

A Soil Survey for Fruit Development in the Ceded Districts

By

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Introduction : The importance of the fruit industry and its great value to the health and economy of the country have received adequate attention only in recent years and with the aid of grants from the Indian Council of Agricultural Research several fruit research stations have been established all over the country. The climatic, soil and water conditions over several areas in this presidency are so favourable that considerable extension of the area under fruits is possible. The per capita consumption of fruits is very low in this country. It is recognised that fruits, in addition to forming a wholesome article of diet, are good sources of vitamins and minerals, provide bulk and possess laxative properties. The higher income per acre from land devoted to fruits must be an additional inducement for the extension of the area under fruits. Incomes of as much as Rs. 5,000/- per acre have been obtained in some of the cheeni growing areas in the Ceded Districts. A family can earn a living from a smaller area devoted to fruits than would be required were ordinary farm crops grown. The development of the fruit industry would thus have far-reaching consequences on the health and economy of the country.

Scope of the survey : The object of the survey was to assess, from an examination of the soil and subsoil layers, drainage and facilities for irrigation, the suitability of the following areas in the Ceded Districts for fruit cultivation :—

Area.	Taluq.	District.
1. Kottur-Ujjini	Kudligi	Bellary
2. Rudravaram	Sirvel	Kurnool
3. Giddalore-Dignvameta	Cumbum	Kurnool
4. Vontimitta Valley	Sidhout	Cuddapah
5. Kodur Firka	Rajampet	Cuddapah

Field work : Preliminary traverses of the areas were made before deciding on the location of the pits so that the soil samples taken would be representative of as large an area as possible. The profile pits were generally dug to 8 feet depth except in cases where either the water table or hard rock was met with earlier. The exposed layers of soil were then examined and samples representing each foot depth of

soil generally taken. Field notes were recorded regarding the nature of the soil at various depths, the drainage, facilities for irrigation, potentialities for sinking wells, the depth of the water table in summer and in the rainy season and the quality of the water. Samples of water from irrigation sources were taken for analysis. Samples of soils and water were also taken from existing orchards, if any, in the areas surveyed.

80 profile pits were dug and 426 samples of soil and 51 samples of water were taken and despatched to Coimbatore as shown below:—

Area	No. of profile pits	No. of soils samples	No. of water samples.
1. Kottur-Ujjini	15	61	6
2. Rudravaram-Sirvel	18	93	8
3. Giddalore-Diguvametta	14	76	11
4. Votimitta valley	15	71	12
5. Kodur Firka	16	109	12
6. Panyam	2	16	2
Total ...	80	426	51

Brief accounts of the salient features of the various areas are given below:—

1. Kottur-Ujjini: There is an attractive stretch of red-soil area on either side of the Kottur-Ujjini road. The red soils are mainly derived from granites with pegmatite veins. On the ridge lines it was not uncommon to find the surface strewn with quartz fragments as big as hen's eggs. Over the greater portion of the area the soils are of very poor depth (2-3 ft.). The surface soils are sandy to sandy loam in texture but the subsoils are heavier. The soils in the valley lines are deeper (5-7 ft.) and heavier and the colour reddish-brown. Near Ujjini shallow, heavy black soils are met with. Irrigation wells in the area are few; the water table is very low (over 60 ft.) and the water brackish. In view of the very low water table the cost of sinking wells is high, an irrigation well easily costing Rs. 2,000/- and there is no guarantee of the supply of sweet water. In the valley lines as at Kalapuram the water table is more favourable, being situated at 40-45 ft. and the quality of the water fairly good. These somewhat favourable conditions are confined to small and very restricted areas and over the major portion of the area, water supply is the biggest problem, no other sources of irrigation being available. It is no

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wonder, than, that orchards are not to be seen anywhere in the area. The gently rolling nature of the country and the topography are favourable to drainage. Considerable soil erosion is in evidence. In common with the western taluqs of the Bellary District, the locality receives higher rainfall than the remaining portions, the average annual rainfall being 25" mostly favoured by the S. W. monsoon (June to September). As regards transport facilities Kottur is well connected by road and rail with Hospet and Bellary. But the Kottur-Ujjini road is very bad and requires considerable improvement.

Rudravaram—Sirvel area: Rudravaram is situated at the foot of the Nallamalais and is about 10 miles from Allagadda, the taluq headquarters and 9 miles from Sirvel. The outstanding features of the Rudravaram—Sirvel area high water-table and good water. Sirvel and the surrounding villages have large areas under fruits and are well known as an important fruit-producing centre. In view of the considerably higher returns per acre from land devoted to cheeni culture there has been considerable extension of the area under fruits in recent years in Sirvel. In Rudravaram just the beginnings have been made.

The soils of the area are mostly derived from Cuddapah formations. The surface soils are generally brown in colour and loamy in texture and the subsoils are yellowish-brown and heavier in texture with very often high proportions of rounded ferruginous gravel in the deeper layers. In and around Sirvel the soils are comparatively shallow, rocks of the Cuddapah formations being met with at the third or fourth foot. In spite of the comparatively shallow soils and high water table (reaching to within 4-5 ft. in the rainy season) which are far from ideal conditions from the point of view of commercial fruit culture, some flourishing orchards are seen in the area and net profits of as much as Rs. 5000/- per acre have in some instances been obtained from Cheeni gardens. In view of the high water table the gardens will naturally be characterised by a short life. All the cheeni gardens in the area are comparatively young and it remains to be seen how the high water table will affect the life of the fruit trees. The high water table is also believed to lead to the fruits being insipid and the keeping quality poor. In spite of these adverse factors, there has been considerable extension of the area under fruits due chiefly to the considerably higher returns from land devoted to fruits. In the Rudravaram area sufficiently deep soils for profitable fruit growing are met with. There are stretches of red soils, sandy loam to loamy in

Kodur : The average annual rainfall of this area is 38", about one third of this being received in the S. W. monsoon period and the remaining two-thirds in the N. E. monsoon period. Kodur is well known as an important fruit-producing centre and famous for its Sathgudi oranges, limes and mangoes. There are about 7,000 acres of cheeni gardens and 10,000 acres of mango gardens in Rajampt taluq and the contribution of Kodur firka to the area under fruits in the taluq is quite considerable. The outstanding feature of the area is the occurrence of very deep soils (more than 8ft.) over the greater portion of the firka. The soils are mainly derived from quartzites and are in general red to reddish-brown in colour and loamy in texture right down to 8 ft., thus permitting good root development. Being derived from quartzites the soils are comparatively poor soils, lacking in the essential plants nutrients. Their success for fruit growing must be attributed to the good depth and favourable physical properties. The water table is quite favourable, being situated at 20-30 ft. and the quality of the water good. Wells form the main source of water-supply for the areas under fruits. The area surveyed includes the following villages : — (1) Pagadalapalli, (2) Rachapalli, (3) Balireddipalli, (4) Satram, (5) Reddivaripalli, (6) Kichchamma Agraharam, (7) Chiyyavaram, (8) Kapupalli, (9) Anantarajupeta, (10) Mangampet, (11) Settigunta, (12) Janakipuram, (13) Maisurivaripalli. In Settigunta there is a compact block of 600 acres of waste land and the utilization of this area for a land colonisation scheme was purposed some time back. It is understood that trial borings by the Industries Department to tap sub-soil water did not meet with success and the scheme has been given up. Kodur is well connected by rail with good marketing centres for fruits but the road communications in the area require considerable improvement.

Panyam : With a view to getting an idea of the conditions obtaining in an ideal orchard and comparing the analytical data with those obtained for the soils collected in the course of the survey, soil samples were drawn from the famous Jaganmohini and Manoranjini gardens of Messrs P. V. Madhava Rao and brothers of Panyam, nurserymen and horticulturists of repute. One pit was put in the mango garden area, which consists of sandy soil and the other in the cheeni garden area which consists of very rich black loamy soil. The soils in both areas are of considerable depth, possess ample natural reserves of calcim carbonate and are well-drained soils, the water table being situated at 40 ft. There are practically no wells in the area and the orchards and wetlands are supplied with water by a big tank fed by

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a perennial spring from the Erramalai hills and the water is excellent in quality. Water is not available for irrigation throughout the year.

An interesting sample of incrustation that forms on the black soils round about the tank during the summer and which is gathered and applied as manure to cheeni trees which are said to benefit considerably from the application, was collected and analysed. The incrustation has been found to contain 0.65% of nitrogen (practically the whole of it in the form of nitrates), 0.59% of P_2O_5 , 3.1% of lime and 1.34% of potash. The water-soluble salts amount to 5.6%, nitrates and chlorides, accounting for the bulk of the salts.

Before proceeding to discuss the results of laboratory examination of the soils it would be useful to review briefly the literature on fruit soils.

Chief among the characteristics desirable in orchard soils are good depth and texture providing for extensive root development and the maintenance of continuously favourable moisture conditions in the soil, freedom from hardpan or impervious strata and good aeration and drainage and freedom from soil alkali and salts.

Texture: The texture of the soil is an important consideration as it determines largely the drainage. The soil must have sufficient body to retain water but it must at the same time drain off the surplus. Sandy soils which are apt to dry out too quickly and lack the essential plant food elements and heavy soils are in general, not suitable. The ideal fruit soil is a light loam of good depth, varying but slightly in the first four feet and well-drained (7).

Although the texture is an important consideration it is impossible to attempt a definition of the soil requirements of fruit trees in terms of mechanical analysis. Experience shows that most fruit trees are not particular as to soil type and are found to thrive on a wide variety of soils, ranging in texture from sands to heavy loams. It is interesting to note that the soils of the Florida coast, famous for pineapples contain 98% of sand. Although the ideal texture is a loam, sandy loams or even sands and heavy soils may be suitable for fruits where favourable moisture conditions are present and where the topography favours drainage (2).

Depth of soil: Most fruit trees have a comparatively deep root system. The extent and depth of the root system has an important bearing on the productiveness and length of life of the fruit

trees. The deeper the soil and the more suitable the texture, the greater the development of root system. The minimum depth of soil for most fruit trees is considered to be 5 ft. There are many instances known in which soils are favourable for fruits simply because of the extensive root development they allow rather than fertility or moisture-holding capacity (6).

Drainage: Fruit trees are very sensitive to poor drainage and cannot stand 'wet feet'. Thorough aeration and drainage are, therefore, very important. The soil must be free from hardpan or impervious strata and no ground water must be present in the surface four feet except shortly after heavy rain. (6). It was found by Oskamp that in New York fruit growing area, the limiting factor was drainage rather than soil fertility (7). The colour of the soil gives an excellent indication as to its suitability or otherwise for fruits. In the case of well-drained and aerated soils the colour is more or less uniform. If the drainage is defective characteristic mottlings are noticed in the deeper layers of soil (7, 8).

Moisture conditions in soil: Fruit trees require continuously favourable moisture conditions throughout the growing season. The moisture content of the soil, its amount and availability throughout the growing season has been found to be of greater importance than any other factor (10).

Importance of physical conditions: Broadly speaking the physical condition of the soil is more important for fruit production than its content of the essential plant food elements. The most favourable soils are not necessarily the most fertile soils (2, 10). A survey of orchard soils in Quebec has shown that a very productive soil for farm crops may not be quite suitable for fruits and conversely a comparatively poor soil in good physical condition may give excellent results with fruits when properly fertilized and managed. If the physical condition of the soil is favourable, a good growth of fruit trees is often secured out of all proportion to what would be obtained from farm crops on the same land (6). Differences in individual tree growth and productiveness are commonly noticed in orchards and these differences have frequently been traced to variations in such factors as texture, drainage etc. rather than plant food content (2). Wallace from an analysis of the soil and pomological data obtained for West Midland soils in England comes to the conclusion that striking correlations exist between soil conditions and tree growth and that the soil conditions associated with success or failure in fruit trees are

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mainly physical in character (13). Thus special emphasis is laid on the physical characteristics of the soil — depth, texture, drainage and favourable moisture conditions.

Water soluble salts: Most fruit trees are injuriously affected by more than 0.2% of salts in the soil. According to Coit less than 0.1% is considered safe. Saline irrigation waters are also detrimental.

Fruit soils considered from the chemical standpoint: Fruit trees require for their growth and development large quantities of nitrogen and potash and only small amounts of phosphates (4, 12).

Nitrogen: In considering the manurial requirements of fruit trees nitrogen is easily the most important and perhaps the only element needed for the most orchard areas. Fertilizer experiments carried out in U. S. A. and Europe have demonstrated that nitrogen in a readily available form is the only element of plant food that is uniformly a factor in the favourable responses when such are secured. Very high nitrogen content of the soil results in rank vegetative growth and decreased yields. Irrespective of the amount of nitrogen present, fruit trees have been found to thrive only when an adequate supply of organic matter is maintained in the soil (4).

Potash: The potash requirements of fruit trees are undoubtedly high and the importance of an adequate supply of potash for the nutrition of fruit trees is recognised. Most orchard soils, however, contain sufficient amounts of this element to make the application of it unnecessary and the use of potash is confined to more or less restricted areas where the deficiency is extreme. Nitrogenous manuring is ineffective or even harmful in the absence of adequate amounts of potash (11).

Phosphorus: The phosphorus requirements of fruit trees are quite low and on account of their deep-rooting habit fruit trees are able to obtain their requirements from the natural supplies in the soil. Fertilizer experiments have demonstrated that fruit trees are not directly benefited by the application of phosphates unless the deficiency is extreme (3).

Chemical analysis of soil: The chemical composition of soils as determined by the present methods of analysis does not afford an accurate guide as to their suitability for fruit growing. Soils that are unproductive from the point of view of ordinary farm crops are often found productive for fruits. Wallace (13) has shown that no correlation could be traced between the contents of plant food elements

in the soils and tree growth. Stewart has analysed the response to fertilizer applications of trees growing in soils of varying productivity and comes to the conclusion that the correlation between the fertility status of the soil as determined by soil analysis and the response to fertilizers is exceedingly slight or absent. In fact the least response to fertilization was found in the soil analysing the poorest of all and some of the largest responses were found in the case of the chemically richest soils. Thus the relationship between the chemical composition of the soils and their suitability for fruit-growing is very little understood (2)

Soil reaction and lime content: Most fruit trees are tolerant of a wide range of soil reaction and are not so sensitive as are many of the ordinary field crops. Surface soils varying in pH from 4.5 to 7.5 have been used and no definite correlation between good or bad growth and pH could be traced within this range (10). The bulk of experimental evidence points to the fact that fruit trees rarely respond to applications of lime. Wallace in his survey of the fruit soils of West Midlands found excellent tree growth both on soils containing natural reserves of calcium carbonate and on others showing lime requirements (13). Lime was considered essential for stone formation in stone fruits and was widely used for all kinds of fruit trees in the past. In view of the fact that fruit trees rarely respond to lime and excellent tree growth occurs even on somewhat acid soils, provided adequate amounts of potash are present regular or heavy applications of lime are considered unnecessary. (11).

Citrus, however, is considered to be calcicolous in nature and its lime requirements are high. Adequate potash may compensate for lime deficiency (9). In Florida the best quality citrus orchards are invariably found on soils with good reserves of calcium carbonate. In California the citrus soils all tend towards alkalinity. The best quality citrus in U. S. A. is grown on arid soils in Arizona. In Italy and Spain the citrus soils are of the *terra-rosa* type rich in lime and often calcareous. In Nagpur oranges are grown on rather heavy black soils rich in lime and underlaid with '*murrum*' (gravelly subsoil) which provides good drainage. The soils of the most important citrus growing areas are thus well supplied with lime and this is supposed to contribute to the success of the orchard (4).

Analysis of soils and waters: In view of the requirements of fruit soils stated above the laboratory examination of the soil samples has been confined to the following: — (1) content of water-soluble-salts by the electrical conductivity method for all samples,

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- (2) Natural reserves of calcium carbonate (qualitative) for all samples, (3) Mechanical analysis by the International method for roughly half the number of samples, (4) Loss on ignition, nitrogen, lime, total potash and phosphoric acid, available potash and phosphoric acid and pH in 35 selected surface samples.

The location of the profile pits in the various areas is shown in maps 1 — 5. * The field observations and profile characteristics, the percentage of stones and gravel, the content of water-soluble salts and information regarding the natural reserves of calcium carbonate in the soils are given in Appendix I. The results of mechanical analysis are contained in Appendix II. These results relate to the 'fine earth' obtained after the removal of stones and gravel (particles greater than 2. mm. diameter) in the preparation of the soil sample for analysis. As will be seen from Appendix I, stones and gravel often form large proportions of the soil and to obtain a good picture of the physical conditions in the soil, the results of mechanical analysis must be read in conjunction with the percentage of stones in the sample. The results of chemical analysis and the pH values of the selected surface samples are set out in appendix III, while Appendix IV gives the results of analysis of the water samples.

The soils of the areas surveyed are, in general, characterised by an extremely low content of water-soluble salts. Exceptions are the black soil area near Ujjini (Kottur-Ujjini area), the area near Vakkileru in Rudravaram, the area round about Kanchipalli village (Giddalore-Diguvametta) which is definitely alkaline and sticky, and Balireddipallo in Kodur firka.

As regards lime status the soils from the Vontimitta and Giddalore areas are well provided with lime. The soils from Rudravaram and Kottur areas contain fair amounts while the Kodur soils are generally extremely poor in lime. Data regarding the number of soils tested and the number which showed effervescence on the addition of dilute acids are given below :

Area	No. of soils examined.	No. of soils showing effervescence.	No. of soils showing no effervescence
1. Kottur-Ujjini	60	22	38
2. Rudravaram	93	55	38
3. Giddalore-Diguvamitta	77	63	14
4. Vontimitta	70	53	17
5. Kodur	109	10	99

* The maps and appendices will be published in the next issue of the Journal.

The total lime content of some selected surface samples from the various areas surveyed is given in Appendix III.

As regards the content of the essential plant food elements, Vontimitta and Giddalore areas are very rich in potash. Except perhaps, the soils of Vontimitta, the soil samples examined have an extremely low content of phosphoric acid, both total and available. The soil from the cheeni garden area, Panyam is a very rich soil, containing as it does 0.12% of nitrogen, 0.55% of phosphoric acid, 0.98% of potash and 3.7% of lime.

The pH values of the soils generally range between 8 and 9, typical red soils showing lower values.

As regards the water samples the well waters from Rudravaram, Vontimitta and Kodur are very good while those from Kottur and Giddalore areas are of somewhat high salt content and of doubtful quality for the irrigation of fruit trees. It will be seen that some water samples from irrigation sources which will be of no use whatever as far as the areas surveyed are concerned have been collected. From Giddalore some water samples have been taken from bore wells which provide drinking water. Taking into account only the wells used for irrigation purposes and in the light of the information gathered during the survey regarding the quality of the water, the above conclusion seems to be justified.

Suitability of the sites for fruit cultivation: In the light of the information available with regard to soil and water conditions in the five sites surveyed, their suitability for fruit cultivation is discussed below:—

1. *Kottur-Ujjini.* In view of the fact that the soils over the greater portion of this area are comparatively shallow, the water table very low and the water brackish, this area is not considered suitable for fruits.

2. *Rudravaram.* The favourable features of this area with regard to the water table and good quality of water have already been referred to. In the stretches of red soil area extending along the foot of the hills near Rudravaram, the water table is neither too high nor too low and the conditions are quite favourable. Over the remaining portions of the area sufficiently deep soils for profitable fruit cultivation are met with. The water table is, however, somewhat high and this may adversely affect the life of the fruit

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trees. Reference has already been made to the fact that a great impediment to the development of the area is the lack of adequate road communications.

Diguvametta-Giddalore. Except near Diguvametta where the soils are shallow, the soil conditions over the remaining portions of the area are favourable. The greatest drawback to the development of the area is lack of irrigation facilities, the water table being very low. The civic Association of Giddalore have sent up a memorial to the Collector of Kurnool, praying for irrigation facilities by improving Vemulakunta and by damming the Sagileru stream at Kattiralabanda. These improvements, if effected, will benefit only an area of about 300 acres and any large-scale development of the area will necessarily have to be dependent on the tapping of subsoil water supplies. About half-a-mile northwest of the level crossing between Diguvametta and Giddalore two new wells have been sunk recently. The water table was found to be 20-25 ft. in the rainy season and the quality of the water fairly good. The supply of water from the wells is reported, however to be poor, being just enough for 1-2 acres under vegetables and chillies. It is possible that if tube wells are sunk adequate supplies and better quality of water may be available. The development of the area is intimately bound up with the availability of adequate and good subsoil water and for deciding this question trial borings will be necessary. As things stand at present, any large-scale and economic development of the area for fruits does not appear to be feasible.

4. *Vontimitta.* Mention as already been made of the fact that there is considerable erosion in this area and that the stretches of good soil are nowhere extensive. There is therefore, very little prospect of any large-scale extension of the area under fruits. There are, however, small but quite appreciable areas of suitable soil in all the villages surveyed, especially in Nadimpalli, Cherlopalli, Kottapalli and Mantapampalli which can be brought under fruits. The area is characterized by a high water table and very good water.

5. *Kodur.* The most characteristic feature of this area is the occurrence of deep soils (more than 8 ft.) over the greater portion of the firka. The water-table is neither too high nor too low and the quality of water good. The drainage is also good. The conditions are, therefore, very favourable for considerable extension of the area under fruits. The waste land near Settigunta is not considered suitable as the soils are of poor depth and subsoil water very low.

Summary:

1. The salient features of the five sites with regard to soil, water and other conditions are given.
2. The literature on the subject of fruit soils has been briefly reviewed.
3. The results of the laboratory examination of the soil and water samples are discussed.
4. In the light of the above information the suitability of the various areas for fruit growing is discussed.

In conclusion the authors wish to accord their thanks to Sri P. D. Karunakar M. sc (Rutgers), A. R. I. C., the Government Agricultural Chemist for the interest he took in the work and for helpful suggestions.

Literature Cited

1. Coit, J. E. (1915) - Citrus Fruits.
2. Gardner, V. R. Bradford F. O., & H. D., H. D. Hooker (1939) - Fundamentals of fruit production, McGraw-Hill Book Co.
3. Gourley, J. H., and Snock (1933) - A survey of Ohio orchard soils relative to Phosphorus distribution and acidity. Bull. 517. Ohio Agr. Exp. Station.
4. Hayes W. B. (1946) - Fruit growing in India. Punjab Fr. Journ. 10, 29.
5. Jogi Raju, G. (1941) - Fruit Culture. With special reference to East Godavari District.
6. Mac Millan, H. E., Modern fruit production.
7. Oskamp, J. (1935) - Soils in relation to fruit growing in New York. Bull. No. 609, Cornell Univ. Agri. Exp. Station.
8. Sweet, A. T. (1935) - Soils of Orleans county - New York in relation to orchard planting. Bull. No. 637, Cornell Univ. Agri. Exp. Station.
9. Tropical Soils in relation to tropical crops. Imp. Bureau of Soil Science. Tech. Communication No. 34.
10. Veatch, J. O. et. al, (1934) - Utilization of land types for fruit production Berrien County; Bull. No. 257 - Agri. Exp. Station, Michigan.
11. Wallace T, (19) - Manuring of fruit crops - Ministry of Agri. & Fisheries, Bull. No. 107.
12. Wallace T, 1933 (1933) - Problems of fruit tree nutrition. Imp. Bureau of Fruit Production. Tech. Commn. No. 4

13. Wallace sandsto Bull.
14. Ward J. A sur Agri.

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13. Wallace T, (1931) - Fruit growing areas on the old red sandstone in the West Midlands — A survey of soils and fruits Bull. No. 15 — Ministry of Agri. & Fisheries,
14. Ward J. F, (1915) - West Cambridgeshire fruit-growing area — A survey of soils and fruits - Bull. No. 61. Ministry of Agri. & Fisheries.

ANNOUNCEMENT

The Ramasastrula-Munagala Prize, 1949

1. The prize will be awarded in July 1949.
2. The prize will be in the form of a Medal and will be awarded to the member of the Union who submits the best account of original research or enquiry, carried out by him on any agricultural science.
3. The subject matter shall not exceed in length twelve foolscap pages, type-written on one side.
4. Intending competitors should notify the Secretary of the Madras Agricultural Students' Union not later than the 1st June 1949 with a covering letter showing full name and address of the sender. The author's name should not be shown on the paper, but should be entered under a *nom-de-plume*.
5. Four type-written copies of the essay should be sent.
6. The name of the successful competitor will be announced and the prize awarded at the time of the Conference.
7. Paper or papers accepted will become the property of the Union and the Union reserves to itself the right of publishing all or any of the papers.
8. All reference in the paper to published books, reports or papers by other workers must be acknowledged.
9. Any further particulars may be obtained from the Secretary, the Madras Agricultural Students' Union, Lawley Road P. O., Coimbatore.

K. Meenakshisundaram,
Secretary.