

had entered the Veterinary Department and after a long service had retired as Deputy Superintendent of the Veterinary Department. The audience, he added, would be interested in hearing that he had, after retirement, taken to Cattle-breeding and was doing very good work in this line in Tinnevely—his native district.

Mr. Vellingiri Gounder M. L. C., remarked that he expected practical instruction on these lines from the officers of the Agricultural Department.

Mr. A. M. Richards—Veterinary Assistant—said that work on the lines of improvement of the milk yield was being done at the Central Farm at Coimbatore and that so far only three generations had been kept under observation. The results obtained thus far had been very interesting, but at the same time had proved that the results of selection and breeding were by no means as simple as they were usually supposed to be. The daughter of a cow with a good record had in many instances shown a diminution in yield, while the granddaughter on the other hand had shown a remarkable rise in yield of milk. He said there was no doubt that a heavy yielding breed can be built up by scientific breeding, though it would certainly take a long time. He further remarked that so far the aim of the cattle breeder in Coimbatore was not a heavy production of milk but the creation of good work animals.

Mr. K. Unnikrishna Menon remarked in this connection that one of the aims of the breeder in this direction ought to be the shortening of the dry period of cows.

Prevention is better than Cure.

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This is a maxim well-known to everybody, though only very few people act up to it. It is often quoted in reference to human ailments but it is more applicable in the case of plant diseases because their treatment is more of a preventive than of a curative nature. In human illness medicinal means are often resorted to to effect a cure.

In plant diseases, this is not often done with any great success, as plants do not possess anything comparable to the blood stream of animals, the movements of sap in the former being essentially different from those of blood in the latter.

In this connection I do not think it will be out of place, to say a few words about that class of plant-life—the *Fungi*—which causes plant diseases. Fungi are low forms of plant-life. In appearance they differ from the higher, more developed plants in that they do not possess the green colouring matter—*Chlorophyll*. This lack of chlorophyll renders it impossible for them directly to absorb and assimilate inorganic materials and to form organic compounds for their development, and so they have to depend for their nourishment on other organic bodies, either living or dead. Those fungi which obtain their food from the living plants or animals are called PARASITIC FUNGI; those that live upon the remains of plants or animals are called SAPROPHYTIC FUNGI.

In this paper I propose to dwell at length on parasitic fungi in as much as they cause most of the destructive diseases that we generally come across in plants. The Mycology section has every-day to deal with one or more cases of the following forms of parasitic fungi; such as *Rhizoctonia* attacking the root of cotton plants, the stem-bleeding disease of coconut palm and the Red-rot of sugarcane attacking stems, Die-back of Citrus attacking branches, Leaf-spot on Turmeric and Rust on coffee attacking leaves, Mabali disease of arecanuts and Mildew on grapes attacking fruits, and smuts of cereals attacking grains. All these diseases are the various manifestations of parasitic fungi and it is evident from the above list that no part of a plant is free from their attack. Side by side with the study of plant diseases attempts have been made, with a certain amount of success, to find out what preventive measures one should adopt in combating diseases. Plant diseases like human ailments can be treated in various ways and the best is of course to act up to the maxim which I have chosen as the title to this paper. In the following paragraphs are briefly given some important principles of treatment, principles that have been formulated after a series of experiments, minute observations and years of continued study.

Clean cultivation. It is of primary importance to keep the plants under thoroughly favourable environments so that their growth may be vigorous and healthy. Such favourable environments are secured by good and clean cultivation, as also by proper tillage which encourages free development of roots, adequate drainage which secures thorough aeration and wide-spacing which allows free circulation of air and admission of light.

Hygienic and Surgical Methods. The surgical and hygienic means of dealing with diseases of plants are not unknown to plant pathologists. When hygienic and surgical methods are assuming increasing importance and popularity in the medical profession, it is of interest to note, that these twin phases of plant sanitation have long been the main-stay of plant-doctors. The first principle in plant-sanitation is to remove as completely as possible the affected parts of the plant or tree so that they may not offer any harbourage for the feeding and multiplication of fungoid pests. If the diseased materials are allowed to remain in the field or gardens or in their vicinity, the fungi which killed the plant will soon fructify and spread the spores around in the same way as if they were still attached to the standing tree. From this it is clear that the mere removal of the affected portions from a plant will not be of much use to eradicate the disease. Such removal must be followed by their speedy destruction by fire *in situ*. In certain cases, e. g. the Mahali disease of areca-nuts in the West Coast, the disease is carried over from season to season by affected fruits left lying scattered about in the garden. Here the resting spores which manage to live through the unfavourable season are mostly found in the old fallen nuts and spadices which are negligently allowed to remain in the garden.

Fruit-trees in particular lend themselves easily to surgical treatment when attacked by certain diseases. When one member of the plant suffers, the other members do not all necessarily suffer and the removal of the affected portion or portions, only benefits the remaining parts of the tree. This is taken advantage of in dealing with

the Die-back disease of Oranges, Lemons, and similar plants. In cutting off the diseased portions of an affected tree or plant, care should be taken to see that the seat of infection is completely removed. In dealing with Stem-bleeding disease of coconut palms the operator opens out the seat of infection with an ordinary chisel and all the diseased portions are completely scooped out and the wound is scorched and tar applied. When large branches of trees are cut off, the exposed surfaces should be smoothened and covered with tar to prevent ingress of wound parasites. It is the accidental wounds and the ill-trained gardener's pruning that offer special facilities for the entrance of wound parasites.

Another point of importance is *seed-selection*. In raising a crop particular attention must be paid to the selection of seeds; only the best and most healthy seeds are to be used. In most cases this is the most natural and easiest way of controlling a disease, e. g. fruit disease of beans is caused by sowing seeds from diseased pods. The diseased pods always contain diseased seeds and in selecting seeds one should see that they are taken only from those plants that are free from disease. The Red-rot of cane and the Ring-disease of the potato do considerable damage to sugarcane and potato crops respectively. The diseases are carried over from season to season by planting setts or tubers from diseased plants and could be mostly prevented if only care is taken to select disease-free setts or tubers for planting.

Rotation. In this connection I wish to emphasise another important practice adopted for checking plant diseases, I mean the rotation of crops. It is a well known fact that the spores of a given parasitic fungus do not indiscriminately infect every kind of plant that the spores happen to come in contact with. On the other hand the majority of the most destructive parasites known, can infect and set up a disease on one particular kind of plant or at most a few closely related plants. To take a concrete example, let us take the wilt disease of cotton caused by *Rhizoctonia solani*. The fungus which causes this disease remains in the soil and is capable of retaining its vitality for a long time. If cotton is repeatedly grown

in the same field the crop gets infected. So to starve the fungus another crop such as ragi or cholam which is not susceptible to the same disease must be grown.

Growing disease-resistant varieties. Just as it is possible to select and evolve varieties to produce improved fruits or grains, so also is it within the reach of the plant-breeder to secure disease-resistant varieties. It very often happens that those varieties which are resistant to disease are poor in quality or in out-turn. Here the Plant-Pathologist and the cultivator have to look up to the expert plant-breeder for assistance in making the necessary desirable combinations. As is well known a certain amount of success has been achieved in this direction, chiefly among the cereals. For instance, in Northern India a disease called RUST was causing immense loss to wheat. By a series of crossing experiments the Imperial Economic Botanist has been able to evolve a new strain (Pusa 12) which besides being a rust-resistant variety is also a very good yielder. We have another equally good example in G. E. B. 24. This variety, which combines both quality and outturn, was evolved at the Paddy Breeding Station by the Government Economic Botanist and has been found to be resistant to two serious diseases of paddy *viz.*, BLAST & BURNIS.

Application of chemicals that are fungicides. This is another mode of treatment of plant diseases which is also important. I refer to the use of chemicals that are fungicides. Of these the Bordeaux mixture (a mixture of copper sulphate and lime) is one that the vine-growers of France first began to use as a means of protection against the much dreaded Mildew on grapes. A fungicide is a substance that will kill or prevent the growth of a fungus or the germination of spores. Fungicides are applied either to the seeds or to the aerial portions of plants. The latter is commonly accomplished by the operation of spraying.

In the former case the intention is to destroy the spores attached to the seeds, else the spores would germinate along with the seeds and infect the seedlings. The Short-smut of cholam which does considerable damage to cholam crops in this Presidency can be

prevented by a simple and cheap method which many ryots have taken to. If the seed is steeped before sowing in a 2% solution of copper sulphate, all the spores adhering to the seeds will be killed. Seed, thus treated, if sown will produce a crop free from smut.

Fungicides should be applied to the aerial portions of a plant before the fungus appears in order that the leaves and stems etc., may be protected from penetration. As already stated, on the West Coast areca-nuts are attacked by a disease known as Mabali which causes immense loss to the garden-owners during the monsoon. If the nuts are sprayed, before the out-burst of the monsoon with a mixture of copper sulphate and lime, they get complete protection since the spores that may subsequently fall on them will not germinate. A spraying machine is essential to give a uniform and complete coating to the surface. The small pressure sprayers used by the arecanut garden-owners of Malabar are the cheapest, best, and most convenient for the purpose. Diseases like Mildew on grapes, Rust on coffee etc., can be entirely or almost entirely controlled by spraying with Bordeaux Mixture at the proper time. I do not propose to dwell further on the subject of spraying, except to mention, in passing, that much money is wasted by spraying at the wrong time. Promptness, as you know, is an essential factor in the treatment of diseases and to deal with any of them successfully they must be tackled at an early stage.

Quarantine. In these days of cheap and quick transport, no country is isolated and farmers very often import more profitable varieties from other countries. Such introduction should be done with the greatest care since we can never tell which diseases are being imported along with them. In many instances, it is impossible to detect anything until it is too late. This brings us to another important item of controlling plant diseases, I mean the system of quarantine adopted in many countries, where newly imported seeds and plants are subjected to fumigation and periodical inspection by qualified persons to see whether they are free from disease. If found infected they are destroyed then and there.

Co-operation and Legislation. It is always necessary to have the co-operation of one's neighbours in combating plant diseases. There

is no use of getting one's own crops free from disease, if they are liable to get infected from the neighbouring fields. The neighbours who neglect to remove the diseased materials or fail to follow the instructions, are a menace not only to themselves but to their fellow-cultivators as well. To deal with such persons State intervention is necessary. The Madras Pests and Diseases Act of 1919, which lays down certain penalties to such ryots as fail to act up to its provisions for combating plant diseases, is an instance in point.

Conclusion. In this paper, I have, gentlemen, given a brief account of a few simple methods of treatment, which even a poor ryot can adopt to save himself from ruin. In these days of famine and struggle a single ear-head or a fruit saved is, I think, a distinct gain to the ever-toiling ryots of our country. If in this attempt of mine I have been able to create an interest in those who are always engaged in Agriculture, to take timely precautions (I say timely precautions because a STITCH IN TIME SAVES NINE) to protect their crops from the ravages of troublesome fungus diseases, I shall consider myself amply rewarded.

My sincere thanks are due to Mr. S. Sundararama Iyer, the Government Mycologist, for his advice in the preparation of this paper.

Discussion.

Mr. Anstead—Director of Agriculture—remarked that most of the methods at present advocated against diseases of plants—whether preventive or curative—aimed merely at the creation of certain artificial conditions. They proved always more or less of the nature of makeshifts and had only a purely temporary effect. He said he preferred the cultural method. This was a slower process and required a thorough grasp of the laws governing plant-life, but it offered a permanent and natural solution to a problem that was world-wide and declared that the present-day nostrums for diseases would some day be relegated to our museums as curios and reminders of the bad old days.

Mr. S. Sundararaman, —Govt. Mycologist—illustrated the great value of preventive measures as regards fungus diseases by an instance which came under his observation recently. He stated that in the earlier years of the Palmyrah Disease operations in the Godavari District, cases of coconuts dying of Bud-rot were not at all rare, but when the prompt destruction of diseased Palmyrah trees was strictly enforced, death of coconut trees absolutely ceased. This fact was borne out by one of the garden owners who had himself suffered in the earlier years. Referring to Mr. Anstead's remark regarding cultural methods for Fungus diseases, he said, experience with spraying for the coffee disease was bearing out this idea.

Mr. C. V. Vellingiri Gounder, M. L. C., referring to the control of the cholam smut, remarked that he found smut very serious on cholam this year. He wished also some remedy for *Sudumalli* (*Striga*) which was a serious pest of cholam. As to helping the ryots, he observed that they did not care for research or elaborate experiments, but wanted to have practical results which needed to be explained to them in popular non-technical language. He also remarked that he thought there ought to be more of co-operation among the various sections of the institution in giving advice to ryots.

Mr. F. R. Parrell, —Govt. Economic Botanist—referring to the remarks of the last speaker said that, in his opinion, there was no foundation for the statement made by him as to a lack of co-operation and affirmed the fact that the various sections were in no way exclusive and that they did help each other.

Mr. G. N. Rangaswami Ayyangar, —Millets Specialist—stated that among the various methods of combating diseases—preventive or curative—the development of immune or disease-resistant strains by breeding and selection was one of the most promising. Good work, he said, had already been done in this direction by breeders especially against fungus diseases, as for example in producing rust-resistant wheats. At Coimbatore, Paddy Breeding Station, it was found, though purely by coincidence, that a new strain, G. E. B. 24

proved resistant to Paddy Blast. In work of this character a detailed study of the various minute morphological characters of the varieties dealt with was needed, as also a great deal of patience. In his opinion, though breeding methods gave good promise, their usefulness should not be strained too much, since the question of breeding for resistance to disease was still in the initial stages of investigation.

Rao Sahib M. R. Ramaswami Sivan,—Govt. Lect. Chemist—replying to the criticism of Mr. Vellingiri Goundar thought that his remarks as to a want of co-operation among the sections should have been based on incorrect information and remarked that in case any help was required he was free to come to the Institution and take the advice and help of the heads of sections. As to the results of research work conducted at the Research Institute, he confessed that there might be many failures but such failures were of value since success is usually built on perhaps a series of failures.

Mr. Anstead stated that the Agricultural Department was taking all possible measures to carry a knowledge of improved methods to the doors of the ryots. Leaflets in vernaculars couched in plain popular language were prepared and distributed. Lectures and demonstrations were given on occasions when people congregated at fairs and festivals, and he assured Mr. Goundar that all possible steps were being taken in this direction to help the ryot.

Mr. Venhatakrisna Mudallar—Assistant Mycologist—gave a short account of the history of development of curative methods.

Mr. Krishna Menon replying to criticism remarked that the Smut alluded to by Mr. Goundar was the "Long Smut"—different from the "Short Smut," which is generally more common and is easily checked by Copper Sulphate steeping.
