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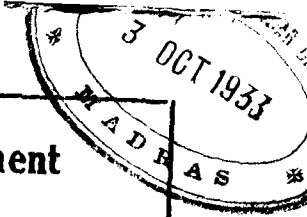
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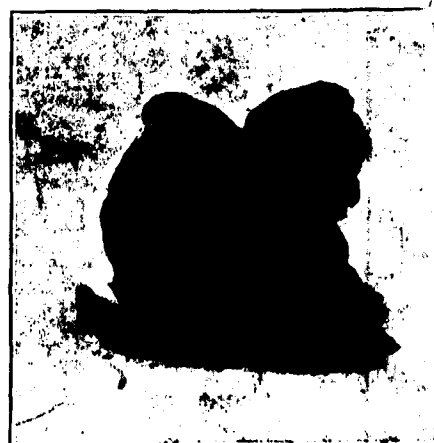
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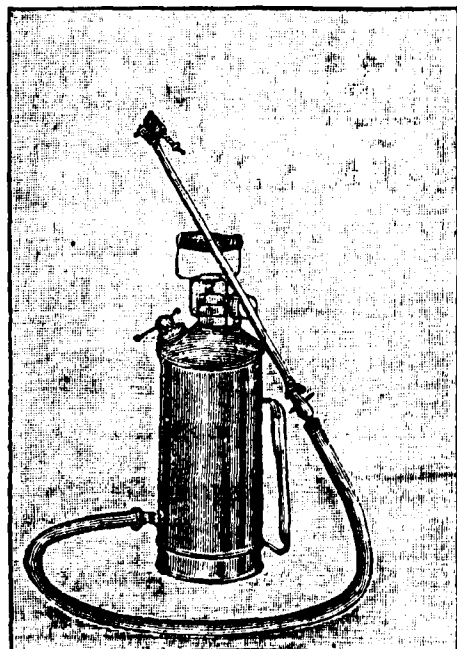
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ECONOMY OF THE FARMER

By K. UNNI KRISHNA MENON, Dip. Agri.,

Madras Agricultural Department.

The depression is felt everywhere. The average farmer generally falls an easy victim to it because he is improvident, ignorant, conservative and uneconomical in his dealings. He is unable to say what his cost of producing 1000 lbs. of paddy is. Without exactly knowing what it is, he is selling the produce to the highest bidder who offers a price per cartload, say, 1000 lbs. The purchaser fully realises the fact that his prices are always lower than the ordinary wholesale market rates and he is sure of a margin of profit in his business. On account of the quick and easy transport facilities, the Indian producer who is following the time-honoured crude and apparently cheap but on the whole costly ways of farming, has to compete with the up-to-date civilised farmer of the West who adopts the latest labour-saving appliances in his production with due regard to economy. The civilised farmer always stops producing any commodity when he finds that the trade is not prepared to pay him at least his cost price. The Indian farmer not knowing what his cost price is and following his time-honoured ways and pinning his faith to the same old crops, does not know whether he actually loses or gets a profit when he sells his produce at a given rate per unit.

The land-owner and producer in South India are always finding fault with the high transport charges by rail etc., while none of them considers seriously as to how far, one can improve the methods so as to reduce one's cost of production.

As regards paddy cultivation, ploughing charges are saved by at least 20% by the use of improved implements which are more efficient. Cost of seed is reduced by 25% as the reduction of the quantity is found possible when improved strains of paddy are grown. No outside manure need be purchased and the manuring charges can be maintained where it was or reduced to almost nothing, if the ryot improves his ways of collecting and conserving cattle manure. This will enable him to improve the quality and increase the quantity of manure. The increase in manure supply can be about 50% and it will easily outgrow the effect of any other improvement adopted by the farmer. Taking the more prominent items alone into consideration, the position is as below:—

The increase for the improved seed alone is 10% of the yield.

The increase of yield for the better manuring is not less than 50%.

It may be manuring over a larger area or more manure in the same area when the manuring is poor. Thus easily a careful ryot can increase his income by about 60% as shown above and reduce the expenditure by 10%.

The account will be roughly as below for a Tanjore ryot:—

	Present cost.	Reduced cost.
Cost of ploughing	5-0-0	4 0 0
Cost of manure	8-0-0	8 0 0
Cost of seed	2 0-0	1 8 0
Cost of planting and thinning	2 8-0	2 8-0
Cost of weeding	2 0-0	2-0 0
Total	20 0-0	18 0-0

Harvest is paid for in kind and hence not taken into account. Value of straw has been put as a set off against the assessment. The capital invested in the price of land is left out of consideration since the profits are due to it.

To calculate cost per unit of produce, cost of production may now be put down as Rs. 20 per acre for 1700 lbs. in Tanjore. That is equivalent to Rs. 11-12-3 for 1000 lbs. Cost of production as per improved methods is Rs. 18 per acre for 2720 lbs. yield per acre; it means Rs. 6-10-0 per 1000 lbs. Reducing it per *kalam* of 64 lbs. the cost of production comes Rs. 0-12-9 per *kalam* in the old way and Rs. 0-6-9 per *kalam* under the improved system.

Calculating the cost of production per unit must be the ordinary way that a ryot should adopt. The idea of calculating cost of cultivation per acre and yield in lbs. will give him no easy solution of the

problem as to whether he is a loser if he sells his produce in a particular market at a particular rate per unit.

By increasing the dose of manure or other treatments given at a heavy cost one ryot is able to increase his acre yield very considerably. Whether it is economical to do so is a question yet remaining unsolved. Calculating the cost of production per unit of the produce as above, will immediately warn the producer to remain within economic limits.

Therefore I suggest that calculations of the cost of production must not end with cost of production and yield per acre, but must proceed further and should be resolved into the cost of production per trade unit of any produce if the producer must know his own economic position at any stage. It is, I believe, the want of such a clear idea of the economic position that does not induce the average wet land farmer to go in for any crop other than paddy and adopt other improvements suggested by the Agricultural Department as rapidly as he should.

AGRICULTURAL METEOROLOGICAL PROBLEMS.

BY S. AUDINARAYANAN, M. A.

Agricultural meteorology deals with the influences of weather on vegetation, particularly on animal life, vegetable food and textile supplies of the nations of the world. That agriculture depends both on the climate and the periodical variations of weather is a well known fact. But the relations are very complicated and there is difficulty in separating the effects of the several factors. So much so, the progress made in applying the data in meteorology to the purposes of agriculture is not as much as might have been expected. The greatest obstacle to the progress is the great inaccuracy in the data expressing acreage and yield. The meteorologist engaged in the study of weather and crop relations is constantly confronted with the internal evidence of gross inaccuracies and lack of homogeneity in acreage and yield values.

A definite advance seems to have been made by the establishment of the Agricultural Meteorological Section under the Indian Meteorological Department. Their programme of work on the Research side includes the investigation of best methods and standardisation of those methods for the measurements of radiation, evaporation, soil temperature, and soil humidity so that these data may ultimately be systematically maintained in addition to those of air temperature, air humidity, rainfall, wind, sunshine etc. The Statistical Officer under the Imperial Council of Agricultural Research is travelling from province to province and is taking every effort to improve the defects in the collection of acreage and yield statistics. But the records at the several Agricultural Farms should be very accurate to be capable of yielding very good results.

At Lyallpur the cotton crop is being subjected to systematic experimentation and results of a far-reaching nature are anticipated. There the results of early and late waterings are being investigated. Also work is being carried out on the causes of the partial failures of the Punjab-American cottons. A very detailed study of the reactions of the plant to various environmental factors is being made which includes an examination of the moisture content of the soil correlated with the speed with which water passes up the stem of the plant, age of the leaves on different portions of the plant relative to their size, the carbohydrates in the various tissues of the plant body and the size and weight of bolls as affected by condition of growth. Such investigations must be started at the several Agricultural Farms and the Agricultural Department must make themselves responsible for meteorological studies relating to the influence of weather conditions on the growing crop.

Temperature, rainfall and sunshine are some of the very important factors that control climate. A broad climatic belt gives the nature of plants growing and there is also a narrow belt in which certain plants will grow. There is what is called optimum combinations of temperature, moisture and sunshine in which plants make their best growth and under which largest of yields will be obtained. Food is available to the roots of the plants only in a soluble form and it is carried up the plant and converted into vegetable tissue under the influence of solar energy which is expressed in heat units or calories. Different plants require unlike proportions of moisture, heat and sunshine. Many plants have a certain period during growth when there must be a well-defined combination of certain weather factors to produce large crop-yields. To determine these critical periods laboratory experiments must be performed side by side with field observations and the several factors must be correlated mathematically from past records. Anticipation of a type of weather known to be injurious or beneficial is of paramount advantage. This line of research requires attention.

High and low temperatures affect crops in various ways. But the principal ones are prevention of germination, checking of growth, killing all or part of the vegetative parts, injuring the blossoms or damaging the maturing parts. Also there are certain definite temperatures below which a plant will make no growth. This zero of vital temperature point is 43°F or 6°C. Kincer in U.S.A. has suggested that the zero of the spring-seeded crops should be the mean daily temperature about the average date of the beginning of planting. Such temperatures have been determined for the following cases.

Spring Wheat	37° to 40°
Oats	43°
Potatoes	45°
Corn	55°
Cotton	60° to 62°

Rainfall. The problem of dealing with the entire range of rainfall from the lowest to the highest limit between which any cultivation of crop is carried on, is not a very difficult one. Though empirical grouping of factors will solve the problem, yet more advanced mathematical methods could be used for calculating and fitting regression curves which is expected to be of wider applicability and more fertile of results.

Soil. Physical circumstances and properties of the soil are of much importance to agriculture. Schubler has tried to find the effect of the colour of the soil on the absorption of radiated heat and the influence of moisture in the soil. A wet soil takes a longer time to warm or cool than a dry one. In permeable soils, rain carries down with it the temperature of the air and the surface layers. The relative importance of the temperature of the air and the soil upon plant growth presents difficulties. The power of the soil to retain water is important in its effect on the temperature of the soil and supply of water to the plant. Necessity of water increases with the nature of the sub-soil, the closeness of the stand of plants, size of leaves, dryness of air, velocity of wind and temperature.

Complete hydrodynamic solution of the movement of sub-soil water has not so far been obtained, but on the assumption that the velocity is proportional to the first differential of the relative saturation of the sub-soil and that the ratio of the surface of all particles per unit volume to the saturation quantity of moisture is constant, an integrable equation results for a linear change of particle surface with depth.

Sunshine. No plant life is perfected and reaches its maturity except through the influence of short wave solar energy. Dark rays of heat can replace sunlight in the growth of vegetation but sunlight can partially replace heat. Sunlight-hour-degree is the measure and is the product of the mean daily heat required to grow and mature and the possible number of hours of sunshine from planting to harvesting.

An enquiry into the relationship between meteorology and a crop or crops in any given district only shows what variations of weather are most desirable in that locality. For, in England the correlation between winter rainfall and subsequent spring crops was found by Hooker to be negative, whereas S. M. Jacob found the same correlation for the Punjab as positive. These opposite conclusions do not prove that correlation is useless but that care is necessary in scrutinising the results. It can rarely establish the standard that the crop really prefers.

The results obtained by Jacob, Wallen and others are a sufficient warrant that the method of correlation is an exceedingly powerful

weapon in the hands of a crop fore-caster. It is abundantly clear that the weather plays a part invisible to the eye in the internal structure of the plant that can be measured by such statistics. These numerical records must be worked up and the results taken into serious consideration and used in conjunction with the facts such as are learned by actual observation in the fields, for fore-telling the future harvest. Far more investigation is yet required into the behaviour of different crops under different conditions of weather. Though the problems are well defined yet the progress recorded has been singularly small.

In India, there is a vast store-house of valuable statistics awaiting expert knowledge and intelligent shifting. The method of correlation is by no means the only way of attack but its vitality is shown by the remarkable series of co-efficients obtained by Hooker in 1922. J. W. Smith has found the weather index of factors injurious to plant growth and finds a correlation between that index and the yield. R. A. Fisher has another method but has put his finger in a weak spot in the method of correlation. As you correlate yield with finer and finer time intervals of rainfall, the co-efficient tends to zero. Applications of statistical methods has been well recognised and what is to be considered is how far the Indian Statistics are going to throw light on the connection of weather conditions and yield.

The main sources of yield data in India are (1) the record of crop experiments by the Government revenue staff during settlement operations and routine of district administrations which gives only a discontinuous series which would not repay closer examination. (2) the record of failed crops noted by village revenue agency which if cautiously handled would give some useful result. (3) agricultural department experimental station records which are the most reliable. and lastly, and (4) the season reports of the Directors of Agriculture.

Jacob is of opinion that though fairly favourable as the conditions in India are for the study agricultural meteorology, yet for the solutions of the problems of agronomic meteorology—which concerns with the direct effect of rainfall, temperature, sunshine and winds in inducing the cultivator to bring varying amounts of unirrigated lands under the plough or of restricting or increasing the use of artificial sources of irrigation—the data provided in North India are unsurpassed in the whole world for the space and time they cover, their accuracy and continuity. The statistician who does not become the slave either of his statistical material or of his mathematical methods can obtain a clue to the variations of crop areas with variations of climate and weather. Though not well served in the side of yield statistics he will have an opportunity of helping to solve some of the world problems of agricultural meteorology.

The several methods of agricultural meteorological research are (1) Laboratory studies with plants, animals under completely

controlled conditions, of the effect of different kinds of temperature, humidity, light etc. in conjunction with different soils and different kinds of nutrition. (2) Pot culture studies in which factors other than the weather are controlled and statistical methods are used to ascertain, the effect of the different weather factors. (3) Field studies in which measurements of crop growth and yield and of the intensity of attack of diseases and pests on the one hand and meteorological factors on the other are carried out side by side. Analogous studies on animals are carried out by observations of the healthy fecundity etc. of herds and flocks in conjunction with meteorological records, and (4) Statistical studies in which records of crop yields and weather over a long series of year are correlated.

Insect pests and plant diseases. Value of forecasts of seasonal appearance of insect pests and plant diseases and their mass outbreaks, and research on the relation between meteorological factors and insect activities and plant diseases, are problems that have immediate bearing on the subject.

Investigations should be carried out on the following lines. (1) Application of climograph method to studies in distribution, seasonal cycle of development and periodic fluctuation in the number of insects. (2) Effect of atmospheric motion on the distribution of insects. (3) The insect fauna of upper atmosphere. (4) Influence of the colouration of insects on their thermal economy. (5) Effects of atmospheric pressure on insect activities and development. (6) Part played by light in the development of insects. (7) Determination of the distribution of the fungus spores by the winds in close co-operation with the meteorologist, by the plant pathologist, and (8) Relation of weather to healthy crop growth and yield.

For each important crop plant, during the whole period of its growth and maturation, the following meteorological data should be recorded. (1) Air temperature (a) above the crop, (b) at the level of the top of the crop, (c) at midcrop height, (d) at the base, (e) in the soil, recorded every two or three hours or by a continuous recorder. (2) Moisture content of the land (a) at base near the crop, (b) under the crop, the usual precipitation records measured twice daily and nightly. (3) Relative humidity of the air (a) above the crop, (b) at the level of the top of the crop, (c) at each quarter of its height, (d) at the base. (4) Cloud records and sunlight intensity. (5) Relative penetration of precipitation into a crop at each degree of density and the length of time moisture remains on the foliage. (6) The relative amounts of dew deposited on crops of different heights for each stage of temperature, moisture and humidity as well as of crop density. (7) Relative penetration of wind of varying degrees of force into the crop and its relation to crop humidity, temperature and spore dispersal. (8) The humidity and temperature of the higher air strata.

and (9) More information about air currents and spore dispersal. The methods of collection of these data should be left to the meteorologist himself. The analysis of these data is a problem involving deep analytical and higher mathematical treatment.

UTILISATION OF DAIRY WASTES.*

T. LAKSHMAN RAO, B.A., D.I.C.,

Assistant Agricultural Chemist, Coimbatore.

The subject of this paper relates to the utilisation of the waste products of the dairy and is based mainly on certain experiments conducted in 1918 with the object of investigating the possibility of manufacturing locally, food and other products which could replace similar products which used to be then and still to a large extent are imported from outside, but which war conditions had rendered very difficult to obtain.

When milk coming into the dairy could be all disposed of as milk there will be of course no waste, but where the demand for fresh milk is limited and production is considerably in excess of such demand the milk will have to be converted into cream or butter or cheese and these processes would always leave a certain amount of waste in the form of skim milk or whey. If, however, by some means these waste products could be converted into something of marketable value not only such waste could be prevented but the mother industry could be made more profitable.

Skim milk contains about 3% of the protein, casein, held in colloidal suspension. The latter is easily separated by precipitation with acids. On a large scale the separation is best effected by the addition of sulphuric acid. In the experiments referred to above, the precipitation was effected by mixing one and a half parts by volume of strong sulphuric acid with seven parts of water and adding the mixture to 1,000 parts of milk. The precipitated casein was washed, pressed to free it of superfluous water and dried in a draught oven at a moderate temperature and finally powdered as fine as possible.

A purer product can be obtained by dissolving the moist casein in the least possible quantity of ammonia and reprecipitating with acid. This process is repeated three or four times. The curd is washed several times with alcohol, extracted with ether in a soxhlet apparatus and finally dried.

Casein has been found to lend itself to an enormous number of uses in industry. The uses to which it is put is increasing year by year. There are probably very few industries in which casein does

* Paper contributed towards a symposium on 'Utilisation of Wastes' and read at a Combined Conference of the Association of Economic Biologists, Coimbatore, The Indian Chemical Society and the Society of Biochemists, Bangalore.

not or cannot advantageously get employed. Thus it is used in the manufacture of distempers, cardboard, paper glazing, leather dressing, soap manufacture, cotton sizing and water-proofing, calico printing, boot polishes, water proof cements, invalid foods, and imitations of bones, ivory, tortoise shell etc.

Casein Paints and distempers. Casein prepared in the manner above described is soluble in solutions of the hydroxides of the alkali and alkaline earthy metals and in many cases of their salts as well, although the quantity of each required for complete solution is different in each case. Thus of sodium hydroxide $1\frac{3}{4}\%$, sodium carbonate $2\frac{3}{4}\%$, sodium bicarbonate $3\frac{1}{2}\%$, sodium tungstate $12\frac{1}{2}\%$ of the casein are required for complete solution. Solutions of borax and ordinary soap also dissolve casein.

Casein similarly dissolves in lime water although to a less extent, but the casein-lime compound thus formed has the property of absorbing carbon dioxide from the air and forming an insoluble compound. It is this property of casein which lends itself to the preparation of casein paints and distempers. These consist of mixtures of casein and slaked lime along with suitable pigments. On the addition of water the casein and lime combine to form a sticky soluble product holding the pigment in suspension. When applied to any suitable surface—wall, timber, or iron, the casein-lime compound in the prepared distemper absorbs carbon di-oxide from the air forming an insoluble durable coating which does not wash or rub off.

The proportions of the various ingredients forming the mixture is important. Too little lime would tend to make the product insoluble and too much would induce the paint to come off in flakes. Similarly too little paint would make the coating brittle and liable to flake off while if too much, the paint will rub off and not stand washing. Further, not all pigments could be used in the mixture, but only those which are not affected by lime. It is, however, possible to select suitable pigments to cover a full range of colours.

White paint may be made up of 100 parts each of casein and lime, levigated chalk 800, borax 1, and ultra-marine 2 to 3 parts by weight, while coloured paints may consist of similar proportions of casein and lime 400 each of levigated chalk and pigment, and borax one part. The ingredients should be all finely powdered and thoroughly dry. The mixture when stored in air-tight boxes will keep indefinitely.

For use, 50–60 parts of water are added to 100 parts of the powder and stirred until the mass is homogenous and free from lumps. This is then covered with a thin layer of water and set aside for the space of about one hour, after which the mass is stirred with more water to the consistency of oil paint. The paint thus prepared should be used without delay as it is liable to set hard in a comparatively short time, becoming unfit for use in twelve hours. The paint which

can be applied to any clean surface such as lime, plaster of paris, cement, brick, timber, stone, metal or canvas dries quickly with a mat surface and after 36—48 hours can be washed without fear and will stand the weather. The painted surface can be varnished if desired, painted or stencilled on. A glossy paint for indoor use can be produced by spraying the surface with a mixture of turpentine and wax and polishing it afterwards.

Casein adhesives. When dissolved in caustic alkalies or their salts, casein has adhesive properties and as such could be applied to the preparation of glues and cements, either liquid or solid, the solid glue only requiring to be dissolved in water for use. They find use for various industrial purposes, especially in wood work as they are ready for immediate use without previous soaking and heating as in the case of ordinary glue.

Two specimens are on exhibit, one prepared with borax and the other with soap. In one the borax serves as a preservative. The other requires the addition of an antiseptic as thymol or carbolic acid or lysol in order to preserve it.

Photographic films. Casein has been used in place of celluloid in the manufacture of photographic films, and in place of gelatin for coating the photographic plate or film, the sensitised "emulsion" in the latter case consisting of a solution of casein holding the halide salts of silver in colloidal suspension. Photographic paper similar in most respects to gelatine-chloride or bromide paper have also been prepared for printing from negatives or for enlargements.

The paper used for the specimen photographs on exhibit was obtained by coating ordinary paper with a solution of casein in citric acid to which a little glycerine had been added to give the paper the requisite pliability. The coated paper was, after drying in the shade, drawn over a 5% solution of ammonium chloride to render the casein insoluble, dried, sensitized in the dark room by floating in a 10% solution of silver nitrate and again dried in the dark room. Prints were obtained as on ordinary P. O. P., the operations of toning and fixing being also the same as with P. O. P.

Boot and shoe polishes. Casein has been found useful in the preparation of shoe and boot and furniture polishes, the casein in such preparations serving the purpose of a protective colloid holding in suspension considerable quantities of the other ingredients, usually wax or paraffin, turpentine and colouring matter. The samples exhibited have been prepared by dissolving casein in a solution of ordinary soap and incorporating with the mixture about twice the quantity of turpentine. A certain proportion of shellac dissolved in borax is also added to give the requisite gloss and finally the colouring matter which in the case of brown polishes may be an extract of

annatto and in black polishes, ordinary lampblack in a fine state of division.

Alimentary Casein. Casein being the chief protein material in milk is of considerable food value and possessing as it does good keeping qualities and no objectionable taste or smell has found favour in the preparation of several alimentary products, some of these being peculiarly suited for invalids. Thus, patent foods have from time to time been placed on the market under the names, Plasmon, Eucasein, Vitafer, Sanagen, Sanatogen, etc. The composition and the process of manufacture of these are not known with certainty but from knowledge gained by their chemical analysis it is possible to imitate them closely. Thus a product similar to Plasmon which is a soda compound of casein is obtained by mixing together 80 parts of casein containing about 5% of fat, 7 parts of sodium bicarbonate and 13 parts of lactose. Eucasein, which is a casein ammonia compound, could be prepared by passing ammonia through casein suspended in alcohol and afterwards separating and drying the casein. A product closely resembling Sanatogen is obtained by dissolving casein in sodium glycono-phosphate, evaporating the viscous mass to dryness in vacuo and reducing the dried mass to fine powder. Samples of these products obtained in the manner above mentioned are on exhibit.

Casein solids - Galalith. By suitable treatment casein could be converted into a plastic mass which could be moulded or pressed into various shapes, the finished product resembling horn, ivory, or tortoise shell according to the manner of treatment. The products are known as Galalith or Lactoform. The plastic mass after being hot-pressed in hydraulic presses is hardened by immersion in a solution of formaldehyde the length of treatment varying from 2—30 weeks, according to the thickness of the articles. A variety of articles can be made from Galalith, e.g., brush backs, combs, cigarette holders, electrical fittings, umbrella and stick handles, buttons, etc. The articles thus made are unflammable unlike celluloid.

Lactose. The whey drained off the curd in the manufacture of cheese contains most of the lactose present in the original milk and could be recovered. The method adopted consisted in first precipitating the milk albumen present in the whey by the addition of acetic acid and warming and then removing it by straining through cloth. The clear liquid was evaporated down on the water bath until the liquid showed signs of turning brown after which it was concentrated in vacuo until a syrup was obtained from which the sugar crystallised out on cooling. The first crop of crystals was quite white after having been washed in a fine spray of water. The mother liquor on treatment with bone charcoal and concentration in vacuo yielded a further quantity of brown coloured crystals.

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OCCURRENCE OF STERILE PLANTS IN BENGAL GRAM (*Cicer arietinum*).

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&

R. BALASUBRAHMANYAN, B. A., B. Sc. (Ag.), Assistant to Cotton Specialist.

At the Cotton Breeding Station, Coimbatore, a few sterile plants (Plate I, Fig. 1) without any pods were observed in the year 1930, among the progenies of single plant selections. During 1931, their appearance was more common, and again in the following season, their percentage occurrence was as high as fifteen in certain fields sown with unselected bulk. As the presence of such a large proportion of sterile plants would considerably reduce the yield of crop, a detailed study of these sterile plants was made with regard to the modifications of their floral parts, and the causes of their occurrence.

The sterile plants (Fig. 1) had their floral parts metamorphosed or virescent, and were distinguished by their characteristically stunted and bushier habit, by the smaller and more greenish leaflets, and by the upright gynophores with empty carpels. Sometimes a plant had only a few branches, or portions of a branch displaying this abnormality. The various monstrosities observed in the flower, might now be dealt with under the various types of floral structures.

Sepals. The gamosepalous calyx was transformed into five separate stalked leaves with entire margin (Fig. 2) inserted in a radial symmetry on the receptacle. In advanced cases, each of the sepals was modified into a pinnate leaf (Fig. 3) with long petioles and serrate edges.

Petals. The corolla lost its pink colour and showed different degrees of virescence (Fig. 3). In such cases the normal Zygomorphism, and hooded character of the standard remained unaffected. In others the differentiation between sepals and petals was lost, and both whorls were metamorphosed into pinnate leaves. In a few instances there was pelory.

Stamens. The diadelphous stamens got dissociated and remained free (Fig. 3). The filaments showed either petalody (Fig. 4), or phyllody with glandular hairs (Fig. 5). The anthers were often transformed into virescent cup-like structures, but if present, they were atrophied and non-dehiscent. In extreme cases the entire androeceum showed metamorphosis into pinnate leaves. (Fig. 7).

Pistil. The most common feature was the grooved petiole-like gynophore terminating in a partially developed carpellary leaflet with a tailed midrib corresponding to the style and stigma (Fig. 2). In some cases the entire pistil had changed into a pinnate leaf (Fig. 3). The funicle showed tendencies to form a bilobed leaflet with prominent glandular hairs. The ovule too was found to be transformed into a leaf (Fig. 6).

Fig. 2.



Fig. 1.

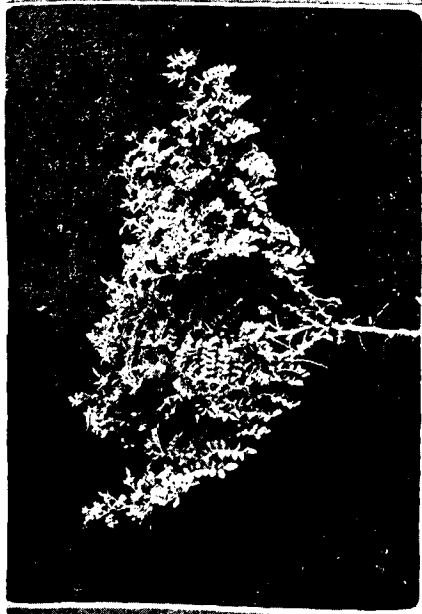


Fig. 3.

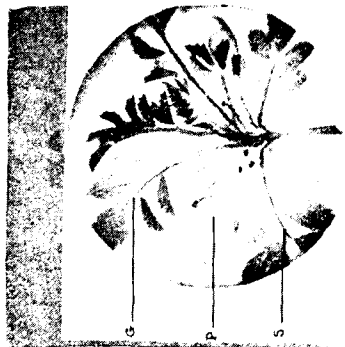


Fig. 4.



Fig. 5.

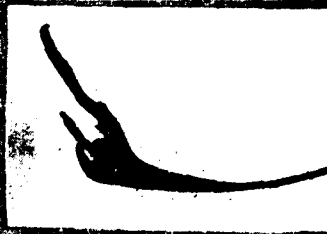


Fig. 6.



Fig. 7.



Plate I. Fig. 1.

An abnormal plant with prominent gynophores.

Fig. 2. Longitudinal section of an abnormal flower.

Sepals changed to stalked leaflets, stamens free. Pistil, turned to leaf.

Fig. 3. Do. Do.

(S) Sepals; modified into pinnate leaves. (P) Petals. Stamens free. (G) Pistil turned to a pinnate leaf. Shows axillary profiforation.

Fig. 4.

Petalody of the filaments opposite to the standard. (A) Anther.

Fig. 5.

Stamens exhibiting leafy nature; anthers showing cup-like modifications and development of glandular hairs.

Fig. 6.

(O) Ovules and funicles showing leafy transformations.

Fig. 7.

All floral members transformed to leaves.

In one plant an interesting monstrosity with all the various floral whorls converted into pinnate leaves (phyllomania) was met with (Fig. 7). In this case a vegetative shoot was found in the axil of the carpel, thus showing axillary proliferation.

Causes. Worsdell (1916) stated that the phenomenon of abnormalities is generally caused "under certain unfavourable conditions of climate, nourishment, or the influence of parasitism" of a fungus or an insect. Janse (1928) explains the same to be due to the disturbances produced in the quality or quantity of the growth enzymes occurring in the plant. The abnormal plants were examined by the Government Mycologist and the Entomologist, Coimbatore, and no sign of fungus or insect attack was detected. Seeds collected from such plants when sown did not produce a greater number of abnormal plants (11.7%) than was noted in the adjoining control area. The continued presence of sterile plants in crops raised during all the three years under observation, precludes one from declaring the climate as the causal factor, as the three years were varied in their characteristics. By elimination, the stimulus responsible for this phenomenon may either be the presence of any virus or purely physiological. Cross inoculations were tried on a small scale, but they failed to produce any results. Further studies into the causes of this transformation are in progress.

It may be mentioned here, that the abnormal plants bore a larger number of root nodules. It is very likely that this feature is the sequel of protracted vegetative phase exhibited by these plants. The presence of an excess of carbohydrates might have stimulated the bacteria to become more active and to produce more nodules.

Worsdell, after an elaborate presentation of teratological data, concludes that the process of Differentiation of floral members is a reversionary phenomenon while their Simplification is an evolutionary event. If the teratological features portrayed above are analysed, the dissociation of the calyx and androeceum will be grouped under dialysis. The production of gynophores and the development of shoot at the carpellary axil are only examples of median and axillary proliferations. The phyllody of the calyx, corolla, pistil, funicle and ovule, and petalody of the stamens are different types of metamorphosis. As these are only different phases of Differentiation, they are to be interpreted that they are reversionary in character, and that they go to prove the foliar origin of the several floral members.

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A NOTE ON THE OCCURRENCE OF SMALL OUT-GROWTHS ON THE CALYX RING OF THE COTTON FLOWER

By C. JAGANATHA RAO, B. A.,

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The author of this note has observed for the past four seasons (1929-'33) some peculiar out-growths or organs on the calyx ring of flowers produced in one of the pure lines of cotton, No. 54, a 'North-erns' Selection (*Gossypium indicum*) grown on the Agricultural Research Station, Nandyal. A fair percentage of flowers produced by this culture were found to have these organs, three in number and about two or three millimeters long when fully developed. Sometimes, only two, also one, either fully developed or in a rudimentary stage have been noticed in the flower. These structures spring from the outer base of the calyx ring and are situated one opposite each of the three bracts. Their shape is either conical, ovate or obovate and often they are cup-shaped, the hollow orienting towards the bract and away from the calyx. Rarely, the organ occupies the entire height of the calyx ring and looks as though the proximal ends of two of the sepals of the calyx have reflexed outwards and given rise to each out-growth. The tissue of this supernumerary structure resembles that of the gamosepalous calyx ring—yellowish-green in colour and dotted with black glands so characteristic of the cotton plant—in contradistinction to the dark reddish-green involucre, also full of black glands in the tissue.

Robbins in his text-book (1) mentions the occurrence of intracal-cicary organs in upland cottons i.e., organs arising between the Calyx and Corolla and also observes that Cooke and Meade regard them as "Supernumerary calyx lobes or as representing free stipular elements of the calyx lobes."

Morphology of these structures apart, their presence serves as an ancillary distinguishing character for the culture.

In the F_1 of courses involving this strain, this character has been observed to be partially dominant.

Reference.

1. Robbins. Botany of crop plants.

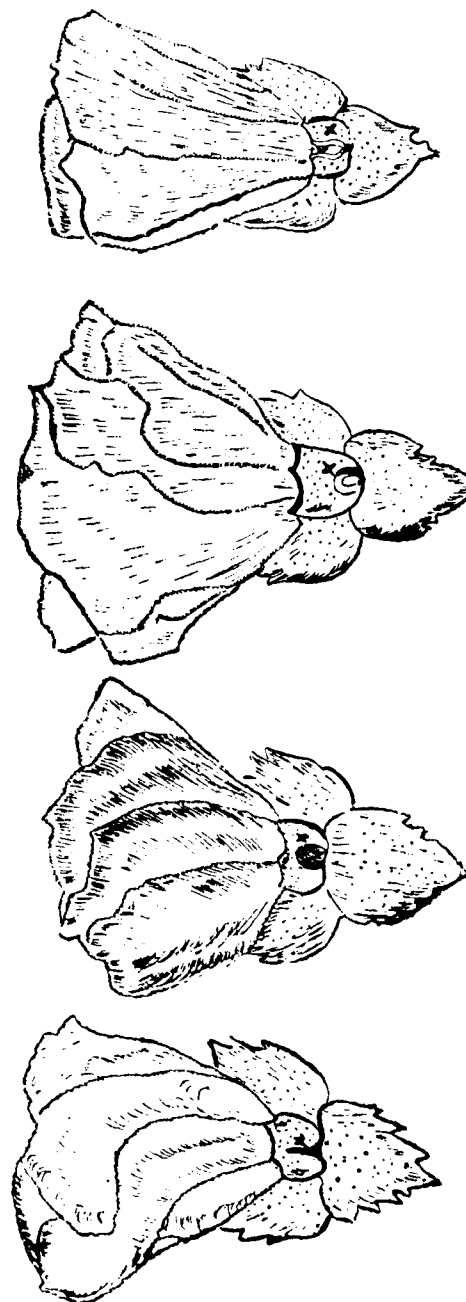
A SUGARY EXUDATION FROM SORGHUM

BY Dr. T. R. SESHADRI, M. A., Ph. D.,

Chief of the Department of Chemistry, Andhra University, Waltair.

In a variety of sweet sorghum called *Tella Jonna* commonly grown in the Bellary district a sweet fluid is found to exude from the ear-head of certain plants from the beginning of the flowering season. It

OUTGROWTHS OF DIFFERENT SHAPES ON THE CALYX RING



SHOWN BY THE SIDE OF X MARK

frequently collects and dries on the leaves and is the cause of attraction for the large number of ants and other insects that visit the plants. Usually it is found as a sticky semi-solid; in several cases however, crystals are formed. When this secretion takes place the ear-head remains small and undeveloped though in all other respects the plant may look normal.

T_1 is a strain which yields this secretion in abundance; T_{12} also gives some quantity of it. The sorghums grown in Coimbatore such as *Periamanjil* do not exhibit this phenomenon so markedly. The juicy nature of the variety and the setting in of the cold weather during the flowering stage seem to be the conditions favouring the production of the exudation. In Bellary district flowering takes place in the coldest part of the year and *Tella Jonna* is sweet and juicy. In Coimbatore this condition is not seen in the summer cholam and even during the main season it is occasionally observed only in certain late varieties and in some of the late side shoots. It is noticed that with the *Tella Jonna*, manuring with cattle manure, green manure or mineral manure which gives rise to a good vegetative growth also renders the plants more susceptible to this condition. Further, insects are found to be most prominent in the plants producing this exudation.

Samples of the secretion in a solid form were collected from *Tella Jonna* (T_1) in the Hagari Agricultural Research Station during two seasons - on 30-12-'31 and 24-1-'32 in the season 1931-'32 and on 20-1-'33 during the season 1932-'33. They were obtained by gentle scraping with a spatula or knife so that very little of the plant tissues was included. It was noticed that the January samples were much more crystalline than those taken in December. They were brought in stoppered bottles to Coimbatore laboratories, dried for a week in a desiccator over concentrated sulphuric acid and analysed. At this stage they were a little sticky and hygroscopic and had the smell and taste of jaggery.

By the iodine test aqueous solutions of the samples were found to contain no detectable amounts of starch or dextrin. The following table summarises the results of analyses of the samples.

Date of sampling.	Acid content as C. C. of N. NaOH for 100 g of sample.	Ash %	Total Sugar	Reducing Sugar	Sucrose %
30-12-'31	7.75	1.36	80.4	23.5	56.9
24-1-'32	8.20	1.53	79.0	14.3	64.7
20-1-'33	8.60	1.49	80.6	17.8	62.8

The reducing sugars consisted of glucose and fructose only and pure sucrose could be isolated from the samples by repeated treatment with 82% alcohol containing acetic acid and subsequently washing with

rectified spirits. When examined under the microscope a fresh sample of the exudation was found to contain yeast along with plenty of bacteria. A 5% aqueous solution when fresh had a pH of 5.5, after 24 hours 3.5, and after 48 hours 3.2. The total acid content increased 15 times when the solution was allowed to stand for 48 hours. The bulk of the organisms increased rapidly; very little alcohol could be found, the fermentation leading mainly to the production of acid. No fungus spores could be detected and this was kindly verified by the Government Mycologist at Coimbatore.

It should be noted that the percentage of the reducing sugars is high, that it decreases with the advance of the season, and that, there is a corresponding increase in the sucrose content. The results are similar to those obtained for the juice of the sugary sorghums by Annett (Bull. No. 41 of the Imperial Agricultural Research Institute, Pusa). It may, therefore, be concluded that the exudation is simply the flowing out of the sorghum sap. What should have gone to fill up the grains and be transferred into starch is poured out as a sugary fluid. But the exact cause of it is not yet clear.

Help from the Farm Manager, Hagari Agricultural Research Station, in the collection of the samples of the sugary exudation is gratefully acknowledged. This work was done when the author was working in the Agricultural Research Institute, Coimbatore.

Correspondence.

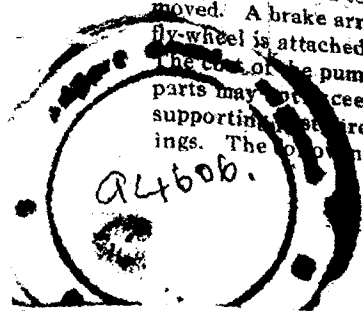
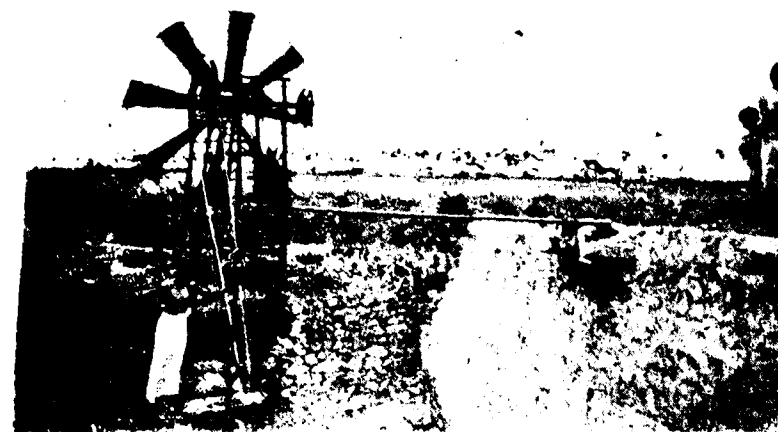
1. A locally made and improved type of Wind-mill.

Mr. S. V. Doraiswamy B. A., B. Sc. Ag. writes from Udumalpet:—

In Mr. Subba Rao's garden about 3 miles from Udumalpet on the Thalli road, an ingenious kind of windmill has been erected and is giving very satisfactory results. Mr. Subba Rao's son Mr. Krishna Rao, M. A., B. L., under whose supervision the garden is being cultivated, has been responsible for its erection. It is interesting to note that Mr. Krishna Rao has taken up for cultivation under his supervision about 25 acres of garden which includes about 6 acres on lease. This is probably the first instance when a highly educated gentleman has taken up the position of a tenant and cultivates land on lease in addition to his own. The gardens are mainly devoted to sugarcane growing and there is an oil-engine and pump fitted to one of the wells. Being a Physical Science graduate Mr. Krishna Rao has utilised his knowledge to erect a cheap, simple and efficient type of windmill, the total cost of which is about Rs. 250.

The mill consists of a fan made locally of iron plates and attached to the central shaft of a condemned motor lorry differential, and coupled to a wooden fly-wheel attached to the back axis of the chassis, the wheels having been removed. A brake arrangement has also been made using the brake drum. The fly-wheel is attached to a rotary pump of two-inch delivery by means of belting. The cost of the pump and connected pipes comes to Rs. 150. The cost of the other parts may not exceed Rs. 100, including the cost of the lorry chassis. The supporting frames are the frames of the chassis. All the parts work on ball bearings. The following are the dimensions of the windmill, discharge etc

TWO VIEWS OF THE WIND MILL IN ACTION



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