is at play and that the several attendant abnormalities described in the case of the sterile plants are the result of the absence of a single gene. A factor 'Stg' governs the manifestation of the normality of the ovary and its absence (stg) brings about a condition which leads to the sterility of the plant.

Summary.

1. The occurrence of a sterile plant is described.

2. Female sterility is found to be caused by the abnormal development of the style and stigma.

3. Parthenocarpic bolls develop sometimes on the sterile plants.

4. This type of sterility behaves as a simple Mendelian recessive to the normal condition of the flower which is completely dominant.

5. The pair of factors responsible for the above phenomenon are represented by Stg—stg.

Reference.

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THE PRESENT POSITION OF STRAIN NANDYAL 14 IN THE 'NORTHERNS' AREA.

By L. NEELAKANTAN M. A.,

Cotton Assistant, Nandyal.

The cotton grower is worried. His crop has again fallen below expectation. He got his seed from the best shop in the bazaar. Yet, they say in the market that his stuff is as poor in quality as ever. The buyer does not prize it to his satisfaction. It is annoying in the extreme. He suspects that insects and diseases are partly responsible for his woes. Yet he instinctively feels that in spite of them his crop could do better, but he does not know. Something is wrong somewhere. He goes seeking for advice and happily meets the plant breeder. The breeder understands him and tells him that one reason as he could see from an examination of his crop is that his seed is impure, that is, it is a mixture of several races of cotton. He infuses hope into the dejected grower by saying that the difficulty can be overcome, and that ere long he will be having a crop which will not only be uniform with a fairly steady yield, but will also be valued highly in the market. The breeder sets to work accordingly. He labours for a time and succeeds in discovering what he calls a promising strain—from the local stock. The eager cultivator welcomes it, and is amazed to find it scoring high directly on being put on the market. Buyers rush up to him prefering his produce to others. All goes well with him, and he is carried on the crest of fortune, but only for a while. Soon a tide turns to his vexation. The demand goes down suddenly in the market, and the strain no longer fetches him more money than the original bulk. The grower gets disheartened. The puzzled breeder who has been watching the whole show quickly adjusts his machinery of improvement to meet current urgent demands.

The above is in brief outline the story of the rise and decline of Nandyal 14 an improved strain evolved from a bulk cotton known to commerce as 'Northerns'. The term refers to the cotton grown annually in the Madras Presidency in the taluqs of Dhone, Kurnool, Nandikotkur, Nandyal, Allagadda and Koilkuntla in the Kurnool district, the native state of Banganapalle in the same District, Jammalamadugu and Proddatur taluqs in the District of Cuddapah, and Tadpatri taluq in Anantapur District. It covers a little over 3 lakhs of acres in extent, and enjoys a reputation for strength and texture, forming one of the chief commercial types of Indian cottons. Though it is recognized as class I according to the Liverpool definition, the crop is a heterogeneous population of several good and bad varieties. The produce as a consequence is a mixture tending to vary widely from year to year in lint qualities. A standard type which is botanically pure, uniform and highly valued in the market would be a great improvement over the local stock. With this object in view the Madras Agricultural Department took up work at the Agricultural Research Station, Nandyal more than 25 years ago. Special attention was bestowed on quality and after years of experimenting, the Department succeeded in isolating a type in the year 1918—now well known as Nandyal 14 (N. 14). With an average yield of 200 lbs. of seed cotton per acre, and capable of spinning to 40's, this strain is one of the few finest cottons at present available in India.

Efforts were then directed towards popularising the same. A number of seed farms was systematically organised. It was planned to get a supply of seeds in the course of a few years sufficient to cover the entire Northerns tract so that thereafter the same stock would be propagated year after year.

More than 15 years have gone by, which is a fairly long period for an improved variety to spread and assert itself, as has been the case of Co. 2 in the 'Cambodia' tract and H. 1 in the 'Westerns'. But N. 14 has failed to expand. At no time in the past has it spread to more than 8 to 10 per cent of the entire area. On the other hand there has been a distinct decline in its acreage. From nearly 30,000 acres in 1930—31 it has dwindled to 2,300 in 1935—36.

In looking out for factors contributing to this state of affairs, the first thing that strikes one is the possibility of a deterioration. But an examination of figures available at the Nandyal Farm shows that apart from fluctuation due to season there is no serious fall perceptible either in yield or lint length. Causes are to be sought for elsewhere.

The opinion of the grower is the best testimony to the capacities of a strain. The Nandyal ryot is not pleased with N. 14 for several reasons. In the first place it has a low lint out-turn having a ginning percentage of 23, whereas the 'Northerns' bulk has a ginning value ranging between 25 and 28. The slight increase in seed cotton claimed for N. 14 on the basis of trials conducted on the farm is not borne out in the trials carried outside the farm. Again N. 14 lacks drought-resistant qualities, its performance coming up to expectation only in seasons of good rainfall. The ryots' bulk is hardier and more capable of standing seasonal vicissitudes. The red-leaf disease recently observed in the Nandyal cottons with its attendant sterility tending to detract from yield, is also present to a greater degree in N. 14 than in the bulk. Apart from these the high premia which this strain was realising—in some years it was paid Rs. 70 over the market rate—are not obtainable now and naturally N. 14 lost its glamour. Further it is found to thrive only in red and mixed soils.

All kinds of seed are being imported from outside every year. Bulk of these comes from Gadag, Dharwar and Bijapur in the Bombay Presidency and belongs to the commercial type known as 'Kumptas', (locally called as 'Gadag'). This importation of Gadag seed has been going on for several years in the past. Besides, Cambodia seeds from Tiruppur area, and H. 1 from the Westerns tract are also finding their way into this region. The component of the original Northerns possessing longer lint is being slowly swamped out. The crop now raised by the ryot is a mixture of all manner of varieties and is perhaps even more heterogeneous than the original Northerns. In quality, it is definitely inferior to N. 14 and is very varying from season to season depending upon its botanical composition. But this is not viewed with any great concern by the grower, as the extra yield is considered ample to compensate for any depreciation in the market value on this score.

To replace this mixture, a strain similar to N. 14 in quality but with a better yield and higher ginning percentage and more suited to a wider range of soil and rainfall conditions is what is needed. Recently attempts have been intensified in this direction at the Nandyal farm. But nature has, as it were, split up the two desired characters, namely yield and quality, such that when one is supreme the other is generally found to be low. The search for ideal type through the ordinary selection method thus becomes elaborate and is bound to be time consuming. During the last 10 years about 3000 plants from various centres of the tract were examined in detail, and yet a type better than N. 14 in all respects has not been found. This number however is a drop in the ocean of cotton material in the tract, and the isolation of a superior type is largely a matter of chance. It is something like casting nets in a big lake to catch the biggest fish available there. The desired catch may be quick or slow to achieve, and luck plays a great part. With patience and perserverance it is bound to come within the reach of even the unluckiest fisherman.

Recent attempts at the Agricultural Research Station, Nandyal, have succeeded in the establishment of three heavy yielding strains. Under the instructions of the Deputy Director of Agriculture, III Circle, Bellary, these are being tried for testing yield with N. 14. and ryots bulk in addition, in various centres of the tract with the co-operation of the Assistant Director of Agriculture, Kurnool. The trials are planned on up-to-date lines to allow of refined statistical interpretation of results and will be conducted for at least three consecutive seasons. The results of these trials are expected to give information also on whether Northerns tract is divisible into difinite zones with a particular strain suited to each zone. In such a contingency the produce that comes to the market will again be a mixture. But that need not cause alarm as such a mixture will be composed of types with similar spinning values and will go a great way in raising the name and standard of Northerns.

My thanks are due to the Deputy Director of Agriculture III Circle, Bellary for his kindness in offering me facilities in writing up this paper.

Selected Article.

Soil Crumb.* The most striking physical attribute of many fertile soils is their natural tendency to the formation of a crumb structure. This tendency is utilised by the farmer or planter in the production of a good tilth in his cultivations. Soil-tilth greatly contributes to the development of suitable water and air conditions which are of primary importance in the successful growth of the majority of crop plants.

Soil crumb cannot develop in soils entirely devoid of colloidal matter. Pure sand never forms crumb; its particles remain separated when the sand is dried, and settle into a closely-packed mass when it is wetted. At the other extreme, highly colloidal clays may only form crumb when certain conditions are realised. In the absence of these necessary conditions, clay soils merely crack into large lumps when dried, or "run together" into an impervious mass when wetted. The most suitable kind of soil for crumb formation is probably one containing a fair amount of colloidal matter in a suitable condition, together with a dilutant consisting of an assortment of grains of silt and sand of various sizes. The colloidal matter may be either inorganic (clay substance) or organic (humus). It possesses the ability of binding together the individual soil particles into aggregates and the aggregates into crumbs. In this way the soil assumes a characteristic and well-known structure, usually associated with high fertility.

It is imperative that the crumb structure developed in a soil by natural processes or by suitable cultivation should be stable. If the crumb be unstable, the soil tends readily to break down into its component particles, which then may be easily washed away by running water or blown about by wind. Such unstable soils suffer severe erosion, and their drifting frequently becomes a serious menace.

* **Acknowledgments** :— The subject matter of this article has been taken mainly from the recent writings of Dr. E. W. Russell of the Rothamsted Experimental Station, particularly "A Physical Description of Soil Tilth", Sands, Clays and Minerals, April 1936, Vol. II, No. 4, pp. 57—63.

Soils possessing no crumb structure at all exhibit a continuous pore-space distribution, which permits either air or water to move more or less freely through them, though air and water cannot each move freely if both occur together. When a stable crumb structure is developed, however, pore-space distribution becomes discontinuous. Although the pore-spaces within the individual crumbs may be continuous, cracks and spaces occur between the crumbs, so that there is sufficient room for the free circulation of both air and water around the crumbs. The finer pores within the crumbs may hold an appreciable amount of water which is available to plants even under fairly dry conditions. The larger cracks and spaces allow surplus water rapidly to drain away, and at the same time, they allow air and carbon dioxide to circulate freely, maintaining a high degree of aeration within the soil. The colloidal matter which binds the soil particles into crumbs also possesses the property of absorbing air as it dries. This air is liberated again when the colloidal matter is wetted but it becomes entrapped in the form of minute bubbles. Hence during temporary water logging, the colloidal matter provides a source of oxygen for plant roots, thus preventing asphyxiation.

The mechanism of crumb formation, and the precise factors which confer stability on the crumb are not yet completely understood, although they are being actively investigated in certain research institutes, notably the Rothamsted Experimental Station in England. It is known that the primary requisite for crumb formation is that the soil should first be wet, and that the water in it should then be removed at a certain rate. Water removal may be effected either by direct drying or by freezing. Frost is perhaps the most effective natural known agent for producing crumb structure and a good soil-tilth. In northern countries, clay lands are roughly ploughed in the late autumn, so that as large a surface as possible is exposed to the action of frost when winter comes. In countries where no winter is experienced, the alternative process of direct drying is utilised for producing a tilth. The land is ploughed into large clods during the early part of the dry season, and these are allowed to dry out during the following months. When the first rains come, the land is cultivated, and the shattered lumps then break down into crumbs The mechanism of this action is probably attributable to the liberation of entrapped air during the wetting process. The air forms holes and channels within the clods, which consequently become mechanically weaker and shatter readily under the action of the plough and the harrow.

A third method is often practised in countries where frost is unknown, and particularly if the soil lacks organic matter. It consists in the growing of heavy grass crops or vigorous leguminous plants, whose rootlets hold the soil particles together, and thus impart a crumb structure to the soil. The incorporation of bulky organic matter into the soil furnishes a supply of colloidal matter, which will confer a crumb-forming ability when the soil lacks colloidal clay.

The particular size of crumb most suited to the crop depends partly on climatic conditions. In humid climates, the chief need is an adequate air supply to the roots, so that an open structure is best, and the crumbs should therefore be of relatively large size. In arid regions, on the other hand, water is usually the limiting factor, so that a close compact structure is best, and the soil should have a fine crumb structure conducive to water conservation. For the best results, the size of the soil crumbs should range from about 0·5 to 3·0 millimetre, depending on the air and moisture-requirements. Smaller crumbs block the air channels without increasing the water-retaining capacity, whilst larger crumbs enhance the rate of evaporation of water, causing plants to die from dessication.

Factors affecting Crumb Formation and Crumb Stability. The proportionate amount of colloidal matter in the soil requisite for the suitable development of a crumb structure is not known with certainty, although the effects of either too little or too much colloidal matter are well understood. The smaller the colloidal content the larger the pore spaces and the weaker the crumbs. The crumbs dry out more readily, but they yield only small amounts of air when re-wetted. Hence plants are liable to suffer both from water-logging and from drought The greater the colloid content, the more difficult it is to obtain a good structure. The pores within the crumbs may be too minute to enable plant roots to remove water from them, in spite of the fact that the clay component of the crumbs contains large amounts of water which is tightly held. Hence plants are liable to suffer from lack of water when the clay content is high, even though the total amount of water present in the soil is relatively great.

The effect of organic colloidal matter (humus) so far as is known, is similar in most respects to that of colloidal clay its main difference probably lies in its effect on crumb size, although the magnitude of this effect has not yet been ascertained. Another important property which organic colloidal matter confers on soil in greater degree than inorganic colloidal clay is to increase the pore space within the crumbs, and thus to improve materially their water-retaining capacity and their ability to supply water at a rapid rate to growing plants. Organic colloid also in some way reduces stickiness and improves a soil's workability, but little is known about the mechanism of these effects. Soils rich in organic matter are never so sticky and are very much more spongy and springy, than soils containing corresponding amounts of colloidal clay. Their humus component probably absorbs more air, and it certainly does not give it up again with the same facility as clay colloid. Highly organic soils are therefore more difficult to wet than heavy clay soils.

The stabilily of soil crumb is of two sorts, namely mechanical stability and water stability. The former enables the crumb to withstand the action of beating rain or gusty wind; the latter enables it to maintain its structure when thoroughly wetted Both types of stability appear to depend on the nature, composition and chemical attributes of the colloidal matter that holds the soil particles together. Recent research has established the fact that the seat of the important binding forces is the surface of the colloidal matter. Such surfaces are chemically very active; they are capable of combining with or "absorbing" entities such as water molecules and ions of various sorts particularly basic ions. for example, calcium, magnesium, potassium, sodium and hydrogen ions. The ability of colloidal material to combine with ions and to exchange them for other ions confers upon it what is known as " base exchange capacity ". In order for soil crumbs to be formed, the base exchange capacity of the soil should exceed 20 units (milligram equivalents per 100 grams of soil). The measurement of base exchange capacity is now a routine procedure in soils laboratories so that the soil chemist can readily determine whether or no any given soil is likely to form crumbs easily, merely by determining its total exchangeable base content.

It is quite likely that basic ions bind colloidal surfaces together through bridges of water molecules. The positively-charged (hydrogen) end of the water molecule (H. OH.) is attracted to the negatively-charged colloidal surface, and the negatively-charged (OH) end is attracted to the positively-charged basic ion.

The conditions that decide the size of soil crumbs are not yet known, but evidently one factor is the rate of drying. The faster water is removed, the smaller the crumb. Another factor appears to be salt content. Soils having large contents of salts (such as sodium chloride) develop only small crumbs. Such conditions may characteristically occur in nature ; for example, arid-land soils are generally subject to rapid drying, and common salt is a usual component in them, so that the natural soil structure in this case is one distinguished by small crumbs. In soil survey studies observations of the natural size and shape of the crumbs is frequently employed as evidence of the conditions under which soils have been formed.

The proportionate amount of the different exchangeable ions associated with the colloidal matter in a soil seems mainly to decide the water stability of the crumbs. If more than 20 to 30 per cent. of the exchangeable ions of a soil are sodium ions, the soil will usually form crumbs that are markedly unstable when wetted. Such "sodium-clay" soils may produce a good tilth when properly cultivated in favourable weather, but the whole structure rapidly and completely disappears when the first soaking rains arrive. The surface may subsequently solidify into a hard cake after drying conditions have again set in, and plant roots may be injured so that the crop is irreparably damaged. Nevertheless, soils rich in exchangeable sodium-ion, but containing at the same time abundant free sodium salts may appear to possess a stable crumb structure, but this is lost when the excess of salts is washed out or leached away by irrigation with pure water.

On the other hand, soils containing a large proportion of exchangeable calcium-ions usually produce crumbs that are very stable in the presence of water. This fact may partly explain the beneficial effect of thorough liming on the physical properties of acidic clay soils. Much fuller information is needed concerning the water and ionic conditions prevailing in the neighbourhood of colloidal surfaces before the causes of water stability of soil crumb can be fully understood. The different ions operate to different extents, but sometimes in opposite directions. Thus sodium-ion and calcium-ion appear to be antagonistic in their effects on crumb stability, whilst magnesium-ion seems to resemble sodium-ion rather than calcium-ion in their ability to confer a fair degree of crumb stability on a soil containing a sufficient amount of colloidal matter.

In farming practice, mechanical cultivation operates in two chief ways. If the soil possesses a good crumb structure, cultivation improves it by developing tilth which directly benefits the crop by improving the moisture and air conditions. If the soil possesses no crumb structure, and has bad tilth, cultivation puts it into the best condition for weathering agents to act on it. Cultivation implements should be used in such a way that a stable tilth is produced in a previously structureless soil, or an already existing tilth is not destroyed, and at such a time that the greatest benefit to the soil's structure is realised. Successful tillage thus demands knowledge and experience on the part of the cultivator both with regard to the correct kind of implement to use, and the right time to use it. Thus, a good stable tilth in a heavy clay soil may be completely spoiled by ploughing with a steel mould-board plough when the soil is too wet, Such a soil should either be allowed to dry before ploughing, or a wooden mould-board plough should be employed. Liming has been proved at Rothamsted to reduce the force needed to draw implements through the soil. This effect may be explained by the more stable crumb structure which the lime confers. on the soil. Heavy dressings of organic manure produce similar result, whilst cropping with green manures probably aids crumb formation through the binding effects of tiny rootlets.

The formation of a satisfactory explantion of the various stages in crumb production and the elaboration of means of measuring the various factors involved seem now to be within reach. Before long it should be possible to design field experiments to test the main conclusions, and thus further to develop the practice of field husbandry on precise scientific lines.

From *Tropical Agriculture*, Vol. XIII, No. 6, pp. 143 to 145.

Press Service.

Nutrition and Agriculture. Further discussions on the subject of improved nutrition standards, which promised to be highly interesting and important, will take place in October next on the occasion of the XIIIth General Assembly of the International Institute of Agriculture of Rome. Certain special studies of this question have been made recently by the League of Nations and by the International Labour Office, in collaboration with the Institute, which has provided both institutions with an ample statistical documentation. A highly informative report has also been prepared for the Assembly by Mr. McDougall, Delegate of Australia on the Permanent Committee of the Institute. A brief summary of this Report is given in the following paragraphs.

The writer shows in the first place that a satisfactory human dietary must be based on an adequate consumption of the "protective' foods which include milk, cheese, butter and other dairy products, fresh fruit and vegetables, eggs, fish and meat. Unfortunately the special studies and statistics which deal with the subject show that the great masses of the population throughout the world do not consume these particular foods in sufficient quantities. The result is frequently the appearance of "deficiency diseases" such as pellagra and beri-beri, and also, especially in the child population, dental troubles, bone malformation, rickets and a general sub-normal physique.

After having demonstrated the benefits that would accrue ,to human welfare through the raising of nutrition standards and directing attention to the growing tendency of public opinion to make the state responsible for the supervision of national nutrition, Mr. McDougall considers the effects to such improved standards on agriculture. Consumption of the "protective" foods might go far to cause a revival in the trade in food products. If practical steps were taken to bring about a rise in consumption, particularly as regards these particular foods, it would be possible for the industrial countries 'to concentrate their attention on producing larger quantities of the more perishable foods, and the production of the chief world agricultural staples, such as wheat and sugar, might be left to a greater extent to the great low-cost exporting countries.

Thus the way would be opened for a general recovery in world trade with beneficial effects, not only upon the economic situation, but also on political relations in all countries.

The writer then considers the different methods of improving nutrition, after stating that malnutrition is due in the first place to poverty and in the second to ignorance.

In reference to the first of these factors, he instances certain of the more important suggestions that have been offered. These include the distribution of milk and other food, either free or below cost, to pregnant and nursing mothers, to children below school age and to children at school; the lowering of the margin between wholesale and retail prices were unduly high; differential prices for certain social groups. Further more subsidies, now granted to producers, might in certain cases be utilised as subsidies to consumption.

In regard to the matter of ignorance, the writer considers that the newer methods to popular education, such as broadcasting, the talking film, etc. might be adopted with advantage.

Mr. McDougall lays stress on the value of adequate credit provision, if agriculture is to be called upon to readjust and intensify production. He considers that the idea of an International Agticu'tural Mortgage Bank, capable of assisting the Governments to turn over to the prodction of the most economic and health promoting foods, might now be revived with better hope of success. The great creditor nations would be the more willing to give their support, since they would see that their own economic interests would stand to gain by the operation of the proposed Bank.

Herein, in the view of Mr. McDougall, there may be found a solution of the hotly debated problem of agricultural protectionism. There can be no doubt that the solution of the questions discussed by the writer of this report might contribute in no small degree to a revival in world prosperity.

[*International Institute of Agriculture, Press Service.*]

ABSTRACT

Tobacco in South India. By W. R. C. Paul, M.A., M.Sc., D.I.S., F.L.S. (*Trcp. Agri.* LXXXVII p. 3). This crop was first introduced by the Portuguese in the 16th century. Its cultivation was restricted to dark, and strong flavoured types and as such there was no or very little export in the early period. In order to meet the demand of the mild flavoured light tobacco in the United kingdom, efforts were made in the direction of introduction of new types, methods of growing and curing. Madras Presidency occupies second largest position in India with an area of 292,000 acres and outturn of 286,000,000 lb. of cured leaf out of the total area of 1,350,000 acres and production of 1,000 000,000 lb. leaf respectively. The different kinds of tobacco grown may be grouped under (a) smoking (b) chewing (c) snuff. Dark tobaccos are strong flavoured and are used in the manufacture of cigars, cheroots, chewing and snuffing. Light tobaccos are generally associated with mild flavour and comprise cigarettes, pipe mixtures and beedies. The light tobacco industry has developed during recent years due largely to the efforts of the Indian Leaf Tobacco company, and Guntur District forms the chief centre of its cultivation with about 40,000 acres under the virginian variety Harrison's special. The flue cured Virginia is used for manufacturing standard brand cigarette while the sun-cured stuff and the finer country types are mostly used in blending the innumerable other cheaper brands and pipe tobaccos, and are exported to United Kingdom and Japan.

Cigar filler tobacco is mostly drawn from certain areas in Dindigul and Trichinopoly while cheroot tobacco is extensively cultivated in the Districts of Madura, Coimbatore, Trichy, Salem, Kistna, Godavari and Vizagapatam to the extent of 105,000 acres. Soil and weather conditions determine the quality of the tobacco. Light soils are suited for mild bright tobaccos, and heavy soils for coarse dark types. Application of cattle manure produces excess of chlorides in the leaf and the burning quality is poor. On the other hand application of organic manures leads to a high nicotine content. Irrigation is found better for chewing and cheroot types, and brackish water produces a greater potash content.

Tobacco curing may be either by flue, sun or air. Most of the light virginians are flue-cured and usually contain about 13% moisture at the time of export.

There are about 30,000 barns in the Guntur area.

R. B.

Gleanings.

Vitamins and Plants. In general, vitamins are products of the vegetable kingdom. Their possible role in plants, however, has been almost totally unknown until quite recently.

Some years ago we followed the synthesis of carotene (the precursor of vitamin A) and vitamin C (ascorbic acid) in plants, and observed that the percentage content of these compounds in the plant is generally the higher the better