THE PLACE OF BOTANY IN AGRICULTURE.*

BY RAO BAHADUR D. ANANDA RAO, B. Sc., I. A. S.

Director of Agriculture, Madras.

Students of Botany, in fact, students of Natural Science are perhaps more fortunate than students of other branches of science, and especially students of Arts and Law, in that they come into daily contact with nature when they study plants—their flowers and fruits, insects, birds and animals of which Nature is so full. Those who come in contact with Nature constantly, see the great unseen hand that is responsible for the creation of universe and all that therein is. We come into contact with Nature through things created. A close study of either Botany or Zoology discloses to one the power, the glory and the majesty of the Creator. Need you, therefore, hesitate to call yourselves fortunate when your study brings you into close touch with Nature?

What is the connection between Botany and Agriculture? While Botany is a science which deals with all plant life in all its aspects, Agriculture is a science, an art and an industry—all combined, which deals with the culture of plants of economic value to man. A student of agriculture before he becomes a scientific farmer should know all he can about the plant—its inside so to speak—its relation to soil, to its environment, how it lives, what causes its illhealth, just in the same way as a mechanic should know his engine and the doctor the human body. Not only this, science is progressive, and the scientific farmer should constantly concern himself with the improvement of the plants in which he is interested. Do we not hear from day to day the so called "improvements" of the various models of motor cars—the new Minx, or the Ford 22 or the Flying Standard, etc. bringing to the notice of the public small points of difference between the old and the new to catch the fancy of the purchaser. Whereas in those concerned with crop improvement the object should not be and is not to "catch the fancy" of some one but to be of lasting benefit to the cultivator.

As students of botany you must have learnt that plants and animals are so different in their complex forms; yet such a difference ceases to exist in their simple organisation. You have also learnt that plants and animals have been derived from pre-existing forms by gradual modification and that there has been a gradual evolution from lower forms.

Those who have read Charles Darwin's *Origin of Species* would recollect how he points out the great variability that exists in plants, how nature reproduces itself to an extremely extravagant degree. For

* A lecture delivered before the Madras Presidency College Botanical Association.

a simple example take the *Margosa* or any road-side tree, and what constant struggle there is for existence and that in this struggle only those that suit their environment best are those that survive. The plant breeder of today who was the student of botany yesterday therefore takes advantage of some of these facts, e. g. of the great variability, and uses it for his own purposes. He looks into the variable mass of material of any particular crop like paddy, millet or cotton, and decides in his mind what kinds of plants suit him best. In the case of paddy, for example, he might look for plants with longest ear-heads and closely set grain or for those which produce ears earlier than others or for those with fine grains or for plants with many tillers or for those which have an erect habit or for those resistant to disease and so forth. He walks in the field examining individually hundreds of plants and selects a few which reach the ideal he has set before him. This process may go on for a number of days, and eventually when he makes up his mind how many he should have, he harvests them separately and keeps the produce of each plant separately till next year making a record of each, indicating briefly for what quality he has selected them. What he has stored is the produce of one earhead of a single plant. This he sows next year in single rows, and compares the progenies with each other as well as with the bulk seed of the crop from which he originally selected the single plants, the object being to compare one with another and with the original. Those which satisfy him he retains, others he rejects. The former he sows again in comparative plots and this process goes on for several years; eventually he may have only 2 to 3 % of plants whose seed he considers is better in different ways than the mass seed. This method of crop improvement is known as 'pure line selection' and each plant is given a distinguishing number and is called a strain. The produce of these strains he distributes to the cultivators and awaits results. In a large province like Madras with variations in climate and soil, it is impossible to expect any particular strain to do well uniformly. Therefore, he issues a number of strains in the hope of finding at least one or two which do better than others in any one locality. So that while he may have a number of strains doing equally well in a particular locality, some of these might behave entirely differently under another set of conditions. The task of the plant breeder is therefore not so simple or easy. It calls for a good deal of patience, optimism, courage and above all honesty, as the result of his work is to be j dged by a set of practically minded people,--people who know what they are talking about.

Let us go into a little more detail in regard to the objects the breeder has in crop improvement. Take the question of *yield*. Supposing a particular variety of paddy in a particular locality yields 2000 lb. of grain per acre. By his efforts which may have meant 6 to 7 years in

time, he finds that the strain selected from this variety had given by repeated tests 10 % more yield (i.e.) 2200 lb. as against 2000 lb previously. What benefit does this mean? In the case of an individual ryot, for every acre of the improved seed he grows, he would get an additional value of Rs. 5 per acre if it is reckoned that for a rupee you could purchase 40 lb. of paddy grain. Therefore, if one has 10 acres, he would obtain Rs. 50 more than before. In the Madras Presidency, there are at least 11 million acres of paddy. If such an improvement could be effected in all the varieties of paddy in the Presidency, it would mean that by this one improvement alone the ryots of the Presidency would get Rs. 55,000,000 annually more than they used to obtain before the introduction of the improvement. In fact, the improvement is as much as 30 % sometimes, but as a general rule, we can reckon on a 10 % increase in regard to yield.

Take again the question of *quality*. We have a strain of paddy known as G. E. B. 24 which has a very fine grain. It is a good yielder but is prized more for quality than yield. It is reckoned that it would fetch 4 to 8 annas more per bag than other varieties. If an acre produces 10 bags, the extra profit by growing this improved variety varies from Rs. $2\frac{1}{2}$ to Rs. 5. So far, for profits that one obtains by plant breeding for high quality. Research is also undertaken to find out what factors are responsible for quality and whether the so called quality is desirable or not. Take, for example, the question of polished rice which educated and well-to-do people prefer to consume. Is it desirable to eat it? It has been shown that it is not as nutritious as unpolished rice, the reason being that in polished rice there is the absence of the aleurone layer in which there is an important principle called tryptophane which is necessary for animal diet. Similarly, in *ragi*, there are two varieties according to colour: white and brown. Which should we consume? Research has shown that while white *ragi*, has a higher nutritive value, the brown has a higher biological value.

There is also the aspect of the duration of the crop. Should the plant breeder look for plants which are earlier maturers or late maturers? In other words, should we look for plants whose life time is short? In a tropical country and in crops which mature by means of irrigation, it is desirable to have plants which ripen off early, as late maturing crops require more irrigation and are therefore more costly to produce. There are certain strains which are excellent as far as yields go, but they need a fortnight longer to ripen. This is indeed a defect from the view point of people who have difficulties for irrigation. On the other hand, if there is no such difficulty, a 15% increase in yield cannot be despised.

Take again the case of a very popular variety of Cambodia cotton called Co. 2 which is a high yielder but is a late variety. As a rainfed

crop, it would be advantageous to have one which matures early in tracts of deficient rainfall. Attempts are, therefore, being made to cross-breed it to obtain the desirable result.

I have just referred to the early and late maturing varieties of crops. This leads on one to the question of the minimum requirements of crops for water. Different crops require different quantities of water, e. g. paddy, sugarcane, and cotton. The same crop requires different quantities at different seasons of the year, e. g. dry months and rainy months. Again, the needs of different varieties of the same crop vary, e. g. sugarcane. From the point of view of crop improvement, it is desirable to have varieties which call for the minimum quantity of water without sacrificing the yield. A variety of sugarcane needs in the Vizagapatam District only one irrigation till the time of harvest whereas other varieties require 20 irrigations. This calls for the study of the root system of plants. When these are examined in a field where different varieties are grown, e. g. sugarcane, it is observed that roots of certain varieties go far deeply into the soil while others remain on the top regions. Further, observations of such varieties show that in a period of excessive drought, varieties possessing a deep root system withstand it better than their shallow rooted neighbours. Here, therefore, is the opportunity for one interested in the welfare of the agriculturist to develop varieties which are drought resistant and suggest to him those which he considers more advantageous, especially in tracts of precarious rainfall.

There are other directions in which a knowledge of Botany is so helpful to the scientific agriculturist. You have heard of fertilisation of plants by various agencies like wind, water and insects. To preserve the purity of his strain, the plant breeder takes steps to see that the plants he selects are self-fertilised, e. g. by bagging whenever necessary. On the other hand, he deliberately crosses one plant with another for the purpose of introducing into his strain certain desirable qualities. For example, you have two varieties of paddy—one is a heavy yielder but is susceptible to a particular disease, and the other though not so good in yield resists the disease. He crosses both varieties with a view to introduce into the blood of their progeny a quality of resistance without sacrificing the yield. We have in Tanjore now a disease resistant strain to a very serious disease of paddy called 'Blast' (*Piricularia oryzae.*)

Similarly, you have heard of parasites living on other living plants. *Striga* is a parasite living on the roots of certain cereal plants. Attempts are being made to evolve strains which are resistant to this parasite. By hybridisation or cross fertilisation, you can increase yield, remove weaknesses like lodging and disease, make plants withstand unfavourable conditions like alkalinity in soils, and resist drought, etc. You may have heard of the intergeneric crosses made

by Rao Bahadur T. S. Venkataraman between sugarcane and sorghum with a view to reduce the age of cane from 11 months to 8 to 9 months. Similarly, we have, under trial, crosses in castor which have brought down the normal age from 8½ months to 5 months. These are of great economic importance to cultivators. In Europe, horticulturists take advantage of this fact of crossing and produce flowers of great brilliance by combining certain colours. You are aware that potatoes are propagated from tubers. They are either cut or planted whole. Potatoes also form flowers and seed, but the latter is a very rare occurrence here. Careful attempts made in our potato farm at Nanjanad have enabled us to produce seed and we have now quite a number of varieties of potato from which fertile seeds have been obtained. We have quite a large number of seedlings obtained in this manner and from these, hybrid varieties have also been successfully produced which are better yielders and earlier maturers.

You have learnt in Botany that plants need food, air and moisture. There are, as you know, certain essential elements without which the plants will either die or do not thrive properly. This knowledge is very essential to the scientific agriculturist as this is the basis of manuring of crops. It is known that crops should have sufficient quantities of nitrogen, phosphoric acid and potash: a deficiency of any one or more of these will at once tell on the health of the crop or on the yield. Although the actual requirement of the crop for each ingredient can be ascertained by analysis of soil and the plant, experience goes a long way in helping the agriculturist to know what kind and what quantity of each should be applied to obtain a normal out-turn.

The plant breeder has also, however, to face the problem of deterioration and disease—deterioration because in the hands of the illiterate ryot the pure seed gets mixed with his old seed and all the trouble he has taken in crop improvement becomes a waste; the department has therefore to concern itself in seeing that such mixtures are removed and the purity maintained as far as possible. In regard to disease, their number is legion. I shall not trouble you with what these diseases are and what is being done in regard to them, but I would like to illustrate one or two interesting instances from the point of view of students of Botany. There is a serious insect pest called 'stem weevil' in cotton which bores into the stem and makes the plant to fall down and in extreme cases kills it. Certain types of the cotton plant however, stem the onslaught of the insect by exuding a gum to cover over the damaged part and thus arrest the progress of the insect.

It is not my desire to take you into the several ramifications of this entrancing subject. I have, I hope, been able to show you how a knowledge of Botany is not only helpful but also necessary for the

scientific agriculturist and what the department of Agriculture does in the direction of crop improvement for the benefit of the ryot with the knowledge of Botany it has in its possession. If Botany is studied from this point of view, I am sure you will agree with me, that the study will not only be interesting but is worth all the trouble you take in mastering it, because it would help to improve the lot of a class of people who need our help most.

THE STORY OF TEA

BY S. DORASWAMI AIYAR, B. A.,

Assistant, Messrs. Parry & Co., Ltd., (Fertiliser Dept.).

Tea is probably the most popular beverage in the world, the total consumption being some hundreds of million pounds per annum. The cultivation of this plant has enabled thousands of acres of what had been, for many centuries, waste land in many countries to be converted into valuable plantations; and the cultivation of the plant, the manufacture of tea and the commerce in tea have given lucrative employment to thousands of people.

The principal countries consuming large quantities of tea are China, Japan, the United Kingdom, the British Colonies, Russia, the United States of America and the Netherlands. The consumption in some European countries, particularly, Germany, France and Denmark and in the Asiatic countries, principally, India, Tibet, Burma and Persia has been increasing. The principal countries producing tea are China, Japan, India, Ceylon and Java.

Tea in China. Tea was known to the Chinese from very early times, even many centuries before Christ. The Chinese names for tea, *Theh* or *Tha* and *Tcha* or *Cha* occur in several ancient literary works. The word *ming* was also used to denote tea. It is said that in the middle of the fourth century A. D. Wang Meng, the father-in-law of the then Emperor, was fond of drinking tea but his friends found it to be too bitter, and that a later Emperor, Wen-ti (589—605 A. D.) was recommended by a Buddhist priest to drink boiled *ming* leaves as a cure for headache. For some centuries tea was probably used only as a medicine. It was only in the 6th or 7th century that it came to be used as a beverage. The use of tea as a beverage should have been so general in China in the 8th century that a duty was imposed on it for purposes of revenue. About the year 850 A. D. an Arab merchant who travelled in China has mentioned in his account of travels that the people of China were accustomed to the use of tea as a beverage and that the leaves were being sold in all towns.

The cultivation of tea began to increase from the 9th century and considering the enormous population and the widespead consumption