# FACT

Vol. 7 No. 3

July-September, 1953





*The Editorial Board do not hold themselves responsible for the views expressed by contributors.*

*Books and Pamphlets on scientific, industrial, agricultural and allied subjects are accepted or review in this Journal.*

Editor

## Contents

### ENGLISH



### MALAYALAM

Vol. 7 | JULY - SEPTEMBER, 1953 | No. 3

## EDITORIAL

# A NEW PROJECT

WE have great pleasure in announcing the commencement of work on a new project to manufacture ammonium chloride.

A scheme for the installation of a modern plant, with a daily production capacity of twenty-five tons, to synthesize ammonium chloride, had been finalised with the active help from the ~~Indian~~ Industrial Finance Corporation, who came forward to render direct financial assistance. The main consideration that prompted and encouraged us to install this plant in FACT was the availability of hydrochloric acid from our sister concern, the Travancore-Cochin Chemicals Ltd.

The manufacturing technique adopted here for the production of ammonium chloride is the direct neutralization of ammonia and gaseous hydrogen chloride, yielding ultimately crystalline ammonium chloride.

Ammonium chloride is a highly useful material and this will be the first time when it is manufactured on a large scale in our country. In addition to its general use in dry cells and batteries, this new product possesses various other uses. Being an important flux material it finds many uses in the metallurigical industries, for soldering, tinning and galvanizing. It can also be utilized as a new fertiliser material yielding more nitrogen than ammonium sulphate.

The erection work is now progressing on a rapid pace and the new plant will be in commission early next year, when it will be ready to play its part effectively in adding to the economic wealth of our country.

The birth of a new industry is always attended by numerous difficulties, some of which may even defy solution; and so it was in this case. But thanks to sheer perseverance and to the timely assistance rendered by the ~~Indian~~ Industrial Finance Corporation, all the hurdles have now been cleared and we can now look forward to the final fruition of the aim.

With the establishment of this plant, the first of its kind in India, FACT has taken yet another step forward along the shining path of industrial progress!

*Editorial Board*

# Utilization of wild Legumes for Green Manuring

M. A. IDNANI AND R. K. CHIBBER
INDIAN AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI.

THE substantial and immediate improvement in the crop production capacity of soils resulting from green manuring is established both by experiment and practice. It is generally realized that on cultivated lands "the soil bank account gets greatly overdrawn and that returns to the land must be made if yields are to be increased. The main problem however is not one concerned with the efficacy or scientific soundness of this method of building up fertility but with its economic practicability in the fields of cultivators who do not have the means to meet the outlays involved." (Stewart, 1947)

The most important desiderata for consideration in the adoption of this practice are (*i*) that the green manure crop should not compete with the main crop for nutrients, and *(ii)* that it must increase the yield of the ensuing crop to such an extent that its application becomes profitable. In practice these limitations have been responsible for the failure to popularize any extensive use of green manures, inspite of propaganda and practical demonstrations on cultivator's fields.

For an approach to this problem it is necessary to examine critically the available experimental evidence on the nature of the factors which bring about improvement in soil fertility with the addition of green manures. A commonly held idea is that the principal benefit results from the increase in nitrogen as well as the humus content of soils, the latter comes from the ploughing in of the upper parts of leguminous plants. It has been observed that when legumes are harvested and only the roots left in the soil the succeeding crop does not benefit. (Stewart *loc. cit.)* Other advantages ascribed to green manuring are, improved physical properties of soil and conservation of soil moisture. Experiments and practical experience in South and West Africa have however led workers in these countries to hold rather different opinions on the functions of green manures. For instance, it has been shown that green manuring under the soil and climatic conditions at Ibadan, benefits the crop not by virtue of improving the nitrogen or organic matter content of the soil or by modifying soil moisture relationships but by mobilisation of mineral nutrients (Faulkner and Mackie, 1933; Haylett, 1943.) In a series of experiments of which a green manure crop was grown for the benefit of the succeeding maize crop, it was found that it made very little difference whether the green manure crop was buried in the soil or burnt *in situ.*

Another important result obtained in Nigeria showed that green manures behave as quick acting manures, the effect being fully exhausted in two succeeding crops. It is thus considered to be a practical proposition only when the green manure crop and another crop can be grown in the same season (Faulkner and Mackie *loc. cit.*) Similar views on green manuring are expressed by South African workers, including Theron (1936) who, concerned mainly with semi-arid conditions discusses the question of humus in relation to soil fertility. He considers that under tropical conditions, organic matter added to soils, gets quickly oxidised without undergoing the type of decomposition which results in the formation of colloidal humus and soil humus complexes. There is thus little residual effect left on any of the physical properties of soils. Addition of organic matter gave disappointing results in Uganda, as regards structure formation (Martin, 1944). According to Theron soils in arid regions are usually in good physical condition due to the general presence of small amounts of salts in them which are capable of retaining the soil in good structure. While therefore a sufficiency of humus in a soil is desirable for other reasons, the maintenance of a minimum satisfactory level of organic matter in tropical soils can be achieved only by the addition of large quantities of organic manures at frequent intervals. The amounts usually applied are entirely inadequate for this purpose and in warmer climates at any rate so rapidly burnt out that the soil is enriched only in the salts left behind (Theron, *loc. cit.*) Experiments at New Jersey showed that large quantities of green manure in the form of 2308 lbs. of dry soya-bean hay per acre had no measurable effect on the organic matter content of the soil even after 28 years of the practice.

These experimental results obtained under climatic conditions similar to those in India clarify the following salient aspects of green manuring:

*(a)* It seems impracticable to obtain improvement in physical conditions due to increase in the organic matter content of soils in tropical regions, by the small addition of green manures. The principal benefit from green manuring under such conditions is due to the nutrient elements contained in the leguminous plants.

*(b)* In green manuring, only the upper parts of leguminous plants are useful which add and liberate nitrogen and other plant nutrients on decomposition. It is therefore not necessary that the green manure crop should be buried in the same land on which it was grown so as to benefit the succeeding crop.

(c) Under tropical climatic conditions green manures behave like quick acting manures, giving higher yields for almost two seasons and are of little value for storing or building up lasting soil fertility.

EXPERIMENTAL

In the light of the above experimental evidence, the traditional value of the practice of green manuring under Indian conditions, resolves itself chiefly to the beneficial effect of the plant nutrients that get added through the buried plant material of leguminous crops. The cultivation of legumes for the production of this material at the cost of a regular crop becomes an uneconomic proposition and it is therefore worth-while to examine to what effect leaves and prunings of wild leguminous plants and trees, as alternative materials of a similar type can serve the purposes of green manuring. Like the cultivated legumes, the wild species of plants of this family are also known to fix large amounts of nitrogen from the atmosphere and in consequence assimilate from the soil, larger amounts of mineral matter than other crops. With a view to their fuller utilization for this purpose, a detailed study of their chemical composition, nitrification under laboratory conditions and effect of burying them as green manure on crop growth, was carried out. Samples of leaves of 38 wild leguminous plants and trees growing around Delhi were collected and analysed for total N, P, K, and Ca.

The data so collected show that the leaves of wild leguminous plants and trees are rich in the major plant nutrients, specially nitrogen which in the majority of cases exceeds 2%—the minimum over which organic nitrogenous materials render nitrogen available for plant growth.

The value of leaves of varying nitrogen contents in liberating assimilable nitrogen for plant growth was examined in nitrification experiments. The results obtained are given in the following table.

NITRIFICATION OF LEAVES OF WILD LEGUMES

Total nitrogen added:-30 mgms/100 gm. soil

| Material | Total N% in leaves | Weeks- 2 | 4 | 8 | 14 | 20 | %N nitrified |
|---|---|---|---|---|---|---|---|
| 1. *Cassia occidentalis* | 5.90 | 11.2 | 15.1 | 15.5 | 16.2 | 12.0 | 54 |
| 2. *Prosopis juliflora* | 5.07 | 9.3 | 12.4 | 13.1 | 16.2 | 12.6 | 54 |
| 3. *Pithecolobium dulce* | 4.91 | 8.1 | 8.9 | 10.7 | 13.6 | 12.0 | 46 |
| 4. *Sesbania oegyptiaca* | 4.00 | 7.4 | 8.9 | 10.7 | 15.0 | 10.8 | 50 |
| 5. *Tephrosia purpurea* | 3.49 | 3.7 | 5.9 | 7.1 | 12.6 | 9.0 | 42 |
| 6. *Tephrosia candida* | 2.96 | 3.0 | 7.8 | 12.0 | 12.6 | 7.8 | 42 |
| 7. *Rhynosia aurea* | 2.61 | 4.8 | 7.8 | 12.6 | 13.8 | 9.6 | 46 |
| 8. *Cassia sp.* | 1.91 | 1.2 | 2.4 | 3.0 | 6.6 | 5.4 | 22 |
| 9. *Tamarindus indica* | 1.59 | 0.6 | 2.4 | 4.2 | 5.4 | 6.6 | 22 |

The data show that the leaves of these uncultivated leguminous plants nitrify easily and commence to make available adequate nitrogen to feed crops, from the second week of their incorporation in soil. Materials containing over 2.6% total nitrogen released 42-54% of their nitrogen in available forms while those with a nitrogen content of less than 2% yielded 22% of their nitrogen.

### Manurial Value of the Leaves

Small scale field experiments were conducted on a soil of low fertility*, to determine the effect of burying the leaves as green manure on the growth and yield of wheat. The average yields of grains and straw obtained are given below:

| | Yield in gms. per plot-30 sq. ft. Grain | Straw |
|---|---|---|
| 1. Control | 99 | 207 |
| 2. Ammonium sulphate | 389 | 719 |
| 3. Berseem (whole plant) | 286 | 504 |
| 4. *Cassia occidentalis* | 332 | 583 |
| 5. *Crotalaria medicaginea* | 291 | 529 |
| 6. *Prosopis juliflora* | 314 | 540 |
| 7. *Tephrosia purpurea* | 339 | 617 |
| Critical difference=1% level | 86 | |

The manures were applied at the rate of 50 lb. nitrogen per acre. The results show that significantly high yields could be obtained by burying the leaves of wild legumes. The response was comparable to that obtained with ammonium sulphate, indicating that the principal benefit from green-manuring in Indian soils is mainly due to the addition of available nitrogen contained in this type of material.

### Conclusion

Evidence in literature shows that under tropical conditions, green manures or other organic manures applied to soil are so rapidly burnt out that there is little resulting effect on the physical properties of the soil that is associated with sufficiency of humus. In the amounts usually applied, green manures are thus inadequate to raise or maintain the organice matter status of soils and the increased yields of succeeding crops obtained are chiefly due to the many plant nutrients in these which get incorporated.

Increased yields obtained in green manure experiments conducted at various Research Stations in India range from 68-333 lb. per acre for wheat and 350-444 lbs per acre for paddy. This is obviously inadequate to compensate the loss of a cropping season that is involved. In view of the above factors the growing of a leguminous crop solely for green manuring becomes an uneconomic proposition and an otherwise useful practice has

*Total N-0.04%; $P_2O_5$0.077%; $K_2O$.54%

therefore not been adopted on any extensive scale.

The chief benefit from green manuring in India would appear to be due to the large amount of available nitrogen in the upper parts of such plants, that gets added to the soil and the utilization of the leafy matter of wild leguminous plants which contain substantial amounts of nitrogen, offers a highly practical alternative for the limitations of the usual practice. It has been found that such leaves can be dried in the sun without loss of their manurial value, which would make it possible to collect and transport the material from areas of abundance.*

REFERENCES

Faulkner, O. T. and Mackie. J. R., West African Agriculture Cambridge, 1933.

Haylett. D. G., *Farm. S. Africa 18* 627-636, 1943.

Martin. W. S., *Emp. J. Expt. Agric. 12*, 21-32, 1944.

Stewart A. B., Soil Fertility investigations in India with special reference to manuring. 1947.

Theron, J. J. Green manuring, Pretoria, 1936.

*The authors are indebted to the Head of the Division of Botany. I. A. R. I and Shri H. B. Singh, Assistant Botanist for identification of the plants and supply of some of the samples.

## Experiments in Nanjanad Exptal. Station

The Agricultural Research Station at Nanjanad is at present investigating the proper method of manuring the potato crop. The grower of potato has now to spend over Rs. 300 per acre for manures and fertilisers. The experiments include studies on the application of lime to improve the intake of the fertilisers applied and the formulation of an ideal mixture for potato.

Another line of investigation is to find out the possibilities of utilising the calcium carbonate studge or slurry as it is commonly known, which is a waste product in the ammonium sulphate industry. Its use as a soil ameliorative is also under examination.

# IMPRESSIONS ABROAD

B. V. D. MENON, B. Sc. (Eng.), Mem. A.I.E.E., A.M I.E., Grad. I.E.E.,
Director, Seshasayee Bros. (Travancore) Ltd.

THE first country I visited was Italy where I investigated the possibilities of the new continuous casting and rolling machine for aluminium invented by Mr. Ilario Properzi of Milan. The conventional hot rolling of aluminium into rods is a complicated process necessitating elaborate and expensive equipment. A complete rolling mill with auxiliary plant for billet making from ingot would easily cost Rs. 50 to 60 lakhs installed in our country. The smallest unit would have an output of about 20,000 tons per annum. This difficulty put such an installation out of the reach of a small consumer of rod, whose requirement was only about 5000 tons annually. Thus small consumers of rod had always to depend on a big fabricator who owned a rolling mill. The invention of the Italian Ilario Properzi, has made possible the manufacture of small quantities of aluminium rod like 3000 to 5000 tons, an economic possibility. The equipment is so simple in construction and operation that it will not be far wrong to predict that in the next few years there may not be any aluminium rod production other than through the Properzi process.

The principle underlying this revolutionary process is not unlike the continuous casting and pouring process for ingot making, which has made possible the phenominal sizes of ingots used for rolling sheets and plates today in big aluminium plants. The idea in Properzi's machine is to cast molten aluminium into a triangular bar about 1⅛" sides and to roll the rod using a minimum of triangular roll series to give a round section after about six or seven rolls. The casting is done through pouring the molten metal into a triangular copper groove around a water cooled steel wheel which slowly revolves. A mild steel band forms the lid of the groove and when the metal has cooled sufficiently the band moves off the wheel at a tangent and the cast bar is led into the rolling unit located close by. The slowly revolving wheel makes the casting and rolling a continuous process. The rolling portion is a self-contained "packaged" unit with fully enclosed self-lubricated rolls. The rolls are all driven by an oil immersed helical gear system. The rolls can be progressively taken out of series from the finishing end thereby enabling bigger diameters to be rolled. Thus there

Mr. B. V. D. Menon who has just returned from a long tour to the continent, England and America, gave a delightful lecture on his impressions abroad under the auspices of FACT Technical Society on 30th September 1953. Here is an extract of that lecture.—Ed.

is practically nothing to go out of order in the Properzi equipment and operation is very simple with the need for only one operator to regulate the pouring. It is best to use electric induction melting furnaces with a high alumina content lining for providing the molten metal. Outputs up to 2000 lbs./hour are possible with the latest model and the entire equipment complete with furnaces will cost only about Rs. 8 lakhs. The economics of this process make it possible for a small consumer of rod to own his own rolling plant, while the process is ideal even for a big consumer since his entire installation of several Properzis will have flexibility of operation. Incidentally, a Properzi unit has been ordered for The Aluminium Industries Limited at Kundara.

I spent some days with the big Italian industrial group of Montecatini. They own several chemical factories scattered all over Italy and aluminium plants in Northern Italy. I also visited their aluminium reduction works and rod mills (Properzi installation) at Bolzano in Italian Tyrol; and an underground hydro power station owned by them at Capagamali, supplying power to the reduction works. Electricity is expensive in Italy and their aluminium prices are high.

When I went to Switzerland from Italy, I visited the Swiss Aluminium (AIAG) plants at Chippis, reducing the metal as well as fabricating it. Even though electric power is cheap, ore is costly and scarce in Switzerland and therefore aluminium is expensive. I also visited the electrical manufacturing factories of Brown Boveri Company at Baden and Oerlikon Engineering Company near Zurich. The recent developments on designs of oil-less and minimum oil type circuit breakers and contact type rectifiers, as well as in the field of electronics were impressive. Most of the switchgear for the new 380-KV Swedish super tension transmission line is being manufactured by these factories in Switzerland. I visited also two modern hydro electric power stations in Switzerland.

My trip to Dusseldorf and Frankfurt in Germany with a visit to a few typical installations helped me to study the economics of aluminium rod rolling and extrusion by conventional processes in detail. The simplicity, cheapness and ease of operation of the Properzi equipment were further revealed through this study.

I visited some steel wire mills in Belgium. The factories are well laid out and modern in equipment and technique. The general layout of modern Belgian factories is strikingly similar to that of Swiss factories.

I spent a week in Sweden, where I visited the electrical manufacturing factories of ASEA at Liljeholmens making copper cables, at Vasteras making motors, generators and relays and at Ludvika, making rectifiers and transformers. My visit to the aluminium conductor factory of AB. Svenska Metallverken at Vasteras comprising of rolling and cable mills showed that Swedish aluminium is cheap — almost as cheap as Canadian or U. S. — due to cheapness of raw material and electric power. I also paid a visit to the underground water power station of ASEA at Bollnas.

I visited steel, aluminium and copper rolling and cable mills in France. The equipment in French factories appear old-fashioned and obsolete according to standards elsewhere in the Continent, with resultant poor productivity. But all the same, the French appeared to be the happiest people in the world a frame of mind no doubt attributable to their own philosophy of life and the almost perfect balance between industry and agriculture which is to be found only there in the post-war world.

On reaching U. S. A., I investigated the range of induction melting furnaces which the Ajax Engineering Corporation are manufacturing in Trenton, New Jersey State, for operation along with Properzi continuous casting and rolling equipment. Latest type of furnaces and control gear have been ordered for The Aluminium Industries Limited at Kundara. One novel installation which I saw in New Jersey State was the Gordon Walker dairy farm with its "ROTOLACTOR" equipment for automatic milking of cows. The cows walk on to a slowly rotating platform about 60′ diameter and are milked automatically standing side by side. After the milking which is completed in about 5 minutes during one rotation of the platform, the cows step off the ROTOLACTOR and move out in a perfect queue. About 600 cows are milked in about 45 minutes.

In Canada, the gigantic Shipshaw hydro electric power station of the Aluminium Co. of Canada is in the Province of Quebec. The installed capacity of the station is about 900,000 K.W. The station is automatic in operation needing only 2 men on shift and supplies the power required for the mammoth Arvida reduction works of The Aluminium Company of Canada. The Arvida works are the biggest units in the world so far, for ore-treatment, reduction of aluminium and rod, sheet and plate rolling. It is also undoubtedly the cheapest producer of aluminium metal in the world. The Aluminium Company of Canada's conductor and accessories factory is at Shawinigan Falls, with foundries at Etobicoke in Ontario Province. For research and development, their associate concern, The Aluminium Laboratories Ltd. have establishments at Arvida and Kingston in Canada. The Aluminium Company of Canada is now working on a gigantic development in the Province of British Columbia known as The Nechako-Kemano-Kitimat Project. This envisages the construction of the greatest hydro-electric power development ever financed entirely by private capital, with an ultimate installed capacity of 16,80,000 K.W. under one roof and a firm capacity of 12,00,000 K.W. This power will be exclusively used for the production of 5,00,000 tons of aluminium annually. This project involving a total capital outlay of some $50,00,00,000 will ensure for Canada the lead as the biggest aluminium producing country of the world for at least the next decade. The magnitude of this project is suggestive of the considerable financial courage and engineering audacity of The Aluminium Company of Canada.

The United Kingdom is no longer a "country of shortages". Industrial research and production trends are comparable with Canada or U.S. and trade recovery has been excellent. The railways, colliery, electric power and metallurgical industries which were very hard hit during the war, have all recovered splendidly and function very efficiently now.

I must here make certain observations on the trends in hydro-electric developments noticed during my sojourn in countries like Italy, Switzerland, Sweden and Canada. Whereas the capital cost per installed kilowatt of hydro-electric power in our country at present is almost in the neighbourhood of Rs. 2000/- on a medium sized scheme, in these countries it is about Rs 1400/-. This economy in foreign countries results from a combination of factors like the bigger size of the project, the speed of its execution, the mechanisation in running the system and also certain basic differences in the design itself. The construction phase of a project is always rushed through in these countries with fully mechanised equipment for the civil works, etc., so that the indirect expenditure spread over months or years of delay are not capitalised on the cost of the project as happens here at home. Automatic operation of stations and auxiliary hydraulic systems reduces cost of generation appreciably. The 9,00,000 K. W. Shipshaw station in Canada is run by 2 men per shift. For economic reasons (in addition to reasons of strategy) the tendency abroad is to locate power station underground. This makes possible the location of the power station at the easiest and cheapest site, reducing length of tunnels to a minimum, eliminating penstocks and avoiding curves and bends in pressure tunnels. Since tunnelling 60 feet or more below solid rock is bound to yield fine stable strata, artificial preparation of foundations and extra expenditure thereon is eliminated. Stations are normally located nearer the intake end of pressure tunnels, leaving greater length of tail race behind the station, which again reduces cost. Moreover, the artificially controlled conditions of ventilation, humidity and temperature essential for an underground station reduces the deterioration of all equipment, so that underground systems are depreciated only as low as 0.5% per annum, as against a minimum overall depreciation of at least 3% we have to provide in our conventional designs. Assuming 3½% interest on capital invested, ½% for depreciation and ½% operating costs, these foreign station can generate elecricity around Rs. 63 per K. W. year, since installed cost per K. W. is only Rs. 1,400. At home, our installed cost is Rs. 2,000 per K.W. and with the same interest on capital, depreciation of 3% and higher operating costs like 1½%, our cost of energy is around Rs. 160 per K. W. year! This state of affairs emphasizes the need for changes in our designs as well as our methods of construction.

Judging from the happiness of the people, which after all is the only basic factor, France appears to be the happiest postwar country! While she is sufficiently industrialised for providing her people with basic industrial necessities and luxuries, the psychology of the people and their very culture and philosophy are such that the utmost delicate balance seems to be maintained between industry and agriculture. There are enough food, drinks and luxuries for happiness and contentment, but certainly, without any over-industrialisation which mars domestic and international harmony; and also there is no hankering after foreign markets to balance overproduction of industrial materials. The quantum of individual happiness obtaining in France is certainly not evident in any other country in the postwar world and the average Frenchman's very balanced state of mind and psychology towards life is probably the great secret of that happiness.

*(See photo of the author printed elsewhere)*

---

# A PRELIMINARY STATISTICAL STUDY ON THE YIELD OF PADDY IN MALABAR

K. A. KRISHNAN, B. A. (Hons.)
and
C. BALASUBRAMONIAN, B. A., B. Sc. (Ag.),
Agricultural Research Institute, Coimbatore.

## INTRODUCTION

An attempt is made in the present paper on the application of the methods of statistics to agriculture. From the treatment of the topic dealt with, it will be clear that with the aid of the computed correlation coefficients between yield and certain meteorological factors it is possible to forecast the yield even before the harvest of the crop from a knowledge of the area under cultivation and prevailing meteorological conditions. The statistical analysis of the crop weather data extending over a good number of years is of considerable importance in any agricultural country, and it is but fitting to remark here, that the recently incepted All India Co-ordinated Crop Weather Scheme aims at such a study and prediction of crop yield. The latter is possible by correlating yield with certain meteorological factors as attempted in this case, and also by correlating it with certain characteristics associated with the crop itself. The importance of crop forecast and a review of the different methods have already been dealt with (3).

## MATERIALS AND METHODS

The region chosen for this study is the district of Malabar, which is subject to the influence of monsoon showers to a great extent. At present there is no dependable irrigation system in this district thereby ensuring that rainfall is the factor that enters directly into the determination of yield.

Data for fortyfour years relating to the estimated output of paddy, area under cultivation and rainfall were collected from the season and crop reports of the Madras State. As the temperature figures averaged over the district were not available, the temperature at the headquarters of the district is taken as representative figure for analysis. These figures were supplied by the Director of Meteorology, Poona. The method of analysis is on the same lines as found in reference (1) cited.

## DISCUSSION

To eliminate the seasonal fluctuations, the entire mass of data is converted into three years moving averages and as the resultant figures are difficult to deal with as they are, indices were constructed for them. For example, to convert the yield of a particular year into proper index, the yield of that year is divided by the average yield of three preceding years and the resultant figure is multiplied by 100. In general, $Y_{3t}$ denoting the three years moving average ending in the year and $Y_t$ the estimated yield of the (t+1)th year the index $\frac{100Y_t}{Y_{3t}}$ is taken for analysis. Similarly, the acreage, rainfall and temperature figures were converted into moving averages and corresponding indices.

Calculating the co-efficients of correlation between the four indices taken in pairs, the co-efficients come out as shown below:

$r_{01}$ (Yield and Area) = + .55
$r_{02}$ (Yield and Rainfall) = + .36
$r_{03}$ (Yield and Mean June temperature) = − .34
$r_{12}$ (Area and Rainfall) = + .18
$r_{23}$ (Rainfall and Mean June temperature) = + .01
$r_{31}$ (Mean June temperature and Area) = − .08

Thus the correlations between yield and area and yield and rainfall are respectively significant. There is a higher correlation between yield and area than between yield and rainfall and this is easily explained when we remember that too much of rains may be injurious to crops, while on the other hand yield increases with area under normal circumstances. The correlations of yield with the maximum and minimum temperatures of different months of the year were not significant, but the mean June temperature is found to be significantly associated with yield as indicated by the magnitude of the co-efficient. The negative sign implies that a lower June temperature is conducive to a better yield.

With the aid of these correlation co-efficients the regression equation can be formed which will give yield when the other three factors are known. The problem is one of the theory of multiple correlation. If $x_o$ stands for yield, $x_1$ for area, $x_2$ for rainfall and $x_3$ for temperature the prediction equation is given by

$$\left( \frac{x_o - \overline{x_0}}{\sigma_0} \right) R_{oo} = -\sum_{n=1}^{3} \left( \frac{x_n - \overline{x_n}}{\sigma_0} \right) R_{on}$$

where $\overline{x_0}$ and $\sigma_0$ etc. denote the respective means and standard deviations and R is the symmetrical determinant

$$\begin{vmatrix} 1 & r_{01} & r_{02} & r_{03} \\ r_{10} & 1 & r_{12} & r_{13} \\ r_{20} & r_{21} & 1 & r_{23} \\ r_{30} & r_{31} & r_{32} & 1 \end{vmatrix}$$

and $R_{01}$, $R_{02}$, and $R_{03}$ are the minors of $r_{01}$, $r_{02}$ and $r_{03}$.

The regression equation in this case reduces to

$$x_o = -1.824x_1 + 0.1059x_2 + 1.344x_3 - 35.59$$

Here $x_o$ represents the yield in tons, $x_1$ area under cultivation in acres, $x_2$ annual rainfall in inches and $x_3$ mean June temperature. This equation is based on forty years data and with the aid of this the probable yield of paddy in any year can be calculated with a fair degree of certainty, if the area under cultivation, rainfall and mean June tempurature are known.

Before concluding, it has to be remarked that the true relationship between the different factors here, on which depends the accuracy of the forecast formula, can be gauged only if the data collected are of ensured accuracy. In this case, the estimated yield is not based on the scientific method of 'Crop cutting experiments'. The error based on the eye judgment is inherent in these figures. Further, if the averaged temperature figures, for the whole district are available, the formula can be made more reliable.

## SUMMARY AND CONCLUSIONS

1. Statistical study of crop weather data furnishes valuable information to agriculturists.

2. The paddy yield in Malabar can be estimated from the regression equation derived above by correlating yield and certain influencing factors.

3. The yield is found to bear significant positive relationship with rainfall and consequently increase in rainfall is conducive to better yield. The mean June temperature is also a decisive factor of the paddy yield. The significance of the correlation co-efficient and the negative sign suggest that yield is associated with low mean June temperature.

## ACKNOWLEDGEMENT

The authors are grateful to Sri M. B. V. Narasinga Rao, B.A., B. Sc.,(Ag.), Assoc. I. A. R. I., Paddy Specialist and to Sri A. Abdul Samad, B.A., B.Sc. (Ag.), Assistant Paddy Specialist for their valuable guidance. Thanks are also due to the Director of Meteorology, Poona for the supply of temperature data.

*REFERENCES:*

1. Adyantaya, N. K. (1931) ... The Madras Agricultural Journal, Vol. XIX, No. 10
2. Anantapadmanabha Rao (1938) ... Journal of the Mysore Agric & Exp. Union, Vol. XVII
3. Krishnan, K. A. (1953) ... The Madras Agricultural Journal, Vol. XL, No. 5
4. Ramakrishnan, S. (1934) ... Sankya, Vol. II

# Travancore-Cochin Chamber of Agriculture

To Sri RAFI AHAMED KIDWAI, Union Minister for Food, New Delhi.

*Sir,*

THIS Chamber of Agriculture and the Kerala Round Table Group to whose representatives you were good enough to grant an interview at Ernakulam on 25th July, 1952 during your visit to T. C. State hail with joy and thankfulness the successful introduction of a large measure of decontrol in food, despite tremendous odds. Permanent removal of the ban on export of tapioca from T. C. State for which we requested the favour of your interference was ordered by the State Government over a month ago, to the great relief of the cultivators.

It is the people of Kerala who are more anxious than any other people in India that your scheme of decontrol should succeed not only because they have already enjoyed and are enjoying the benefits of partial decontrol, but also because they have always held that the deficit in food is exaggerated and that it could be got over by proper inducement for larger production of food crops like tapioca, a hardy crop whose production possibility is unlimited in Kerala soil and climate.

You will remember that we brought to your kind notice at the time of the interview that at least 25% of India's deficit in food can be made good by the introduction and encouragement of tapioca as an important subsidiary food in the whole of the Indian Union, particularly for our armed forces. The Food Technological Laboratory at Bangalore has found that tapioca is as good as rice or wheat in point of calorific value and better than either in calcium content. That palatable dishes and excellent confectionary can be made with tapioca and that tapioca flour mixed up to 50% with wheat atta make crisp chapathies has been well demonstrated.

This Chamber ventures to suggest that in order to ensure the implementation of your hope and ambition, as announced at Madras on 4th Dec., 52, of "feeding the country on the country's produce" in future, the adoption, acceptance and popularisation of tapioca as an important article of food for the nation just as potato is for all Europe, would prove to be the wisest course causing a saving of about 30 crores to the country under import of food-grains.

We are glad to publish here the letter from Mr E. I. Chacko, Retd. Director of Industries, and President of the Travancore-Cochin Chamber of Agriculture, addressed to Mr. Rafi Ahamed Kidwai, Union Minister for Food. Mr. Chacko has rendered yeoman service in the field of tapioca cultivation and in the establishment of the Cottage Industry to manufacture starch from tapioca.—Ed.

We are very grateful to you also for having passed prompt and favourable orders on our request for stopping the import of starch, because, between Travancore-Cochin State, Malabar and Salem Districts, the entire requirement of starch per year of over 50,000 tons costing nearly 4 crores for the textile industry can be manufactured and supplied.

We have however, to add with regret that the production of tapioca in Travancore-Cochin State and in Malabar too in 1952-53 has gone down to less than half of the crop in the previous year because of the extremely uneconomic prices ruling since 1951 consequent on the hesitant and wavering policy of the State Governments regarding the ban on export of tapioca. This has, caused a loss of over Rs. 20 crores to the middle and lower class agriculturists who form the bulk of the population, upsetting thereby the basic entire economy of the State and indirectly the revenues of the State.

The price may shoot up for a while owing to the decrease in production. But if the Government does not become panicky on that account, and would leave the agriculturist undisturbed for his normal peaceful rehabilitation, the situation will improve marvellously within another year, so that in 1953-54, we can expect a crop of 20 to 30 lakhs of tons from 8 to 10 lakhs of acres which will be under tapioca in T. C. State, Malabar and other districts of S. India. After earmarking 2,50,000 tons of raw tapioca for manufacture of 50,000 tons of starch required for our textile industry, there will be left over 20 lakhs of tons raw tapioca or 10 lakhs of tons of dried chips which could well replace 10 lakhs of tons of cereals and save so much import to the value of about thirty crores to the exchequer.

With a view to implement the programme forecast above, we have recently organised an "All Kerala Agricultural Development Association" comprising Travancore-Cochin State and Malabar which are ideally suited for the cultivation of tapioca.

Although this year we may not have very much to spare over and above our food requirements, we may profitably use the year to familiarise the people of India in the use of tapioca flour mixed with atta for chapathies, and tapioca rava unmixed or mixed with wheat flour for 'uppuma'. It is now extensively used by merchants to mix up with wheat flour or American flour, but the poor consumer doesn't get the benefit of it, because it is retailed as atta or American flour at the high prices ruling for that commodity in the market.

It would be a great blessing if the Central Government could make arrangements with the State Governments to retail it in the fair price shops set up by them. We are prepared to give quality powder with our guarantee in 7 lb. bags to enable the poor consumer, who cannot afford to buy wheat or wheat flour at the ruling high price, to buy at a very much lower price either mixed or unmixed flour or rava for his various food purposes. The State Governments may also be asked to open tapioca cafetarias in industrial towns, and we are prepared to supply the materials and the men required to run them efficiently.

We are also prepared to send our representative to Delhi at the time of the Food Ministers' Conference when you can come to a definite decision on the food requirements of the various States. We are confident that with an Administrator Statesman like Rajaji at the helm of affairs at Madras, we shall be able to supply the food requirements of our sister State and come to the help of our country at this time of crisis.

We hope that you will quickly realise the enormous possibilities unfolded by this scheme and take advantage of our offer, as our organisation is backed by tapioca growers and agriculturists of Malabar, Cochin and Travancore.

ALWAYE, }
........................ }

(Sd.) E. I. CHACKO,
President.

## Burbank and the Cactus

The achievements of Luther Burbank, the American "wizard of the garden," savour so strongly of the mysterious that, if he had lived three centuries earlier, he would probably have been burned at the stake as a wizard. Take for example, his work on the cactus. What did he do to it? Or rather, what didn't he do to it?

As we all know cactus is a desert plant with thick fleshy leaves, covered with deadly spines. Burbank wanted to change its life and make it useful to man and cattle—and he succeeded wonderfully! After long years of breeding work, Burbank first removed all its thorns and *created* a spineless cactus. Then to *took away* its hard, woody pulp of the leaves and transformed them into juicy forage to cattle! Did Burbank stop with that? No. He started to breed the fruit of the cactus to a perfection, never before dreamt of by man. The new fruit had a mixed flavour of peach, melon and pineapple! A single Burbank—Cactus, three years old, produced 600 lbs. of *food*. Its leaves could be candied or used as a vegetable. Cactus converted into healthy food—that was what Burbank accomplished!

# QUALITY CONTROL

S. SUNDARAM, B. Sc., B. Sc. (Tech.), M. Sc., FACT Ltd.

IN recent years two highly specialised branches of theoretical science have made inroads into the affairs of practical organised industry and scientific undertakings, namely, nuclear physics and statistics. The findings and conclusions of mathematical and nuclear physicists are already helping to alter the course of history through such manifestations like the atom, hydrogen and cobalt bombs and also promise to usher in an era of atomically propelled ocean liners and atom-operated electric generators. Likewise, statistics which had all along been the field of mathematicians has already started taking other fascinating shapes of living interest for hard-headed businessmen and matter-of-fact machine operators. To suit the palate of chemists, research workers, management and operators a branch of applied statistics called statistical quality control or simply quality control has been evolved.

## Origin

Statistical quality control, or Q. C. as the Britisher terms it, is a methodology of collection, presentation and appreciation, on rational lines of what is already known or what can be easily known from and about a process. It is not the collection of data that is important, but it is how best one can ride on them without tripping which results from haphazard guess. It is a simple and yet powerful weapon to reduce cost, improve quality, face competition with courage in a world of free enterprise, that too, not by spending an extra pie more, but from what is already being done.

Just during and after the war, quality control methods were applied in the electrical, textile and ammunition plants in the U. S. But as a result of the good work done by pioneers like Shewart of the Bell Telephones, Grant of Stanford University, Aschcroft, Deming, Dodge, Edwards, Tippet and Youden, the applications have gained favour with aircraft, chemical, food canning and preserving, milling, metallurgical, cable and wireless industries. The introduction of this technique in a great variety of manufacturing plants has been so highly useful to the concerned unit, that it can be safely asserted that there is not a single unit or item of production or process which is really so different as to be unable to make use effectively of one or more aspects of quality control. This is a fact and at the same time a challenge also. An industry however big or small, major or small scale, heavy or light can make use of these techniques. To give specific examples, even indigenous establishments like those making chalmoogra, citronella and cashewnut oils can make use of quality control techniques.

### The Shewart Control Chart

The essential tool in statistical quality control is the Shewart control chart. It is based on the principle that measured or measurable quality of manufactured product is ever subject to a certain amount of variation. This variation in quality is as a result of chance. Some stable system of chancecauses is inherent in any particular scheme of production. Variation within this stable pattern is inevitable. The reasons for variation outside this pattern may be discovered and corrected. In the control of production processes, random variation in quality or yield has to be discriminated from definite variation assignable to traceable causes. The Shewart technique only helps us to separate out these assignable causes of variation.

The most important and commonly used working tools in quality control are:—

1. The Shewart charts for measurable quality characteristics or charts for variables or $\overline{X}$ and R charts.

2. The Shewart control chart for fraction defective or P chart.

3. The Shewart control chart for number of defects per unit or C chart.

4. The theory of sampling dealing with assurance of quality and sampling acceptance procedure.

### Variables and Attributes

In an attempt to elaborate the above working methods, it is necessary to differentiate between "variables" and "attributes". Any quality which can be actually measured is a variable. Examples of variables are, operating temperatures in degrees Fahrenheit, the acidity of a batch liquor expressed as grams per litre, specific gravity, weight of each unit of package of a fertiliser material and percentage of a component in a chemical compound. When, on the other hand, the quality is expressed in more general terms, it is said to be recorded in attributes. This especially applies to many things that may be judged only by visual examination. For example, the level in a vessel seen through a gage glass is either high or low and the surface finish of a painted or polished material either presents a satisfactory appearance or not.

### Aids for the Trouble Shooter

For the trouble shooter the Shewart charts for $\overline{X}$ and R form a firm foundation to prevent troubles. They betray useful information about the basic variability of the quality characteristics, about consistency of performance, and about the average level of the quality characteristic. The type and nature of basic variability depend on men, machines and materials. Certain amount of variability due to the inherent nature of the process itself, is quite unavoidable. So consistency of performance has also to be considered when one looks for trouble. If assignable causes are present, then the variability will show an erratic behaviour. Combined with a knowledge of the average level or process centre, these three factors will help to define as to how the process operates. The Shewart control chart for $\overline{X}$ (subgroup average) and R (range of subgroup) or $\overline{X}$ and $\sigma$ (standard deviation) help to translate basic variability, performance consistency and average level into precise mathematical forms.

Though the control chart for fraction defective is less sensitive than the control chart for $\overline{X}$ and R or $\overline{X}$ and $\sigma$ yet it is extremely helpful for production supervision. It is an aid to find out where and when to exert pressure for improvement of quality. It may even enable us to observe erratic fluctuations in the quality of inspection. In addition to its help in improvement of quality and reduction of cost P chart has a great value in dealing with vendors and customers. For instance, in the cable industry there are certain standards and specifications called for when marketted. The control chart for fraction defective can be usefully applied by test laboratory to see whether every specified length sent out is cent percent perfect. If there are defective lengths, it would help us to find out how and in what mode it appears and then once we arrive at the number of defectives, a follow-up will help us to locate the source of the defective product and verify the same.

The control chart for defects per unit applies to two fairly specialised situation met with in industry. One is the case where the number of defects like pinholes, cracks, cold laps and excess porosity, etc. are actually counted in welding metals, or the spots of bud enamelling in a enamelled wire, or the hair-line cracks, pinholes, bad finish in each unit of ceramic product, or air bubbles, cracks, hairline, sprays and finish of each piece of glass article manufactured in a glass factory. The other is the case of inspection of fairly complete assembled units like electricity meters, wireless sets, ceiling fans, electric motors, sewing machines, bicycles, etc. where a great opportunity exists for occurrences of defects of various types and the total number of defects of all types found by the inspectors is recorded for each unit.

### Simple Definitions

In all the types of control charts discussed above, a few items have to be included to make them useful. These are the average of the process, the standard deviation of the process, the control limits, the tolerances and the specifications of the process. In presentation of data, the average or central tendency and the spread or dispersion of the observations are the most concise form to be adopted. The measures of central tendency and dispersion important from the point of view of quality control are the average or arithmetic mean and standard deviation respectively. This standard deviation is the root-mean-square deviation of the observed members from the average. Other important measures of central tendency are the mode and median. The *mode* is the value occurring most frequently in a set of observations and the *median* is the magnitude of the middle case i. e. the value that has half the observations above it and half below it. The spread can also be the *range,* which is the difference between the largest observed and smallest observed value.

The control limits in all these types of charts are set in a way to detect assignable causes of variation. They tell when to take action and when to leave a process alone. It is absolutely essential not to confuse between control limits and specification limits. The latter indicate as to what a process is expected to do, but the former is deduced from what the process actually does. The control limits are not necessarily the specification limits. The control chart for variables may influence specifications in two ways. They may be used to determine the capabilities of a manufacturing process before specification limits are set. They may be also used to betray an inherent weakness of the process to meet existing specification limits even when the process is in control.

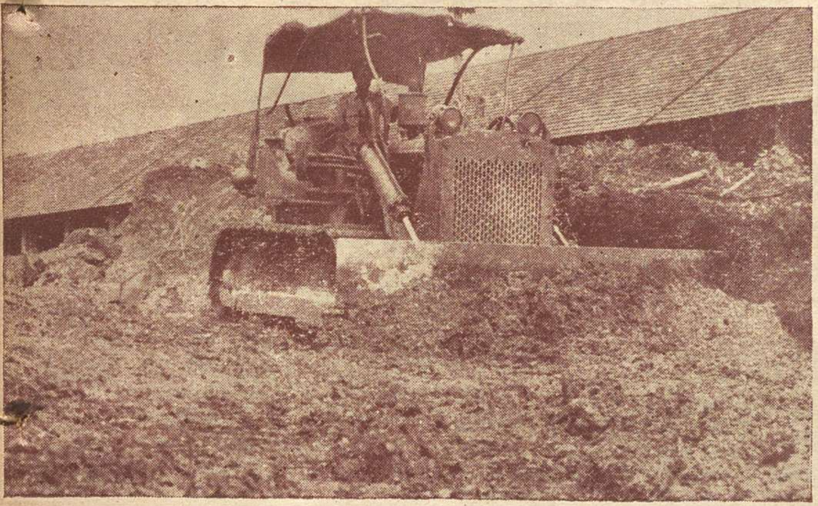
When some of the products submitted for inspection does not conform to specifications even 100% inspected will seldom eliminate it. Acceptance inspection of raw materials, manufactured parts and final product are part of manufacturing. The statistical approach to sampling is an improvement on conventional procedures of sampling and acceptance because it protects the interests of both the seller and buyer impartially. By application of probability theories it attempts at assessing the risks involved in accepting articles which contain defective items. It helps to clearly enunciate how far the risks can be taken and safely too.

The different types of control charts provide a graphic presentation of quality history that gives a clearer picture than could be obtained from mere tabulation of data. Statistical methods serve as land marks which point to further improvement beyond that deemed obtainable by experienced manufacturing men.

## Bibliography


1. Statistical Quality Control – E. L. Grant Mc. Graw. Hill.
2. A New Science in Trouble Shooting— Seder. Ind. & Engg. Chemistry, Vol. 43, No. 9, Sept. 1951.
3. Locating Sources of Variability in a Process– Youden– Ind. and Engg. Chemistry– Vol. 43, No. 9, Sept. 1951.
4. Construction and Use of Statistical Control Charts on continuous Variables— Brownlee– Ind. & Engg. Chemistry, Vol. 43, No. 6, June, 1951.

# Our Ammonium Chloride Plant



Our bull-dozer clearing the ground for the erection of the new plant to manufacture ammonium chloride.

On 3rd Aug., '53 the first sod was turned. The photo shows Messrs. K. A Varugis, V. N. Kasthurirangan, Nallaperumal and Paul Pothen using tools for this purpose. Sri V. S. Pillai who is in charge of this new project can be seen behind Mr. K. A. Varugis.

★

FACT is now erecting a 25-ton ammonium chloride plant, the first of its kind in India. The work is progressing at a rapid pace and the plant will soon be in commission. It will be producing ammonium chloride by the direct neutralization of gaseous $NH_3$ and HCl. This new product which is going to be synthesized on a large scale for the first time in India is a highly useful material for galvanizing, tinning, for making cells and batteries and as a fertiliser supplying nitrogen.

★

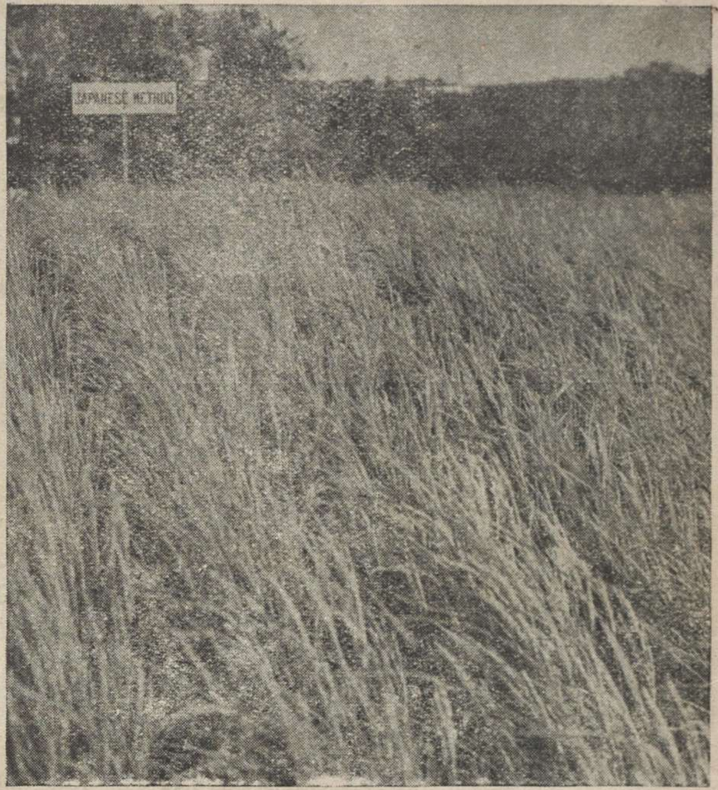
# The Japanese Method of Rice-Culture — In Pictures

**Part —— II**

(5)

Photo taken on 22nd July, '53—20 days after planting The rows of the planted seedlings can be seen distinctly. The women are engaged in inter—culturing work and they are using Japanese hand—paws for this purpose.

(7)




The Crop is now in bloom. Photo taken on 27th Aug. '53. The inflorescences have just appeared and the crop is now at it is best.

(6)

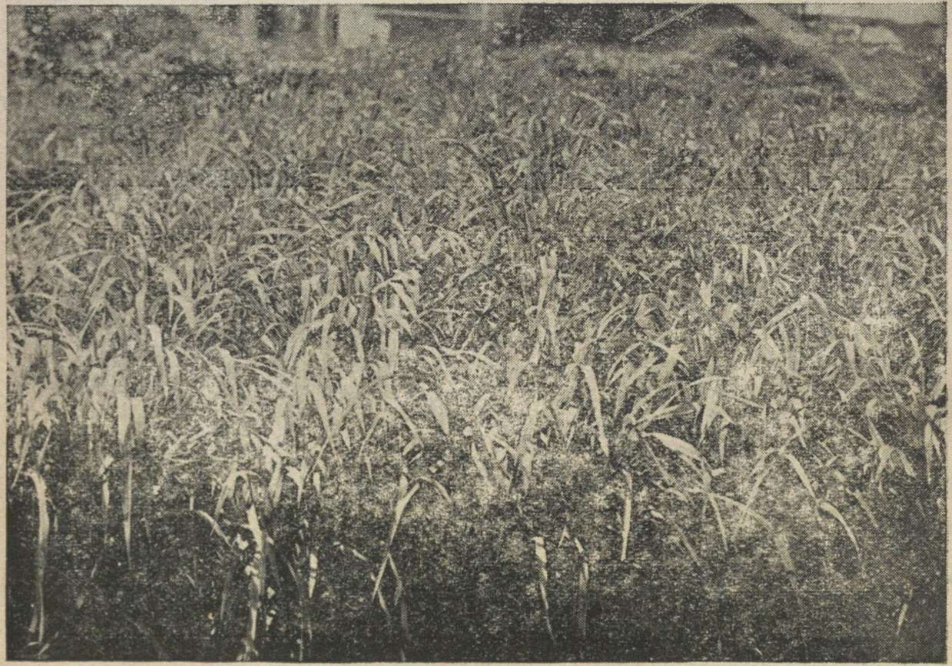
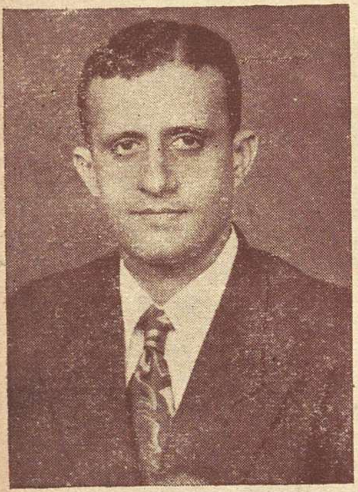


Photo taken on 5th Aug. '53. The interspaces between the rows have now been completly filled up Each clump has more than two dozen tillers. The breadth of the leaf--blades is impressive and the growth of the crop has been speeded up by the periodic top-dressings with fertiliser-mixture.

(8)

Photo taken on 14th Sept., '53—The crop is now ready for harvest. The golden ear-heads are well-filled and they bow down because of their weight. The maximum number of earheads on a clump is as high as 32.



MR. B. V. D MENON
who has just returned after a sojourn in the Continent and America.
We have published his "Impressions Abroad" elsewhere in this Journal.

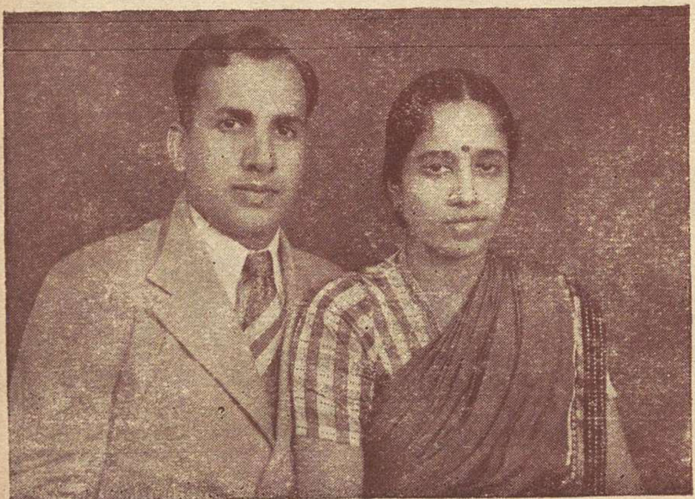
(See pp. 8—12)

# Japanese Rice-Culture

We have published the photos taken of our demonstration plots, in which we have been raising paddy, the Japanese way. The previous issue of this Journal carried the first part of this feature. The photos speak for themselves!

The seed used for this trial was a Chinese strain. It responded well to the liberal doses of fertilisers and the periodic inter-culturing operations. The harvest was purposely delayed for more than a week and the actual duration for this crop was just 90 days. The crop gave out an yield of 4050 lbs. per acre, a very good yield for a short duration crop like this one! We heartily invite all agriculturists to take up to this mode of cultivation and we are ever ready to educate them in this new art and if needed demonstrate it on their fields.

# Gopalakrishnan—Lakshmi



Sri R. Gopalakrishnan L. E. E., of our Utilities Divn. was recently married to Sow. Lakshmi, daughter of Sri T. K. Nilakanta Iyer of Thycaud, Trivandrum. Our hearty congratulations to the married couple!

# A Search for Saving Steam

N. S. THYAGARAJAN, Chemical Engineer, FACT Ltd.

THE title of my topic will make it clear to you that I am only attempting at a search for saving steam. This means that I do not have any blue print for direct action. It should be perfectly understood that there cannot be cut and dried scientific method of saving steam. Preventing escape of heat, reducing work to be done and using heat over again are the fundamental guides to steam economy. Now, I shall confine myself to a discussion on reducing valves, thermo-compression, multiple effect evaporation, steam accumulators and conclude my paper with a note of caution on estimation of such steam savings.

Steam at atmospheric pressure is a gift from God, in that it contains 1150 BTU at 212°F. Were it a curse from Satan, for the same total heat, it might well have been a searing incandescent gas at 2300°F which would rise to white heat, soften or melt all pipes and vessels. But four-fifth of this heat is hidden or latent. We cannot see it. We cannot feel it. So we waste it. There is nothing new about steam. The alluring titles and awe inspiring columns in steam tables reveal all that needs be known about steam. Well then, it is but proper that this wonderful energy that lies latently hidden in those puffs of steam, trap flashes, pump exhausts, etc. should not be so light-heartedly dissipated.

Now, instead of talking about steam economy in an abstract manner, I shall start with a concrete example with which most of us are familiar. The steam calandria in the ammonium sulphate crystallising evaporator is fed by O p. s. i. g. (or even less) steam from a 3″ 100 p. s. i. g. saturated steam main, through a reducing valve. Fig. No. 1 shows what happens to this steam.

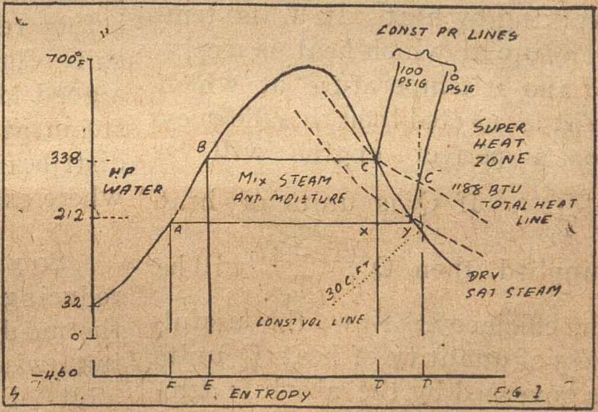


FIG 1

Here point C represents 100 p.s.i.g. 100% dry saturated steam before reducing valve. C[1] is the condition of the same steam after the reducing valve. This change of pressure reduction is isen-

The author has recently passed the A. M. I. Chem. E. (Home Paper) Examination of the Institution of Chemical Engineers, London.——Ed.

thalpic, i.e. the total heat remains constant before and after reduction, i.e. C and $C^1$ are in same 1188 BTU total heat line. From the figure we find that C lies in O p. s. i. g. const. pressure line at which pressure it should have only 212°F temp. if the steam is 100% dry and saturated. But from diagram, temperature corresponding to $C^1$ is 289°F. So it means that it has a super heat of 77°F. So the net result is change in quality of steam because of entropy increase equal to length $DD^1$. Incidentally, this frightening mysterious term 'Entropy' which causes needless headaches deserves a clear and simple explanation. Most of the misgivings about this entropy would disappear if we realise that it plays the same part in heat and steam engineering as weight does in mechanics.

Take for instance an engine working by heat. If $T_1$ is temperature at which heat is received and $T_2$ temperature at which heat is rejected then the efficiency for a perfect engine will be $\frac{T_1 - T_3}{T_1}$. If Q is units of heat supplied, then $Q\,\frac{(T_1 - T_2)}{T_1}$ will be the efficiency. Now, the usefulness of quantity of heat Q units is governed by the absolute temperature at which it is received by the engine, i.e. it is $Q/T_1$ that is important and not Q units. This $Q/T_1$ is entropy. To put it bluntly, if area is represented by total heat and length represents the absolute temperature, the entropy is given by the breadth of the rectangle. Here it is very important to note that T and $T_1$ are measured from greatest imaginable cold, i.e.–460°F when all molecules are at perfect rest.

Switching over to our point, we have found that since quality of steam changes, if steam has been 2% wet before reduction which you can expect in our example, since the location of calandria is far off from the boiler house, this steam will become 100% dry, but not superheated. While superheated steam is bad steam for heating, wet steam is equally a nuisance, since moisture in steam has no available heat, but reduces heat transfer rate by a coat of additional water film and increases load on the trap. But I personally believe that in our example, it is not unlikely if we have 5% wet steam in 100 psig steam main before reduction of pressure in spite of good lagging. It will be a good idea to get the quality of steam at various remote steam distribution points, to find out where exactly we stand.

So you see clearly that this reducing valve has done nothing thermo-dynamically than just improving the quality of steam a bit. But actually such a pressure drop from 100 psig to O psig can be put to a better use by substituting this reducing valve by an engine, accumulator or distilled water still.

Under special circumstances, as is the case in our example, this entropy increase can be made to give a good account of itself in doing some thermo-compression by a thermo-compressor and add incidentally a double effect economy in a single effect with a lesser capital outlay. In principle, high pressure motive steam entrains part of low pressure vapour going to barometric condenser, while it expands from 100 to O psig. By this low pressure vapour gets boosted to a higher pressure and replaces to this extent an equal amount of high pressure steam which is thus saved. Part of the heating value of vapour which is otherwise lost by condensation in a barometric condenser is recovered, at the same time reducing cooling water requirements for the condenser, because of reduced load to be handled.

Theoretically speaking, the amount of entrained vapours that can be got under our conditions will be as follows:-

$$\frac{\text{Lbs. H. P. motive steam}}{\text{Lbs. low Pres. entrained vapour}} = \text{Entrainment ratio}$$

$$= \frac{\text{Enthalpy of entrained vapour after compression to O psig (1255)} - \text{Enthalpy of entrained vapour before compression i.e. @23'' Hg. vac. (1125)}}{\text{Enthalpy of H. P. motive steam at 100 psig (1190)} - \text{Enthalpy of H. P. motive steam at O psig (1025)}}$$

i.e. if total steam fed is 7000 lbs/hr. theoretically, if entrainment ratio is 0.8 then live steam taken will be 4000 lbs/hr. But actually this entrainment ratio is dependent on pressure of motive steam, operating vacuum pressure in heater efficiency of nozzle, efficiency of compression and efficiency of transfer of momentum from high speed jet to slow moving entrained vapour. Usually it is around 30 only, i.e.

$$\frac{\text{Lbs. H.P. steam}}{\text{Lbs. entrained vapour}} = \frac{.8\text{x}100}{30} = 2{\cdot}67$$

If x is the H. P. steam and total steam is 7000 lbs / hr., then

$$\frac{x}{(7000-x)} = 2.67 \therefore x = 5093 \text{ lbs/hr.}$$

$$\therefore \text{Vapour} = 1907 \text{ lbs/hr.}$$

So saving effected = 1907 lbs/hr. steam. Fig. (2) given below gives the steam consumption and vapour compression for actual operating conditions.

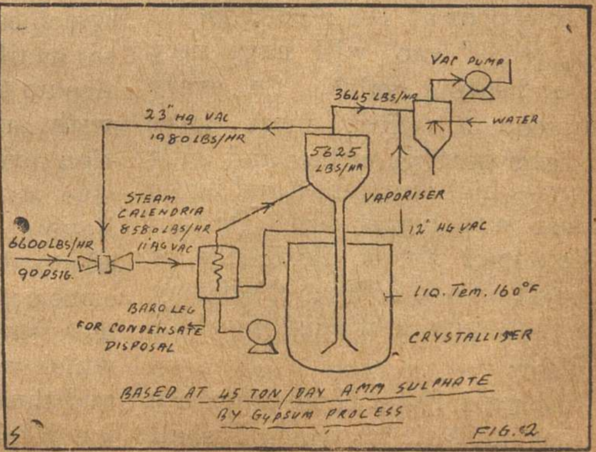



FIG. 2

Now this brings us nearer to multiple effect evaporators. Latent heat is the most important heating medium and hence its successive reuse will decidedly save steam. Briefly speaking, this consists in equally sharing the total temperature drop available between steam and vapour, over number of effects, the vapour from preceding effect serving as a heating medium for the next effect. The table below will give the importance of multiple effects:

| | |
|---|---|
| Consumption of steam with existing FACT crystallizer . . | 1.9 tons/ton sulphate |
| Do. Do. with thermocompressor . . | 1.3 ton steam/ton sulphate. |
| Do. Do. in triple effect evaporator | 0.5 ton steam/ton product |

But in practice, the total capital investment and the capacity of the plant automatically fixes the number of effects that are economically feasible. Multiple effect multiplies size of plant. In the example under consideration, more than a double effect should notbe attempted. Vapour at 212°F is a first class heating medium. But vapour at 122°F corresponding to 26″ vac. will have very poor heating value. So every subsequent effect must have greater heating surface and must handle higher volumes and hence must be of bigger size. Further there may not be flexibility of operation and a third effect may have to remain blinded most of the time.

Apart from these there are other limitations which I shall presently mention. When any solid is dissolved in water there arefewer water moleculesper unit area of liquid surface than in pure water. Hence to exert sufficient vapour pressure for boiling, these lesser water molecules must require greater energy than in pure water, to compensate for their reduced number. Hence these solutions require high temperature for boiling. The difference in temperature of boiling liquid and its vapour is called boiling point elevation (B. P. E.) This B. P. E. limits the number of effects. 60% NaOH solution has over 102°F B. P. E. i.e. even if you have temperature drop of 102°F between heating and heated medium, no boiling will take place. Now the ammonium sulphate solution under the existing conditions has 13° B.P.E., i.e. if we have three effects and say, total of 60°F drop then 26°F goes off for B. P. E. and only a net 34°F is available which means 34/3 = 10°F drop across each effect. Here again B. P. E. increases with pressure as well as with concentration. So it can be more in the last effect in which case we will have still lesser available drop. But in practice up to 3 effects are possible with ammonium sulphate solution evaporators. Often corrosive and scaling properties of liquors limit the number of effects because equipments become costlier. Corrosive vapour means unsatisfactory condensate which we may not be able to use and thus this heat in condensate is a total loss.

Before I conclude, I just wish to make a passing mention on steam accumulators, and wastage of flash steam in condensate overhead tanks.

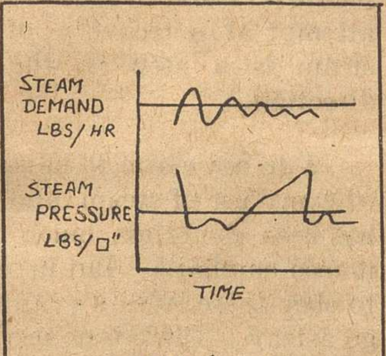



FIG. 3

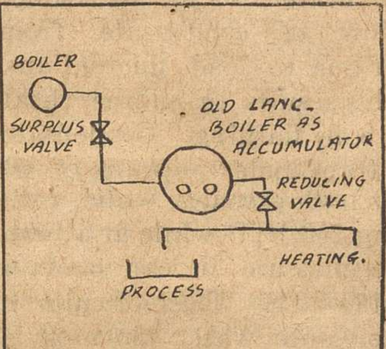



FIG. 4

Steam accumulator is the answer for fluctuating steam loads. Particularly in a factory of our type, ironing out peak-loads, steadier steam pressures and steaming rates and large steam reserve will lead to a balanced boiler load which means fuel economy. Steam accumulator takes the necessary latent heat of evaporation from the hot water itself. During low loads boilers can generate more steam than required and can supply this surplus steam to a well insulated steam accumulator containing water. Steam thus stored can be used for any peak load. Steam accumulators are large and cost much. But an old spare Lancashire boiler can be made to act as an accumulator. An average Lancashire boiler working at 100 psi will store 320 lbs steam if pressure is allowed to rise to 110 psi. If pressure is allowed to drop to 90 psi boiler will give up an extra 630 lbs. steam in addition to above. Figure 4 illustrates an accumulator installation. Here surplus steam enters accumulator through surplus valve which opens automatically as soon as boiler pressure exceeds its normal value, i e. when the demand for steam is lower. This steam is thoroughly mixed with water content of accumulator. Temperature of water rises causing corresponding increase in accumulator pressure. During peak load, the steam is discharged again through the automatic reducing valve (a necessary evil here) and pressure is kept constant. If the surplus valve to accumulator is set so as to open before boiler pressure reaches blow off pressure, then losses through safety valve blowing can be saved. Through a $\frac{1}{4}''$ opening 300 lbs/hr. of steam at 100 psig can be easily lost. So it is no exaggeration if I say that safety valve losses can result in as much as 6% of fuel loss. Incidentally almost the same steam consumption takes place with each steam jet ejector of the smallest size.

Sometimes we instal an open overhead condensate tank to collect hot condensate ahead of feed water heater, so as to reduce overflow of condensate from heater due to load fluctuations. But this results in another heat loss, i.e. by flashing. Condensate from traps under pressure of 60 psig is high pressure water containing 250 BTU while at atmospheric pressure it can contain only 180 BTU. The molecules in high pressure water move at a very rapid speed and when opposed by a back pressure only equal to atmospheric pressure will try to fly away, i.e. flash so that their energy is reduced to suit the new condition, i.e. it gets rid of 70 BTU for every pound of condensate. This will be 70/971 = 7.2% loss, where 971 BTU is latent heat at atmospheric pressure. This comes to 7.2% loss. Probably our loss in condensate overflow may be less than this. In the calandria in sulphate plant we use only steam at O psig and this does not contain flash steam. So no loss due to flashing is encountered here. Another defect of open condensate tank is the introduction of greater percentage dissolved oxygen in the feed water and hence greater load on deareator. You may naturally be tempted to ask why this overhead tank cannot be a closed vessel. In that case it will become an unfired pressure vessel and will need a big flash tank, etc. Its size will be appreciated if it is just borne in mind that a flash steam from 100 psi condensate occupies 1600 times as much space as the condensate itself when it passes into a tank near atmospheric pressure. Nevertheless an attempt at a recovery of flash steam is a step in the right direction.

I do not claim to have covered every use of steam and there has been doubtless much ill-balanced emphasis. But in seeking to obey these rules we can easily go astray. There is no use blindly collecting flash steam or waste vapour or hot effluent if we just end up by wasting an equal amount of live steam elsewhere. All thermal devices deserve investigation, deserve a careful estimate of probable cost and deserve a conscientious calculation of the return they may bring. But the estimate is like a Bickini Bathing suit—what it reveals is suggestive but what it conceals is vital! In making out estimates of return, say for a thermo-compressor, we are justified only in taking marginal cost of steam and should exclude the fixed costs like overhead, depreciation, labour, maintenance, etc. which are more or less constant whether you operate one boiler or 3 boilers. This means we should take into consideration only the cost of oil corresponding to quantity of steam saved. A stainless steel thermo-compressor installation for each crystallizer calandria in our example will cost Rs. 60,000 (roughly). We save about 2000 lbs/hr. of steam. Though from generation point of view we get 14.5 lbs. steam/lb.

oil, from the distribution aspect we are faced with only 12 lbs. steam per lb. of oil burnt as an yearly average. So, eduivalent oil saved $= \frac{2000}{12} = 160$ (approx) lbs/hr. Of course here since the vapour compressed is corrosive, the hot condensate has to be wasted. But fortunately since we use O psig steam there is no loss in condensate due to flashing. The condensate will be arround 180°F. It will contain 90 B. T. U. per pound over datum temperature of 90°F. Hence its cost will be about one-tenth of the cost of steam, which will roughly be equal to 8% of fuel.

$\therefore$ Actual oil saved $= 160 \times \frac{90}{100} =$ 148 lbs/hr. only.

At Rs. 200/- per ton of oil, our saving per 24 hrs. day

$$= \frac{148 \times 24}{2240} \times 200$$
$$= \text{Rs. } 300$$

Besides we save water to barometric condenser because of reduced load. Even neglecting this small saving we can recover the investment made in less than a year on a 7200 hrs. per year basis.

In conclusion, it is pertinent to point out of this general comment arising out of experience. The steam once it leaves the steam drum becomes a public property, and the boiler house has little control over its distribution. Naturally those who do not have responsibility for generation cannot be expected to be very conservative about its use. In many cases the steam cost is but a negligible percentage of production cost and for this reason, is looked upon as secondary to production. We know that production is all—important, but it is an established fact that maximum production is in every case obtained only when maximum heating efficiency is got from steam-using equipments and steam consumption per pound of product is at its lowest. Judicious use saves steam. Saving steam means saving fuel. Saving fuel inevitably results in saving money.

*References:*

1) Bulletin by spirex. Manu Co. Ltd., Cheltenham Glos.
2) Efficient use of steam.

## *He Could not tolerate artificial divisions!*

In the year 1926, Sir Jagadis Chandra Bose, the scientist who startled the world by announcing that plants had hearts, was giving a lecture before the British Association at Oxford. When the lecture was over the great Einstein, who had listened to it with rapt attention, declared solemnly that Bose ought to have a statue erected in his honour in the Capital of the League of Nations.

Why was Einstein so impressed? The reason is obvious. Bose was the first scientist of repute to prove that all life is one and that even the 'inanimate' objects had life in them. Remember, this was not one of his pet beliefs or sentiments; he actually demonstrated by experiments that iron and other metals could *feel*, that plants had *emotions* and that everything created *lived* and died.

# Role of Chemists in Chemical Factories

JOHN PHILIP, B. A., B. Sc. Chemical Control Divn.. FACT Ltd.

CHEMISTS occupy a key position in chemical factories. Their work is unique and their services indispensable, in as much as their analytical values control the different stages in the process and determine the quality of the final product. While the quantity of the final product is fixed by the operating personnel, its quality is the chemist's own responsibility. In other words, the prestige of a chemical factory depends on the chemists, defacto. Those factors that give an appeal value to customers, viz., acidity or alkalinity, moisture content etc. of fertilisers, purity of gases like $CO_2$, $NH_3$, $O_2$, $Cl_2$, strength of acids and the like, wait for the chemist's appraisal and are finalised by him before the despatch of the finished product. His analytical values determine whether a finished product is worthy or not to go out for sale.

The chemists act as a sort of safety-personnel whose technique is preventive rather than curative. By taking cognizance of analytical results that transgress the safety-limits and promptly apprising the operating personnel about the same, the chemists can avert hazards. Any wrong-assessment of values may lead to explosions that can blow up a whole factory or to gas-hazards that can jeopardise the lives of numerous workers.

The chemist ascertains the exact proportion of the various materials that go to the making of the finished products, and also of the materials that make up the waste products and by-products. The nature of routine analysis being such that it takes many things for granted, if a chemist be a little indolent or not sufficiently sincere in his work, large quantities of materials will unobtrusively go to waste. Deliberate malpractice on his part cannot easily be detected. Hence his alertness and sincerity go a long way in reducing the cost of production.

Fully realising his importance, the chemist takes a just pride in his work. He co-operates with the operators for the smooth and efficient running of the plants to which he is assigned from time to time. In the silent hours of the night, even when the operators inside sit quiet, looking at the panel boards, the chemist has got to tread his heavy legs, taking samples, analysing, calculating, to guide them (operators) with his results. Knowing fully well that even when the plants are having a smooth run, the chances are there for trouble arising any time, the chemist goes about his work, authoritatively giving his values without any compromise. Should anything untoward happens, he would be the hardest hit, he knows. No chemical factory is immune against hazards and periodically changes will occur in the methods and processes. Hence, honesty and diligent work on the part of chemists, may lead to investigation in times of unexpected variations in values, and thence to new and useful knowledge. And, for that matter, even a shift chemist, whose duty is dull routine analysis, could find out some thing new about the things he has got to deal in, if he were only inquisitive enough. There is little doubt, therefore, that chemists are the very back-bone of chemical factories. But it has to be said that the importance of a chemist's work is always minimised. However he has got the consolation that, as remarked by the leaderette of "Indian Express" of 24th July, 1953, "duty done brings its own reward."

The shift-chemist's work is dull, dry-as-dust, routine. So much so, he can't help being a little immobile at times, an immobility expressed often in the form of a listlessness that is apt to be construed as indifference to duty. But it would be harsh to view it in that light. A shift chemist knows his work, and he is confident that he could be equal to any emergency that might crop up in analyses pertaining to his sector of work. No wonder then, that he does not fret and worry in unison with the operators when things go off at a tangent. Sure of the confines of his narrow field of work, the chemist sits cosy, unnerved by ordinary provocations. He thus shrinks bit by bit within his own shell, strengthening inwardly, but not expanding outwards! And this is his weakest point too. As somebody has wittily remarked, the analytical chemist thus gets to 'know more and more of less and less!' Unless he were a vivacious reader, his universe of knowledge recoils and shrinks within itself.

But, how does it profit a chemist, if, on the contrary, he goes on amassing knowledge in his line of studies? He finds that if his field of work is insular, his field of learning is far too large for anyone to get an expert knowledge in a desultory way. He can learn much but be master of none.

---

# Growth of Agricultural Science

T. S. R.

CHAPTER VI.

## Truth Prevails

AFTER a very long period of darkness and confusion, the salient truths regarding plant nutrition had now become clear. There was a time when it was thought that plants took in only water as their food; it was later put forward that plants lived on soil particles and then came the organic school of thought that advanced the theory that plants could absorb organic matter as such. All these beliefs had been disproved and had been relegated to the background.

After these early gropings the scientists of various countries took a hand in the systematic study of plant nutrition. Instead of merely putting forward unfounded hypotheses and then arguing about them in an endless way, they conducted experiments both in the laboratories and in the fields. They patiently collected data and then arrived at certain conclusions. The following are a few of the important truths, regarding plant nutrition, which were laid down by them and which they had proved and demonstrated.

1. Plants took in a large quantity of water from the soil. This water was needed for per forming various vital functions inside the plant-body, such as maintaining the turgidity of the stems, leaves, flowers, etc., for keeping down the temperature of the plants and for translocating the absorbed minerals and manufactured food materials inside the plant.

2. Plants breathed in the same way as animals, by taking in oxygen and giving out carbon di-oxide.

3. Plants had the unique capacity to synthesize the carbohydrate, starch, by first breaking down carbon- di-oxide and water and then uniting their components; this they were able to perform with the help of sun's energy. During this process of photosynthesis, plants gave out oxygen, thus helping to purify the air.

4. In addition to water and carbon-di-oxide, plants took in simple salts such as nitrates, phosphates, sulphates, etc. Only those salts that had dissolved in the soil-water entered the plant. Though the quantity of minerals thus absorbed was very small, they were absolutely essential as they performed vital function such as the building up of protein, alkloids, protoplasm, colouring matter, etc. If any one of these minerals was lacking the plant would not be able to develop normally and with full vigour.

5. The usefulness of each of these various chemicals was not of the same degree, nor were they needed in equal quantities. A few were more important and needed more than the others.

6. Analysis of the plant and its ash had revealed the inescapable fact that of these minerals, only three namely, nitrogen (N), phosphate (P) and potassium (K) were the most vital as they had very substantial controlling effects on the development of the plant.

### Attention Focussed on NPK

The farmer had no worries regarding the supply of carbon-di-oxide and oxygen as they were to be had in unlimited quantities from the air. As regards water which was needed in enormous quantities, the solution lay in supplementing the natural sources with artificial irrigation facilities. Steps along this line were taken up very early in the history of agriculture; earthern tanks and dams to store up water for cultivation had been established. With the progress of modern engineering science the construction work has been pushed through at a rapid pace and with increased efficiency; these mighty construction projects are going on even today.

* Incidentally, will it not look rather strange if some body starts a compaign against these 'artificial' modes of supply of water? The campaigners may argue that these man-made reservoirs and canals constitute a violation of the laws of nature; they are not *natural*! But we are sure that no one shall even dream of adopting such obstructionist tactics, for after all it does not need much intelligence to understand the obvious truth that more water means more plant life and more agricultural production. But this sort of natural-versus artificial-argument is exactly what is being aired in the case of fertilisers. Whenever the natural supply falls short of our needs, we are forced to tap other sources to supplement them. Natural manures and organic refuses that can be collected are not enough to feed our crops and consequently man has learnt the art of providing himself with other richer sources of plant food. When he produces these new materials they are termed artificial and those whose minds are wedded to old beliefs and who are incapable of adjustment to any change or departure from routine, do not hesitate to decry these new products. But it is gratifying to note that these charges, that tend to put the clock back do not always succeed in preventing progress.

Let us now come back to the topic on hand. The agricultural ascientists maintained that the three vital plant nutrients (NPK) could be supplied to the crop *directly* in the form of simple salts that could go into solution with soil-water and enter the plant immediately after application. Such a method if adopted on a large scale would solve the problem of feeding the crops adequately. This theory was fully backed up by field experimentation. From this it naturally followed that sufficient supplies of these materials must first be located.

### More Nitrogen

Among the Big Three (NPK) the most dominant was nitrogen, for it was the element that made plants grow. Without it the living protoplasm could not be synthesized by the plant. Consequently what was needed was more and still more nitrogen. Ordinary bulky manures contained very little nitrogen. (Farm yard manure—0.6 to 1%; green leaf—O. 2 to 3%; compost—0. 6%.) To supply all the nitrogen that a crop needs the farmers would have to apply tons and tons of these materials and this became impractical with phenomenal increase in the area under cultivation.

These natural manures were later supplemented by other organic manures like the oil-cakes, which were rather richer in their nitrogen content (3 to 8%.) But even with their addition the overall nitrogen requirements could not be met. Other sources for nitrogen had to be discovered if the crop yields were to be maintained.

*(To be continued)*

## *Response to Japanese Method of Rice--Culture*

According to preliminary reports 34.72 lakhs acres of land have been put under the Japanese method of paddy cultivation during the current Kharif season. In the 17 States which have given information about the number of small size holdings which have taken to this improved method of paddy growing and the total number of farmers with holdings of less than five acres each who have grown paddy this season, the 'Japanese Way' is nearly 46,300. The experience gained so far has proved that the best results have been obtained with a seed rate of 10 lbs. an acre and that a larger use of chemical fertilisers is indispensable for greater production not only of paddy but also of jowar, bajra, wheat and cotton.

# Hon'ble Minister Shri K. C. Reddy

## Visits FACT

WE had the pleasure of receiving Hon'ble Shri K. C. Reddy, the Union Minister for Production, when he visited us on 20th Sept. 1953. He spent a full day with us. He first visited the Travancore-Cochin Chemicals Ltd., a sister concern of ours. During the after-noon he inspected our factory in detail and later proceeded to the Rare Earths Ltd. Towards the evening he gave a lecture under the auspices of FACT Technical Society. We are glad to publish below the proceedings of this function.

Mr. M. C. Verghese the President of the Society, in his welcome address said,

" The Hon'ble Minister Shri K. C. REDDY and Friends,

"It is our rare good fortune this evening to welcome, the Hon'ble Minister for Production, Shri K. C. REDDY to this meeting of the FACT Technical Society. We are very grateful to you, Sir, for accepting our invitation.

"The FACT Technical Society is intended to fulfill the need for a meeting place of the technical personnel directly connected with FACT & TCC to discuss technical problems, enhance their knowledge and contact with outstanding men. It has been our endeavour to associate members of companies around us like the Indian Aluminium Co. Ltd., the Indian Rare Earths Ltd, the Travancore Rayons Ltd., the Tata Oil Mills Ltd. the Ogale Glass Mfg. Co Ltd., and the Standard Pottery Works Ltd, in our symposiums and study groups and we have had some success so far. Unfortunately if I am permitted to say so, the vicissitudes through which all these companies are going through and especially our own, has greatly reflected in the activities of our Society and many symposiums and discussions planned for enhancement of our aims had to be dropped. As an example, this year, worse than as in previous years, we were forced to suspend our activities for a period of about four months due to shut down of the works owing to electrical power shortage. A great deal of despondency and pessimism seem to have entered into the work-day life of the technical personnel and they seem to have lost some confidence about their future. This is a serious matter and we appeal to the Hon'ble Minister that necessary vigorous steps should be taken and assistance given so that production in our companies can go on smoothly and the fear and despondency of technical men dispelled. We rightly feel, Sir, that Societies such as ours cannot exist and much less prosper without our parent company prospering. We feel, Sir, we have a right to claim that we represent a national undertaking not less in importance or technical advancement of any other in our country working for the betterment of India.

"With these remarks I request the Hon'ble Minister to speak to us."

*Then, the Hon'ble Minister addressed the meeting. He said,*

"*Friends,*

It is needless for me to say that it has given me great pleasure to be amidst you this evening. For the whole of the day I have been going around the Fertiliser Plant and the Rare Earths Plant, which have been established in this part of the country. As I was saying a little while ago, I have been looking forward to visiting these factories a long time back and it so happened that I have not been able to come here till now. It is good in a way, because I can appreciate the problems that are facing your factory at present, if I may say so, better equipped than I would have been able to appreciate if I had come here say some years ago, simply because of the fact that I have been associated during the last 18 months with another Fertiliser Plant, the name of which is now a household word in our country, viz., Sindhri. I am very grateful for the very warm welcome you have accorded to me on this occasion, and also for the great interest that many of you have taken to show me round your factory and acquaint myself with what is going on here; also to tell me as to what are the needs of the factory at the present moment.

"This is a Technical Society and I do not know much about technical matters. And if I have my own way I would rather like to listen and learn from what some of you have to say on technical matters from your experience. You who are working here are all experts in the field, in the particular spheres in which you are working and so far as technical knowledge is concerned you know better than a lay man like myself. As a layman what I can say on an occasion like this is what the common people expect of the technical man.

"As all of us are aware there are many problems which are facing our country and the sooner we are in a position to solve all these present problems, the better will the people appreciate and feel satisfied that their present needs are being fulfilled to the maximum extent possible. After all application of technical knowledge to the needs of the common man is what is important and I am sure that all of you are devoting and applying your full energies towards fulfilment of the great task that is before all technical men in our country at the present moment. Our country had a past about which we are all familiar. Our great men in the past evolved a science which for whatever reason it might be fell into disuse during the last few centuries and we forgot to apply it to increase the standard of living of the common people of our country. In this respect we have now to learn from the west where they have evolved an economic and technical system, and enabled people to live a decent and satisfactory life than we have been able to do in this country. The problem that faces us at the present moment is to utilise science to improve the standard of living, or, to use the scientific phrase, to press the button and get the light. And that is what we have been trying to do during the last four or five years after the establishment of our own government in this country.

"As all of you are aware we are having at the present moment at the head of our Government one who has got the deepest and most abiding faith in the possibility of what science can do in order to alleviate the sufferings of the vast millions of our country. I am referring to our Prime Minister Shri Jawaharlal Nehru who is also the acknowledged leader of the country. If he has given any attention to any problem in an ever increasing measure I should say it has been to this problem of scientific development. During the last few years we have established Laboratories in various parts of the country and the problem that is before us is to apply the knowledge gathered therefrom for the good of the country. All of you here are technical men. There is no scope for any despondency on the part of technical men. There may be hurdles. There may be difficulties. But they have to be faced boldly and overcome. Technical people like you must have abundant store of faith and optimism on which you have to draw when any hurdle or difficulty comes before you. After all what are the problems, as far as the fertiliser factory is concerned that are facing them now? It has been firstly the problem for finding a market for the products manufactured viz. ammonium sulphate and superphosphate, or the problem of an accumulation of stock causing financial difficulties for keeping the plant going. Secondly, electricity. Owing to the difficulty of supply of electric power your plant has had to shut down for a period. The solution is of course many sided. We have to pool our resources and attack the problems on all points to get over the difficulties.

"Take for instance a small country like Japan which produces and consumes 18 lakhs tons of fertilisers every year. What is the acreage of their agricultural cultivation when compared to that of ours? Even taking into account only the irrigated part of the land of our country it is much more than the extent of the Japanese crop lands. Yet we are utilising only a maximum of about 3 to 4 lakhs of tons of fertilisers per year in our country. You see the enormous leeway. Food problem and poverty of our country are due to the low yield of our agriculture. So what is required is that we have to make a concerted move to make the fertiliser popular. We must go to each farmer and tell him the ways of improving agriculture. We have to bring home to him the advantages of scientific cultivation by utilisation of manure etc. The Community Project Schemes and the National Extension Schemes will play a useful part in this direction. We have got to utilise all these schemes to solve our problems. I once again take this opportunity of appealing to you not to give way to any spirit of despondency.

"I have just been able to get a bird's eye view of the expansion programme of FACT. There can be no insuperable difficulty inimplementing that programme. TCA aid is required and it seems to me that this expansion programme of FACT is the only immediate solution for the problem viz. of reducing cost of production. And if I may say so without commitment on my part and on behalf of the Government of India, even if ultimately the cost of production of this factory is more than that of Sindhri permanently it should not serve as a reason for closing down the factory. We have got to take the facts as they are and bring all these units of different sizes into one integrated unit. The production of all the units should be pooled together and there should be a rational distribution. The fertiliser produced in the South may be very well arranged to be distributed in the South while that of Sindhri can be arranged to be distributed in the North. These are all problems to be solved from time to time.

"The technologists should make up their mind to look into the technical aspects of these problems unceasingly. It is a common feature in our country that a particular person or a person who is engaged in one vocation will go on asking for reduction of prices of articles for the production of which he is not connected. For example, so far as the agriculturist is concerned he wants the biggest and highest price for his produce. But he wants his cloth and other requirements to be cheap. He wants the same to be subsidised by the Government one way or other. It is so in other spheres also. They do not look into the other aspects of the question.

"If the cost of production is to be low it has to be brought down by various factors such as increasing efficiency by using scientific knowledge etc. I notice a sort of tendency on the part of employees in several industrial units to demand high salaries as in other parts of the world forgetting conveniently the standard of efficiency achieved in those countries. For example let us say an Indian employee does only 1/3 of the work that his

Western compeer does. But the ever increasing agitation for higher payment as in the Western countries is always there. I am all for welfare measures, for liberalising the scales of pay and for making the life of the workers happy. But I would like to say that when we demand for the standard of payment as in other countries we must simultaneously give pointed and emphatic attention to the standard of work and efficiency that those countries have reached.

"I hope the expansion programme of FACT will be decided upon at a very early date and would be in operation in about two or three years' time; and that so far as the off-take is concerned the demands for the fertiliser would have grown as a result of increasing propaganda and we will be set on the high road for not only the economic prosperity of this unit but also the economic prosperity of the country.

"I should take this opportunity to pay my tribute to Seshasayee Brothers (Travancore) Ltd. who have done quite a good deal in this part of the country to build up the industrial sector and for the expansion programme at which they are working hard in order to see to its successful completion. I wish them all success and I wish this factory all success and I thank you one and all for the great interest you have evinced and the efforts you have made to make my visit to this area a success."

The Secretary of the Society, Sri S. Sundaram then gave the vote of thanks. He said,

"It gives me great pleasure to propose a hearty vote of thanks for this evening's function. It has been a rare privilege and an unique opportunity to listen to one who combines in himself the qualities of an able administrator, an astute politician and a great speaker. Sir, we thank you for having agreed to be present with us for sometime despite your heavy ministerial responsibilities, multifarious engagements and pressurized work and time. We all feel heartened at your sagacious advice and wise words at a time, and especially now, when there has been a certain amount of depression among all of us. Especially, the feeling of elation has been strengthened further when we understood from your kind words that you had already given your blessings to our development projects and further future plans. On behalf of the Society, on behalf of all the gentlemen assembled here and on behalf of myself, I wish to thank you once again for your abiding interest, abundant kindness and courteous condescension in our affairs."

The happy function then came to a close.

---

# Your Queries Answered

(In this Section answers are given by our Agricultural Chemist to questions received from the public on Soil, Agriculture and use of Fertilisers.)

*Question No. 111*

**Please instruct me as to the proper time and method by which fertilisers are to be applied for tapioca.**

*Answer*

There are two distinct methods by which tapioca is planted, namely, pit planting and ridge planting. In the first case the tapioca setts (cut pieces of the stem, used for planting) are planted in circular pits containing loosened soil. For pit-planted tapioca fertilisers or fertiliser-mixture may be applied about two months after planting, that is, when the earthing up operation is carried out. The fertilisers are to be applied around the base of the clump, *as low in the ground as possible*, and then they are to be covered with a layer of soil. The surrounding soil may then be heaped against the clump so as to form a conical mound. These operations of manuring and earthing are to be taken up only after a systematic weeding of the plot.

In the case of cultivation of the crop along ridges, the manuring cannot be carried out easily, once the ridges are formed and setts planted on them. As the setts are planted along the apex of these ridges, it is difficult to apply the fertilisers around each planted sett. The best method of applying them will therefore be prior to the formation of the ridge itself. Normally each ridge is formed by first upturning the soil on its two sides and heaping it up in the middle. Green leaf, yard manure, upturned turfs, ash, etc. are generally spread at the base of the ridge and then covered up by soil, layer by layer so that ultimately the ridge will attain a height of 1½ to 2 feet. When the ridge is in the making, that is to say, when it has come up to a height of only 3/4 to 1 foot, the fertiliser-mixture may be uniformly scattered over it. Please see that the fertilisers fall *well inside* the ridge. After this, the soil may be piled up to form the ridge. The setts are then planted on the apex. The applied fertiliser will be about 3/4 to 1 foot below the planted sett. This kind of application is sure to give the maximum response.

When the roots of tapioca penetrate down in search of food, they come in contact of the plant nutrients, absorb them with relish and swell up into long good sized tubers.

*Question No. 112*

**I hear that the incorporation of a substantial quantity of straw prior to the planting of paddy will do more harm than good. Is this true?**

*Answer*

The paddy straw contains very little nitrogen; and it is chiefly cellulose. When a large quantity of this straw is incorporated in the soil what really happens is that the soil bacteria immediately pounce on it and start decomposing it. But to do this successfully they need a lot of available nitrogen and as they cannot get it from the straw itself, they recklessly draw upon the available nitrogen present in the soil. They do this in an efficient manner, with the result that they produce a temporary scarcity of nitrogen so far as the growing crop is concerned. As the decomposition of the straw proceeds, all the nitrogen sources within the soil-body are consumed by the voracious bacteria and consequently the growth of the young crop is depressed. This is why it is said that incorporation of straw will be harmful to the crop.

But this can be effectively prevented by applying available fertiliser-nitrogen, like ammonium sulphate, along with straw and other bulky organic matter having very little nitrogen in their composition. Then the bacteria will have a ready source to draw upon for their nitrogen requirements; decomposition will go on efficiently without causing any injurious effect on the growing crop.

*Question No. 113*

**What exactly do you mean by the term "available plant food in the soil" which you use often? Any plant food in the soil will be available to the crop; is it not so?**

*Answer*

Please permit me to remark that you are not quite right in saying that all the plant foods in a soil will be available to the crop. The two terms 'total plant food' and 'available plant food' are quite different; the former stands for the quantity that is actually present in the soil, while the latter indicates that fraction of the former which is in an *immediately* available condition.

For instance, out of the total quantity of nitrogen in a particular soil, a substantial fraction of it may be in an insoluble, complex form. This portion is really nonavailable to the plant right now. It is true that in course of time this will decompose releasing the combined nitrogen for the plant. But at a particular moment, only that portion of the total quantity of plant-food which is soluble, and therefore in a readily available condition, can be grouped under the head 'available plant food.' So also in the case of phosphate, much of it may be "fixed" with iron and alumina in the soil and thus rendered nonavailable.

Only those plant foods that are actually available will directly go to help the growing crop. A soil analysis conducted to find out the total quantities of the different plant foods will not be able to give a correct view of the composition of the soil. The reaction (pH) of the soil has a lot to do in fixing the ratio between the available and the non-available fractions of a plant food.

Chemists have now devised analytical methods by which we can estimate the available fractions of the various plant-nutrients in a soil. Such an analysis will give a true picture of the soil.

# ഭക്ഷ്യസ്വയംപര്യാപ്തതയ്ക്ക് കേരള പ്രവിശ്യയുടെ സംഭാവന

E. I. CHACKO, Retd. Director of Industries, Alwaye.

മരച്ചീനിക്ക് ഉരുളക്കിഴങ്ങിനേക്കാൾ ഇൻഡ്യയിൽ ഒരു ശതാബ്ദക്കാലത്തെ പാരമ്പര്യവും പഴക്കവും ഉണ്ടായിരുന്നിട്ടും, അതിൽ ശരീരത്തിനുവേണ്ട പോഷകാംശങ്ങൾ ഉരുളക്കിഴങ്ങിനെ അപേക്ഷിച്ച് ഇരട്ടിയിലധികമുണ്ടായിട്ടും, കഴിഞ്ഞ കുറെ വർഷങ്ങളായി കേരളത്തിൽ ധനവാനെന്നോ ദരിദ്രനെന്നോ ഉള്ള വ്യത്യാസം കൂടാതെ ഭക്ഷ്യമായിട്ട് ഉപയോഗത്തിൽ വന്നിരിക്കുന്ന ഈ സാധനത്തിന് ഇപ്പോൾ ജനതാമദ്ധ്യേ പാവപ്പെട്ടവന്റെ ഭക്ഷണസാധനമെന്നൊരു ന്യൂനത കല്പിച്ചിരിക്കുന്നത് എന്താണെന്നുള്ളത് രസകരമായ ഒരു ചിന്താവിഷയംതന്നെയാണ്.

ഈ രണ്ടു കിഴങ്ങുകളും ഈ രാജ്യത്തേയ്ക്കു കൊണ്ടുവന്നത് വിദേശസഞ്ചാരികളായ യൂറോപ്യൻ വ്യാപാരികളാണ്. ഉരുളക്കിഴങ്ങ് 1822-ൽ കോയമ്പത്തൂരിലും നീലഗിരി ഡിസ്ത്രിക്ടിലും കൃഷിചെയ്തത് ആദ്യത്തെ ബ്രിട്ടീഷ് കലക്ടരായിരുന്ന ജോൺ സള്ളിവൻ ആയിരുന്നെങ്കിൽ, കേരളത്തിൽ മരച്ചീനിക്കമ്പ് പോർത്തുഗീസ് വ്യാപാരികളെക്കൊണ്ട് തെക്കെ അമേരിക്കയിലെ ബ്രസീലിൽനിന്നും വരുത്തി പരീക്ഷണാർത്ഥം തന്റെ തോട്ടത്തിൽ നട്ടത് അക്കാലത്തു വിശ്വവിഖ്യാതനായിരുന്ന തിരുവിതാംകൂർ മഹാരാജാവ് ശ്രീ വിശാഖം തിരുനാൾ തിരുമേനിയായിരുന്നു. കൊട്ടാരത്തിലെ തോട്ടത്തിൽ നട്ടുവളർത്തി കിഴങ്ങുണ്ടായപ്പോൾ കൊട്ടാരം സിൽബന്തികളിൽ ആർക്കും അതു പാകംചെയ്തു ഭക്ഷിക്കുന്നതിന് ധൈര്യമുണ്ടായില്ല. മഹാരാജാവുതന്നെ തന്റെ അമൃതേത്തിൽ ഒരു ഭാഗമായി പാകംചെയ്ത കപ്പ ഭക്ഷിച്ചു കാണിച്ചുകൊടുത്തതിൽ പിന്നെയാണ് രാജഭൃത്യന്മാർ അതൊരു വിഷദ്രവ്യമല്ലെന്നു വിശ്വസിച്ചത്.

ഇക്കാലത്ത് രാജ്യത്തെ സാധുലക്ഷങ്ങൾക്ക് ദാരിദ്ര്യപീഡ കൂടാതെ ഉപജീവനം കഴിക്കുന്നതിന് ഏകാവലംബമായിരിക്കുന്നതും ക്ഷാമപീഡയിൽനിന്നും ഏതൊരു യുദ്ധകാലത്തും കേരളത്തെ മുഴുവൻ രക്ഷിച്ചുകൊണ്ടിരിക്കുന്നതുമായ ഈ സാധനത്തിന്റെ ചരിത്രവും ആസന്നഭാവിയിൽ അതിന് ഇന്ത്യ ഒട്ടുക്ക് സാമൂഹ്യമായും സാമ്പത്തികമായും ഉണ്ടാകാൻ സാദ്ധ്യതയുള്ള മഹനീയ സ്ഥാനവും മിക്ക ആളുകളും വേണ്ടുംവണ്ണം ധരിച്ചിരിക്കയില്ല.

ഭാരതത്തിന് യഥാർത്ഥ സ്വാതന്ത്ര്യം കൈവരുത്തുന്നതിനുള്ള ഏക ഉപാധി ഭക്ഷ്യ സ്വയംപര്യാപ്തതയാണെന്ന് നമ്മുടെ രാഷ്ട്രനേതാക്കന്മാർ ഉച്ചൈസ്തരം ഘോഷിക്കുന്നുണ്ടല്ലോ. പക്ഷേ, കേരളം മുഴുവനും ഇൻഡ്യയിൽ വേറെ പല പ്രവിശ്യകളിലും കൃഷിചെയ്തുണ്ടാക്കുന്നതിനു സാധിക്കുന്നതും വളം ചെയ്യുന്നതനുസരിച്ച് വെറും പാറയൊഴികെ ഏതുതരം ഭൂമിയിലും സമൃദ്ധിയായ വിളവെടുക്കുന്നതിനു സാദ്ധ്യതയുള്ളതുമായ മരച്ചീനികൃഷിക്ക് അതർഹിക്കുന്ന പ്രാധാന്യം നമ്മുടെ സംസ്ഥാനഗവൺമെന്റാകട്ടെ കേന്ദ്രഗവൺമെന്റാകട്ടെ ഇതേവരെ നല്കിയിട്ടില്ലാത്തത് പരിതാപകരംതന്നെ. ഭാഗ്യവശാൽ നമ്മുടെ ഇപ്പോഴത്തെ കേന്ദ്ര ഭക്ഷ്യമന്ത്രിയായ ശ്രീ. റാഫി അഹമ്മദ് കിദ്വായി മേല്പറഞ്ഞ സാദ്ധ്യതയുംകൂടി മനസ്സിലാക്കിയിട്ടായിരിക്കണം 1954 മുതൽ വിദേശ വിപണികളിൽനിന്നും കോടിക്കണക്കിനുറുപ്പികയ്ക്ക് അരിയും ഗോതമ്പും വരുത്തുകയില്ലെന്നു പ്രസ്താവിച്ചിരിക്കുന്നത്. അടുത്തു കഴിഞ്ഞ രണ്ടു മൂന്നു കൊല്ലങ്ങളിൽ അനേകം കോടി ഉറുപ്പികയ്ക്ക് മൈലോ എന്ന ധാന്യം ചൈനയിൽനിന്നും മററും ഇറക്കുമതി ചെ

ഷ്കിരുന്നതിൽ പോഷകാംശം പറയത്തക്കതായി ഒന്നുംതന്നെ ഇല്ലായിരുന്നെന്നും അതു വെറും അറപ്പുപൊടിക്കു സമമാണെന്നും ഈയിടെ മൈസൂർ ഭക്ഷ്യഗവേഷണ ഇൻസ്റ്റിററ്യൂട്ട് വിദഗ്ദ്ധന്മാർ കണ്ടുപിടിച്ചിരിക്കുന്നു. കൃത്രിമ അരിയാകട്ടെ, എത്രയൊ ലക്ഷം ഉറുപ്പിക ചെലവാക്കി ഗവേഷണങ്ങൾ നടത്തിയിട്ടും ആകൃതിയിലൊ പ്രകൃതിയിലൊ മനുഷ്യനു തൃപ്തികരമായിട്ടുള്ള ഒരു ആഹാരമായി ഇനിയും തീന്നിട്ടില്ല. മേല്പറഞ്ഞ ഇൻസ്റ്റിററ്യൂട്ടിൻെറ ഗവേഷണഫലമായി പച്ച മരച്ചീനിയിൽ ഉരുളക്കിഴങ്ങിനേക്കാൾ അധികം പോഷകാംശങ്ങൾ ഉണ്ടെന്നും ഉണങ്ങിയ മരച്ചീനിക്ക് ഗോതമ്പിൻേറയൊ നെല്ലരിയുടേയൊ ഒപ്പം അദ്ധ്വാനശക്തി വിലയുണ്ടെന്നും അവ രണ്ടിനെക്കാളും അധികം കാൽസിയം കപ്പയിൽ അടങ്ങീട്ടുണ്ടെന്നും കണ്ടിരിക്കുന്നു. മരച്ചീനിക്ക് എന്തെങ്കിലും കുറവുണ്ടെങ്കിൽ അതു പ്രൊട്ടീൻ മാത്രമാണെന്നും ഈ കുറവ് സസ്യഭക്ഷകർക്ക് പയർവർഗ്ഗങ്ങൾകൂടി ഉപയോഗിച്ചും മത്സ്യം ഉപയോഗിക്കുന്നവക്ക് അതുകൊണ്ടും പരിഹരിക്കാമെന്നും കണ്ടിരിക്കുന്നു.

പക്ഷെ ഇത്ര അധികം പോഷകാംശങ്ങളുള്ളതും, ഗോതമ്പുപൊടിയോട് കൂട്ടിച്ചേർത്തൊ, അല്ലാതെയൊ രുചികരമായ ആഹാരങ്ങൾ ഉണ്ടാക്കുന്നതിനു പററിയതുമായ മരച്ചീനിമാവിനേയും, റവയേയും പററി കേട്ടിട്ടില്ലാത്ത—അഥവാ കപ്പ ഒരു ആഹാരസാധനമാണൊ എന്നുപോലും തന്നെ അറിഞ്ഞുകൂടാത്ത പാർലിമെൻറ് മെമ്പറന്മാർ ധാരാളമുണ്ടെന്ന്, ഈയിടെ പാർലിമെൻറിൽ നടന്ന ചോദ്യോത്തരങ്ങളിൽനിന്ന് വായനക്കാക്കു മനസ്സിലായിരിക്കുമല്ലൊ.

ആഹാരസാധനമാണ് എന്നുള്ളതുപോലും ഇതേപ്പററി അറിഞ്ഞിരുന്നെങ്കിൽ കഴിഞ്ഞ ആണ്ടുതന്നെ 9000 ടൺ മൈലൊ (ഏകദേശം 50 ലക്ഷം രൂപാ വിലയുള്ളതു്)മദ്രാസ്സ്,മൈസൂർ സംസ്ഥാനങ്ങളിലെ ആവശ്യത്തിന് ഇൻഡ്യയിൽ ഇറക്കുമതി ചെയ്യുമായിരുന്നോ? കേരളീയരായ നമ്മുടെ ബഹുമാനപ്പെട്ട പാർലിമെൻറ് മെമ്പറന്മാർ തങ്ങൾക്കു ലഭിച്ചിരിക്കുന്ന അവസരത്തെ സാധുക്കളായ നാട്ടാരുടെ ഗുണത്തിനായി ഉപയോഗിച്ചെങ്കിൽ നാട്ടിനെത്ര മെച്ചമായിരുന്നു.

ഇനിയും ഇതിൻെറ കാഷികാഭിവൃദ്ധിയുടെ സാദ്ധ്യതയെപററി പറകയാണെങ്കിൽ, അതു സിമാതീതമാണ്. ഉരുളക്കിഴങ്ങ് കടൽനിരപ്പിൽനിന്നും 5000 അടിയിൽ കൂടുതൽ ഉയരമുള്ളതും 70 മുതൽ 80 ഡിഗ്രിവരെ മാത്രം ചൂടുള്ളതുമായ പ്രദേശങ്ങളിലെ ധാരാളമായി വിളയുകയുള്ളു. അങ്ങിനെയുള്ള സ്ഥലങ്ങൾ കാലാവസ്ഥാനുകൂല്യത്തോടുകൂടി കൃഷിക്കുപയോഗ്യമായവ തുലോം വിരളമാണ്. ഇൻഡ്യയിലാകെ 50,000 ഏക്കറിൽ കൂടുതൽ ഉരുളക്കിഴങ്ങുകൃഷി ഇല്ലെന്നാണറിയുന്നതു്. അതുകൊണ്ടായിരിക്കണം അതിൻെറ വില മരച്ചീനികിഴങ്ങിനേക്കാൾ മൂന്നുനാലിരട്ടി അധികമായിരിക്കുന്നതു്. മരച്ചീനിയാണെങ്കിൽ തിരു:-കൊച്ചി സംസ്ഥാനത്തും മലബാറിലുംകൂടി ഇപ്പോൾതന്നെ ഏഴെട്ടു ലക്ഷം ഏക്കറിൽ കൃഷിയുണ്ട്. പക്ഷെ ശരാശരി ഒരു ഏക്കറിൽ മൂന്നുനാലു ടണ്ണിൽ കൂടുതൽ വിളയുന്നില്ല. കാരണം, കടുംകൃഷിചെയ്ത് മലയായിലെപ്പോലെ ഏക്കറൊന്നിന് പത്തു ടണ്ണിൽ കുറയാതെ വിളവെടുക്കുന്നതിനു വേണ്ട പ്രോത്സാഹനമൊ പരിതസ്ഥിതിയൊ കഷകനു ലഭിക്കുന്നില്ല.

അനാവശ്യമായ നിയന്ത്രണങ്ങൾ മാത്രം ചെയ്യാതിരുന്നാൽ, മരച്ചീനികൃഷിയെ സംബന്ധിച്ചും അതു വദ്ധിപ്പിക്കുന്നതിനുള്ള മാർഗ്ഗങ്ങളെപററിയും ഇന്നാട്ടിലെ കഷകക്കു യാതൊരു നിദ്ദേശങ്ങളും ആവശ്യമില്ലാത്തതിനാൽ അതിലക്കു മുതിരുന്നില്ല.

കഷകരോടും ഗവമ്മെണ്ടിനോടും ഒരു അഭ്യത്ഥനകൂടി ചെയ്തുകൊള്ളട്ടെ. തിരു:-കൊച്ചി ചെയിമ്പർ ഒഫ് അഗ്രിക്കൾച്ചറും ആലുവായിൽ ഹെഡ്ഡ് ആഫീസ്സായി

ആരംഭിച്ചിരിക്കുന്ന അഖില കേരള കാർഷിക വികസന സംഘവും, ഗോതമ്പിനും അരിക്കും വില കൂടിവരുന്ന ഈ അവസരത്തിൽ അതിന്റെ ഏകദേശം പകുതി വിലയ്ക്ക് ഇതര പ്രവിശ്യകളിലുള്ള നമ്മുടെ സഹോദരങ്ങൾക്കും നമ്മുടെ കര-നാവിക-വിമാന സൈന്യങ്ങൾക്കും ഭക്ഷണഭാഗമായി ഉപയോഗിക്കത്തക്കവണ്ണം രുചികരവും സമീകൃത പോഷണമുള്ളതുമായ ആഹാരം മരച്ചീനിപ്പൊടികൊണ്ടും റവകൊണ്ടും പലേ രൂപത്തിൽ പാകംചെയ്ത് 'അന്നപൂർണ്ണ ഭോജനശാലകൾ' വഴിയായും മററും പരിശീലിപ്പിച്ച് ഇൻഡ്യയ്ക്ക് എത്രയും വേഗത്തിൽ ഭക്ഷ്യ സ്വയംപര്യാപ്തത വരുത്തുന്നതിന് ചെയ്തുകൊണ്ടിരിക്കുന്ന അക്ഷീണ പരിശ്രമങ്ങൾ വിജയിപ്പിക്കുന്നതിനു ഹാർദ്ദമായ സഹകരണം നല്കുക.

നമ്മുടെ ഗവർമ്മെൻറാകട്ടെ, കേവലം അനാശാസ്യമായ നിയന്ത്രണമെല്ലാം ഉടനെ വിട്ടിട്ട് ഇനിയൊരു യുദ്ധം പൊട്ടിപ്പുറപ്പെടുന്നതുവരെയെങ്കിലും ഡമോക്ളീസിന്റെ വാൾ ആയി നിലകൊള്ളുന്ന നിരോധനാധികാരം പ്രയോഗിക്കയില്ലെന്ന് ഉറപ്പു കൊടുക്കുന്ന ഒരു പ്രഖ്യാപനം ചെയ്യുക.

കൂടാതെ, മരച്ചീനിക്കും അതിന്റെ സർവ്വ ഉല്പന്നങ്ങൾക്കും പൂർണ്ണ കയററുമതി സ്വാതന്ത്ര്യം കൊടുത്തു് ഇതര പ്രവിശ്യകളിൽ അതു പ്രചരിപ്പിക്കുന്നതിനു സഹായിച്ച്, കർഷകന് ഒരു ന്യായവില നിലനിർത്തുന്നപക്ഷം ഉല്പാദനം ഇനിയും അഞ്ചെട്ടു മാസത്തിനകംതന്നെ രണ്ടോ മൂന്നോ ഇരട്ടിയായി വർദ്ധിക്കുന്നതാണ്. ഇതിനും പുറമെ സ്റ്റാർച്ച് നിർമ്മാണം കഴിയുന്നത്ര ഒരു കുടിൽ വ്യവസായമായി നടത്തണമെന്ന് ഗവർമ്മെൻറ് നിഷ്കർഷിക്കുന്നതായാൽ കഠിന ദേഹാദ്ധ്വാനം ആവശ്യമുള്ള നെൽ കൈക്കുത്തു സമ്പ്രദായത്തിൽനിന്നും സാധു സ്ത്രീകളെ വിമുക്തരാക്കി ഓരോരുത്തരുടേയും വീടുകളിൽ ഇരുന്നുകൊണ്ടു ജോലിചെയ്ത് നെല്ലുകുത്തി കിട്ടുന്നതിൽ പത്തിരട്ടി ആദായമുണ്ടാക്കാവുന്ന സ്റ്റാർച്ച് നിർമ്മാണ വ്യവസായത്തിലേക്ക് അവരെ തിരിച്ചുവിടാം.

---

1. ജീവിതമെന്നതു് ഉല്ലാസമോ വേദനയോ അല്ലെന്ന് ഓർക്കണം. അതു് ആത്മപരിത്യാഗത്തിന്റെ ആത്മാവോടും ചങ്കുറപ്പോടുംകൂടെ പ്രവേശിക്കേണ്ട ഗുരുതരമായ ഒരു വ്യാപാരമാണ്.

(ഡീ. ടോക്വിവില്ലി)

2. ചെറിയവയും ഓർമ്മിക്കപ്പെടാത്തവയും സ്നേഹമസൃണവുമായ ദയാകൃത്യങ്ങളാണ് ഒരു മനുഷ്യന്റെ ജീവിതത്തിലെ ഏററവും നല്ല ഭാഗം.

* * * *

3. ആന്തരമായതിനെ കണ്ടറിയുക. അതനുസരിച്ചു ജീവിക്കുക. ഇതാണ് അറിവിന്റെ പരമരഹസ്യം.

# നിങ്ങൾ ചോദിക്കുക

(ഈ പംക്തികളിൽ മണ്ണു്, കൃഷി, വളങ്ങളുടെ ഉപയോഗക്രമം ഇവയെ കുറിച്ചുള്ള പൊതുജനങ്ങളുടെ സംശയങ്ങൾക്കു് ഞങ്ങളുടെ കാർഷികവിദഗ്ദ്ധൻ മറുപടി നല്കുന്നതാണു്)

## ചോദ്യം 111

മരച്ചീനിക്കു് വളം ചേർക്കേണ്ടതിനു പററിയ സമയം എപ്പോഴാണെന്നും, അതു് എങ്ങിനെയൊക്കെയാണെന്നും ഒന്നു മനസ്സിലാക്കിതരുമൊ?

## ഉത്തരം

മരച്ചീനി സാധാരണയായി രണ്ടു വിധത്തിലാണു് കൃഷി ചെയ്യുന്നതു്. കുഴിയെടുത്തു് അതിനകത്തും, അല്ലെങ്കിൽ വാരങ്ങളുണ്ടാക്കി അതിനു മീതെയും. കുഴിയിൽ മരച്ചീനി നടുമ്പോൾ, ആ കുഴിക്കകത്തുള്ള മണ്ണു് നല്ലവണ്ണം കിളച്ചു് അയവു വരുത്തിയതായിരിക്കണം. ഈ വിധത്തിൽ നടുന്ന മരച്ചീനിക്കു്, കൃത്രിമവളമൊ കൂട്ടുവളമൊ ചേർക്കേണ്ടതു്, അതു നട്ടു് രണ്ടു മാസം കഴിഞ്ഞു് ഇട കിളക്കുന്ന സന്ദർഭത്തിലാണു്. ഇടക്കുള്ള കളയെല്ലാം നശിപ്പിച്ചു് മണ്ണിളക്കിയശേഷം, ചുവടിനു ചുററും കഴിയുന്നത്ര താഴ്ത്തി, വളമിട്ടു കൊടുക്കണം. അനന്തരം അതിനു മുകളിലായി, മരച്ചീനിയുടെ ചുവട്ടിൽ മണ്ണുകൊണ്ടു് ഒരു കൂമ്പാരം കൂട്ടണം.

വാരങ്ങളിൽ നടുന്ന മരച്ചീനിക്കു് വളം പ്രയോഗിക്കേണ്ട രീതി വ്യത്യസ്തമാണു്. ഇങ്ങനെ നടുന്ന മരച്ചീനിക്കു വളമിടേണ്ടതു്, അതു നടുന്നതിനു മുൻപെയാണു്. കാരണം, വാരങ്ങളിൽ കൃഷി ചെയ്യുന്നതുകൊണ്ടു്, ഓരോ ചുവട്ടിലും വളം പ്രത്യേകം ഇട്ടുകൊടുക്കുന്നതു് വിഷമമുള്ള കാര്യമാണു്. അതിനാൽ വാരം നിർമ്മിക്കുമ്പോൾതന്നെ വളപ്രയോഗവും നടത്തണം. സാധാരണ ഇരുവശത്തുനിന്നും മണ്ണുവെട്ടി മദ്ധ്യത്തിലേക്കു് മറിച്ചുയർത്തിയാണല്ലൊ വാരം നിർമ്മിക്കുന്നതു്. ഇങ്ങനെ വാരം നിർമ്മിക്കുന്ന വേളയിൽ, പച്ചിലകൾ, കുണ്ടുവളം മുതലായവ ഇടയ്ക്കിടയ്ക്കു തട്ടുകളായി വാരത്തിലുണ്ടായിരിക്കണം. ഇങ്ങനെ ഉണ്ടാക്കിയെടുക്കുന്ന വാരത്തിനു് ഒന്നര മുതൽ രണ്ടടി വരെ ഉയരവുമുണ്ടായിരിക്കണം. വാരം ഏകദേശം ഒരടിയോളം ഉയർന്നുകഴിയുമ്പോഴാണു്, മരച്ചീനിക്കുള്ള പ്രത്യേക കൂട്ടുവളം ഒരേ രീതിയിൽ വാരത്തിൽ നെടുനീളെ ഇട്ടുകൊടുക്കേണ്ടതു്. വാരത്തിന്റെ ഉപരിതലത്തിൽനിന്നും കൂട്ടുവളം ചേർത്തിരിക്കുന്ന സ്ഥലത്തേക്കുള്ള ദൂരം ഏതാണ്ടു് ഒരടി ആയിരിക്കും. മരച്ചീനിയുടെ വേരുകൾ, കീഴോട്ടു് ഓടിത്തുടങ്ങുമ്പോൾ, നേരത്തെ അവിടെ നാം സ്ഥാപിച്ചിട്ടുള്ള സസ്യാഹാരങ്ങൾ ഭുജിച്ചുകൊണ്ടു്, അവ ഉരുണ്ടു തടിച്ച കിഴങ്ങുകളായി രൂപാന്തരപ്പെടുന്നു.

### ചോദ്യം 112

പാടങ്ങളിൽ നെൽകൃഷി ഇറക്കുന്നതിനു മുൻപ്, ധാരാളം വൈക്കോൽ അവിടെ മണ്ണുമായിട്ടു ചേർന്നിരിപ്പുണ്ടെങ്കിൽ അതു ഗുണത്തേക്കാളധികം ദോഷം ചെയ്യുമെന്നാണ് ചിലർ പറയുന്നത്. ഇതു വാസ്തവമാണോ?

### ഉത്തരം

വയ്ക്കോൽ പ്രധാനമായും, 'സെല്ലുലോസ്' (Cellulose) എന്ന പദാർത്ഥംകൊണ്ടു നിറഞ്ഞിരിക്കുന്ന ഒരു വസ്തുവാണ്. അതിൽ പാക്യജനകം വളരെ കുറവാണ്. ധാരാളം വയ്ക്കോൽ മണ്ണുമായി പുതഞ്ഞുചേരുമ്പോൾ എന്തു സംഭവിക്കുന്നുവെന്നു വച്ചാൽ, മണ്ണിലുള്ള ജീവാണുക്കൾ ഉടൻ ചാടിവീണ് ആ പദാർത്ഥത്തിന്റെ വിയോജനക്രിയ സമാരംഭിക്കുന്നു. ഇതിലേക്ക് ധാരാളം പാക്യജനകം ആവശ്യമാണ്. എന്നാൽ ഈ പദാർത്ഥത്തിൽ പാക്യജനകാംശം വളരെ കുറവായതിനാൽ, മണ്ണിലുള്ള പാക്യജനകം കൂടി ഇതിലേയ്ക്കുപയോഗിക്കുന്നു. ഇതിന്റെ ഫലമായി നിലത്തിനു പാക്യജനകാംശം വളരെ കുറഞ്ഞുപോകയും, ചെടിയുടെ വളർച്ചയ്ക്കു കാര്യമായ ഹാനി തട്ടുകയും ചെയ്യുന്നു. ഇതു നിമിത്തമാണ്, വയ്ക്കോൽ നിലത്തിനു ദോഷം ചെയ്യുമെന്ന് സാധാരണ പറയുന്നത്. എന്നാൽ, അമ്മോണിയം സൽഫേറ്റ് ആവശ്യാനുസരണം ഉപയോഗിക്കുകയാണെങ്കിൽ വയ്ക്കോലിന്റെ സാന്നിദ്ധ്യംകൊണ്ട് നിലത്തിനു കേടുതട്ടുന്നതല്ല. ഈ വളത്തിൽ ധാരാളം പാക്യജനകം അടങ്ങിയിരിക്കുന്നതിനാൽ, ചെടിയുടെ വളർച്ചയ്ക്കു ബാധകമാകാത്തവിധത്തിൽ, വയ്ക്കോൽ മുതലായവയുടെ വിയോജനക്രിയ കാര്യക്ഷമമായി പുരോഗമിക്കുന്നു.

### ചോദ്യം 113

നിങ്ങൾ സാധാരണയായി "മണ്ണിൽ ക്ഷണലഭ്യമായ സസ്യാഹാരം" എന്നു വിവക്ഷിക്കുന്നത് എന്തിനെയാണ്? മണ്ണിലുള്ള സസ്യാഹാരം മുഴുവനും ചെടിക്ക് ഉപയോഗയോഗ്യമല്ലേ?

### ഉത്തരം

മണ്ണിൽ സ്ഥിതിചെയ്യുന്ന സസ്യാഹാരം മുഴുവൻ ചെടിക്കു ലഭ്യമാണെന്നുള്ള ധാരണ തെറ്റാണെന്ന് ചൂണ്ടിക്കാണിച്ചുകൊള്ളട്ടെ. മണ്ണിൽ "ആകെയുള്ള സസ്യാഹാരവും" "ക്ഷണലഭ്യമായ സസ്യാഹാരവും" രണ്ടും രണ്ടാണ്. "ആകെയുള്ള സസ്യാഹാരം" എന്നുവച്ചാൽ മണ്ണിൽ സ്ഥിതിചെയ്യുന്ന സസ്യാഹാരത്തിന്റെ ആകെത്തുകയാണ്. 'ക്ഷണലഭ്യ'മായ സസ്യാഹാരമാകട്ടെ, ചെടിക്ക് പെട്ടന്നുപയോഗിക്കാവുന്ന രൂപത്തിൽ, മണ്ണിൽ കുടികൊള്ളുന്ന സസ്യാഹാരമാണ്.

ഉദാഹരണത്തിന്, മണ്ണിൽ ആകെ സ്ഥിതിചെയ്യുന്ന പാക്യജനകാംശത്തിൽ ഒരു ഭാഗം അലേയരൂപത്തിലായിരിക്കും. പദാർത്ഥങ്ങളുടെ വിയോജനക്രിയ നടക്കുന്തോറും, കൂടുതൽ കൂടുതൽ പാക്യജനകം ലേയരൂപത്തിലായിത്തീരുമെങ്കിലും, ഒരു നിശ്ചിതസമയത്ത് മണ്ണിൽ ആകെയുള്ള പാക്യജനകത്തിന്റെ ഒരംശം മാത്രമെ ലേയരൂപത്തിൽ ചെടിക്ക് ഉപയോഗയോഗ്യമായി കാണപ്പെടുകയുള്ളു. ഈ അംശം 'ക്ഷണലഭ്യമായ സസ്യാഹാര'ത്തിൽ പെട്ടതാണ്. അതുപോലെതന്നെ മണ്ണിലുള്ള ഫോസ്ഫേറ്റിന്റെ ഒരു ഗണ്യമായ ഭാഗം, ഇരുമ്പ്, അലൂമിന (alumina) ഇവയോടു ചേർന്ന്, അലേയരൂപത്തിൽ സ്ഥിതിചെയ്യുന്നുണ്ട്.

ലേയരൂപത്തിലുള്ള സസ്യാഹാരം മാത്രമെ ചെടിയുടെ വളർച്ചയ്ക്ക് സഹായകമായി ഭവിക്കുന്നുള്ളു. മണ്ണിന്റെ ഘടന വിശകലനംചെയ്തു പരിശോധിക്കുമ്പോൾ, അതിൽ എന്തെല്ലാം സസ്യാഹാരം അടങ്ങിയിട്ടുണ്ടെന്നു മാത്രം നോക്കുന്നതുകൊണ്ടു പ്രയോജനമില്ല. ക്ഷണലഭ്യവും അലഭ്യവുമായ സസ്യാഹാരങ്ങൾ എത്ര ശതമാനം വീതം അടങ്ങിയിട്ടുണ്ടെന്നുള്ളത് ആ മണ്ണിന്റെ പ്രതിപ്രവർത്തനത്തെക്കൂടി ആശ്രയിച്ചിരിക്കും. ക്ഷണലഭ്യമായ സസ്യാഹാരം എത്ര ശതമാനം വീതം മണ്ണിൽ അടങ്ങിയിരിക്കുന്നുവെന്നു കണ്ടുപിടിക്കുവാൻ നൂതനമായ വിശകലനരീതികൾ ഇപ്പോൾ ഉപയോഗിച്ചുവരുന്നുണ്ടെന്നുള്ളതും പ്രസ്താവ്യമാണ്.