COMPOST AND DISEASE

By VINCENT A. WAGER, D.Sc., Acting Officer in Charge, Botanical Station, Durban

During the past few years the subject of compost has been receiving more and more publicity. This is as it should be, for no one can deny that compost is one of the best promoters of vigorous plant growth known, and every agriculturist should be induced to use it.

But, unfortunately, in many of the popular articles on the subject published in farming papers, the authors' handling of statements continually occur that compost will prevent or cure all diseases, that vegetables grown on compost will not be subject to plant diseases or insect pests, and that animals or humans fed on such compost-produced plants or vegetables also, in turn, will not be subject to all manner of illnesses or ailments. One might just quote a few of these statements here—

King says: 'As the fertility of our soil is built up (with compost), pests and diseases disappear because, once the soil is fertile, the crops produce themselves. I believe compost is a certain cure for all diseases of tomatoes. . . . If healthy plants are secured and compost is used . . . total immunity from disease can easily be obtained.'

Baker says: '. . . a healthy soil gives no encouragement to disease in animals or plants and does not bring forth insect pests . . . the addition of mineral fertilizers to the soil decreases plant resistance to disease.'

Ballour says: '. . . if the fertility of the soil is built up with adequate supplies of humus, crops do not suffer from disease and do not need sprays to control parasites . . . animals . . . and man . . . fed on these plants develop a high degree of disease resistance.'

And finally Howard says: 'Resistance to insect and fungus diseases is conferred by humus. . . . The policy of protecting crops from pests by means of sprays, powders and sprays is unscientific and unsound. . . . There can be no doubt that the work in progress on disease at the Experiment Stations is a gigantic and expensive failure.'

It may well be, of course, that such statements are made, with tongue in cheek, as propaganda, to provoke argument, or to stir the imagination of the more gullible farmers or backyard gardeners, and thus give more publicity to the main theme, which is, commendably, 'Use more compost.'

But actually, no good can come of publicising false statements and thereby alienating the interest of scientists or the sympathy of progressive farmers. For compost is not the panacea of all ills and it is no good saying so.

Before proving the falsity of such statements with experiments, let us discuss the situation. It is a well recognised fact that some human diseases are transmissible with epidemic or endemic frequency: tuberculosis, for example. In such cases there is no definite correlation between the health of the person and susceptibility to disease. Another example of this would be that a bee sting might have no effect on a healthy man but might kill one who had a weak heart. There are many human diseases that are no respecters of persons. For instance, think of the millions of people killed by influenza after the war and how often has one heard it said that it was the biggest and most robust person who went down with it first.

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are vulnerable to the attack of large numbers of diseases in their early days. Which means that most young; if unprotected, have some fungi, bacteria or insects on them. If the attackers can get a firm hold, then they may weaken or kill the victim or remains prey on it for years or for its life. If, however, the victim rapidly becomes strong and vigorous, it may shake off the attackers or feel little ill effects from them. This then is possibly the explanation of the claim that compost cures disease. The cabbage growing vigorously on compost might be able to carry a large population of aphids or catterpillars without showing many ill effects from their presence, whilst a neighbouring cabbage growing on infertile soil might, as a result of the same infection become stunted or even prematurely killed. To the untrained eye therefore it might well seem that the composted plant is thus resistant or immune to attack.

When speaking of diseases the compost enthusiasts evidently do not consider the "cause" of the disease as a living organism which also has to live. For instance, Rust\(^1\) that destroys the leaves and wipes out a field of wheat is no less a disease than a herd of one's neighbour's cattle that breaks into the same field, or a swarm of locusts that settles on it. A lovely garden of green peas is just as easily destroyed by a flock of sparrows as a plague of caterpillars or by an infection of the Mildew\(^2\) fungus. So why should growing our peas on compost, as we are asked to believe, prevent the depredations of the one, but not the other?

Let us again quote King\(^3\): "Sparrows are often troublesome amongst the peas . . . also blue tits or hawfinches . . . nothing but small meshed netting gives adequate protection. Attacks of aphids or mildew will seldom occur if good cultivation is followed."

A catterpillar has to feed on plants just as a sparrow, cow fungus or bacterium does. So why should a vegetable grown on compost promote good health in a cow any more than in a catterpillar or fungus?

A silkworm should be regarded as a pest just as much as the cabbage catterpillar, but I expect these compost fordistes would advise you to grow your mulberries on compost to get the best food to make bigger and better silkworms.

These discussions could be continued ad infinitum, but the subject is one so easy to prove that one wonders why such sweeping statements about compost cures continue to appear without any backing.

Two experiments have just been carried out by the writer using tomatoes and two of their commonest ailments in South Africa, Bacterial Wilt\(^4\) and Eelworm.\(^5\) The compost used in these experiments was very kindly prepared and given to the writer by Mr. G. C. Dymond of Darnall, Natal, who claims to have cured sugarcane of Streak disease with compost.

THE EXPERIMENT ON BACTERIAL WILT.

Infertile, red, sandy soil was used for the following mixtures.

The first series of tins was given no treatment—that is, just a poor soil.

The second series was given a fertilizer dressing at the following rate:—

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<tr>
<th>Fertilizer</th>
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<tr>
<td>Ammonium sulphate</td>
<td>200 lbs. per acre</td>
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<tr>
<td>Potassium chloride</td>
<td>200 lbs. per acre</td>
</tr>
<tr>
<td>Superphosphate</td>
<td>400 lbs. per acre</td>
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<tr>
<td>Agricultural lime</td>
<td>10,000 lbs. per acre</td>
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The third series was given the lime at 10,000 lbs. per acre and compost at the recommended rate of 20 tons per acre.

The fourth series was given the same lime dressing and compost at the rate of 100 tons per acre.

The soil had been placed in tins, of 2-gallon capacity, mixed as above, at the beginning of spring. Thinning of spring seedlings months later, tomato plants two inches high, which had been propagated in sterile soil, were planted in all the tins, four plants to a tin.

Two tins of each series were then inoculated with bacteria (by simply pouring on bacteria from cut-up stems of wilted tomato plants soaked in water; the roots were not disturbed at all) at the following intervals:

(a) when the plants were 4 ins. high;
(b) when the plants were 10 ins. high;
(c) when the plants were flowering;
(d) when the plants were fruiting.

The idea of the delayed intervals was to give the plants every opportunity of absorbing the magical qualities of the compost that would ward off the disease.

The results in each case were the same: all the inoculated plants wilted in due course.

Two tins of each series had not been inoculated; here all the plants lived until they died of old age. The tomatoes in the 100 ton compost were much the same; while the same: all the inoculated compost were less a disease than the same: all the inoculated compost were less a disease than the same:

The soils were mixed in exactly the same manner as for the previous experiment. Three months later eelworm nodules from infected plants were added to the soil of five tins of each series. Two tins of each series were not infected but were kept as checks. A month later four healthy tomato seedlings (grown on sterilised soil) were planted in each tin.

All the eelworm-infected plants, whether growing in the poor soil, fertilised soil, or soil with compost up to 100 tons per acre, became stunted, and their roots, on being dug up, were found to be one mass of nodules. The checks were perfectly healthy.

In this experiment, then, it was shown that compost did not have any magical quality which would kill the eelworms or prevent their infection of the plants. However, claims have been made that compost has indeed produced good eelworm-free crops in severely infected soil and the reason for this is interesting.

Park and Fernández\(^\#\) say: "... large quantities of organic material, green manure, compost, etc., added to the soil may reduce the eelworm population due to the increase of fungi, insects and other nematodes which prey on the eelworm."

These two experiments show that certain diseases are not cured or prevented by compost. Other diseases may be cured or prevented by improving the health and vigour of the individuals. Malnutrition of the human race is one of the most serious ills in the world at present. The promotion of health, strength and vigour of our agricultural products is the initial step toward the cure, so let us continue to urge all farmers to keep on using more compost.

But do not let us lose sight of the fact as stated by Russell\(^6\), renowned soil chemist and Director of the world-famous Rothamsted Experimental Station, that: "Best results are obtained by using judicious combinations of farmyard manure and inorganic fertilizers."

This discussion may well be ended with a quotation from Crowther\(^7\) also of Rothamsted, who says: "Nothing is to be gained by treating composting as a universal panacea. The
enthusiasts who support their propaganda for some special ritual, by attacking the use of fertilizers, would be doing a great disservice to our present food production programme, if, in fact, notice were taken of them outside the popular press.

"I do not think that anything can usefully be said on present evidence about those hypothetical ingredients of compost which have been said to confer perfect health and immunity from all diseases on plants, animals and man."

References.

FIG. 1. BACTERIAL WILT IN TOMATOES
Tin (1) is control with 100 tons compost per acre. The rest were inoculated with bacteria when the plants were 10 ins. high: (2) 100 tons compost. (3) 20 tons compost. (4) fertilizer only. (5) poor soil.

FIG. 2. BACTERIAL WILT IN TOMATOES.
Tins (1) 100 tons compost per acre and (5) poor soil are controls. The rest were inoculated when the plants were fruiting: (2) 100 tons compost. (3) 20 tons compost. (4) fertilizer.
FIG. 3. EELWORM IN TOMATOES.

Tom (1) is control with 100 tons compost per acre. The rest were all inoculated with eelworm: (2) 100 tons compost. (3) 20 tons compost. (4) fertilizer only. (5) poor soil.

(Photo V. A. Wager)

FIG. 4. EELWORM IN TOMATOES.

One root of each of the above dug up: No. 1 is control and is free of nodules; the rest are all severely infected.

(Photo V. A. Wager)
Mr. DYMOND welcomed Dr. Wager's paper as so few plant pathologists had expressed their views on this subject and had conducted scientifically controlled experiments on the so-called compost and disease controversy. It was high time they did, for only pathologists and allied scientists could thoroughly investigate the sometimes crude methods and perhaps imaginative observations of the untrained enthusiast. The House of Lords had twice discussed this subject and a Royal Commission might be appointed. The South African Sugar Technologists' Association had shown great interest in it, and it was hoped that Dr. Wager would continue his experiments.

He found the discursive, but not the experimental part of Dr. Wager's paper, strangely contradictory. The author admitted that there were many diseases produced by fungi and bacteria which occurred only on unhealthy and weakened plants due to cultural, soil or climatic conditions, and that there was a definite correlation between the health and vigour of a person and his susceptibility to disease. He further admitted the value of compost as one of the best promoters of vigorous plant growth known, and advocated that every horticulturalist should be induced to use it. He was of the opinion that overcoming the evil of malnutrition was the first step towards inducing a healthy race and that a plentiful supply of fresh vegetables was one of the first necessities to this end. After these admissions and statements it was difficult to see how the author could still maintain that it would be absurd to suggest that good health could be induced by eating vegetables grown on compost.

The speaker accepted the results of Dr. Wager's experiments as positive and as facts obtained under definite conditions of scientific experiment, but he questioned their value. Dr. Wager had planted tomato seedlings grown in sterilised soil into tins of soil prepared three months earlier, and after inoculating the plants with bacterial wilt and eelworm, they all died. He had prophesied they would.

Bacterial wilt and eelworm were two most serious diseases of some crops, but they were not found when healthy plants were grown on virgin soil, and virgin soil was simply soil that had been composted for centuries by nature, or one in which the cycle of life and death had been balanced. The question was whether continual composting could restore a soil to its original virgin state of health, and in this connection he would suggest that Dr. Wager should continue his research on the following lines: He should prepare large beds of unsterilised soil and inoculate them with bacterial wilt and eelworm. These beds should then be treated with compost periodically and replanted progressively every two or three months with tomato seeds. He expected that the virginised soil would eventually eliminate the disease.

The Department of Agriculture, Ceylon, had found that large quantities of organic matter greatly reduced the population of eelworms. Our Chief of the Division of Entomology stated in the South African "Farmers' Weekly," 13th April, 1945, that the only way to combat eelworm in gardens was to apply heavy dressings of manure or compost. This evidence, and there was more, rather contradicted Dr. Wager's results with eelworm. Howard maintained that eelworm in potatoes and similar diseases in wheat and rice were caused principally by the loss of porosity of the soil and poor aeration. Aeration, however, was greatly improved by earthworms, which loved compost.

Fifty-six species or forms of fungi had been discovered by mycologists, and it was found that twenty-five lived on nematodes, twenty-three on amoeba, five on rhizopods, while the remaining three were aquatic, but these natural enemies did not have a chance in the limited period of Dr. Wager's pot tests.

Dr. McMARTIN said he thought what Dr. Wager had in mind was that there were some diseases to which plants were more susceptible when undernourished, but there were other diseases which a plant could get as readily whatever its state of health might be, and whether it had been fertilised with compost or not.

Dr. DODDS said that compost, which was largely only a new name for the very old term farmyard manure, had come into prominence in recent years because of the shortage of artificial fertilizers owing to war conditions and the urgent need for increased foodstuffs. It had helped to maintain an increased soil fertility, but unfortunately some of the principal writers on the subject had made such wild claims for it, that they had prejudiced reasonable people against compost. Dr. Wager called attention to some of these claims and his paper was of great value on that account.

Mr. CUTLER said that the Department of Agriculture and the Division of Chemical Services had been very interested in the controversy about compost, especially so on account of the fertilizer shortage during the last few years. There was ample
evidence as to the beneficial effect of compost on the plant growth but there were no indications that it conferred immunity to disease. No statistical or material proof had been brought forward from any experiment as far as he knew. It would be very difficult to lay down the necessary experiments to prove the point beyond any doubt, as the main effect would be obscured by other factors.

The PRESIDENT said that the danger of a universal claim was that it required only one adverse result to disprove it. A qualified claim, however, was much more difficult to disprove.

He suggested that Mr. Dymond and Dr. Wager should cooperate in this work and lay out experiments as suggested by Mr. Dymond or in some modified form. The result of their observations could then be brought before us at a later date, and it would be the results of a definite scientific experiment and not a preordained answer from a doctrinaire school.

Dr. WAGER, in reply, stated that he had drawn attention to the apparent confusion that existed in certain quarters about the word "disease." He had tried to show that some diseases of plants, animals and man were due primarily to malnutrition or adverse conditions. Such cases could be prevented, perhaps even cured, by taking steps that would promote vigorous growth. There were, however, very definitely other organisms which were the primary cause of disease, and which would attack plants, animals and man no matter what their state of health.

No critics of his paper had attacked the subject of disease-resistant varieties. If a poor non-composted soil was responsible for disease why then did the resistant varieties survive and flourish?

Compost enthusiasts claimed that compost conferred some property on plants which made them immune to attacks from pests and disease. The way to prove this was to grow the plants on compost and then to add the pest or disease. He could see no other way in which to plan such an experiment except the one described.

A virgin soil, to his mind, was one which at least during man's mismanagement in overgrazing and veld burning had received little if any compost. A virgin soil was one which had not been cultivated by man, and which, therefore, had not become contaminated with the disease organisms peculiar to the crop which the farmer intends to plant in it.