | | | | | | | | | | | |
| 2 | Drawn from different stock including central portion of bags ... | 59 | 18 | 71 | 70 | 32 | ... | ... | 11 | ... | 11 | ... | ... | 100 | 100 | 100 |
| | **Fifth Fumigation :—** Mint New I Methy Bromide @ ½ lb. per 1000 cft. of space for 72 hours 7618 bags 10—5—1949 | | | | | | | | | | | | | | | |
| 8 | Drawn from different stocks including central portions of bags ... | 25 | 3 | 42 | 4 | Not received | | 29 | 9 | 58 | 41 | Not received | | 13·0 | 33·3 | ... |

# Manuring of paddy in relation to the present food crisis in India*

*By*

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(Communicated by the The Director of Agriculture, Madras.)



**Introduction:** Rice is supposed to represent the staple food of the greatest number of people in the world and being comparatively a safer and more regular crop than other food-grains, its cultivation is practised on a very wide scale in various countries in the world. According to the estimates published by United States Department of Agriculture (2) in 1946, the world acreage and production of this crop in 1945–46 came approximately to 197 million acres, and 6,300 million bushels of paddy as against 382 million acres and 5,200 million bushels for wheat. These figures also show that the average world production of clean rice and wheat was of the order of 960 and 816 lbs. per acre respectively.

The position of rice vis-a-vis other food crops in India, including Indian States prior to partition, according to the Agricultural Statistics of India, 1938–39 was approximately as follows:—

| | Area in million acres. | Approximate production in million tons. |
|---|---|---|
| Total food grains | 234 | |
| Rice | 74 | 25·0 |
| Wheat | 34 | 9·8 |
| Millets | | |
| (Jowar, bajra, maize and ragi) | 68 | 18·5 |
| other food grains | 58 | |

Figures of acreages under various crops in the Indian Dominion are not available but the population figures recently published by the Statistical Office of the United Nations (18) are 331 millions as against 405 millions for the whole of India prior to partition. For purposes of calculation if we assume, for the time being, that the areas under various food crops have been reduced more or less in the same ratio as the reduction in population, the acreages in the Indian Dominion would be as follows:—

* Paper read at the Conference of Agricultural Scientists held at the I. A. R. I., New Delhi, from 6th to 9th April 1949.

| | Area in million acres. | Percentage of the total area under food crops |
|---|---|---|
| Total food grains. | 193 | |
| Rice | 61 | 32·0 |
| Wheat | 28 | 14·0 |
| Millets | | |
| (jowar, maize, bajra, and ragi) | 56 | 29 |
| Other food crops. | 48 | 25 |

From the figures given above, it will be seen that rice occupies a high place in Indian Agriculture. From the point of food resources of the country, rice also occupies a unique position, as the average outturn of this crop is estimated to be 700 to 750 lbs. of clean rice per acre, as against the averages for wheat, and other millets like jowar, maize, and ragi, of 650 to 700 lbs. and 400 to 700 lbs. per acre respectively (19). Rice not only produces a better average outturn per acre, but its calorific value is also comparatively higher than those of other cereals, 100 grams of rice producing 350 calories as against 340, 342 and 345 for wheat maize, and ragi respectively (4). According to the average figures for the years 1935 to 1940 rice average in India was 73 millions or 35% of the world acreage of 206 millions (2). Although in respect of acreage, India occupies the first place in the rice producing countries of the world, the average yield per acre is the lowest as compared to the yields obtained in other countries, like China, U.S.A., Japan, etc., A comparative statement (2) of average yields of clean rice per acre of certain countries for the years 1935 to 1940 is given below:

| | *Clean rice per acre in lbs.* |
|---|---|
| Italy | 3120 |
| Japan | 2280 |
| Egypt | 2160 |
| China | 1560 |
| U.S.A. | 1500 |
| Siam | 900 |
| Burma | 825 |
| India | 780 |

**Factors affecting rice production in India.** The very low yields in India may be attributed to the following factors: (i) The erratic nature of the monsoon, (ii) lack of irrigation facilities in most of the rice-growing tracts, as only about 48% of the area under rice is irrigated. (iii) inadequate supply of seed of improved



varieties, and (iv) a stationary state of soil fertility at a low yield level, as a result of cultivation over many centuries without adequate returns to the soil of organic matter, and nitrogen (9). Although this paper is intended to deal specifically with the aspect of manuring in relation to rice, a brief reference to the effect of other factors on the production of rice will not be out of place.

It is well known that the most important factor involved in the successful growth of paddy is water (20,13). It is not enough merely to provide the total quantity of water required for this purpose, but it is essential to be able to supply water as and when required, and particularly at the time of sowing, and at transplantation in the case of transplanted paddy. Delays in sowing due to late monsoon, or in the case of transplantation due to lack of water in canals, results in reducing the outturns very markedly.

In this connection the following selected figures from those given by Viswanath-30 will be found interesting:

| Station. | Date of planting. | Yield of paddy per acre in lbs. |
|---|---|---|
| Samalkot | 15th July | 3935 |
| ,, | 7th August | 2048 |
| ,, | 21st August | 1505 |
| Godavari dalta (East) | upto 15th July | 1739 |
| ,, | ,, 15th Augut | 1279 |

Results from other experimental stations in South India as well as those recorded by Copeland (14) for U.S.A. were found to be similar to those given above. In view of the fact that out of the total area under paddy, only 28% is irrigated, the adverse effects produced on the outturns of paddy by inadequate irrigation water supply and capricious nature of the monsoon, cannot therefore, be over-emphasized. They also further point to the immediate need to augment the water resources to the maximum extent possible.

In this connection it may be mentioned that constant submergence of the soil under water does not appear to be beneficial in the case of heavy soils as in the case of lighter types (11). This observation is particularly important from the point of utilising available water supplies in relation to soil types, economically and efficiently, so as to ensure maximum production.

Experiments carried out by a number of research workers have shown that the existing yields of field crops can be increased by

10 to 20% if improved varieties are grown in place of local ones. Since only a small fraction of the area under rice is, at present, covered with improved varieties, the paramount need to immediately increase seed mulsiplication centres by increasing the number of seed farms, plots, and growers' societies, with suitable organisations for seed distribution to the required extent, is quite obvious.

General experience of various countries shows that clay loams, silt loams, sandy loam, and marshy soils fairly free from stagnant water, are suitable for paddy. Where irrigation facilities are not available heavier soils with high waterholding capacity are particularly suited to this crop, which is semi-aquatic in character. Results of analyses of various soils from India, Ceylon, and other eastern countries have shown that rice soils of these countries fall mainly under the four categories mentioned above (12), with a large number of short, medium, and long duration varieties being available, rice can thus be successfully grown in a variety of soils under varying conditions of climate, and it is chiefly this aspect of rice culture which makes it a safer and surer crop than other field crops.

Studies on the effect of soil reaction on the growth of paddy, show that a slightly acidic reaction, i.e., about pH 6·5 is definitely more beneficial than an alkaline reaction (10). Analyses of rice soils from Malaya, Japan, Philippines and Central Provinces in India show that the reaction of the soils is between pH 4.4 and 7.6. Soils of Burma, Ceylon, and South India, however, show a slightly alkaline reaction, the pH value varying between 7.8 and 8.7 although some soils in Ceylon are acidic having a pH value of 4.5. to 6.9.

**Fertility status of rice soils:** In regard to the fertility status of the soils from India and other eastern countries, it is seen that the percentages of chief fertilising constituents and organic matter in these soils, leaving exceptional cases, are generally of the following order (6,12).

| | |
|---|---|
| Loss in ignition (Organic matter and combined water) | 1.0 to 10.0% |
| Nitrogen | 0.94 to 0.10% |
| Total $P_2O_5$ | 0-05 to 0.4% |
| Total $K_2O$ | 0.40 to 1.00% |

The following limits have been suggested by Jack, quoted by Copeland (14) regarding the suitability of various soils for rice production:



| | 1st class soils. | 2nd class soils.. |
|---|---|---|
| Nitrogen | 0.24% | 0.15% |
| Total $P_2O_5$ | 0.07% | 0.04% |
| Total $K_2O$ | 0.51% | 0.18% |

If we take into consideration the average figures of soils from India and other eastern countries given above the standard suggested by Jack would appear to be very high, particularly in respect of nitrogen. Taking the yields of paddy per acre, as are at present being obtained, the following standards appear to represent the upper and lower limits according to the analyses of soils from Bombay Province given by Sahasrabuddhe :— (22)

| | Good soils | Poor soils |
|---|---|---|
| Nitrogen | 0.05% and above | Below 0.04% |
| Total $P_2O_5$ | 0.10% and above | Below 0.10% |
| Total $K_2O$ | 0·40% and above | Below 0.40% |

It may be particularly noted that in accordance with the standard suggested by Jack, the majority of our rice soils fulfil the requirements in respect of $P_2O_5$ and $K_2O$, a point to which a reference will be made later while considering the question of manuring of rice.

**Manurial experiments conducted in foreign countries:** Results of various experiments carried out in U.S.A., Italy, Egypt, and other countries to study the effect of the three important fertilizing constitutents, N,P. and K on the growth of rice, show the following:—

(1) Nitrogen plays a very important role in the fertilization of rice crop, large quantities of nitrogen being required even in the early stages of growth. The form of nitrogen most suitable has been found to be the ammonium sulphate. Generally speaking, nitrate manures are not considered to be satisfactory for rice and may even have toxic effects on this cereal (15). The dose of ammonium sulphate recommended (16) is about 100 to 150 lbs. per acre and 300 to 400 lbs. where rice is cultivated on intensive lines.

(2) Applications of phosphates are attended by beneficial effects to the rice crop. On an average a dressing of 200 lbs. of superphosphate per acre is recommended and about 300 to 350 lbs. per acre where cultivation of paddy is done on intensive lines.

(3) Potash is important in the earlier months, while towards the end of growing period, absorption of nitrogen is greater.

It is recommended to apply potassic fertilisers two to four weeks before planting. Ordinarily a dressing of 53 to 100 lbs. potassium sulphate per acre is recommended and 100 to 200 lbs. per acre where rice is cultivated on intensive lines.

Results of various experiments briefly summarized by Copeland are as follows:

"It can be stated as a general conclusion from such experiments, that for continuous rice culture it pays to use phosphatic fertilisers freely, the best form depending upon soil conditions and the immediacy of the results desired; that a liberal addition of nitrogen is also profitable, whether as a green manure or in some other organic from, or as ammonium sulphate; that it usually pays to apply potassium and that the most generally satisfactory inorganic form is the sulphate."

It has also been mentioned by him, that the quantities of various fertilizers to be used will have to be modified in accordance with the local needs of different places, based on the physical composition and fertility status of the soils and availability of water. Chemical analysis of the soils should be a better guide to the choice of fertilizers for rice than for most crops.

Experiments at the Texas Experiment station (27) during 1934-40, to determine the effect of ammonium sulphate on paddy, show the following:

| Quantity of Ammonium sulphate added in lbs. per acre. | Percentage increases in yields over control. |
|---|---|
| 100 | About 15 to 20% |
| 200 | About 39 to 48% |

**Manurial experiments conducted in India:** Results of manurial experiments on paddy in India have been summarized and published from time to time by Vaidyanathan (29) Allan (5) Sethi (24) Burns, (13) and recently by Stewart (25). As various workers in India are acquainted with these publications it does not appear necessary to deal with them in any great detail, and our purpose will be served if a reference is made only to the following salient points therefrom, which are intimately connected with the objective in view of increased agricultural production:-

(1) A great majority of the experimental results show that nitrogen deficiency is extremely widespread in the soils of India. Applications of ammonium sulphate to paddy at the rate of 20 to 40 lbs. nitrogen per acre, have given profitable responses, and increases in yields of the order of 20 to 60% have generally been obtained.



Organic nitrogen in the form of oil-cakes and green manure (8) has also been found to increase the yields very considerably. It has been observed (17) that if the green manure is applied one or preferably two weeks before the date of transplantation, the yield obtained is considerably higher than that obtained when the green manure is incorporated with the soil at the time of transplantation.

(2) In regard to the applications of phosphatic manures, the general result has been that there is either no response, or where some response has been observed, it has not been high enough. In some exceptional cases, however, where the soils are deficent in phosphoric acid. e. g. some of the light soils of Central Provinces, phosphatic fertilisers have given positive responses, and the responses have been on definitely higher order where phosphatic fertilisers are applied in combination with nitrogenous manures and fertilisers.

In the case of phosphate deficient soils it is important to use phosphate fertilisers both from the point of obtaining higher yields and also from the point of nutrition, as applications of nitrogenous manures alone reduce the percentage of $P_2O_5$ in the seed (1).

(3) General experimental results show that most Indian soils are relatively well supplied with potash, and for most crops there is, therefore, little need for potassic fertilisers. Experiments with paddy confirm this general observation and show that the need for supplying potash to this crop is comparatively unimportant except in the case of some few soils known to be deficient in potash. Potash deficiency symptoms in the case of paddy do not appear to have been so far recorded in India. The above findings are in agreement with the results of analyses of a large number of rice soils from different parts of India.

Various manurial experiments conducted all over India have shown that, out of the various field crops, paddy gives the highest response to nitrogenous manures and gives an extra yield of 10 to 20 lb. of paddy for every 1 lb. of nitrogen added to the soil per acre. The range of responses of some cereal crops, when manures are applied at the rate of 10 to 20 lb. of nitrogen per acre, are given below:— Response per lb. of nitrogen per acre. Paddy 10 to 20 lb. Wheat 8 lb. Jowar 8 to 13 lb. Bajra 8 to 12 lb.

In regard to the work which has so far been done in the laboratories and at agricultural research stations, there is, however, as mentioned by Russell-21 a great gulf which separates the research stations from the peasants, which needs to be bridged, and what is now immediately required is to bring effectively the improvements which can be effected in certain important directions, as indicated above, to the cultivator's door on a mass scale.

**Future requirements:** Although the data given above are useful in indicating to us the lines on which we can chalk a programme to immediately increase, production of rice in the country, further work in some important directions is still necessary to active maximisation of production, e.g. (1) evolution of improved varieties for certain tracts where this work has not hitherto been possible, (2) analyses of soils to determine their fertility status, and (3) manurial experiments on the basis of soil and climatic zones.

**Other aspects of rice culture:** In addition to the immense potentialites of increasing production of rice by using improved varieties and adequate quantities of manures and fertilisers, rice also offers an additional advantage of allowing a second or a catch crop like linseed, masoor, popat (*Dolichos* sp.) or other lugumes, in heavier soils in many areas whose average annual rainfall is about 35 40 inches and where at least one or two light winter showers are normally received during the period October-November. Where this type of double-cropping is possible, we can easily expect an outturn of at least 200 lb. per acre of pulses or linseed, over and above the yield of the main crop of paddy. This practice of double cropping is followed by cultivators in certain parts, but not in others, and there are vast undeveloped areas where this system can be profitably introduced. Assuming that out of the total area of 61 million acres under paddy at least about 10 millions can be newly brought under this system of double-cropping, the additional outturn on account of the second crop would easily come to 0·9 million tons per year. Increase in the production of pulses in rice-producing areas will also help to improve the nutrition of the people whose intake of pulses falls short of what is desirable-3. The importance of this system of double-cropping has been recently emphasised by the Board of Agriculture in India, Crops and Soils Wing at its meeting held in Madras in April 1948.

In a trial conducted at the Institute of Plant Industry, Indore, this year, to investigate the possibility of double-cropping after rain-fed-transplanted paddy in an area of 1·22 acres, an outturn of 200 lb. of linseed per acre, in addition to paddy was obtained. The total rainfall received from 1st June to 31st October 1948, was 36·7", and thereafter there was one shower of 0·9" on the 7th November and showers from 20th to 22nd November 1948, amounting 1·4".



From the point of immediate increased production of food in the country, rice which is the staple food of more than 70% of the population, thus offers the following specific advantages over other cereal crops:

(1) Higher production of food per acre, (2) food of higher calorific value, (3) better response to manures, (4) facilities for double-cropping, and (5) safer and surer crop. Instead of attempting to manure all the cereal crops, if we were to select paddy for intensive work, in the first instance, on account of its special features given above, we shall be able to secure an increased production of at least 0·9 million tons of clean rice per year, and, in addition, about 3 million tons of other produce as a result of double-cropping, if we can manure only half the area under rice at 10 lb. nitrogen in the form of ammonium sulphate or 18 lb. of nitrogen as oil-cake or green manure per acre.

As we become able to increase our manurial resources, we can take the remaining area and other crops as well, so that our production based on very moderate estimates should progressively increase reaching the figure of about 5 million tons of extra food per year of all food grains in addition to the produce derived from areas newly brought under double-cropping.

The above estimates of increased production are on the lower side than the conservative estimates given by Burns. According to him an application of 22·4 lb. of nitrogen per acre is expected to increase the production by 5·6 million tons per year, due to manuring alone, and 8·4 million tons on account of the combined effect of the three important factors, (1) improved variety, (2) increased manuring, and (3) protection from certain pests and diseases.

Dr. Salter-23 chief of Bureau of Plant Industry and Soils, U. S. A., actually estimates an increase in the world production of cereals by 20% in 1960, by using the present cropped area more intensively. According to these estimates, the increase in rice production from 60 million area would come to 4 million tons of clean rice.

I have, however, based my estimate on the basis of application of lower quantities of nitrogen per acre partly because the financial position of the average rice cultivator is not such as to permit him to invest large sums of money per acre to manure his lands, and partly because it has been the experience in Central Provinces that smaller applications of nitrogen, give a better return per rupee invested than higher applications which are profitable and give higher outturns per acre. Owing to the limitation of space, actual calculation in this behalf have not been given.

In view of what has been said above, the paramount importance of rice in the solution of the present food crisis cannot be over-emphasised. From a study of this problem in so far as has been possible, it would be apparent that if the problem is tackled immediately with a realistic approach and by appreciating sympathetically the difficulties, requirements and aspirations of our cultivators, rice, if cultivated on intensive lines will very considerably help increasing the food production of the country. Increased production of rice will also incidently release equivalent quantities of wheat and other cereals for allotment to these whose staple diet consists of cereals other than rice. For this purpose, schemes for subsidised manuring of paddy lands in the hitherto comparatively undeveloped areas should, therefore, be called for and put into operation in the coming season. In so far as the newly formed Madhya Bharat, Rajasthan, and Vindhya Pradesh Unions are concerned there are, at least 1·1, 1·0, 6·6 lac acres respectively under paddy, which need adequate manuring.

According to the statement of Shri A. D. Birla(28) reported recently, Rs. 32/- crores have been spent as subsidy to foreign growers, and in addition, a substantial amount must have been spent on the maintenance of the special department of food, and other organisations. Although the total quantity of foodgrains imported against the subsidy is not nown, it is expected to be about 3 to 4 millon tons which worked out to Rs. 10·7 or Rs. 8 crores per million tons respectively.

One of the factors which limits increased food production, is lack of capital with the average Indian cultivator, and if adequate quantities of manures and fertilisers and financial help in the form of subsidies and interest-free loans are made available to him, it can be easily seen that we can increase the production at least by 1·8 million tons of clean rice from 60 millions acres, and for which purpose a sum of Rs. 15 crores only would be required on the basis of a subsidy of Rs. 2—8—0 per acre



or Rs. 8/3 crores per million tons of extra produce. The subsidy can be reduced year after year and can be stopped altogether after a period of, say, 3 years, and thereafter only interest-free or interest-bearing loans can be given.

The Hon'ble Pandit Jawaharlal Nehru (26) India's Prime Minister, has recently declared that India did not propose, after two years, to import food, no matter what happened, even if people died. In the light of the information recorded in this paper, it can be said with certainty that we can produce the increased quantity of food in the country, if a decision in this behalf is promptly taken by the Government and steps are taken to immediately implement the plans, as the monsoon is now only two months away. The most important measures capable of giving higher yields, and producing immediate results, such as seed of improved varieties, and application of manures and fertilisers, and the like, are known to Departments of Agriculture as well as to the rice growers who have been fully convinced of the importance of these as a result of the propaganda which it was possible for the departments to carry out with the help of grants and subsidies received from the Government of India under the Grow More Food Campaign. The chief difficulty has, however, been lack of full facilities for their adoption. P. M. Kharegat (28), former Vice-Chairman, Indian Council of Agricultural Reserch, and Secretary Department of Agriculture, Government of India, has recently indicated the drawbacks and impediments in the way of increasing food production, and if these are removed forthwith, we can certainly attain our goal in a period of 2 years prescribed by the Hon'ble Prime Minister.

In the light of the various points referred to in this paper, I therefore, strongly appeal to the Conference to pass a suitable resolution, urging upon the Government of India the immediate need to give their earnest consideration to the question of concentrating attention on the manuring of rice crop in view of its paramount importance in the solution of the present food crisis, by utilising all available resources of manures and fertilisers for this crop, and to take all possible steps to increase the supplies of manures for this purpose.

**Conclusion:** To conclude, various methods by which production of rice can be immediately increased, and the paramount importance of this crop in solving the present food crisis, have been dealt with, which indicate that if we have the will and if we approch the problem in all earnestness, we can certainly achieve our object as mentioned by Dr. Salter, chief of the Bureau of Plant Industry and Soils, U. S. A. in the following paragraph :

'If the people of the world really have the determination to give battle to the problem of hunger, if they are willing to extend a small part of the energy and capital poured into World War II, only then can we see hope of victory'.

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# Notes and News

"Mechanisation of Agriculture" an address delivered by Prof. A. W. Ashby of the Oxford University under the auspices of the Agricultural College Students' Club, Coimbatore :—

Prof. Ashby said that mechanisation was a process pursued only when labour began to be dear or when other materials began to be cheap. Mechanisation did not come into a static industrial organisation. It came only in moving developing industrial organisation and that applied equally to agriculture and to other industries. The problem for most communities was that of the appropriate allocation of power functions between man, animals and mechanical power units. The general principle involved in so far as this one was concerned was that the richer the community the more mechanical power would be used, the poorer the community the less mechanical power units would be used. One could even draw from that statement and say that the poorer the community the less non-manual power in any form that they would use and the richer the community the more non-manual power in all its forms would be used. One might view the situation from the other side and say that the use of non-manual power caused wealth and the existence of wealth could not itself cause a further increase in the use of non-manual power. To some extent at any rate, the processes were cumulative.

Prof. Ashby continuing, said that if they were really to consider the relationship of mechanised agriculture to the general community, it was necessary that he should state the first principle of material civilisation. That first principle was this. That in a self-sufficient economy, the rise of material civilisation was dependent upon a reduction in the proportion of people engaged in improved production and on the problem of increasing proportions in non-agricultural occupations. If they wanted a concrete illustration of that position, in the U. S. A. just over a hundred years ago, eighty per cent of the people were engaged in agriculture and the export trade of that country was very small. By successive changes not only in the power resources of agriculture but by successive changes right throughout the technical scope of the industry, the proportion of people engaged in agriculture had now been reduced to approximately 20 per cent and the 20 per cent of the occupied population of the U. S. A. was now feeding the whole population far better than it was ever fed before. Estimates had been made that in the commercial world which was concerned with exports and imports of foodstuffs approximately 15 per cent of the people occupied in agriculture could feed the whole adequately. If they looked at the other extreme from that position they would find it in their own country and in China. In India at least some 70 per cent of the occupied population engaged in agriculture and if anything there had been a slight import balance. 70 per cent was required to feed a hundred per cent of the population. It did not matter very much what the level of efficiency in their other industries might be, what the increase in their efficiency might be. The national wealth could not increase at any very appreciate rate while that position existed. For one simple reason at any rate that, of the remaining 20 per cent of the population engaged in non-agricultural occupations, some half of them were engaged in personal professional services including domestic services in which there was no appreciable increase in efficiency at any stage. With 70 per cent of their people engaged in agriculture, if they could get, say over a course of five years five per cent increase in their output that was equal to 3½ per cent over the total of their population. If they got five per cent increase over their other 30 per cent that was 1½ per cent over their total population. They had got to get cent per cent efficiency in persons and organisations producing material supplies. While in any country there was a very high proportion of people engaged in agriculture the advice of material civilisation must be extremely slow. There was of course a limit to this process of transferring labour from food production to other occupations. But in any case no society could run into any serious danger in this transfer until the 50—50 point was reached, until the agricultural population was reduced to one half of the total. Until that point was reached any social disability or disadvantage which arose from the transfer arose from the inability to make the secondary change following on the change towards agricultural efficiency and output. The higher the proportion of occupied persons engaged in agriculture the greater was the importance of their efficiency and its increase. As to that general proposition there could not be two points of view. The primary social function of agriculture was to provide foodstuffs for all the people. But particularly to provide a surplus for the support of the non-agricultural population. Therefore the primary measure of output in agriculture was output per person engaged or the output per functional man engaged. The higher this output per person engaged in the industry the greater was the surplus for exchange.

Prof. Ashby said that if he had no other message to give to a body of agricultural students he would give them this: That under most circumstances there was no greater social fallacy than that of measuring agricultural efficiency or output by output per acre only. The output per acre was never a real measure of output in agriculture for the important reason that an acre of land was a pure geometrical measurement which had no relationship to the essential productive capacity in that unit. So that when they were measuring outputs per acre, they were measuring outputs for variable production units and not for equal production units. Apart from that, it was extremely important that the agricultural community itself should adopt the measure of its own efficiency as that of the output per person because that was the measure that determined the average income over the whole of the producers. The higher the output per person engaged in the industry, the higher at any rate the possibility of the average income per person. And if the agricultural community was as competent in economic organisation as it was in technical processes when it raised the output per person it would also raise the income per person. But it was absolutely essential for the agricultural community to apply to its own organisation the measure of the output per person engaged. Economically, the increase in the surplus production of agriculture should imply an equal exchange of non-agricultural products and services to ensure social justice. When agriculture increased its surpluses for the support of non-agriculturists it must expect from the latter a contribution to agricultural welfare equal to the surplus offered in exchange. This surplus which agriculture could offer for the support of the non-agricultural population very largely depended upon the amount of non-manual power used in the industry, that is, first on the amount of animal power used in the industry, second on the type of the animal power used in the industry and third on the type and amount of mechanical power used in the industry. Some of them might not be conversant with this measure of agricultural efficiency to the agricultural surplus. If they looked into the work of agricultural economists in small countries more particularly Switzerland they would find that they had applied this measure to their farming system. The larger the unit of an organisation the greater the surplus for exchange for the non-agricultural population. Prof. Ashby here said that small holdings which barely supported the agriculturists would not be able to yield surpluses for the non-agricultural population though there were of course various soil and climatic conditions which enabled cultivators to reach very high intensities of production. But if they considered the mass of their land as in India, only a large scale organisation would be capable of yielding surpluses.



Coming to the actual forms of power used in agriculture Prof. Ashby said that the earliest forms of power everywhere were water, wind and animals. Water and wind were used for stationary purposes and animals of course for mobile power purposes. Perhaps there was little that he need say of water power or wind. Water power in the form of hydro-electric power was one of the most important forms of power in the world. Wind power was used in some countries as in Holland or in parts of Australia. But animals had been and were of universal importance. There were some points about the use of animal power in which it was necessary to be as explicit as possible. The poorest of people use only manual power. The first transfer was from manual power to animal power. Early peoples commonly used animals for dual, triple and quadruple purposes but always practically for dual purposes. Even in some parts of Europe at the present time the working bullock had two purposes, energy production or draught power and meat production. In some other parts of Europe the working animal was the cow the dual purpose being production of power and milk. In India, they had the other function that of fuel production. There were two causes of a revolutionary change in agriculture, change in the power source for agricultural purposes and the change in the fuel source for domestic and industrial purposes. And the change in the fuel source had been quite as important in agricultural development in many communities as the change in the power source. In his own country, England, when they were able to build roads and canals they were able to change the fuel source from local timber and scrub to coal mines and they were able to add a very large area to the area available for human food production. He wondered what would be the situation in Indian agriculture in the yields of its crops and general productivity if they could save cowdung and use kerosine and electricity for fuel purposes. It was something worth speculating upon especially when their politicians talked about self-sufficiency in food production.

Prof. Ashby continuing, said that the history of live stock breeding in England or northern Europe in the 18th and 19th centuries would show that the breeders were concerned with specialisation towards draught animals on the one side and towards dual purpose milk and meat animal on the other side. Most if not all the countries which had succeeded in specialising from work animals had found an economic advantage in the process. But there were two steps in this change. The first was specialisation of the bovine stock, second, change over from bovine stock to pure working stock, the horse. This change over depended perhaps very largely on climatic conditions. It brought great changes in the agriculture of northern Europe, about the end of tht 18th and the early part of the 19th century. If they looked at the English literature of agriculture round about the year 1880 they would find controversies about this change over from the ox to the horse. They would find the principles connected with this controversy even now when the change over from horse to mechanical power took place. When they changed over their power source, in order to make that change effective they must change the implements that were associated with that power source. The general results of the transfer were lighter impliments more effective for their purposes with the consequence that the cultivations including the whole of the processes were improved, and work was done more speedily. There was a marked improvement in the yields of crops, side by side with considerable reduction in the amount of man power required for a given area or given output.

Prof. Ashby then went on to describe the various mechanical implements introduced for agricultural operations like threshing and harvesting such as reaping machines, self-binders, the combined harvester, all of which made for great economy in agricultural production. For example the combined harvester had 36 times the power of man measured in potentials. Efficiency as measured by output per man in British agriculture was little more than doubled since 1870 and the yields per acre had also increased from that year. That was what they meant when they talked about revolution in Agriculture Mechanisation of transport began to revolutionise rural community life. Transport developments began to make radical changes in agricultural marketing.

With regard to the effects of change in power sources in agriculture Prof. Ashby said thefirst was increase in work capacity, second improvement in quality of work, third, increase in output per man hour, fourth, generally but not universally increase in output per acre, and almost universally it was possible to add the increase in total output came even though there might not be increase in output per acre through one of the most important effects of change in power namely use of resources otherwise unused. In his own country, quite recently the almost universal use of the tractor for cultivation purposes had enabled to extend the area of cultivation by one million acres. It was about four per cent of the total area. The general position was that mechanisation did bring into agricultural use land previously unused. Nowhere was that position more marked that in the U. S. A. There, between the two world wars 14 million acres were added for human food production. Successful mechanisation depended upon the adaptation of the power unit to the task or vice versa. The second principle was that the divisibility of power unit was extremely important. The power requirements of different tasks in agriculture were very wide. And the divisibility of power units led them to economy in power units. It was quite possible to train a mechanic to deal with an agricultural power unit. Training a mechanic and training a ploughman were two different things. Unless the tractor driver was also a ploughman he would not make the best use of his tractor in cultivation processes. But if they were thinking of mobile power in all processes then a skilled driver had be a skilled manipulator of a number of different materials.

Describing the influence of mechanisation not only on different processes in agriculture and their economic results but on the social life of the agricultural community, Prof. Ashby said that supposing for the sake of illustration they began to add some mechanical power units to the animal power units which they already had in Indian agriculture. The first result was increase in their total harvest. If the increase in output was not equal to the increase in the total cost then their agricultural community would be a loser by the change. Quite commonly the result would be an increase in total output and a reduction in total cost. Most of the changes that had been brought about in all progressive agricultural systems of the world had been followed by diminishing costs and that of course was essentially the result of mechanisation. Mechanisation while diminishing the costs also contributed to the rise in the standard of intelligence of the agricultural community.

"Courtesy of Correspondent The Hindu".

# Weather Review — For January 1950

## RAINFALL DATA

| Division | Station | Total for the month in inches | Departure from normal in inches | Total since January 1st in inches |
|---|---|---|---|---|
| Orissa & Circars. | Gopalpore | Nil | —0·3 | Nil |
| | Calingapatam | Nil | —0·2 | Nil |
| | Vizagapatam | Nil | —0·4 | Nil |
| | Anakapalle* | Nil | —0·2 | Nil |
| | Samalkot* | Nil | Nil (d) | Nil |
| | Kakinada | Nil | —0·3 | Nil |
| | Maruteru* | Nil | —0·1 | Nil |
| | Masulipatam | Nil | —0·2 | Nil |
| | Guntur* | Nil | Nil ** | Nil |
| | Agrl. College, Bapatla* | Nil | Nil (b) | Nil |
| | Veeravanam* (College Farm) | Nil | (x) | Nil |
| Ceded Dists. | Rentichintala | Nil | Nil (b) | Nil |
| | Kurnool | Nil | —0·2 | Nil |
| | Nandyal* | Nil | Nil | Nil |
| | Hagari* | Nil | —0·1 | Nil |
| | Siruguppa* | Nil | -0·1(a) | Nil |
| | Bellary | Nil | —0·1 | Nil |
| | Cuddapah | Nil | —0·4 | Nil |
| | Anantharajpet* | Nil | —0·7 | Nil |
| Carnatic. | Nellore | Nil | —1·3 | Nil |
| | Buchireddipalem* | Nil | —0·3 | Nil |
| | Madras | Nil | —1·0 | Nil |
| | Tirurkuppam* | Nil (c) | -2·5 @ | Nil(c) |
| | Palur* | Nil (d) | —1·6 | Nil(d) |
| | Tindivanam* | 0·7 | —1·0 | 0·7 |
| | Cuddalore | 0·1 | —2·3 | 0·1 |
| Central. | Vellore | Nil | —1·5 | Nil |
| | Gudiyatham* | Nil | —0·7 | Nil |
| | Salem | Nil | —0·3 | Nil |
| | Coimbatore (A. C. R. I.)* | Nil | —0·8 | Nil |
| | Coimbatore (C. B. S.)* | Nil | —0·8 | Nil |
| | Coimbatore | Nil | —0·6 | Nil |
| | Tiruchirapalli | Nil | —0·8 | Nil |

| Division | Station | Total for the month in inches | Departure from normal in inches | Total since January 1st in inches |
|---|---|---|---|---|
| South. | Negapatam | 1·1 | —1·6 | 1·1 |
| | Aduturai* | 0·7 | —1.2 | 0·7 |
| | Pattukottai* | 1·2 | —0·2 | 1·2 |
| | Mathurai | Nil | —0·8 | Nil |
| | Pamban | 2·1 | —0·5 | 2·1 |
| | Koilpatti* | Nil | —1·0 | Nil |
| | Palamcottah | Nil | —1·7 | Nil |
| | Ambasamudram* | 0·1 | —2·8 | 0·1 |
| West Coast. | Trivandrum | Nil | —0·8 | Nil |
| | Fort Cochin | 0·1 | —0·8 | 0·1 |
| | Calicut | Nil | —0·2 | Nil |
| | Pattambi* | Nil | —0·3 | Nil |
| | Taliparamba* | Nil | —0·1 | Nil |
| | Niloshwar* | Nil | —0·3 | Nil |
| | Pilicode* | Nil | -0·5 @ | Nil |
| | Mangalore | Nil | —0·3 | Nil |
| | Kankanady* | Nil | —0·3 | Nil |
| Mysore & Coorg. | Chitaldrug | Nil | —0·3 | Nil |
| | Bangalore | Nil | —0·2 | Nil |
| | Mysore | Nil | —0·1 | Nil |
| | Mercara | 0·2 | J. Nor. | 0·2 |
| Hills. | Kodaikanal | 0·3 | —2·9 | 0·3 |
| | Coonoor* | Nil | —4·8 | Nil |
| | Ootacamund* | Nil | —1·6 | Nil |
| | Nanjanad* | Nil | —1·3 | Nil |

*Note*:—
(1) * Meteorological Stations of the Madras Agricultural Department.
(2) Average of ten years data is taken as the normal.
(3) (x) Readings are recorded only from February, 1948.
(4) @ Average of seven years data for Tirurkuppam and eight years data for Pilicode is given as normal.
(5) (a) Taluk office normal is 0·08" and Rainfall is 0·0".
(6) (b) Actual figure is 0·01".
(7) (c) Actual figure is 0·2".
(8) (d) Actual figure is 0·04".
(9) ** Actual figure is 0·01".

## Departmental Notifications

### SUBORDINATE SERVICE

#### Appointments and Transfers

| Name | From | To |
|---|---|---|
| Sri K. Gopala Rao, B. Sc., Ag. | | Cotton Asst., Narasaraopet. |
| Sri George, P. F. | Asst. in Chemistry Compost manure works, Coimbatore, | Addl. A. Mathurai. |
| ,, James Colaco, | Special A. D., Sugarcane Development Scheme, Mangalore, | Superintendent, Coffee Research Scheme, Balehonnur. |
| ,, Krishnamurthi, R. | Special A. D., Sweet Potato Scheme, Ponneri, | Asst. Fertilizer Inspector Cuddapah. |
| ,, Muthaiah, V. | Addl. A. D., Mathurai, | Asst. in Chemistry, Coimbatore. |
| ,, Narasimha Rao, M. | On leave, | A. R. S., Guntur. |
| ,, Raman, N. V. | On leave, | A. D., Trivellore. |
| ,, Raghavan, N. | Asst. in Fruits Pomological Station, Coonoor, | A. D., Ootacamund. |
| ,, Rajagopal, V. V. | A. D., Ootacamund, | Coimbatore. |
| ,, Ranganathaswami, G. | On leave, | Seed Development Asst. in Paddy, Cuddapah. |
| ,, Santhana Raman. | On leave, | Asst. in Entomology, Coimbatore. |
| ,, Seshadri, N. | Teaching Asst. in Entomology, Bapatla. | Teaching Asst. in Economics, Bapatla. |
| ,, Sithapathi Rao, S. | A. D., Pithapuram, | A. D., Amalapuram. |
| ,, Venkatachalam, K. M. | On leave, | A. D., Trivellore |

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5. FULLER (H. J.) AND TIPPO (O): College Botany. 1949: Henry Holt and Co., New York.
6. INDIA. University Education Committee: Report: V. I. 1949: Manager of Publications, Delhi.
7. JEHU (I. S.): Ed.: Indian and Pakistan year book 1948 and 1949: Times of India Press, Bombay.
8. KRAUSKOPF (K. B.): Fundamentals of Physical Science. Edn. 2. 1948: Mc. Graw Hill Book Co.,
9. MARTIN (H): Scientific principles of plant protection, Edn. 3. 1948: Edward Arnold London.
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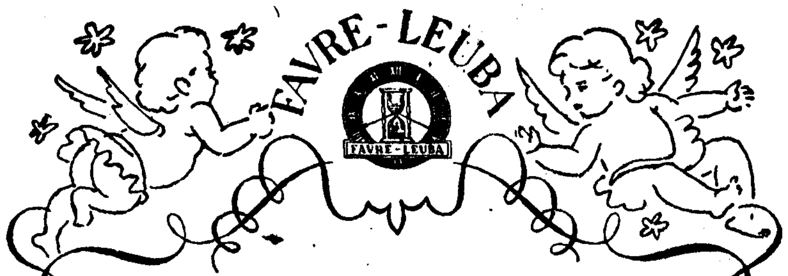




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