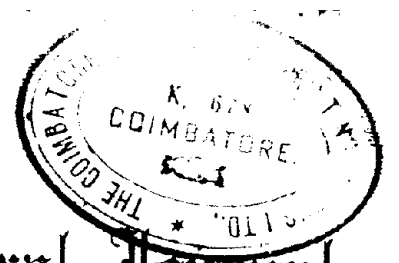


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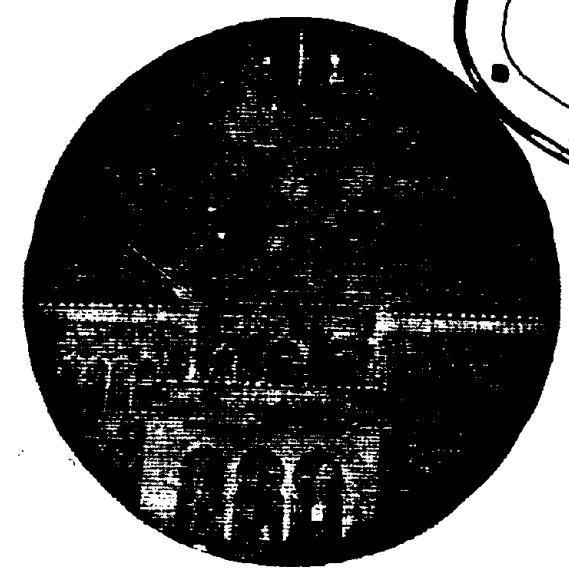
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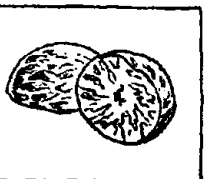
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* Studies on Drought Resistance in Rice — Part II

by
K. RAJAGOPALAN,
Agricultural College & Research Institute,
Coimbatore

Introduction: Considerable work has been done on the physiology of drought resistance in crop plants. Most of the work, however, represents attempts to find some simple index of measuring drought resistance by means of easily observable anatomical or physiological characters. Studies of such physiological characters as water requirement, transpiration rates, bound water content, osmotic pressure and water balance are some of the popular aspects of approach to the problem of drought resistance.

Among these characters, osmotic pressure and transpiration rate have been studied in great detail by many workers. Root studies have not received adequate attention owing to the difficulty in studying this underground part of the plant. The present studies relate to the above three characters in rice varieties which differ in their degree of drought resistance.

Materials and Method: *Osmotic pressure:* Variability in osmotic pressure of germinating seed of the different varieties was studied by immersion in sugar and salt solution of different concentrations. Sucrose solutions of 0.10, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45 molar strength were used in the trials. The survival of the germinated seeds in the sucrose solution was recorded until the sixth day which was found to be the maximum period after which they tended to become mouldy. Further germination tests in 0.25 molar sodium chloride solution, 3 percent solution of copper sulphate and 3 percent solution of potassium chlorate were conducted. Seeds were soaked in the above solutions for 24 hours and the soaked seeds were germinated in water using germination trays. Counts of germinated seed were recorded everyday till the end of ten days.

Osmotic concentration of the plant sap and root extract of twelve varieties of rice was determined by 'cryoscopic' method using the 'Beckmann apparatus'. The varieties were all grown in the

* Part of the thesis entitled "Studies on Drought Resistance in Rice" approved for the award of M. Sc. degree by the University of Madras. Part I was published in this Journal, 44 : 194—205 and 227—237, 1957.

puddle under identical conditions. Sampling of the leaf material was done when the seedlings were 60 days old in jam bottles fitted with lids provided with rubber washers and kept in a mixture of ice and salt for pre-freezing for 14 hours and the material was 'thawed'. The cell sap was extracted in a hydraulic press at a uniform pressure of 12,000 lb. per sq. inch applied for three minutes. The extracted juice was centrifuged for five minutes to remove the cell debris and freezing point of the sap was determined with the 'Beckmann thermometer'.

Relative Transpiration : Two varieties Co. 13, a wet variety and MTU. 17, a dry variety were subjected to atmospheric drought as per the method evolved by Mallik (1946). Rice seedlings grown in galvanized iron drums at 40 percent moisture level by weight were kept in the enclosures when 30 days old. Evaporation from the soil surface in the drums was prevented by covering with a sheet of rubber cloth. The enclosures were provided with 10' x 10' khus-khus screens on all the four sides to a height of six feet, with the top open. One enclosure served as dry environment and the other as a humid environment. The humid enclosure was kept wet throughout the experimental period by rolling the screen frequently through the column of water underneath.

The experiment was conducted for ten days during which time hourly observations of evaporation and relative humidity were recorded within the two enclosures from 07:22 hours to 17:22 hours with 'Piche evaporimeter' and 'Assmann Psychrometer' respectively kept at the same level as that of the plants. Everyday the loss by transpiration was made up by adding water to the pots through a glass tube running through the soil column. The loss in weight recorded everyday in the evening is the loss due to transpiration from the plant during the day. Leaf area measurements were taken in each plant during the experiment.

Root Development: Development of the root in the seedling stage at different levels of water below the soil was studied with root development apparatus obtained from the Director of Agricultural Meteorology, Poona. The apparatus consists of a metallic outer jacket with a lid through which passes an inner cylinder with a perforated bottom. The outer jacket at the bottom has a bent outlet for glass tube attachment on which readings to record levels of water inside the apparatus can be measured. Water is poured into the apparatus through an opening in the lid. The inner cylinder is filled with soil to a depth of 37 inches and rice seedlings are grown in this soil column.

Two sets of experiments were laid out to study the development of the root system of different varieties at flowering. One set consisted of growing plants inside earthen rings buried in the field under dry as well as wet conditions. Twenty four cylindrical metallic pots 12" depth and 10" in diameter were each filled with 30 lb. of air dry black tank silt resting on a layer of two inches pebbles at the bottom. Water was added through a glass tube passing through the soil and resting on the pebbles. Thirty percent level of moisture by weight was maintained in all the pots throughout the experiment. One seedling of each variety was grown in each pot and 12 varieties in duplicate were studied.

To study the root development in the field, three earthen rings each of the dimension of 12 inches diameter and nine inches depth were buried in the plots placing one ring over the other. The total depth of the ring was 27 inches out of which three inches was kept above the ground level. Pits were dug at three feet apart and earthen rings were buried and filled with the same earth dug out of the pit, care being taken to see that the bottom soil was filled first and the top soil added to maintain the original condition of the field, the operation being done a month in advance of the sowing time for the consolidation of the soil. Growing the plants in the ring facilitates easy washing of the roots without otherwise tearing them.

Review of Literature: Osmotic Pressure: A very important characteristic of xerophytes affecting their water relation, is the osmotic pressure in the cell. Maximov (1929) has reviewed the early work of Zelenki (1904), Fitting (1911), Iljin (1917) and others on the important aspect of osmotic pressure in the plant cell. According to Bolsunov (1927), Pavlov (1931), Snoep (1932), Timofeeva (1935), Buchinger (1936), Semikin, (1938) (reviewed by Ashton, 1948) and Bartel (1947), germination test of seed under conditions of limited water availability induced by suitable concentration of salt or sugar solutions, provided an useful method of determining varietal drought resistance. Aamodt and Johnston (1936) found a relative rapidity of germination of drought resistant varieties of wheats in various concentrations of sodium chloride, potassium chloride and sucrose solutions. Lal and Mehrotra (1949) working on sugarcane found that higher the concentration of solution and osmotic pressure of cell sap the greater was the possibility of the variety to exhibit resistance to drought. Newton and Martin (1930) and Sankaran (1933) however, did not find any relationship between osmotic pressure and drought resistance in crops like wheat and cotton.

Yamasaki (1929 a) in his experiment of seed germination of both lowland and upland varieties of rice in three percent solution of potassium chlorate, three percent copper sulphate, 0.25 molar sodium chloride and 0.30 molar sucrose found that when the soaked seeds were germinated in water the upland varieties germinated and flourished better than the lowland ones. Hector (1927) Yamasaki (1929 b) distinguished the upland and lowland rice by determining the osmotic concentration of the cell sap by the freezing point method while Onodera (1931) did not find any relation between the osmotic pressure of cell sap and drought resistance.

Relative Transpiration: Various investigators have subjected plants to atmospheric drought and the work has been adequately reviewed by Ashton (1948). Atmospheric drought tests have been reported on sugarcane by Mallik (1946) and Lal and Mehrotra (1949). Mallik tested the drought resistance of two varieties of sugarcane by studying their transpiration rates in 'dry' and 'humid' environments and comparing these rates with evaporation rates in the two environments with 'piche evaporimeter'.

Root Development: Exact determinations by Rotmistrov (1910) and Modestov (1915) (quoted by Maximov 1929) in Russia and Weaver (1926) have shown that crop plants such as wheat and oats have root system reaching a depth of one to two metres with an equal spread. Miller (1916) found that corn and sorghum could mature crops of grain when the upper two feet of soil was below the wilting coefficient and water was being absorbed from as great a depth as six feet. Sankaran (1933) found that the drought resistant *herbaceum* cotton possessed a much longer and thicker root than the *indicum* type. Ostermeyer (1934) (quoted by Ashton 1948) has recorded in oats that the roots of more drought resistant plants penetrated deeper into the soil, while Aamodt and Johnston (1936) found that drought resistant wheat varieties possessed a more highly branched primary root system than the non-resistant varieties. Root development of wheat varieties in relation to drought resistance has been referred to by Udoljskaja (1936), Stefanovskii (1937 b), Sokolenko (1938), Ivanov (1939) and Ashby and May (1941) (reviewed by Ashton, 1948).

Evans (1939) suggests that transpiring and absorbing surface in sugarcane might give a coefficient for drought resistance and the total water loss might be related in some degree to the total leaf surface. Lal and Mehrotra (1949) found the drought resistant cane 'Rheora' to show a diametrically opposite effect to that of POJ. 2878 with regard to shoot number, green leaf number and total root extension.

A study of branching and depth of root system in rice varieties was made at Coimbatore, (Srinivasan, 1937), while Sethi (1931) has studied the root system of rice varieties both in pots and in fields. Except for the above references in rice, the root system has not been studied in connection with the drought resistance of this crop.

Observations: *Osmotic Pressure of the Germinating Seed:* Cane sugar solutions of 0.25 molar and 0.50 molar strength were used and it was found that the drought resistant varieties, PTB. 28 and PTB. 30 had the quickest growth and better survival followed by MTU. 17, MTU. 18, TKM. 2 and 'Bairuvadlu', while the wet variety GEB. 24 had the least growth in 0.25 molar cane sugar solution. In 0.50 molar solution, on the third day except TKM. 2, PTB. 28, PTB. 30 other varieties had started dying, and on the fifth day the mortality was maximum in both the concentrations while the dead seeds became mouldy. Plate I, Figure 1 shows the differences in survival between the varieties PTB. 30 and GEB. 24 in the two concentrations and it may be noticed that the wet variety GEB. 24 succumbed in both the concentrations while the dry variety PTB. 30 showed survival in 0.25 molar solution.

The experiment was repeated with solutions of 0.10, 0.20, 0.25, 0.30, 0.35, 0.40 and 0.45 molar sucrose and the survival values of the varieties recorded on the sixth day are given in Table 1, and plate I, Figure 2. In 0.10 and 0.20 molar sucrose solutions, germination and survival of all the varieties were good and the growth of both the radicle and plumule was quite normal. However, on the fifth day some of the germinated seeds in GEB. 24 had died whereas the death in the dry varieties was comparatively few ranging from nil to 21 percent. In 0.25 and 0.30 molar sucrose solution, differences between the wet variety and dry varieties were noticed on the third day and the dry varieties were able to withstand the water deficiency better than the wet variety. In 0.35 molar solution death started on the third day in all the varieties and development of germinated seeds that survived was very slow, the growth of the plumule being 0.4 cm. to 0.6 cm. whereas the radicle growth was quite negligible. In 0.40 and 0.45 molar concentration of sucrose the germinated seeds of all the varieties were unable to withstand the amount of water deficiency and death started from the second day onwards.

The results of seed germination in 0.25 molar sodium chloride solution, 3 percent potassium chlorate solution and 3 percent copper sulphate solution (Table 1) showed that on the first day after setting

for germination the seeds had started uniform germination in the control while the germination in 0.25 molar sodium chloride solution was delayed in general but the dry varieties 'Bairuvadlu', PTB. 28 and MTU. 17 had a better start. The total germination percentage shows that the wet rice GEB. 24 had the poorest germination of 79 percent whereas the dry rice varieties showed a range from 94 to 100 percent.

In 3% solution of copper sulphate the development of the radicle was very much arrested though the plumule had come out earlier. The radicle started drying on the third day owing to the toxic nature of the solution. 'Bairuvadlu', a dry rice showed maximum of 97 percent germination. MTU. 18 and PTB. 28 had quick germination. MTU. 17 though slow in germination, had better percentage than the wet rice GEB. 24. Germination in 3% solution of potassium chlorate was comparatively quicker than in copper sulphate solution. Dry rice variety MTU. 17 showed the quickest germination and the germination was mostly complete on the fifth day, the maximum being on the second day. It was found that the radicle was drying owing to toxicity of the solution, but the development of the plumule was normal.

*** Osmotic Concentration of Cell Sap:** The osmotic values of rice tops range from 4.808 atmospheres to 6.969 atmospheres and that of roots, from 0.478 atmosphere to 1.161 atmospheres. The sap concentration is highest in one of the most drought resistant variety, MTU. 17. Among the five early duration varieties tested, all the dry rice varieties show significantly higher osmotic concentration of tops than the wet rice Co. 13. Next to MTU. 17, PTB. 28 and MTU. 18 have higher osmotic concentration followed by PTB. 30. The osmotic values of the cell sap from roots show that the two dry varieties PTB. 28 and MTU. 17 alone have higher concentration than the wet rice Co. 13. In the medium duration group the wild rice T. 1702 and 'Bairuvadlu', a dry rice alone possess higher concentration of tops than the wet rice GEB. 24. The other dry and wild rice varieties have lower values. The osmotic values of the cell sap from roots show that all the dry and wild rice varieties have significantly higher values than the wet rice, GEB. 24.

Relative Transpiration: Temperature, relative humidity and evaporation recorded in the two environments showed that the temperature in the dry enclosure was higher than the humid enclosure

* A summary of this study was published in April 1957 issue of 'Rice News Teller'

by 1.9°C, on the average. Similar evaporation was about 2.16 times greater and the relative humidity was 11 percent less than that of the humid enclosure. Table 2 gives the mean values for each day of transpiration in grams per square centimeter of evaporating surface from 'Piche' evaporimeter under humid and dry environments. The relative transpiration for the two rice varieties under humid and dry environments given in the table show that the ratios of Co. 13 and MTU. 17 in the dry environment are respectively 52 percent and 58 percent of those in the humid environment.

Root Development in Seedling Stage: This study, as mentioned before, was made in four root development apparatus. Four leaves of water 3", 6", 9" and 12" below the soil surface were maintained in the four apparatus and two rice varieties were studied at a time, at the four different levels of water. Two seedlings of each variety were grown in each of the apparatus. Both the varieties were grown in all the four levels of water at the same time. The seedlings were examined for their root development when 25 days old. Two wet rice varieties GEB. 24 and Co. 13 were compared with the dry rice varieties MTU. 17, PTB. 28, PTB. 30, 'Bairuvadlu' and T. 1702, a wild rice type. The data are presented in Table 3.

Since the experiments were conducted during the different parts of the year starting from March to December, the same varieties grown during different seasons show variation in growth. In the apparatus where the level of water was 12 inches below the soil surface the wet rice Co. 13 showed symptoms of drying at the tip of the leaf and wilting on the tenth day whereas the dry rice variety MTU. 17 survived and looked healthy. On examination of the root system on the 25th day the plants of MTU. 17 showed a deeper and more penetrating root system, going to a mean depth of 34.5 cm., whereas the root length of Co. 13 was a meagre 3.5 cm. The growth of the two varieties in the three inches water level was normal and the wet rice Co. 13 had a better shoot development than MTU. 17. As the free water level increased from three inches to six inches in the apparatus the growth of the dry rice was better than the wet rice, the root also showing a marked increase in length and development. The growth was maximum in the nine inches water level and here again the development of the root system of the dry rice variety was three times that of the wet rices. The wet rice showed symptoms of wilting on the 15th day and died on the 19th day. Similar results were obtained with two more dry rice varieties PTB. 28 and PTB. 30 and both showed increase in root length over the wet rice Co. 13 in all the four levels of water.

Plate 1, Figure 3 shows the root and shoot development of GEB. 24, a wet rice and Bairuvadlu, a dry rice belonging to the medium duration group. The experiment with GEB. 24 and T. 1702 representing the wild rice *Oryza sativa* var *spontanea* showed that the wild rice had delayed germination, and completed its germination only on the fifth day after seeding whereas the wet rice had completed its germination on the third day itself. Growth observations made showed, that the wild rice had a quicker growth than the wet rice and the shoot length was more in all the four levels of water as can be seen from table and the root development of the wild rice was much more than the wet rice in all the four levels of water. Here again, as in the previous cases the development of the root was equal to shoot development in the three inches and six inches levels of water whereas it was more in the nine inches and twelve inches levels in both the varieties. The dry weights of root show that the drought resistant types have more root weight than the wet rice in all the four levels of water revealing thereby that even in the seedling stage these varieties produce more number of roots which increase the absorbing surface of the root system.

Root development at flowering phase: Development of the root system of 12 varieties of rice was studied by growing them in pots at 30 percent moisture level. The plants were grown exactly under identical conditions and their roots examined when the last ear had emerged out of the boot.

Growth observations were recorded at weekly intervals and the height of plant, the number of tillers and the number of leaves per plant were counted every seven days and finally the leaf area measured. The drying and death of the leaves was also noted to see at what stage the plants suffered from drought. Finally the roots were washed and the number of roots and also the total length of the root system were determined. The total dry weight of the root and shoot were also determined to ascertain the root shoot ratio. The data obtained are presented in Table 4.

Observations made regarding the shoot development are as follows:

Height: The averaged height of two plants measured at weekly intervals a fortnight after seeding, in the five short duration varieties show that the initial height of the varieties range from 16.7 cm. to 25.8 cm. Some of the dry varieties TKM. 1, TKM. 2, PTB. 28 and the wet variety Co. 13 had a quicker germination, whereas the

wild rice *Oryza sativa* var. *spontanea* was slow in germination. The short duration varieties had quicker growth than those of a medium duration. The growth in the short duration varieties was continuous and quick up to the sixth week after which it appeared to be slow because of the cessation in the vegetative phase of growth before flowering would start when the growth must again be very rapid. The short duration varieties attained their full height quicker than the medium duration ones. Though the growth was slow in the beginning in the medium duration varieties it became continuous and rapid as the plants advance in age.

Tillering: The data regarding production of tillers are presented in Table 5. It was observed that production of tillers commenced from the third week after sowing in all the varieties studied and thereafter it appeared to increase at a rapid pace. The maximum number of tiller production was reached by the ninth week in the short duration varieties and the eleventh week in the medium duration varieties. In the short duration varieties the maximum production of tillers and starting of flowering almost synchronised and very few tillers died away. The tillers started dying only after the tenth week by which time these varieties had completed flowering. It was found, however, that among the short duration varieties, most of the tillers produced by the plants of dry varieties, survived up to the completion of blooming while many tillers died in the wet rice. The same observations were made in the medium duration varieties also. It was observed that the death of tillers was more than 50 percent in the wet rice GEB. 24 by the time it had completed flowering, whereas, in all the dry varieties and wild rice this was much less.

Number of leaves: The leaf production steadily increased from the second week onwards and it was observed that older leaves started dying off from the sixth week. Thereafter the number of healthy leaves, as well as the dried leaves were recorded. Though the death of the leaves went on increasing, the maximum production of leaves was, however found to coincide with the maximum production of tillers. The drying of the leaves increased from the appearance of the shot blade. Again it was found in the short duration varieties studied that the percentage of dried leaves is 50 percent of the total number of leaves produced in a wet rice like Co. 13, whereas it was found to range from 28 to 43 percent in the drought resistant varieties. This is naturally due to higher rate of death of tillers in the tillers in the wet rice, Co. 13 than in the other varieties studied.

Leaf area: This was measured a few days before the plants completed flowering and when the number of leaves was maximum. The length and breadth of a leaf varies in the same plant according to its tropic alignment and spatial disposition and hence the total area of the leaf lamina itself is subject to variation from leaf to leaf. The actual area of bottom leaves of a tiller is less than those in the central region and then again the area of the top most leaf is also less than those of the mid region. In the blooming stage when the boot leaf appears the area of the leaf fluctuate again as the breadth of the boot leaf is always greater than the other leaves though its length is somewhat less in comparison with the others. The area of the boot leaf is, however, less than that of the leaves in the mid region though it is conspicuously the broadest leaf in a rice plant.

Length and breadth of the leaf is a varietal character and some of the varieties like PTB. 28, T. 1702 and 'Bairuvadlu' have long flowing leaves with a length of 37 to 40 cm., whereas other varieties like MTU. 17 and MTU. 18 have but short leaves with a mean length of 23 to 25 cm. The breadth of the leaf varies from 0.58 cm. to 0.81 cm., and the leaf area varies from 34.9 sq. cm. to 59.1 sq. cm. The total transpiring surface of a plant does depend upon the area of the leaf lamina and the number of leaves in a plant, but the differences noted between the varieties in their total transpiring surface do not appear in any manner to be associated with the drought resistance or a wild habit as seen from Table 6

Root characters: The root system in the pots was massed together and as such the depth of penetration and spread of the root of the different varieties could not be studied, the roots being found to be spreading and touching the sides of pots as well as the bottom. But some of the dry varieties possessed a large amount of root system, completely filling the pots and making it difficult to wash the soil from the congested mass of roots seen entangled and matted together at the bottom of the pot whereas the wet rice showed comparatively fewer roots with lateral branches (Plate 1, Figure 4).

Observations were made after the completion of flowering in all the varieties and they show that the least number of 204 roots was met with in the earliest variety MTU. 17 and the maximum number of 556 and 612 in the medium duration varieties GEB. 24 and T. 129 respectively. T. 129 also possessed the maximum number of 63 tillers followed by GEB. 24 with 53 tillers. Though there are a few exceptions, the general trend is, the more the number of tillers

and longer the duration the larger the number of roots in the rice plant. Production of roots was almost complete in the medium duration varieties but few new young roots were met with in the short duration varieties at the time of completion of blooming. It was noticed that the dry rice varieties had more of thick roots than thin ones as can be seen from Table 4.

The total length of the root system depends to a large extent on the number of roots in the plant. But the mean length of the root system of all the dry rice varieties are longer than that of the wet rices. For example Co. 13 and GEB. 24, the wet rice varieties have 24.9 and 24.8 cm. of mean root length respectively, whereas in the dry rice it varies from 25.4 to 30.5 cm. The wild rice variety T. 129 has, however, a slightly lower value than the wet rice. The root shoot ratios determined after recording the dry weight of root and shoot show that the dry and wild rice varieties have usually a greater ratio than the wet rices, except in the wild rice, T. 129.

Development of root system in a wet field: Nine varieties in duplicate were studied for their root development in a wet field to find out the depth of penetration and spread of the root system. Seedlings were transplanted in earthen rings buried in the field and short duration varieties were examined on the 50th day and the medium duration ones on the 65th day after transplanting. The data obtained are presented in Table 7.

A general study of the root system of the rice plant in the field reveals that most of the thin branched roots are concentrated in the top soil alone. Starting from one to two cm., from the soil surface the roots ramify to a maximum depth of 15 cm. These thin and many branched roots are to be seen running rather horizontally upto 15 cm. along the surface. In marked contrast to this, the more thick and brownish roots are going obliquely as well as vertically downwards from the base of the plants, occupying the central column of the soil and penetrating deeper. Most of these roots are free from any lateral roots in the top 6 to 8 cm. after which numerous lateral roots are met with along the length of the root except the growing tip. A few, very thick, white, smooth roots are also found and these do not have any lateral branches nor do they go deeper.

Depth of penetration: The depth of penetration of the root system varies from 39 to 55 cm. in the short duration varieties while it is found to vary from 48 to 72 cm. in the medium duration

varieties. The data show that the wet rice, Co. 13 has a depth of penetration of 39.3 cm., whereas the dry rice varieties have a depth of penetration ranging from 50.8 cm. to 55.2 cm., the maximum being in the case of the drought resistant variety MTU. 17 (Plate 1, Figure 5). In the case of medium duration varieties studied, the wet rice GEB. 24 has a root penetration of 48.9 cm., while the dry rice and wild rice show a much deeper penetration, ranging from 55.2 to 71.5 cm. Fewer roots are found in the top 10 to 15 cm. of the soil in the case of dry rice and thick brownish roots with lateral branches are found growing deeper into the soil.

Spread of the Root: The spread of the root system varies at different depths. In a wet rice, the spread of roots at two to three cm. depth is about 10 to 12 cm. At a depth of about six cm. to ten cm. below soil surface, the roots are found touching the sides of the earthen rings with a maximum spread of 30 cm. The thin fibrous roots arising below the base of the node, travel horizontally and are often seen touching the sides of the rings and then going vertically down to two to three cm. A few roots in the central region again are found going obliquely and touching the sides of the rings at about 16 cm. depth. The root spread below the 16 cm. level is much less, i. e. about 20 cm. and very few roots are met with in the central region of the ring which reach a depth of about 40 cm. In the case of the 'dry rice' the spread of the roots about two three cm. below the soil surface is similar to the wet rice, but below this depth upto 15 cm. the spread is comparatively less than that of the wet rice. Unlike in the wet rice, numerous roots are found concentrated in the central region which after starting from the base of the plant are found going at an angle of 45 degrees with a maximum spread of 30 cm. Most of these roots which penetrate deep into the soil are found in the central region of the ring in a space of about 25 cm. This kind of arrangement enables the roots to minimise their transverse spread and to go deeper.

Development of root System in a Dry Field: Plants grown in earthen rings in a dry field under extremely dry conditions were examined at the stage when they showed symptoms of wilting. The growth of the rice seedlings in this condition was poor and stunted except for some of the dry rice varieties which managed to withstand the early drought. Symptoms of drying of the leaf tips were noticed in the wet rice Co. 13 and wild rice T. 740 on the 50th day and they wilted beyond recovery on the 65th day while the dry rices, MTU. 17

and PTB. 28 were healthy. The development of the root system was poor when compared to those in pots or the wet field. The dry rice varieties had the maximum root length ranging from 24.7 cm. to 43.5 cm., even exceeding their shoot length but the wild and wet rice showed a shallow root system of 13.8 cm. and 12.4 cm. respectively. GEB. 24 (wet rice) showed a root penetration of only 21.9 cm. while the dry rice MTU. 18 had 48.4 cm. followed by Bairuvadlu with a root penetration of 40.2 cm. One plant of MTU. 18 completed flowering on the 105th day and it had the longest root penetration reaching a depth of 74.9 cm. It had produced 13 tillers with a shoot growth of 80.2 cm.

Discussion: Among the physiological peculiarities, osmotic pressure, relative transpiration and development have been studied in fair detail in some of the rice varieties with different degrees of drought resistance.

Osmotic Pressure of Germinating Seed: Germinating the seed in solutions of sucrose and sodium chloride has been followed in the study. This kind of subjecting the germinated seed to water deficit has given some valuable results. It has been found that the suitable concentration of sucrose solution for testing osmotic pressure is between 0.25 molar and 0.35 molar sucrose in which concentration the difference in survival between the drought resistant and drought susceptible varieties was quite marked. Beyond 0.35 molar it was deleterious and toxic as well, for the seedling to survive. A period of six days was found to be optimum for the observation of the differential survival rates. The radicle growth was very much arrested and growth of plumule was about one centimeter in the course of six days. However, there is indication that the drought resistant types are able to withstand the water deficit to a greater extent than the drought susceptible wet rices. But some of the wild rices did not show any better survival than wet rices. The wild rices are inherently slow in their germination and this may be the cause for their poor survival.

The above results are in conformity with those of Yamasaki (1929 a) who observed the same results in Japonica and Indica races of rice. Yamasaki also noted the same difference in 0.25 molar sodium chloride, 3 percent solution of potassium chlorate. These trials conducted in the present studies show indications of better germination of drought resistant varieties in 0.25 molar sodium chloride solution and 3 percent solution of potassium chlorate.

Osmotic Concentration of Sap: From the observations recorded it has been found that leaves have much higher osmotic pressure than roots as has been reported in other crops by Karmer (1949). Regarding osmotic pressure of the cell sap and drought resistance, opinion seems to be divided among various workers. Newton and Martin (1930) and Sankaran (1933) found osmotic pressure an unsatisfactory index of drought resistance whereas Bartel (1947) and Lal and Mehrotra (1949) found some correlation between drought resistance and osmotic pressure.

In rice, Hector (1927) found a higher osmotic pressure of the cell sap in the highland 'aus' varieties than that of the deep water 'amr' rice whereas Onodera (1931) did not find any such difference in osmotic pressure of the cell sap between varieties differing in drought resistance. The findings in this study show that in the short duration varieties all the drought resistant varieties have significantly higher osmotic concentration than the wet rice types but the osmotic value of the cell sap from root of the medium duration varieties shows that the dry and wild rice varieties have higher concentration than the wet rice whereas the osmotic concentration of tops do not have the same difference. It is not, therefore possible to say which of the two, the concentration in the top of the plant or the roots, is more responsible for drought resistance of a rice variety.

Relative Transpiration: It has been found that relative transpiration in the two rice varieties Co. 13, a wet rice and MTU. 17, a dry rice, under dry environment is half of that under humid environment. This definitely indicates the existence of some biological control which tends to cut down the transpirational loss and resist to a large extent the desiccating influence of a dry atmosphere. It has also been found that the drought resistant variety MTU. 17 uses water more economically than the drought susceptible rice Co. 13 since the transpirational loss from Co. 13 is one and a half times that from MTU. 17 under both the dry and humid environments. The relative transpiration of the two varieties Co. 13 and MTU. 17 in the dry environment is just 52.0 percent and 58.0 percent respectively of that in the humid environment. This shows that the two varieties behave almost similarly in the adjustments of transpiration in the case of aerial drought.

*** Root Development:** Root studies with the root development apparatus at four levels below the soil surface showed that rice varieties differing in degrees for their resistance to drought show

• A summary of the studies was published in January 1957 issue of 'Rice News Teller'

differences in their root length in the seedling stage. The difference in root length is quite marked in 9" and 12" depths where the more drought resistant types have elongated their root system quickly and penetrated deeper. In a few cases the root length has exceeded the shoot growth which shows that the roots have grown at a quicker rate.

The dry weight of roots recorded in the case of these varieties has also revealed that the drought resistant types have a better developed root system. This confirms the fact that the rice seedlings exhibit marked differences in their root length and number from the early stages of their growth and this corresponds with their behaviour towards drought. It was interesting to observe in one of the experiments conducted during the month of March, the driest period of the year, that the wet rice Co. 13 wilted in the apparatus when the level of water was 12" below the soil surface, unable to withstand the severe drought, whereas the dry rice MTU. 17 survived. The root development of this variety showed a penetration of 34.5 cm. whereas the drought susceptible type had a root length of 3.5 cm. This rapidly growing, deeply penetrating root has enabled the plant to obtain water even though the surface soil has dried out during the summer drought. Such hereditary differences in depth and form of root system play a great part in the drought resistance of plants.

Further studies in pots and fields have given more information regarding the depth of penetration, lateral spread, number of roots per plant and total length of root system. In addition, attempts have been made to correlate the development of the shoot portion including height, tillering, number of leaves and leaf area with the development of the underground part of the plant.

A general study of the literature regarding root and shoot relation (Kramer, 1949) shows that the proportion of roots to shoots is determined by the heredity of the plant as well as by its environment. Root and shoot growth are closely correlated and the modification in the development of one affects the other likewise. The physiological characteristics of root system have important effects on the shoot growth.

From the study of plants grown in pots and examined at their flowering, higher root/shoot ratio has been obtained in the highly drought resistant types than in the susceptible forms. This is an important factor which enabled them to withstand drought. By

possessing more of underground parts as compared to their shoot, the plants must naturally be able to withstand the water deficit more efficiently. It will naturally possess more of absorbing surface and an efficient conducting system.

The mean root length of the root system of the drought resistant types is higher than that of the susceptible forms which enables deeper penetration. The resistant types were characterised by more of thicker roots than the thin and fibrous ones. Such comparatively thicker roots will have more of absorbing surface. The number of roots in a variety is closely associated with the duration of the variety and the number of tillers per plant. The total length of the root system has been found to depend on the number of roots.

The rate of growth of the shoot depends also on the duration of a variety and as such height and rate of growth could not be correlated with its drought resistance. Number of tillers and number of leaves per plant depend upon the variety. It has been found that most of the tillers formed in the drought resistant types survived up to flowering, whereas in the drought susceptible types, the reduction by death of tillers in the course of tillering is more. The difference in the percentage of reduction of tillers between the drought resistant and the drought susceptible types was quite marked in the varieties studied. Ramiah and Narasimham (1936) suggest the possible cause for such a reduction of tillers as a result of the late tillers not producing any root system to enable them to lead an independent existence. Hence the better survival of most of the tillers in the drought resistant types is due to efficient root system. Reduction of tillers resulted in reduction in the number of leaves. An indication of more leaf withering in the drought susceptible plants was noticed during the study though it was not uniform in all the varieties studied.

The transpiring surface as determined by the leaf area did not give any clue regarding the drought resistance of a variety. Thus it is found that varieties with least number of leaves per plant do not differ substantially in their total leaf area from those with maximum number of leaves. In general, when the leaf area is small, the number is more, whereas leaves are few when they are long and broad which is typical of the dry and wild rice varieties.

The study of root penetration and root spread in the field has revealed the natural disposition of the root system of the rice plant in addition to the type of the root system. Two kinds roots as

observed by Sethi (1931) were noticed. The drought resistant varieties were characterised by the presence of more of thicker roots which go obliquely and vertically downwards and concentrated in the central region. The root spread was less in these varieties, whereas the drought susceptible varieties have their roots which are mostly thin occupying the surface soil up to a depth of 15 cm. Depth of penetration is much more in the resistant varieties confirming the observations made in the study of the hybrid progenies of the drought resistant crosses in the field as well as the varieties grown in the root development apparatus.

The number of roots and the total length of the root system are higher in the drought resistant varieties and higher root/shoot ratio has been obtained in all of them in the study made in a wet field at a particular stage of growth showing thereby that the drought resistant types possess a characteristic root system despite the supply of abundance of moisture.

The observations made in the dry field under extremely drought condition showed the plants were slow in their growth with poor production of leaves and tillers. Plants wilted at different periods according to their susceptibility to drought, the wet rice being the first to wilt followed by the wild rice *Oryza sativa* var *spontanea*. The development of the root system under this severe condition of water deficit was poor corresponding to that of the shoot development. However, the depth of penetration of the root system showed the inherent capacity of the drought resistant types to elongate their root system into the deeper layers of soil.

Summary: Osmotic pressure of the germinating seed was tested in solutions of sucrose, sodium chloride, copper sulphate and potassium chlorate. By such germination tests it has been possible to distinguish between the drought resistant and drought susceptible types by their differences in percentages of survival. Tests with sucrose solution gave more precise information. Osmotic concentration of tops and roots of rice varieties determined by 'cryoscopic' method showed that in short duration varieties the drought resistant rices have significantly higher osmotic pressure of tops than the drought susceptible varieties. The root extract did not show similar difference. In the medium duration varieties the root concentration was higher in all the drought resistant varieties than the susceptible ones.

Two rice varieties MTU. 17 and Co. 13 tried for their aerial drought resistance were equally efficient towards aerial drought but MTU. 17 uses water more economically and consequently is capable of withstanding soil drought better than Co. 13. Development of the root system in the seedling stage at three inches, six inches, nine inches and twelve inches level of water below the soil surface revealed that the drought resistant types, viz., 'dry' rices extend their root system at a much quicker rate than the drought susceptible 'wet' rices.

Development studies of the root and shoot at 30 percent moisture level in pots have shown that the rate of shoot growth and height of plant are not associated with drought resistance while duration plays a greater part in determining the rate of growth. The survival of tillers till the blooming stage, is found to be more in the drought resistant types than in the susceptible types due to the better development of the root system in the resistant types which prevent the death of tillers in large numbers. A similar association between the death of leaves and drought susceptibility has been found. More of leaves die away in the drought susceptible types in the early duration varieties. The total leaf area of different rice varieties studied, does not seem to play any part in their drought resistance.

The number and total length of the roots depend upon the duration and the number of tillers. Drought resistant varieties possess more of thick roots and have a greater mean length of the root system. The 'dry' varieties have a greater root/shoot ratio in general than the 'wet' rices though the wild rices are found to be an exception.

The depth of penetration of the root in the wet field shows that the dry rices and wild rices have a longer root system going into the deeper layers of soil. The typical arrangement of the root system in the resistant types, which have more of thick roots going obliquely and vertically down into the soil help them to go deeper. In the drought susceptible types more of thin fibrous roots are found concentrated in the top soil and the depth of penetration is much less. The root number, total length of the root system and dry weight are more in the case of drought resistant types, and a high root/shoot ratio has been obtained in all of them.

The study of the root system in a dry field has shown that the 'wet' rices are the earliest to wilt followed by the 'wild' rices. Root penetration is greatest in the 'dry' rice varieties even exceeding their shoot growth. The 'wild' rices have a slightly longer root system than the 'wet' rices.

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TABLE 1

Percentage survival of rice varieties in solutions of sucrose, sodium chloride, copper sulphate and potassium chlorate

No.	Name of variety	Percentage surviving on the sixth day							Percentage germination after ten days			
		Strength of sucrose solution (molar)							0.25 molar sodium chloride	3 percent copper sulphate	3 percent potassium chlorate	
		0.10	0.20	0.25	0.30	0.35	0.40	0.45				
1	GEB. 24 (wet rice)	88	80	77	66	57	27	5	79	78	72	
2	MTU. 17 (dry rice)	100	100	100	100	99	75	33	94	86	99	
3	MTU. 18 do	100	100	100	100	87	55	17	98	85	98	
4	PTB. 28 do	98	97	95	90	85	34	18	100	81	89	
5	Bairavadlu do	96	96	93	89	79	62	21	100	97	95	
6	PTB. 30 do	99	99	89	82	81	30	15	..	..	..	
7	TKM. 1 do	91	87	79	74	72	30	7	..	..	..	
8	TKM. 2 do	97	97	93	87	84	65	19	..	..	..	

TABLE 2

Relative transpiration in Co. 13 (wet rice) and MTU. 17 (dry rice) in dry and humid environments

Transpiration in grams per sq. cm. of leaf area				Evaporation in grams, (Piche) per unit area of exposed surface		Relative transpiration. Transpiration by evaporation			
Co. 13		MTU. 17				Co. 13		MTU. 17	
Humid	Dry	Humid	Dry	Humid	Dry	Humid	Dry	Humid	Dry
1.07	0.54	0.47	0.46	0.24	0.57	4.46	0.95	1.96	0.81
0.64	0.87	0.32	0.57	0.24	0.53	2.67	1.64	1.34	1.08
0.27	0.41	0.30	0.46	0.22	0.41	1.23	1.00	1.37	1.12
0.21	0.63	0.13	0.36	0.12	0.35	1.75	1.80	1.09	1.03
0.56	0.44	0.25	0.32	0.22	0.37	2.55	1.19	1.14	0.86
0.31	0.41	0.23	0.30	0.17	0.38	1.82	1.08	1.35	0.79
0.34	0.44	0.27	0.34	0.14	0.37	2.43	1.19	1.93	0.92
0.38	0.37	0.33	0.19	0.14	0.28	2.71	1.32	2.36	0.68
Mean 0.47	0.51	0.29	0.38	0.19	0.41	2.45	1.27	1.57	0.91

TABLE 3

Root and shoot development of wet, dry and wild rice varieties at 3", 6", 9" and 12" water level below the soil surface (Mean values)

Name of variety	3" water		6" water		9" water		12" water	
	Length in centimeters							
	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root
Co. 13 (wet rice)	18.4	12.9	3.9	9.3	15.5	10.1	8.1	3.5
MTU. 17 (dry rice)	8.0	10.7	13.4	13.7	22.7	30.4	11.8	34.5
Co. 13 (wet rice)	35.7	35.3	38.5	34.7	41.5	42.7	34.9	47.8
PTB. 28 (dry rice)	48.6	46.4	41.9	35.1	46.4	47.9	47.8	52.8
Co. 13 (wet rice)	36.5	28.7	40.2	36.2	40.9	36.9	38.4	37.4
PTB. 30 (dry rice)	33.5	32.8	34.9	34.1	38.1	42.1	34.3	45.8
GEB. 24 (wet rice)	39.1	32.7	30.0	24.9	39.4	34.5	38.7	34.8
Bairavadlu (dry rice)	51.7	34.9	52.2	35.2	49.5	40.9	44.4	41.2
GEB. 24 (wet rice)	20.5	28.5	24.3	24.3	29.9	34.5	27.7	35.6
T. 1702 (wild rice)	31.5	32.4	32.3	32.5	35.8	38.9	35.7	43.7

TABLE 4

Development of root and shoot of rice varieties grown in pots
at 30 percent moisture level
(Mean values)

Name of variety	Time of flowering (days)	Root					Dry weight of root gm.
		No. of roots	Thick roots	Thin roots	Total length of root Cm.	Mean length of root Cm.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Short duration:</i>							
Co. 13 (wet)	91	336	129	207	8367	24.9	7.69
MTU. 17 (dry)	72	204	119	85	6141	30.1	6.34
MTU. 18 (dry)	75	319	198	121	9133	28.6	9.16
PTB. 28 (dry)	82	219	152	67	6471	29.5	6.33
PTB. 30 (dry)	75	218	157	61	6493	29.8	8.24
<i>Medium duration:</i>							
GEB. 24 (wet)	117	556	222	334	13773	24.8	10.58
TKM. 1 (dry)	113	422	272	150	12869	30.5	13.99
TKM. 2 (dry)	109	449	277	172	11405	25.4	10.66
Bairuvadlu (dry)	103	451	287	164	12084	26.8	12.76
T. 129 (wild)	109	612	195	417	14331	23.41	9.06
T. 740 (wild)	113	395	232	113	11401	28.9	9.27
T. 1702 (wild)	109	259	172	87	6445	24.9	8.82
Name of variety	Height of shoot Cm.	Shoot					Root/shoot
		Number of tillers	No. of productive tillers	No. of leaves	Dry weight of shoot gm.		
(9)	(10)	(11)	(12)	(13)	(14)		(14)
<i>Short duration:</i>							
Co. 13 (wet)	121.3	24	15	113	31.83		0.242
MTU. 17 (dry)	86.1	32	24	103	22.36		0.283
MTU. 18 (dry)	82.7	36	27	143	29.49		0.311
PTB. 28 (dry)	127.6	12	11	70	25.14		0.252
PTB. 30 (dry)	91.2	31	21	104	26.92		0.306
<i>Medium duration:</i>							
GEB. 24 (wet)	89.8	53	24	189	40.91		0.259
TKM. 1 (dry)	94.9	21	15	128	35.17		0.398
TKM. 2 (dry)	112.1	26	14	130	37.21		0.287
Bairuvadlu (dry)	104.7	26	14	126	35.59		0.359
T. 129 (wild)	94.9	63	30	218	44.01		0.206
T. 740 (wild)	101.8	26	18	129	37.58		0.247
T. 1702 (wild)	109.6	19	12	86	26.53		0.333

TABLE 5

Tillering of dry, wet and wild rice varieties grown in pots at 30 per cent
moisture level measured at weekly intervals. (Mean values)

A				
Short duration varieties			Number of tillers	
Co. 13 (wet rice)	MTU. 17 (dry rice)	MTU. 18 (dry rice)	PTB. 28 (dry rice)	PTB. 30 (dry rice)
0	0	0	0	0
3	3	3	3	4
6	7	6	5	7
11	13	13	10	14
15	17	22	11	20
19	26	31	12	23
23	28	35	12	26
24	31	36	12	28
24	32	36	12	28
24	..	36	12	31
24	..	..	12	..
20	..	..	..	..

B						
Medium duration varieties				Number of tillers		
GEB. 24 (wet rice)	TKM. 1 (dry rice)	TKM. 2 (dry rice)	Bairuvadlu (dry rice)	T. 129 (wild rice)	T. 740 (wild rice)	T. 1702 (wild rice)
0	0	0	0	0	0	0
3	4	3	3	4	3	2
6	8	8	6	6	6	3
12	13	13	11	12	11	7
21	18	21	18	25	17	12
32	19	24	23	36	22	17
46	21	25	26	49	25	19
50	21	26	26	53	26	19
52	21	26	26	57	26	19
53	21	26	26	63	26	19
53	21	26	26	63	26	19
46	21	25	24	60	24	18
45	21	22	21	59	24	14
36	20	19	20	56	23	13
26	17	..	..	..	22	..
24	..	..	..	..	..	..

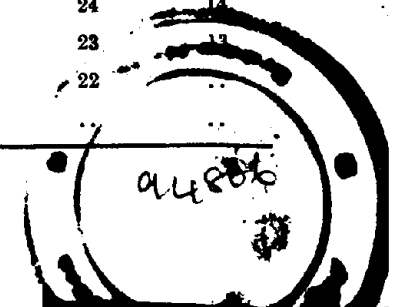


TABLE 6

Leaf area of wet, dry and wild rice varieties
(Mean values)

Name of variety	Number of leaves	Length in cm. (l)	Breadth in cm. (b)	Leaf area in sq. cm. (2l x b)	Total transpiring area sq. cm.
<i>Short duration</i>					
1. Co. 13 (wet rice)	113	28.3	0.66	37.4	4221.7
2. MTU. 17 (dry rice)	103	25.5	0.73	37.2	3833.7
3. MTU. 18 ..	143	23.5	0.77	36.2	5175.2
4. PTB. 28 ..	70	37.9	0.78	59.1	4138.4
5. PTB. 30 ..	104	26.0	0.81	42.1	4380.4
<i>Medium duration</i>					
6. GEB. 24 (wet rice)	189	33.1	0.47	31.1	5876.0
7. TKM. 1 (dry rice)	128	34.8	0.60	41.7	5337.6
8. TKM. 2 ..	130	34.2	0.68	46.5	6042.4
9. Bairuvadlu ..	126	37.9	0.59	44.7	5630.9
10. T. 129 (wild rice)	218	30.3	0.41	24.9	5421.7
11. T. 740 ..	129	30.1	0.58	34.9	4502.1
12. T. 1702 ..	86	39.9	0.69	55.1	4738.6

TABLE 7

Development of root and shoot of rice varieties grown in a wet field
(Mean values)

Name of variety	Depth of penetration cm.	Approximate lateral spread cm.	Root			Total length of root cm.	Mean length of root cm.	Dry weight of root gm.
			No. of roots	Thick root	Thin root			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Short duration:</i>								
Co. 13 (wet)	39.3	25-30	101	49	52	2356	23.3	1.19
MTU. 17 (dry)	55.2	20-25	144	81	63	3684	25.6	1.49
PTB. 28 (dry)	50.8	20-25	94	56	38	2397	25.5	1.25
<i>Medium duration:</i>								
GEB. 24 (wet)	48.9	25-30	127	25	102	2873	22.6	0.80
TKM. 1 (dry)	71.8	20-25	251	142	109	8738	34.8	3.97
TKM. 2 (dry)	55.2	20-25	152	83	69	4139	27.2	1.71
Bairuvadlu (dry)	61.9	20-25	166	111	55	4272	25.7	1.97
T. 129 (wild)	63.7	25-30	263	194	69	7222	27.5	4.39
T. 740 (wild)	63.1	25-30	243	152	91	6326	26.0	3.10

Table 7 (Contd.)

Name of variety	Height of shoot (cm)	Shoot		Dry weight of shoot (gm)	Root/shoot
		No. of tillers	No. of leaves		
	(10)	(11)	(12)	(13)	(14)
<i>Short duration</i>					
Co. 13 (wet)	80.4	10	37	7.33	0.154
MTU. 17 (dry)	75.7	14	32	5.44	0.274
PTB. 28 (dry)	87.5	5	20	5.16	0.242
<i>Medium duration</i>					
GEB. 24 (wet)	59.3	9	31	4.54	0.176
TKM. 1 (dry)	85.3	11	43	14.98	0.265
TKM. 2 (dry)	71.8	8	33	7.76	0.220
Bairuvadlu (dry)	82.7	6	26	8.49	0.232
T. 129 (wild)	67.7	14	48	13.91	0.316
T. 740 (wild)	87.6	14	46	13.37	0.232

APPENDIX

Description of rice varieties used in the study

1. PTB. 28. 'Kattamodan'. Isolated from Kattamodan, a dryland variety common in the West Coast. When sown in June it matures in 100 days. Under good manuring it yields upto 2,000 lb. per acre. It is grown in wetland also for its short duration. Duration: 100 days, Grain size: L. 8.7 mm., B. 3.1 mm., T. 2.2 mm. Glume colour: Straw; Rice: red.

2. PTB. 29. 'Karutha (Black) modan'. Isolated from Karuthamodan, a dryland variety popular in West Coast. This is slightly earlier than Kattamodan. It matures in 90-95 days when sown in May-June, Duration: 90 to 95 days, Grain size: L. 8.8 mm., B. 3.0 mm., T. 2.2 mm., Glume colour: Black; Rice: Red.

3. PTB. 30. 'Chuvanna (dirty glume) modan'. Isolated from Chuvanna-modan, a dryland variety grown in the West Coast. It is earlier than blackmodan. Duration: 85-90 days, Grain size: L. 8.5 mm., B. 3.0 mm., T. 2.2 mm., Glume colour: Brown furrows; Rice: red.

4. MTU. 17. 'Kodi Budama'. Isolated from Kodibudama, a variety grown in the heavy black soils of Godavary, Krishna and Guntur districts, purely under rainfed conditions between the months of June-October when a rainfall of 20 to 30 inches is received. Under favourable condition it yields upto 1,500 lb. grain per acre. Time of harvest: Middle of October, Grain size: L. 8.2 mm., B. 2.9 mm., T. 2.1 mm., Glume colour: Dull straw; Rice: Red.

5. MTU. 18. 'Kodi Jillama'. Isolated from Kodijillama, a variety grown in the heavy soils of Godavari, Krishna and Guntur districts, purely under rainfed conditions. It is a fortnight later than MTU. 17. Under favourable conditions it yields 1,500 lb. grain per acre. Time of harvest: End of October, Grain size: L. 8.2 mm., B. 2.9 mm., T. 2.0 mm., Glume colour: Dull straw; Rice: Red.

6. **TKM. 1. 'Pisini'.** It is pure line selection from the dry paddy variety called Pisini grown in Chingleput, North Arcot and Chittoor, under purely rainfed and open conditions. Sown in August-September, it comes to harvest by end of December. It has given up to 20 per cent higher yield over the local seed. Time of harvest: End of December, Grain size: L. 8.0 mm., B. 3.2 mm., T. 2.0 mm. Glume colour: Brown furrows; Rice: red.

7. **TKM. 2. 'Sembali'.** It is a pure line selection from the dry paddy variety called Sembali, grown in Chingleput and South Arcot districts purely under rainfed conditions. Yields upto 30 percent higher over the local seed. Sown in August-September it comes to harvest by end of December. Time of harvest: End of December, Grain size: L. 8.0 mm., B. 2.9 mm., T. 1.7 mm., Glume colour: Gold; Rice: white (slightly goldish tinge).

8. **'Bairuvadlu'** This is a dryland variety grown in Chingleput and South Arcot districts purely under rainfed conditions. Sown in August-September it comes to harvest by end of December. Time of harvest: End of December, Grain size: L. 8.0 mm., B. 3.2 mm., T. 2.1 mm. Glume colour: Brown furrows; Rice Red.

Explanation of Plate I

Fig. 1 — Germination of rice varieties, GEB. 24 (wet) and PTB. 30 (dry) in 0.25 molar and 0.50 molar cane sugar solution.

Fig. 2 — Germination of rice varieties in different concentration of sucrose solution.

Fig. 3 — Root development of rice varieties, GEB. 24 (wet) and Bairuvadlu (dry) in seedling stage. Difference between soil surface and free water level—9".

Fig. 4 — Root development in rice varieties, (from left to right) GEB. 24 (wet), TKM. 1 and Bairuvadlu (dry) grown in pots at 30 per cent moisture level at flowering stage.

Fig. 5 — Root development in rice varieties, Co. 13 (wet), MTU. 17 and PTB. 28 (dry) grown in a wet field.

PLATE I

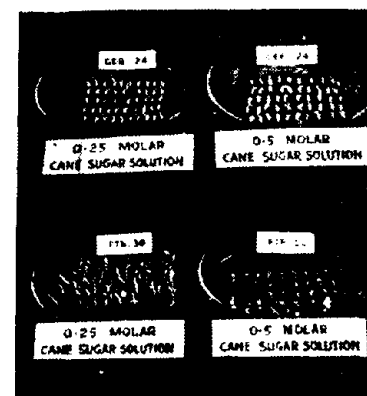


Figure 1

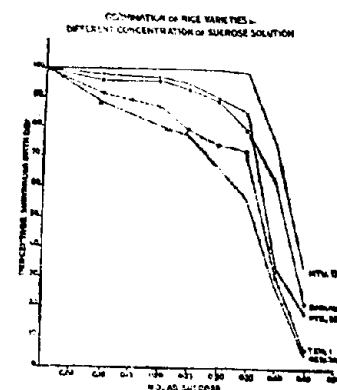


Figure 2

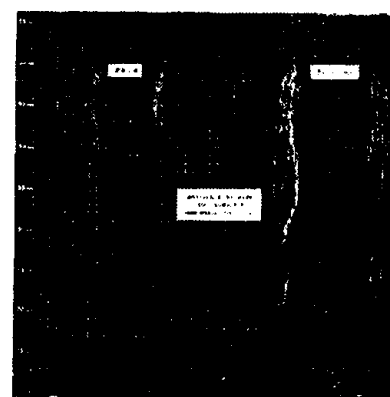


Figure 3

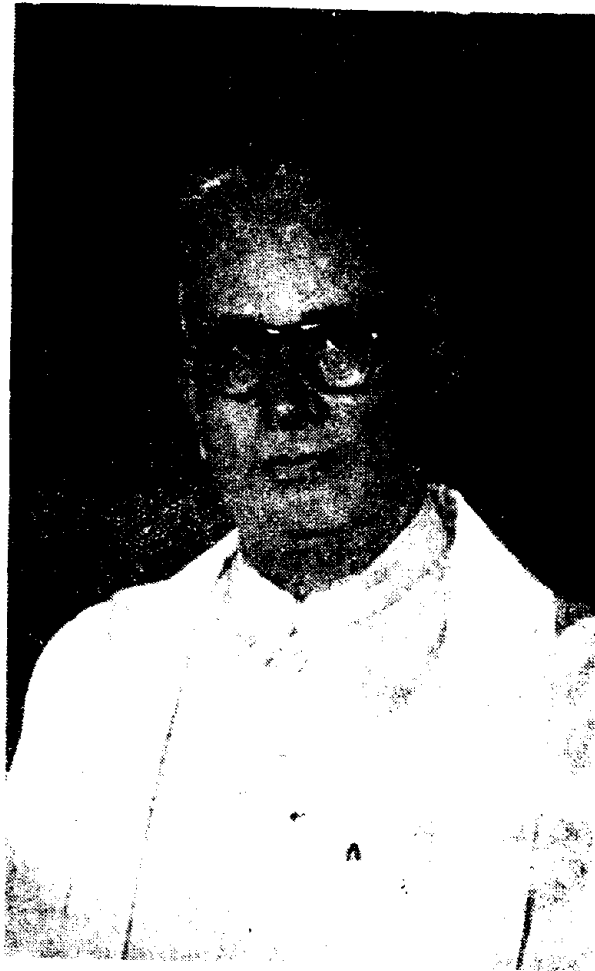


Figure 4



Figure 5

SRI V. C. PALANISWAMI GOUNDER



We gratefully acknowledge the receipt of a generous donation of Rs. 1,000 - (Rupees One Thousand) from Sri V. C. Palaniswami Gounder, Vellakkinar, Coimbatore, on the occasion of the Golden Jubilee Celebrations of the Agricultural College and Research Institute, Coimbatore. Sri Gounder is an enlightened and enterprising practical Agriculturist. He was a former Minister in charge of Animal Husbandry and Prohibition Departments in this State. He has been associated with this Institute for a long time as honorary visitor and has taken abiding interest in its development. He is one of the Patrons of the Madras Agricultural Union. Hailing from a noted family of agriculturists, Sri Palaniswami Gounder has demonstrated his keen desire in the cause of Agricultural education and research by his gracious offer of this donation.

Control of the Leaf Spot Disease of Turmeric Caused by *Colletotrichum capsici* (Syd.) Butl. and Bisby

by

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Mycology Section,

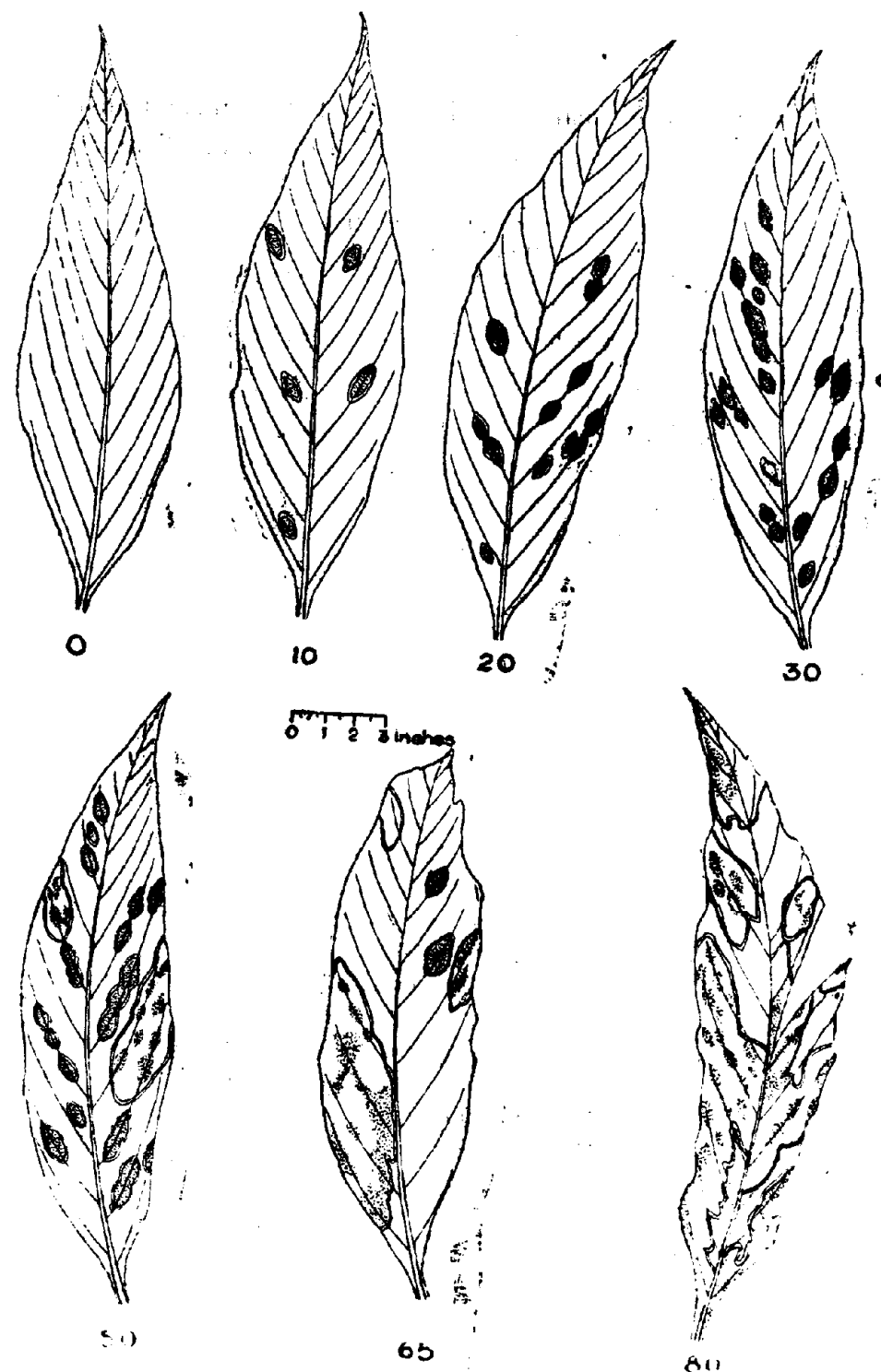
Agricultural Research Institute, Coimbatore.

Introduction: The leaf spot disease of turmeric is widespread in India. The disease is incited by *Colletotrichum capsici* (Syd) Butl. and Bisby (syn. *Colletotrichum curcumae* (Syd.) Butl. and Bisby) which causes extensive spotting of the leaves. The leaves may eventually dry up and thus adversely affect the formation of rhizomes. The consequent loss has been estimated to be about 50% by Ramakrishnan (1954). He has also observed that high atmospheric humidity favours the development of the leaf spots (Ramakrishnan, 1954) and that the disease is controlled by two sprayings with 1% Bordeaux mixture, the yield being increased by more than 90%. However no statistically-laid out trials with fungicides seem to have been conducted. The availability of several fungicides received for test was therefore taken advantage of in laying out a randomised and replicated experiment on the control of this disease.

Material and Methods: Four months old planted turmeric crop in Chavadipalayam (Erode, Coimbatore District) a representative tract, was selected in 1955-'56 season and a land two miles from Bhavani was selected during 1956-'57 to conduct the experiment. Forty-eight plots of 8' x 30' were laid out for the experiment in randomised block design replicated four times. There was no leaf spot incidence prior to the start of the experiment. Eight fungicides were used in 1955-'56 season comprising of the spray chemicals Orthocide 50, Dithane Z 78, Bordeaux mixture, cupravit ob 21, Parry copper, copper oxychloride (Mysore chemicals), copper oxychloride (Kirti chemicals) and cupramar.

Eleven fungicides were used during 1956-'57 season comprising of the spray chemicals orthocide 50, Flit 406, Dithane Z. 78, Bordeaux mixture, Copper oxychloride (Kirti Chemicals) Mycop 50, Fytolan, Cuprous oxide and dusts Micop DO 4, Micop DO 6 and Parry, cop 4%.

Grading chart for Turmeric leaf spot disease.



Leaf Spots Disease of Turmeric

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The sprayings were given with a Sapperlot type Addison rocker sprayer and the dusts were applied by an Addison's rotary duster. An untreated control was kept for comparison. In the experiment conducted during 1955-'56 first spraying was done in the first week of December and a second spraying was done in the first week of January. Infection counts were recorded before each spraying and a final count was recorded one month after the final spraying. The yield data could not be recorded since the harvest was done by the landowner without previous intimation.

In the experiment conducted in 1956-'57 the first sprays and dusts were given during the last week of September on 24-8-'56 when the crop was four months old. The second and third sprayings were given one month and 2 months after the first spraying on 27-9-'56 and on 5-11-'56 respectively and adjusted to coincide a day after receipt of rainfall during the respective months. The rainfall received during the period of the experiment in 1956-'57 presented below.

Month	Total rainfall in inches	No. of rainy days
August, 56	0.79	5
September, 56	3.50	11
October, 56	13.73	17
November, 56	7.94	15
December, 56	0.48	4
January, 57	0.11	1
February, 57	0.45	2

Infection counts on the incidence of the disease were recorded every time before the fungicidal treatment and a final count was recorded 45 days after the last spraying. The intensity of infection was classified into seven grades by collecting leaf samples of different disease intensity and each grade was assigned a category value by eye judgement i. e. 0, 10, 20, 30, 50, 65 and 80 each representing the percent of leaf area infected. The grading chart used is appended. One hundred leaves were graded for each treatment and the mean grade of infection for each calculated. The rhizomes were unearthed on 15-3-'57 and the yield of fresh rhizomes was recorded at that time.

Experimental Data and Results: The intensity of infection in the different plots and the yield data are presented in the table. The results were statistically analysed and found to be significant. Relation between the incidence of leaf spot disease and the yield was also studied.

Discussion: From the results Bordeaux mixture was found to be superior in controlling the disease though Orthocide 50 and Dithane Z. 78 were statistically on a par with Bordeaux mixture.

However when the yields were considered Dithane Z. 78 gave the highest yield being comparatively better than Bordeaux mixture or Orthocide 50 and being statistically superior over untreated control.

There is a highly significant negative correlation between the percentage of infection and the yield as indicated by the correlation coefficient. $r=0.5582$. (Table value $r=5\%$ level 0.2875 , 1% level— 0.3721 .) So there is a definite indication that the leaf spot disease of turmeric has a depressing effect on the yield of the crop.

Acknowledgment: The author is grateful to Dr. K. Ramakrishnan, Government Mycologist for his guidance in the conduct of the experiment and helpful suggestions in the preparation of this paper. The author is also grateful to Sri S. R. Subbian of Chavadi-palayam and Sri S. N. Arthanariswamy Chettiar of Bhavani for placing their fields at his disposal to conduct the experiments.

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- Ramakrishnan T. S. (1954) Leaf spot disease of Turmeric (*Curcuma longa*) caused by *Colletotrichum capsici* (Syd.) Butl. and Bisby. *Indian. Phytopath.* 7: 111—117.

TABLE I
Effect of spraying on disease incidence and yield.

Treatment	Active ingredient	Concentration used	Disease incidence 1956-'57	Yield per plot	Calculated acre yield
Spray Chemicals:					
Orthocide 50	N (Trichloromethylthio) 4-Cyclohexene-1,2-Dicarboximide.	1 lb in 50 gallons of water	7.9	84.25 lb	15291 lb
Flit. 406	do	do	20.00	75.25 "	13,668 "
Dithiocarbamate:					
Dithane Z. 78	65% Zinc ethylbis dithiocarbamate.	1 lb in 60 gallons of water	8.2	100.25 "	18,195 "
Copper group:					
Bordeaux Mixture		1% strength	7.2	95.0 "	17,243 "
Copper oxychlorides:					
Cupravit ob 21	50% Copper oxychloride	1 lb in 40 gallons of water	8.9	..	..
Parry Copper fungicide	do	do	10.1	..	..
Copper oxychloride (Kirti Chemicals)	do	do	12.7	82.0 "	14,883 "
Copper oxychloride (Mysore Chemicals)	do	do	14.6	75.75 "	13,744 "
Mycop 50%	do	do	18.86	72.0 "	13,068 "
Fytolan	do	do	19.33	..	..
Copper oxide group:					
Cupramar	50% Cuprous oxide	do	11.5	8.45 "	14,792 "
Cuprous oxide (Kirti Chemicals)	78-80% do	do	..	..	..
Dust Chemicals:					
Mycop DO.	4% Copper dust	..	20.94	70.5 "	12,792 "
Mycop Do. 6	6% "	..	22.2	73.25 "	12,792 "
Parry Cop. 4%	4% "	..	20.0	76.25 "	13,295 "
Untreated control	..	..	22.2	76.0 "	13,839 "
		Critical difference.	3.24	20.40 "	13,794 "

Madras agric. J., 45 (2): 61—68, 1958.

A Note on the Effect of Cultivating Cotton in Rice Fallows on the Yield of Succeeding Paddy Crop

b2

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Introduction: During the past seven years attempts are being made to fit in a short duration American cotton for the deltaic rice lands of Tanjore, as a well irrigated crop in summer, and capable of recording good yields of the order of 800 lbs. or more of kapas per acre, with a quality of lint suitable for spinning 36 counts. For this purpose, the imported variety P. 216F from punjab, with a duration of five months, was found to be suitable. This cotton has now spread over an area of about 6,000 acres in the districts of Tiruchirappalli, Madurai, Tanjore, North Arcot, South Arcot and Chingleput. Although the practice of growing cotton in the tankfed rice lands after harvest of paddy is popular with the cultivators of the Ramanathapuram, Tirunelveli and Madurai yet certain cultivators of the deltaic areas of Tanjore and other centres feared that the cultivation of cotton might depress the yield of paddy. Observations were therefore made for a period of three years on the yield of paddy in the rice fallows where cotton was grown during summer, at Aduthurai, Palur and Coimbatore representing deltaic, coastal and non-deltaic rice lands, with different durations of fallow periods. The purpose of this note is to record the results of the observations.

Observations: After the harvest of paddy, the land is usually left fallow in summer. Some cultivators however sow green gram or blackgram immediately before the harvest of paddy. The raising of green manure crops like *Sesbania* in the fallow period in order to augment the supply of green leaf to the paddy crop is also common. In the experiments discussed below some of the above treatments were included and the yield of the succeeding paddy crop was observed in each case. The observations were made during the years 1953 to 1956 at the Agricultural Research Station, Aduthurai and Palur and also the wet lands of the Central Farm at Coimbatore. The results of the trials conducted in 1953 - '54 at Palur have been summarised by Kalyanaraman and Rangaswamy (1955) who have concluded that the yield of paddy after cotton is not depressed

provided the usual manures are given to the paddy crop in addition to the cotton residue. In 1954-'55, trials were conducted at Aduthurai and Coimbatore. The summary of the results are given below :

TABLE I

Year	Centre of Trial	Grain yield of paddy in lb/acre	
		'After Fallow'	'After Cotton'
1953—	Palur	2293	2396
1954	(Percentage on control-Fallow)	160	104
1954—	(a) Aduthurai	2317	2283
1955	(Percentage on control-Fallow)	100	99
	(b) Coimbatore	1640	3215
	(Percentage on control-Fallow)	106	139

It is seen that the yield of paddy is not depressed by growing cotton as a summer crop in all the three centres in both the years.

With a view to have further critical information, observations were continued in all the three centres in 1955-'56. Three major treatments namely (1) paddy after fallow, (2) paddy after cotton (3) paddy after pulse i. e., greengram or *Sesbania* were adopted. In the case of minor treatments, the procedure adopted for the two major treatments "after fallow" and "after-pulse" were:—

(a) Application of green manure alone at 5,000 lb of *Sesbania* per acre.

(b) Application of artificials only, i. e., superphosphate at 150 lb per acre plus ammonium sulphate at 100 lb per acre.

(c) Green manure plus artificials at the doses mentioned in (a) and (b).

(d) 'No manure' treatment.

In the case of the major treatment "after-cotton", to the three manurial doses (a), (b) and (c) mentioned above, a supplementary quantity of 6,000 lb per acre of cotton residue was incorporated into the soil after pulling out the cotton plants, and instead of the sub-treatment 'no manure', the treatment "cotton-residue alone" which received 6,000 lb of residue per acre was substituted, as item (d). In addition, ammonium sulphate was applied at 150 lb per acre instead of 100 lb at Coimbatore. The treatments were replicated four times and the experiment was laid out on a split plot design and was statistically analysed.

Planting of paddy was done after the harvest of cotton in September at Aduthurai and Coimbatore and in October at Palur. Observations were made on the strain Co. 25 at Aduthurai with a duration of 186 days and on ADT. 25 with a duration of 176 days at Coimbatore and Palur. The harvesting of paddy was completed by end of January at Aduthurai, by the first week of February at Coimbatore and by the end of February at Palur. In the case of the major treatment, 'after greengram' a deviation had to be made at Palur where *Sesbania* was grown instead of greengram as an off-seasonal crop between 24-8-'55 and 10-10-'55, and paddy was planted between 11-10-'55 and 13-10-'55. This deviation was done since green gram is not normally grown in the tract. The *Sesbania* crop gave an acre yield of 68,340 lb of green matter and only 5,000 lb were incorporated in the required plots. In the case of green gram at Aduthurai and Coimbatore harvesting was completed by the end of April and the residue was utilised as busa for cattle, after collecting the grain which recorded 134 lb per acre at Aduthurai and 430 lb at Coimbatore.

The results of the three major treatments in the three centres of trial viz., Aduthurai, Palur and Coimbatore representing the rice fallows of deltaic, coastal and non-deltaic areas of the State, respectively, are given in Table II below :

TABLE II

Mean grain field of paddy per acre in lbs. in 1955-'56
Major treatments

Centre of trial	After fallow	After cotton	After pulse (greengram) or <i>Sesbania</i>	Mean
	1	2	3	
Aduthurai	4865	4950	5107	4974
Palur	2419	2741	2728	2629
Coimbatore	1757	1726	1848	1777
Man of three centres	3014	3139	3228	3127
Percentage on control. (fallow)	100	104	107	...
Percentage of general mean (3127 lb/acre)	96	100	103	...

N. B : 'F' test is satisfied C. D. = 157 lb. per acre.

S. E. = 40 lb. per acre.

Conclusions : 3, 2, 1.

It is seen that when compared with fallow the yield of paddy 'after cotton' is not depressed in any way in all the three centres of work. The results are in agreement with the indications obtained in the previous two years (Table I).

The yields of paddy obtained in the three centres for four minor treatments under the three major treatments are given in Table III appended.

It is seen that 'no manure' treatment (d) in 'Fallow' has given the lowest yield. The treatment "green manure alone" in "fallow", "cotton residue" in the case of the major treatment "after cotton", and 'no manure' in the major treatment 'after green gram' have all given more or less equal yields and better than 'no manure' treatment in 'fallow'. Application of artificials alone or green manure and artificials have increased the yields of paddy in all the three major treatments. Application of cotton residue alone is not sufficient to bring the yield of paddy to the level recorded in the case of minor treatments 'green manure and artificials' in the major treatment "fallow", which condition represents the normal practice of the rice cultivators. It is therefore considered very necessary that in addition to cotton residue, the usual doses of artificials and green manure should also be applied to the paddy crop.

During the year 1956-'57, information was available on large sized observation plots ranging from 6 to 14 cents, at Palur and Coimbatore. Paddy strain Co. 19 was planted at Palur on 21-10-'56 and the crop was harvested on 12-3-'57. The crop received a basal dose of 150 lb of super and a top dressing 150 lb ammonium sulphate per acre in all the four treatments given below. The final acre yields recorded for the four treatments are as under :

Treatment		Yield of paddy (wet weight in lb acre)
		Grain
1.	After cotton	2,954
2.	After <i>Sesbania</i>	2,214
3.	After cowpea	2,026
4.	After fallow	1,370

It is seen that the yield of paddy after cotton is not in any way depressed, when compared to the other treatments.

In the large sized plots laid out at Coimbatore, the Paddy strain Co. 2 was planted on 20-9-'56 and it was harvested on 2-2-'57. The paddy crop in the four treatments received uniformly 5,000 lb of *Sesbania*, 150 lb ammonium sulphate and 75 lb of triple-super, per acre, to supply 30 lb of N and P_2O_5 , per acre, respectively. The yield of paddy in the four treatments is as follows :-

Treatments		Yield of Paddy (grain) in lb. per acre (Dry Weight)
1.	After cotton	2,549
2.	After <i>Sesbania</i>	3,760
3.	After green gram	2,574
4.	After fallow	2,150

It is seen that the yield of paddy after cotton is not lowered when compared to 'fallow' and 'green-gram'.

It is clear that the above large scale observation of cotton as an off-seasonal crop in the rice fallows, will not in any way depress the yield of paddy, provided the paddy crop receives the manurial doses normally given to it. The available cotton residue only helps to augment the supply of green matter to the paddy crop.

Acknowledgment: The authors wish to acknowledge help rendered by the Superintendents, Central Farm Coimbatore, Aduthurai and Palur in furnishing the data and conduct of the experiment.

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TABLE III
Grain yield of paddy in lb. per acre.

Major treatments	I Paddy after fallow				II. Paddy after cotton				III. Paddy after green gram or Sesbania				Remarks.
Minor treatments	Green manure alone	Artificial alone	Green manure + artificial	No manure	Cotton residue and green manure	Cotton residue-artificial	Cotton residue-artificial and green manure	Cotton residue-artificial due only	Green manure alone	Artificial alone	Green manure and artificial	No manure	
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	
<i>Centre of trials:</i>													
Aduthurai	4780	5136	4696	4750	4820	4814	5266	4800	5023	5271	5314	4821	
Palur	2400	2528	2700	2046	2662	2818	3065	2417	2710	2907	2935	2361	
Coimbatore	1585	1930	2073	1440	1560	1906	1976	1463	1732	2097	2073	1488	
Mean of three centres	2955	3198	3156	2745	3014	3193	3436	2913	3155	3425	3441	2890	
Percentage on (d) *	108	116	115	100	105	110	118	100	109	119	120	100	* In the respective major treatments.
Percentage on general mean 3127 lb./acre	94	102	101	88	96	103	110	93	101	110	110	92	
Mean of major treatments	3014				3139				3228				General mean = 3127
Percentage on general mean 3127 lb. acre	96				100				103				

DETAILS

DETAILS									
I.			II.			III.			
(a) Green manure alone	(a) Cotton residue and green manure	(a) Green manure alone	(b) Cotton residue and artificials	(b) Artificial alone	(b) Artificial alone	(c) Green manure and artificials	(c) Green manure and artificials	(c) Green manure and artificials	(c) Green manure and artificials
(b) Artificial alone	(b) Cotton residue only	(b) No manure	(c) Cotton residue only	(c) No manure	(c) No manure	(d) Cotton residue only	(d) No manure	(d) No manure	(d) No manure
N. B. MAJOR TREATMENTS:									
F. test satisfied			C. D. = 167 lb. per acre			S. E. = 55 lb. per acre			
S. E. = 40 lb. per acre			C. D. = 163 lb. per acre			C. D. = 163 lb. per acre			
Conclusions			III, II, I.			III (c), II (c), III (b), I (b), I (c), III (a), II (a), III (d), I (d).			

Madras agric. J., 45 : (2) 67-71, 1958.

Some Studies on Sugarcane Juice Clarificants

by

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The manufacture of jaggery is an important cottage industry in this state, and nearly 70% of the cane crop grown is being converted into jaggery. It is not possible to get jaggery cent per cent free from colour and impurities. The quality of jaggery produced depends on the variety, soil, manurial and cultural treatments and the clarification of juice. The aim of clarification is to remove as far as possible all the impurities that may be present and to prevent non sugars being formed again in the juice. The object is therefore to produce jaggery of light colour and good quality. There is thus need for adoption of a suitable clarificant.

Various clarificants are used in the different states of India. Lime is popular in Madras and Andhra, and lime with superphosphate in Bombay. In subtropical India, vegetable clarificants like juice of *Bhindi* (*Hibiscus esculentus*) are being used. In Trichy, Salem and Coimbatore districts of this state, hydros (sodium hydrogen sulphite) is used. (Roy. 1951) There is a marked improvement in color by the use of this salt, but the keeping quality of the jaggery is very much affected. It has been reported from Bihar (Khanna and Chakravathy 1955) that the process of clarification of juice by a water extract of castor seed or groundnut seed, showed outstanding results. It has also been reported that the gur prepared by using soyabean, tablets (soyabean flour supplemented by a small amount of monocalcium phosphate), was found to be superior to that obtained with the use of castor seed extract. The work done at Anakapalle (Mohanrao and Narasimhan, 1954) indicated that the jaggery obtained by clarification with both castor seed and groundnut seed extracts was poorer compared to the normal lime treatment. This jaggery did not set properly and was also softer than that from lime treatment.

Materials and Methods: In order to assess the relative efficiency of three clarificants, soyabean tablet, castor seed and groundnut seed extract, alone and in combination with lime, as compared to lime alone, four boilings were conducted at Sugarcane Research Station, Gudiyattam. The addition of lime was adjusted so that the pH of the juice was between 6.1 and 6.4. The variety of cane chosen was Co. 419.

The samples of jaggery from the various treatments, were analysed for moisture, sucrose, reducing sugars, acidity, color, turbidity and pore space. The methods of analysis followed are given below:

(i) *Moisture*: Determined by drying samples mixed with prepared sand, in a steam oven.

(ii) *Sucrose*: Determined in half normal solution by the usual polarisation method.

(iii) *Reducing sugars*: Determined in half normal solution by titration with Fehling's solution after lead clarification and deleading.

(iv) *Acidity*: Determined in standard solution by titration against N/50 alkali using phenolphthalein as indicator.

(v) *Colour*: Intensity of color was measured in $\frac{1}{2}$ normal solution, after filtration through a double layer of No. 3 filter paper, by means of Klett Sommerson photo electric colorimeter.

(vi) *Turbidity*: Was determined in $\frac{1}{2}$ normal solution by means of Klett Sommerson photo electric colorimeter. The ratio of the scale readings of the instrument in the original solution and that after filtration through a double layer of paper, is a measure of turbidity.

(vii) *Pore space*: Measurement of pore space was done by soaking weighed samples of jaggery in kerosene for 24 hours and finding out the volume occupied by kerosene.

Results and Discussion: The results of analysis of the samples of jaggery from the seven treatments are given in the accompanying table. The data were statistically analysed.

(a) *Sucrose*: Obviously a jaggery of high sucrose content indicates its good quality. The highest sucrose content has been recorded by the treatment "lime+soyabean", closely followed by "lime alone" and the lowest by "soyabean alone". The treatments "lime alone" and "lime in combination with the other three clarificants" are found to be significantly superior to the two clarificants, soyabean tablet and groundnut seed extract.

(b) *Reducing sugars*: A low glucose content characterises jaggery of good quality. The treatments "lime alone" and "soyabean alone" have registered the lowest and the highest reducing sugar contents respectively. As regards reducing sugar content, lime alone is observed to be significantly better than the other three clarificants.

(c) *Moisture*: A low moisture content is a sign of good quality in jaggery, as the rate of deterioration will be less. The lowest moisture content is found in jaggery from lime treatment and the highest from soyabean treatment. Anyhow the treatment differences were not significant.

(d) *Acidity*: This denotes bad taste and as jaggery deteriorates, this constituent increases. Lower values would therefore indicate better quality. Not much of difference is noticed in the samples of jaggery from the various treatments.

(e) *Colour*: Of all the quality factors, color is the most important in the market yard, in the determination of quality of jaggery. Light coloured jaggery is preferred to dark coloured.

The pH is over 7.9, when lime is used in excess in the process of clarification, and then the colour of the jaggery is affected. In these trials, pH was controlled at 6.1-6.4, thereby limiting the quantity of lime used. As regards colour, there was no significant differences among the various treatments, though lime alone and in combination with groundnut seed extract has given jaggery of lighter colour than others.

(f) *Turbidity*: A smaller value of turbidity generally indicates the greater purity of jaggery. In these trials, "lime" has given the lowest value and "castor seed extract" the highest. Lime is found to be significantly superior to groundnut and castor seed extracts. No significant differences were observed, among the three clarificants, soyabean tablet, castor seed and groundnut seed extracts.

(g) *Pore space*: Measurement of pore space gives an idea of the texture. An open texture denotes better crystallisation. Samples of jaggery from the two treatments 'lime alone' and 'lime in combination with soyabean tablet', are found to possess a slightly more open texture than those from other treatments. Further, the addition of lime to the other clarificant seems to have slightly improved the texture of the jaggery.

Physical Features: Regarding hardness and crystal formation, the jaggery from the lime clarified juice was found to be better than that from other treatments. Softness and lack of crystal formation was observed particularly in jaggery from three treatments, "soyabean tablet", "castor seed" and "groundnut seed extracts" alone. The combination of lime with clarificants, appeared to produce a better product with regard to physical features.

On a comparison of the relative efficiency of the four clarificants, lime, groundnut seed extract, castor seed extract and soyabean tablet, lime appears to be the best though it was not significantly superior in respect of all the chemical constituents. In most of the cases, the addition of lime seems to have improved the efficiency of the other three clarificants tried in this experiment. The general conception is that the jaggery obtained by clarification with lime is dark coloured. In these trials, juices from mature canes have been used, and in such cases if liming is suitably adjusted, it is quite possible that jaggery of good quality and fairly light colour may be obtained. But, of course, in the case of juices of overripe and young canes, they require more lime i. e., high pH and hence the color is affected and this aspect requires further investigation.

Summary: Trial boilings were conducted with Co. 419 juice, at sugarcane Research Station, Gudiyattam and the efficiency of the various clarificants, lime, soyabean tablet, castor seed and groundnut seed extracts, alone and in combination with lime, was studied. The samples of jaggery from the various treatments, were analysed for their physical and chemical characteristics, and it was observed that lime appeared to be a better clarificant than the other three. The addition of lime to the particular clarificant is also observed to improve the quality of jaggery.

Acknowledgment: I am indebted to Sri S. V. Parthasarathy, Sugarcane Specialist of this state, for his keen interest in the work and valuable suggestions in the preparation of the paper. My thanks are due to Dr. A. Mariakulandai for affording facilities for the analysis of jaggery. My thanks are also due to the staff of the sugarcane research station, Gudiyattam for their valuable help in the preparation of jaggery.

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Results of analysis of samples of jaggery.
(Average of four boilings)

Factors of analysis.	Results of analysis of samples of jaggery. (Average of four boilings)							Significant or not P=0.05	Critical Difference
	A	B	C	D	E	F	G		
1. * Moisture	4.65	6.44	6.25	5.81	5.23	6.30	4.31	No	0.55
2. * Sucrose:	76.66	67.70	73.30	68.41	72.61	71.01	76.07	Yes (1)	5.57
3. * Reducing sugar:	11.78	14.05	11.76	12.75	11.60	11.94	10.17	Yes (2)	1.58
4. Acidity (number of ccs of N alkali per 100 gm. of jaggery).	5.30	5.38	4.85	5.58	5.05	5.43	5.05	No	0.93
5. Color (N/4 Solution)	29.5	33.5	27.3	32.8	30.0	30.8	26.8	No	6.07
6. Turbidity (N/4 Solution)	3.48	3.76	3.34	4.72	4.09	4.90	2.89	Yes (3)	1.30
7. Pore space (ccs per 100 gm)	2.09	0.72	1.65	0.96	1.31	1.03	1.83	No	0.26

* Expressed as percentage on oven dry basis.

(1) A C C E F D B (2) B D F C A E G (3) F D E B A C G

Research Notes

Chromatographic separation of Potassium and Sodium in Soil extracts for Quantitative Estimation.

The separation of potassium and sodium in soil by the routine methods is a laborious and time consuming process. This is a type of estimation wherein the modern chromatographic technique could be advantageously applied, economising both time and labour. Employing descending technique of paper chromatography it has been found that there is clear and good separation of potassium and sodium in soil.

The following is the outline of the method employed for the separation :—

The apparatus consists essentially of a dish containing the developing solvent. The dish is kept at a height of about 10 inches above the table. A filter paper strip 9 inches long and 1.5" wide, previously washed with dilute HCl and then with distilled water till free of any chloride and dried, is taken. The HCl extract of the soil is prepared by digesting about 10 gms. of soil with about 25 c. c. of concentrated HCl for about 8 hrs. It is filtered and the filtrate made up to 250 c. c. About .05 c. c. of the extract is spotted on the paper strip. The spotting is adjusted so that a spot almost circular and of 0.3 inches diameter forms on the paper an inch away from one of the narrow edges. The spotted filter paper is air dried, for about 10 minutes and hung from the dish containing the solvent so that the edge of the paper nearer the spot dips in the solvent in the dish and the spot is an inch away from the surface of the solvent. The entire arrangement is made air tight by enclosing inside a glass cylinder. After sometime the solvent travels down to the lower edge of the paper strip. The paper strip is then removed, air dried and sprayed with 2 N. Ag.NO₃ solution followed by a 1% solution of *Fluorescein* in alcohol from an all glass sprayer to develop the bands and dried. The Rf. value of each band is measured. The individual ions are also subjected to an identical treatment and Rf. values are determined for each solvent. It is thus possible to identify the individual ions after the separation. The specific reagents for the metallic ions have also been used to identify the metals. Potassium has been identified with sodium cobaltinitrite (yellow colour) and sodium with zinc uranyl acetate (pale yellow colour)

The lack of a thorough understanding of the processes involved in the separation of ions on paper has led to an empirical approach to the selection of suitable solvent mixtures. This is inevitable in a technique which has so recently developed but there are some factors which assisted in making the choice of the solvents tried for the present work. The nature of the alkali metals require that only polar solvents which are completely miscible with water should be used. So the range of solvents and solvent mixtures investigated are restricted to ethyl alcohol, methyl alcohol and mixtures of the above with different proportions of water. The stability of solvent mixtures require consideration, as esterification

will occur between the HCl in the extract spotted and the alcohol. Halogen acids esterify tertiary alcohols extremely rapidly and so only primary alcohols are used. The effect of water is another factor to consider in choosing the solvent mixture. Water plays a very important part in paper chromatography and for some separations the water content must be kept low whereas in others it is essential to have the content high. It is seen that whereas absolute methylalcohol will move alkali metals to reasonable Rf. values, ethyl alcohol will not move them at all unless water is present.

The main features of the results obtained are presented in Table I.

TABLE I

Solvent	Time of irrigation for the solvent to travel 8"	Rf. values of metallic ions		Remarks
		K	Na	
1 Absolute ethyl alcohol	2 hrs.	0	0	No movement
2 Ethyl alcohol and water in the proportion of 9:1	2 hrs. 25 mts.	0.21	0.30	Medium resolution. Diffused bands which are not clearly separated
3 Absolute methyl alcohol	50 mts.	0.74	0.92	Good resolution both the cations get clearly separated
4 Methyl alcohol and water in the proportion of 2:1	1 hr.	0.65	0.86	Good resolution separation of bands not sharp
5 Methyl alcohol and water in the proportion of 1:1	1 hr. 15 mts.	...	...	Very poor resolution. The bands overlap and appear near the solvent front

Further work is in progress with a view to standardise the above procedure and also to use it for the quantitative estimation of potassium and sodium in the soil.

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}

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Madras agric. J., 45 : (2) 74—75, 1958.

Recent Observations on the Control of the Sweet Potato Weevil (*Cylas formicarius* Fb.)

The damage caused to the sweet potato crop (*Ipomea batatas*) by the weevil *Cylas formicarius* Fb. is very severe. The insect invades both the crop in the field and the tubers in storage. Invariably 60 to 70% of the harvested produce gets spoiled by this beetle and becomes unfit for consumption. Being a borer the control of this weevil is still a problem all over the world and several experiments are being conducted in India and elsewhere for tackling this pest. Unfortunately there is also no effective natural enemy on this pest in this country and hence it is able to multiply in large numbers. The generally recommended methods like field sanitation, planting of weevil free setts, fumigation of setts before planting, collection of adult beetles etc., though useful to certain extent are not found to completely check this pest. Hence it was found necessary to develop a spray schedule with a view to protect the standing crop with insecticides at regular intervals and prevent the weevil from attacking the vines and tubers. Based on this programme detailed investigations were taken up from 1952 at Coimbatore. Experiments were conducted under replicated conditions at Central farm attached to Agricultural College and Research Institute, Coimbatore with various insecticides which included some of the new chemicals also the results of which are furnished in the following lines.

Experiments and Results: The trial was first started in 1952 with DDT 5% dust and 0.1% spray, Lindane 0.65% dust and 0.1% spray and Calcium arsenate and lime dust and spray. The chemicals were applied at tri-weekly intervals from the sixth week of planting and three such applications were made. The results were assessed by recording the yield of good and weevil infested tubers and calculating the percentage of weevil infestation. Among the three chemicals crop in Lindane treatment alone showed comparatively less incidence. The same chemicals were tested in the subsequent year 1953 and this year also only Lindane was found to be better than the other two. But however none of them gave satisfactory measure of relief. Since the two years' trials have not given much satisfactory results, it was decided to test some more new chemicals and also increase the number of rounds of treatments with shorter intervals. The trials were continued in the year 1954 in which D.D.T. and Calcium arsenate were deleted and instead Aldrin and Dieldrin were included, as dust at 2.5% strength and spray at 0.1%. The dusts were applied in the soil at the base of the plants at 30 lb. per acre. The treatments were repeated once a fortnight from the sixth week of planting and six such applications were made. The results are furnished in Table I. Aldrin and Dieldrin gave excellent control of the weevil in giving low percentage of weevil infestation. Lindane was not found as good as these two chemicals. Again to confirm the action of these two chemicals the trial was repeated in 1955 in which Lindane was deleted and in its place another new chemical Endrin was included in the form of dust at 1% strength and spray at 0.1% strength. The chemicals were applied in the same way as the previous year's trial. The results are furnished in Table II. In this trial all the three chemicals were found to give good control of the pest.

Conclusions: The various experiments conducted for the control of the sweet potato weevil from 1952 to 1955 indicated that Aldrin, Dieldrin and Endrin are highly useful in controlling this pest, Dieldrin being superior to both of them. Maximum reduction in infestation and high yields were obtained in plot treated with Dieldrin spray and further an increased value of over Rs. 500/- per acre was obtained over the control plots in this case. The cost of one round of treatment with Dieldrin spray worked out to Rs. 15/- per acre. No off-flavour was detected in the tubers treated with any of these chemicals. The high yield recorded amply justifies cost involved in treatment, allowing a good margin of profit. The method of control indicated, well merits repetition in various other Sweet potato growing regions.

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T. R. SUBRAMANIAN, M. Sc.

TABLE I

Year: 1954.

Variety: V. 6.

Treatments	Yield of tubers obtained per acre in lbs		Total	Percentage of weevil infestation
	Good	Weevil infested		
1. Aldrin 2.5% dust	4530	900	5430	16.6
2. Aldrin 0.1% spray	5300	4879	10179	47.9
3. Dieldrin 2.5% dust	6999	871	7870	11.1
4. Dieldrin 0.1% spray	10919	1016	11935	8.5
5. Lindane 0.65% dust	2352	2643	4995	52.9
6. Lindane 0.1% spray	2817	3369	6186	54.4
7. No treatment	1713	4414	6127	72.0

TABLE II

Year: 1955.

Variety: V. 6.

Treatments	Yield of tubers obtained per acre in lbs.		Total	Percentage of weevil infestation
	Good	Weevil infested		
1. Aldrin 2.5% dust	7260	1180	8440	13.9
2. Aldrin 0.1% spray	12015	1598	13613	11.8
3. Dieldrin 2.5% dust	10781	635	11416	5.6
4. Dieldrin 0.1% spray	12582	381	12963	2.9
5. Endrin 1% dust	9983	581	10564	5.5
6. Endrin 0.1% spray	11180	1579	12759	12.4
7. No treatment	2577	3122	5699	54.8

Weather Review — For January, 1958.

RAINFALL DATA (IN INCHES)

Division	Station	Total rainfall for the month	Departure from normal	Total since 1st January 1958
North	Madras (Meenambakkam)	0.4	— 1.0	0.4
	Tirurkuppam*	Nil	— 1.0	Nil
	Vellore	1.1	— 0.4	1.1
	Gudiyatham*	1.6	+ 1.1	1.6
East Coast	Palur*	0.5	— 0.9	0.5
	Tindivanam*	1.8	— 1.1	1.8
	Cuddalore	1.6	— 0.8	1.6
	Nagapattinam	0.4	— 2.3	0.4
	Aduthurai*	0.5	— 1.1	0.5
	Pattukkottai*	0.8	— 0.8	0.8
Central	Salem	0.1	— 0.2	0.1
	Coimbatore (A. M. O.)*	0.2	— 0.2	0.2
	Coimbatore	0.2	— 0.4	0.2
	Tiruchirapalli	0.1	— 0.7	0.1
South	Mathurai	0.5	— 0.3	0.5
	Pamban	0.4	— 2.2	0.4
	Koilpatti*	Nil	— 1.1	Nil
	Palayamcottai*	0.6	— 1.1	0.6
	Ambasamudram*	1.1	— 1.9	1.1
	Nagercoil*	Nil	— 0.7	Nil
Hills	Kodaikanal	0.9	— 2.3	0.9
	Coonoor*	3.4	+ 0.1	3.4
	Ootacamund*	0.1	— 0.6	0.1
	Nanjanad*	0.3	— 0.1	0.3

Note:— 1. *Meteorological Stations of the Madras Agricultural Department.

Due to the persistence of an easterly trough over the West Laccadives and neighbourhood in the south east Arabian sea, weather was mainly dry in Madras State on 1—1—1958. As the easterly wave was affecting the coastal Madras on 2—1—1958, localised showers were received in Tamil Nad on that day. A fresh easterly wave that was approaching Ceylon and South Coromandal coast brought localised rains in Madras State on 3—1—1958, and scattered light showers in south Madras on 4—1—1958. As a result of the dry continental air that was generally prevailing over the country outside the Bay Islands, dry weather was prevalent in Tamil Nad for 4 days from 5—1—1958. Though an incursion of relatively moist air was taking place into the South Peninsula, weather continued to be dry in Madras State for 16 days from 9—1—1958. As a feeble wind discontinuity at 3 Km. a s. l. passed through Cuddalore and Honavar on 25—1—1958, weather was dry in Tamil Nad except for isolated light showers in coastal and South Madras. Dry weather prevailed in Madras State on 26—1—1958 and the following three days, though a feeble incursion of moist air was taking place into the South Peninsula. On 30—1—1958, except for isolated light showers at Pamban, mainly dry weather was prevalent in Madras State. On the last day of the month, though scattered showers were received in south Madras, weather was dry elsewhere in the region.

Regarding the fluctuations of temperature, the night temperatures were generally above normal throughout the month.

There were ten frosty nights with a lowest temperature record of 31°F at Ootacamund, and sixteen frosty nights recorded at Nanjanad.

Rainfall: The noteworthy rainfalls and the zonal rainfall for the month are furnished below:

Noteworthy Rainfalls for the month

S. No.	Date	Name of place	Rainfall in inches
1.	2—1—1958	Cuddalore	1.10
2.	3—1—1958	Vellore	1.14
3.	26—1—1958	Coonoor	1.05

Zonal Rainfall (in inches)

Name of Zone	Rainfall for January 1958	Departure from Normal	Remarks.
North	0.8	— 0.3	Below normal
East Coast	0.9	— 1.2	Far below normal
Central	0.2	— 0.4	do.
South	0.4	— 0.4	Below normal
Hills	1.2	— 0.7	do.

Agricultural Meteorology Section,
Lawley Road Post, Coimbatore.
12—2—1958.

C. B. M., M. V. J., & M. S. D.

AWARD OF RESEARCH DEGREE.

Sri T. A. GOVINDA IYER, Statistical Assistant, has been awarded the M. Sc., degree of the Madras University for his thesis "A study of the physico-chemical properties of saline and alkaline soils of the Cauvery delta and their reclamation".

Our congratulations to him.

Departmental Notifications

POSTINGS AND TRANSFERS

Upper subordinates — Agricultural Department

Name and Designation	Posted to or Transferred
Sri P. Vincent, Paddy Asst. Coimbatore	Asst. in Mycology, Coimbatore.
„ Manamohan Lal, Paddy Asst., Coimbatore	Asst. in Paddy, A. R. S., Aduthurai.
„ S. Narayanan, Asst. in Paddy, A. R. S., Aduthurai	Extension Officer in Agriculture, Avadayarkoil.
„ M. Mahalingam, Asst. Central Exhibition, Coimbatore	Coconut Nursery Asst., Thackalai, Kanyakumari District.
„ G. Ramanathan, P. P. A., Kumbakonam	Chemistry Asst. Coimbatore.
„ N. Bapu, Extension Officer in Agriculture, Tiruvadanai	Extension Officer, Srivilliputhur.
„ S. V. Hariharan, F. M., S. S. Farm, Tilangi	Farm Supervisor, Koilpatti.
„ S. H. Hydroos, A. D., Vaniambadi	Soil Cons. Asst. Pallikonda.
„ V. R. Natarajan, Farm, S. S. Farm, Bhavani	Extension Officer in Agriculture, Mathur Block.
„ M. Aravindakshan,	Appointed Millets Asst., Coimbatore.
„ A. Chidambaranathan,	„ Oilseeds Asst., Tindivanam.
„ M. Devaraj,	„ Instructor in Agriculture, Arni.
„ N. Mahalingam, A. D. Villupuram	Extension Officer, Polur.
„ Avudanayagam, F. M., S. S. Farm, Tirupathur	Extension Officer, Tiruvannamalai.
„ C. D. Samuel, Dairy Manager, Coimbatore	Hort. Dev. Asst., Tirunelvely.
„ S. Palaniswamy, P. P. A., (Ento.), Mayuram	Extension Officer in Agriculture, Achalpuram.
„ K. R. Ramaswamy, Asst. in Paddy, Coimbatore	Asst. in Paddy Coimbatore, (Piricularia Scheme), Coimbatore.
Srimathi L. Dhanaraj, Paddy Asst., Tirur (Drought scheme)	Paddy Asst., Main Section, Tirur.
Sri R. S. Bhindumadhava Rao, Asst. in Paddy, A. R. S. Pattukottai	Paddy Asst., R. R. S., Tirur.
„ John Chandra Mohan, Asst. in Paddy, R. R. S., Tirur	Asst. in Paddy, A. R. S. Pattukottai.
„ Seshadri, Extension Officer in Agriculture, Kallayarkoil	Instructor in Agriculture, Krishnagiri.
„ Sreyankumaran, A. D., Sankarapuram	A. D., Villupuram.
„ W. R. Nargunam, F. M., S. S. Farm, Kakuppam	Extension Officer in Agriculture, Ulundurpet.

Name and Designation	Posted to or Transferred
Sri V. G. Mathew, F. M., S. S. Farm, Pepparaipatti	Hortl. Dev. Asst., Chingleput (Guindy).
„ V. Srinivasan, P. P. A., Pattukottai	Hortl. Dev. Asst., Pattukottai.
„ V. Nagarajan, F. M., S. S. Farm,	Hortl. Dev. Asst., Tanjore.
„ C. Krishnamurthy, A. D., Tirukoilur	Hortl. Dev. Asst., Vellore.
„ G. Ramanathan, Soil Cons. Asst., Kodaikanal	„ Trichy.
„ P. A. Krishnamurthy, A. D., Tirukoilur	„ Cuddalore.
„ S. Padmanabhan, Soil Cons., Trainee	„ Coimbatore.
„ A. Ramalingam,	„ Trichy.
„ A. J. Knight, (on leave)	Fruit Asst. F. R. S., Periskulam.
„ V. Srinivasan, A. D., Mettupalayam	Extension Officer in Agriculture, Sular.
„ K. P. Srinivasan, A. D., Extension Officer	Special Agriculture Demonstrator, (Sugarcane) Gudlatham.
„ T. L. Subramaniam,	Appointed as Dairy Manager, Coimbatore.

POSTINGS AND TRANSFERS

Emergency Appointments of Fieldmen as Upper Subordinates during the month of February—1958.

Name	Appointed as Farm Manager Satate Seed Farm.
Sri. Appandraj	Fieldman Sirukaverikuppam
„ K. Pandurangan	„ Vanur
„ P. George	„ Vellapakkam
„ V. Santiago	„ Sathlathope
„ N. Bhushanam	„ Kakuppam
„ T. Parthasarathi	„ Ayyanarkoilpatti (Pattukottai)
„ P. R. Nageswariah	„ Kappaloor
„ N. Palanikumaraswamy	„ Veerapandipudur
„ S. Hariharan	„ Ayyalur
„ L. Ramamurthy	„ Devadanam
„ V. Venkatasubbiah	„ Iranji
„ R. D. Lakshminarayanan	„ Kolathur
„ V. Muthukrishnan	„ Tirupathur
„ N. S. Natarajan	„ Krishnagiri
„ R. Natesan	„ Harur
„ S. K. Karuppannan	„ Bhavani
„ L. Subbuswami	„ Kakathope
„ A. Bellie	„ Colgrain Estate
„ K. Venkataraman	„ Kanjikudikadam
„ M. Natarajan	„ Vattakaul
„ V. Mallayan	„ Harur
„ M. K. Vittoba	„ Mallakombai

Name	Appointed as Farm Manager State Seed Farm	
Sri. T. C. Narashimalu	Fieldman	Uppupet
„ R. Pandurangan	„	Kakuppam
„ V. N. Heridoss	„	Devadanam
„ K. G. Marimuthu Pillai	„	Kakathope
„ M. Palaniswami	„	Kolandalore
„ M. S. Gopalekrishnan	„	Meelathur
Agricultural Demonstrator.		
Sri. N. Srinivasan	Fieldman	Gummidipoondi
„ V. Narayanaswami	„	Thiagadrugam
„ S. Kandaswamy	„	Gandavankottai
„ P. A. Retnam	„	Jayakondan
„ M. Koviadaswamy	„	Sithalai
„ R. Soosamanickam	„	Nilakottai
„ A. Chidambaram	„	Salem
„ T. V. Subramaniam	„	Uthangarai
„ A. K. Kanniah Naidu	„	Spl. Ad. (Cotton), Coimbatore
„ K. Meenakshisundaram	„	Pollaohi
„ P. Arumugam	„	Arkonam
„ Y. P. Annusami	„	Tirupathur
Farm Manager		
Sri. T. N. Sithapathi	Fieldman	Bhavanisagar A. R. S.
„ C. N. Subrahmanyam	„	do. do.
„ N. Muthuswamy	„	Pallathur
Extension Officer in Agriculture		
Sri. Ahmed Malik	Fieldman	Musiri
„ Amaldoss	„	Lalgudi
„ V. Tirunavukarasu	„	Thottiam
„ Soundararajan	„	Andipatti
„ Jacob Paramanandam	„	Sivakasi
„ Subbiah Thevar	„	Thiruvadanai
„ V. R. Ranga Rao	„	Nemagiripettai
„ S. Ayyaswamy	„	Shenmanarkoil
„ A. N. Sivasubramaniam	„	Kallal
„ A. Michael	„	Kallayarkoil
„ R. Rangaswami	„	Asst. Coconut Nursery Pattukottai
„ G. Lakshminarasimhan	„	Fruit Asst. Thimmapuram
„ C. Sethumadhava Menon	„	Asst. G. E. 'S Section, Coimbatore
„ M. Saravanabhavanandam	„	do. Paddy Section do.
„ E. Balagangadharan	„	do. Central Exhibition do.
„ K. K. Palaniappan	„	do. Cotton Section do.
„ S. S. Anandanarayanan	„	do. do. do.
„ S. T. Ramaswamy	„	do. G. E. 'S Section do.
„ K. Rajamani	„	P. P. A. Mayuram
„ R. Venkatanarasimhan	„	do. Kumbakonam
„ V. Ganesan	„	do. Mayuram
„ T. M. Kanakasabai	„	Soil Cons. Asst. Kinathukadavu
„ S. Amirthalingam	„	Cotton Certification Inspector, Rajapalayam
„ Kalla Ayyar	„	Oilseed Dev. Asst. Madurai.

Postings and Transfers during the Month of
January — February, 1958.

Name and Designation	Posted to or Transferred
Sri B. Sambandam, Asst. Cotton Specialist, Tiruppur	Posted as Asst. Cotton Specialist, Tiruppur Vice Sri P. N. Krishnaswami Rao, Granted leave.
„ U. Achutha Warier, Seed Dev. Officer, Coimbatore	Retired from Service from 27-1-1958.
„ B. G. Narayanan Menon, Curator, Govt. Botanical Gardens, Ooty (on leave)	On expiry of the leave reposted as Curator, Govt. Botanic Gardens, Ooty.
„ K. R. Nagaraja Rao, Asst. Entomologist, (Insect Collection) Coimbatore	To be Asst. Entomologist, Coimbatore.
„ E. V. Abraham, Asst. in Entomology, Coimbatore	Is appointed and to act Asst. Entomolo- gist, Coimbatore.
„ K. C. Chandy, Asst. Seed Dev. Officer, Madras	„ „ „ Granted leave from the date of relief.
„ N. G. Narayanan, Cotton Certification Officer, Rajapalayam	„ „ „
„ K. C. Thomas, Dist. Agric. Officer, (on leave)	Posted as Spl. DAO., (Crop sampling) Madurai.
„ P. Chandrasekharan, Asst. Cytogenetics Section, Coimbatore	Appointed as Cytogeneticist, Coimbatore.
„ T. V. Swaminathan, Senior Superintendent, D. A's. Office, Madras	Is appointed temporarily as Administra- tive Officer, Central Office A. C. R. I., Coimbatore.
„ C. S. Krishnan, Asst. Cotton Specialist, Coimbatore	Asst. Cotton Specialist, (Khadi Scheme) Tiruppur.
„ S. Kamalanathan, Asst. Cotton Specialist, (Khadi Scheme) Tiruppur	A. C. S., Coimbatore.
„ K. P. Kuppuswami, Curator, Govt. Botanic Gardens, Ooty	On reversion granted leave.
„ R. Anandapadmanabha Pillai, Supdt., Central Farm, Coimbatore	Is appointed to act temporarily as Deputy Director of Agriculture and posted as Oilseeds Dev. Officer, Coimbatore.



Review of Market Conditions of Commercial Crops in the Notified Areas for the Month of January 1958.

Cotton: (In this Section Lint: Candy of 784 lbs.
Kapas: Pothi of 280 lbs.)

Section: There were no rains during the month under report. The standing crop is reported to be satisfactory.

Tirupur: The market started with an opening balance of 1,229 candies of Cambodia and 66 candies of Karunganni lint. The total arrivals into the market at Tirupur during the month were 1,582 candies of Cambodia and 75 candies of Karunganni lint which included 281 candies of Cambodia locally ginned. The total despatches from Tirupur accounted for 1,046 candies of Cambodia and 45 candies of Karunganni lint sent to Madras, Salem, South Arcot, North Arcot in Madras State and Ahmedabad, Tiruchur and to places in Kerala and Andhra States. There was a closing stock of 1,761 candies of Cambodia and 96 candies of Karunganni lint.

Kapas: The kapas market opened with a stock of 2,066 pothis of Cambodia and 33 pothis of Karunganni kapas. The total arrivals into Tirupur during the month were 5,713 pothis of Cambodia and 105 pothis of Karunganni. The disposals during the month were 5,917 pothis of Cambodia and 106 pothis of Karunganni kapas in the market area of Tirupur. At the closing of the month there was a closing stock of 1,568 pothis of Cambodia kapas.

Prices: Good demand continued for all varieties of cotton. New crop cotton of Coimbatore and Pollachi areas has started moving into the market. Salem crop cotton is also continued to be received. The price ranges were as follows:

Market Committees Chronicle

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Lint per Candy of 784 lbs.

Cambodia superior quality	Rs. 900 to 981
Cambodia average quality	Rs. 800 to 875
Karunganni superior quality	Rs. 860/-

Kapas per pothi of 280 lbs.

Cambodia superior quality	Rs. 125 to 134
Cambodia average quality	Rs. 100 to 120
Karunganni superior quality	Rs. 104/-

Ramanathapuram District: Rainfall during the month was practically negligible. The standing crop of Karunganni is generally fair.

The following were the arrivals and disposals of kapas and lint in the important markets of the district during the month.

Kapas: In pothis of 280 lbs. practically Nil during the month.

Lint: In candy of 784 lbs.

Opening stock	Receipt	Total	Disposal	Closing stock
1390	20	1410	780	630

The following were the prices of cotton kapas, lint and seeds in the district during the month.

Kapas: pothi of 280 lbs.

Practically Nil during the month.

Lint: candy of 784 lbs.

Karunganni lint	... N. A.
Tinny Karunganni	... 800 to 826
Tinny	... 700 to 772
Certified Uganda	... 1061 to 1115
Seed Farms MU. 2.	... 1130
Uncertified	... 1001 to 1061

Seeds:

Karunganni seed 82 2/7 lb.	... 12 to 12.53
Tinny seeds	... 12.33 to 12.83
Uganda seeds	... 10.66 to 11.33

South Arcot District: The season being slack, arrivals were meagre. Villupuram market had an arrival of 153 pothis which were sold at an average price of Rs. 91.10 per pothi of 280 lb. Despatches to Tirupur from Villupuram Market amounted to 163 pothis. The trade had a stock of 53 pothis at the end of the month.

Groundnut: South Arcot District: The market opened with a balance of 3,589 tons. The arrivals of kernels amounted to 4,706 tons from the district itself and 2,196 tons from North Arcot, Tiruchirapalli districts etc. A quantity of 3,501 tons was consumed by oil mills and 360 tons was consumed by country chekkus in the district for extraction of oil. A quantity of 2,970 tons were despatched to Madras, Tiruchirapalli, North Arcot and Coimbatore districts and 18 tons to Pondicherry State. Wastages amounted to 244 tons and there was a closing balance of 3,398 tons at the end of the month.

Demand for oil being slack, prices of oil and kernels were on the decline. The average prices of kernels in the several markets ranged from Rs. 123.24 to 143.09 per candy of 531 lbs. according to quality.

North Arcot District: The stock position of groundnut was as follows in the district during the month.

Stock position:

	O. B.	Arrivals.	Disposals.	Closing balance
Groundnut kernels ...	698	1225	1455	468
Groundnut pods ...	1467	712	1063	1116

The price of groundnut kernel and oil etc., were as follows:

Groundnut kernels (Cdy of 531 lb.)	Rs. 100 to 152
Groundnut oil (per Cdy of 500 lb.)	Rs. 280 to 300
Groundnut pods (bag of 80 lb.)	Rs. 8 to 15
Oil cake (per standard maund.)	Rs. 7.81 to 9.00

Ramanathapuram District: The winter crop groundnut season is nearing completion. About 85% of the local crop have already been marketed and a few is left with the villages. Hence arrivals of pods gradually declined during the month.

The following were the arrivals, disposals and closing stock of groundnut pods and kernels during the month at Virudhunagar.

	Opening balance	Receipt	Total	Disposal	Closing stock.
Groundnut pods in tons ...	600	1550	2150	1560	650
Groundnut kernels in Cdy. 2045 of 531 lb. ...	2045	1560	3605	1300	2305

The following were the prices for kernels, pods, and oils during the month.

Groundnut pods (per md. of 82 2/7 lb.)	Rs. 12.50 to 16.
Groundnut kernels (per Cdy of 531 lb.)	Rs. 140 to 154.
do katcha.	Rs. 110 to 140.
Groundnut oil 35 lb.	Rs. 20 to 20.5
Groundnut oil cake 82 2/7 lb.	Rs. 8.33 to 10.

Gingelly: South Arcot District: Arrivals during the month decreased and totalled 626 bags from district produce, 258 bags from Tiruchirapalli district. Despatches to neighbouring districts amounted to 292 bags and the consumption by chekkus to 700 bags. A stock of 333 bags was left with the trade at the end of the month.

Prices were steady at an average of Rs. 59.95 per bag of 168 lbs. at Vridhachalam market.

Tobacco: Coimbatore District: The condition of the standing crop is reported to be satisfactory during the month under report. Harvesting of chewing tobacco is in progress in scattered areas of the Pollachi taluk and harvesting of early plantings of cheroot tobacco has commenced in Bhavani taluk. The tobacco market improved on support from trade buying consequent on abolition of Sales Tax in Kerala State and on expectation of a smaller crop this season.

The price ranges as follows: (per candy of 500 lb.)

Variety	I Grade	II Grade	III Grade
	Rs.	Rs.	Rs.
<i>Chewing Tobacco: Suncured:</i>			
Meenampalayam	230—290	180—220	100—170
Other Varieties	200—260	100—190	50—100

Cheroot varieties:

(Grown in Erode & Bhavani taluks)	200—250	130—180	70—110
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Pit cured:

Chewing tobacco (grown in Palladam & Sular Areas)	200—250	100—200	50—100
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Cardamom: There was fairly good rainfall during the last week of the month and the condition of the crop was reported to be good.

The arrivals of cardamom in different assembling centres like Bodinaickanoor, Pattiveeranpatti, Thevaram, Kombai, Uthamapalayam, Cumbum, Gudalore etc., in Mathurai district were declining due to picking season for Malabar type coming to a close. Picking and curing of fruits for Malabar type came almost to a close in most of the estates by the end of the month.

The market was firm and steady at the beginning of the month. The range of price fluctuation was not wide and it was only 20 to 30 nP. per lb. for all grades depending upon demand in Bombay and other North Indian cities and demand from importers.

The minimum and maximum prices that prevailed for different trade qualities during January, 1958 are given below:

Name of Trade Quality:	Prices in Rs. per lb.	
	Minimum. Rs.	Maximum. Rs.
1. Sundried:		
Superior	... 9.05	10.04
Inferior	... 7.52	8.93
2. Store Green:		
Green	... 9.00	10.15
Extra	... 10.12	11.06
Extra bold	... 11.00	12.46
3. Shipment	... 7.73	9.00
4. Splits	... 5.50	8.82
5. Lights	... 5.00	7.95
6. Rice	... 10.99	11.52
Inferior	... 5.00	9.06

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Review of Administrative activities of Market Committees during January, 1958.

General: The Market Committees of South Arcot Market Committee, North Arcot Market Committee and Coimbatore Market Committee continued to function briskly during the month. The Market Committees of Ramanathapuram and Tirunelveli districts could not be worked due to the cases pending with the Supreme Court.

Enforcement: The progress of licencing by the Market Committees during the month are as follows:

Name of the Market Committee	Section 5 (1)		Section 5 (3)		Weighmen	
	A	B	A	B	A	B
South Arcot Market Committee	640	640	425	425	399	399
North Arcot Market Committee	252	252	236	236	134	134
Coimbatore Market Committee	167	167	117	117	117	117

A: Issued during the month.

B: Up to the end of the month from January 1958.

Meetings: *Coimbatore Market Committee:* There were two meetings on 10—1—58 at Gobichettipalayam and 25—1—58 at Coimbatore. At the meeting of the following important subjects were discussed and passed.

- Amendment to bylaw 24 (3) for conducting secret tender system of the sales in the regulated markets.
- Necessary amendments were incorporated to regulate turmeric trade.
- Approved the place selected for opening spot market at Coimbatore.

South Arcot Market Committee: No meeting was held during the month.

North Arcot Market Committee: No meeting was held during the month.

Quality analysis: No analysis was done during the month.



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