hormones containing the α,β unsaturated ketone structure also contain an enzyme that will oxidize the Δ^5-3-ol structure to the conjugated form in the presence of DPN as a hydrogen acceptor. This enzyme would appear fundamental in the biological synthesis of these important hormones.

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Morphology of the Ovary of *Oryza Sativa* Linn. Var. *Plena* ("Double Rice")

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The ovary of *Oryza sativa* Linn. is superior, one-celled and contains a single ovule. In the variety *Plena* of the same species Prain (*1*) has recorded that there are as many as 7 ovaries in some specimens, the usual number of ovaries found being 2–5. Neither he nor any other worker has mentioned the number of ovules present in each such ovary. S. K. Mukherjee, Curator of the Herbarium, Indian Botanic Gardens, Sibpur, Calcutta, writes from the notes available in the Herbarium thus:

> After the stamens wither, it is most usual to find that only two ovaries continue to develop and then not infrequently one of these fails to grow as fast as the other; but very often both grow equally, and the result is the ''Double Rice.'' In this case the inner faces of both the grains are flat with a whitish vertical central band, and on section, the embryo of each is found at the outer, or glumal, aspect of the base of the grain. In a few cases three grains are developed, and then instead of having flat faces, they meet in the centre at the white line already mentioned, this line being at the apex of an obtuse angle; the embryo is in each case at the outside, as before.

In the course of our study on this variety, we have observed in several cases the presence of 2 ovules in a single ovary, the number of ovaries being the same as mentioned by Prain (*1*). These ovules grow to maturity side by side. They have 2 integuments each. More than one archesporial cell has also been observed (Fig. 1). Morinaga and Fukushima (*2*) found 2 ovules in an ovary of a haploid rice plant (*O. sativa*) and several ovules with 2 embryo-sac mother cells. In *Inapostol*, a Philippine variety of *O. sativa*, Juliano and Aldama (*3*) also recorded a two-celled archesporium in addition to the normal one-celled. They, however, recorded that only one of them becomes functional. Kuwada (*4*) also found a single instance of a two-celled archesporium in a Japanese variety of *O. sativa*.

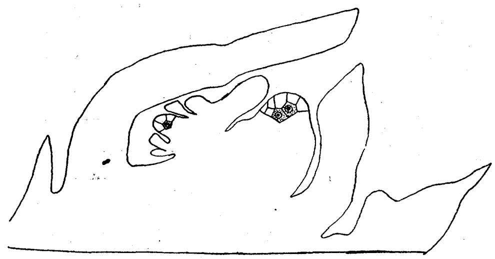

FIG. 1. Section of the ovary of "double rice" showing 2 ovules with two-celled archesporium in one of them. (× 475.)

Hence, "double rice" is not only due to the presence of 2 or more ovaries, each containing a functional ovule, but also due to the presence of more than one ovule, generally 2, in each such ovary—a fact not recorded before. Fuller details will be published later.

[1] We offer our sincere thanks to S. K. Mukherjee for supplying us with the notes at the disposal of the Gardens.

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A Root Disease of Plants Caused by a Nematode of the Genus *Trichodorus*

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A root disease of plants that seriously hampers the growing of certain vegetable crops in Florida is caused by a nematode of the genus *Trichodorus* Cobb, 1913. Stubby-root and the stubby-root nematode are suggested as common names for this disease and the causal organism, respectively. Thorne (*1*) places the genus *Trichodorus* in the family Diphtherophoridae of the superfamily Dorylaimoidea. No other member of this superfamily is known to be a serious plant pest, the only ones generally regarded as probably feeding on and injuring the roots of plants being species of *Xiphinema*.

Trichodorus primitivus (deMan 1876) Micoletzky, 1922, was collected first in the Netherlands by deMan, who named and described it (*2*). Subsequently, nematodes that Thorne believed to be the same species were collected by him near Fort Collins, Colo., near San Luis Obispo, Calif., and at various points in Utah, and by Cobb (*3*) near Arlington, Va. The stubby-root nematode is closely related to *T. primitivus*, but because there appears to be doubt in the minds of some taxonomists regarding its specific identity it is herein designated *Trichodorus* sp., pending further study.

Stubby-root has been produced experimentally under conditions sufficiently well controlled to provide reasonably convincing evidence that *Trichodorus* sp. is in fact the cause. Nematodes of the species in question were isolated from soil collected around the roots of affected plants and, in lots of 100 or more, were transferred in a few ml of water to autoclaved soil. An attempt was then made to build up this nematode population by growing in the soil some suitable plant. In this manner abnormalities of growth have been produced on the roots of beets (*Beta vulgaris*) and sweet corn (*Zea mays*) that were the same as those found on the roots of field-grown plants. In comparable controls, where the soil differed only in the absence of these nematodes, the roots of the experimental plants showed no such abnormalities.

In addition to beets and sweet corn, abnormalities of root growth that, without much doubt, were caused by this same nematode, have been observed on field-grown plants of bean (*Phaseolus vulgaris*), cabbage (*Brassica oleracea capitata*), cauliflower (*Brassica oleracea botrytis*), celery (*Apium graveolens dulce*), chayote (*Sechium edule*), cowpea (*Vigna sinensis*), Lima bean (*Phaseolus limensis*), pea (*Pisum sativum*), pepper (*Capsicum frutescens*), sesbania (*Sesbania emerus*), and tomato (*Lycopersicon esculentum*). Stubby-root is known to occur in the regions of Sanford, Hastings, Winter Garden, Plant City, and Ruskin, Fla.; Auburn, Ala.; Tifton, Ga.; and Florence, S. C. Undoubtedly the disease is widespread in the South and affects a great many different kinds of plants.

The stubby-root nematode is primarily an external feeder, its head very rarely becoming embedded in or attached to the root to such an extent that the parasite can be observed in the feeding position. In a few cases, when roots were removed from the soil carefully and placed immediately in a Syracuse watch glass containing water, large numbers of the parasites were seen loosely adhering to the surfaces of the root tips. They soon left the roots and sank to the bottom of the dish. Even when roots are dug with care most of the nematodes are left in the soil, and if the roots are washed all that remain on them are likely to be removed.

Abnormalities of root growth are caused, for the most part, by injury inflicted at the root tips. In general, necrosis is not very extensive during early stages of the disease, though the amount depends, to some extent, on the kind of plant. In most cases the tips of the roots turn brown, but the roots of some plants, such as corn, may show little or no discoloration, even at the tips. At later stages of the disease there may be a good deal of necrosis, with many of the roots wholly or partly killed, but probably this is due to secondary invaders and other causes.

The disease is especially damaging to seedlings. When a seed is germinating, the growing tip may be attacked and killed while the shoot is very short. It seems probable that injury of this kind is responsible for a great deal of preemergence damping-off. As the first roots of the seedling develop, the tips are attacked and growth is stopped. The roots then form branches, and the tips of these are likewise attacked. The radicle of a corn seedling may be affected but quite frequently escapes injury, at least until it has acquired a moderate length. The roots that develop near the base of the corn stem are quite likely to be attacked, sometimes while they are very short (Fig. 1). Occasionally one or two roots may escape injury and, for a time at least, grow more or less normally. Plants are frequently found whose entire root system has developed from one main root.

FIG. 1. Stubby-root on corn seedlings (field-grown plants).

The type of root growth that characterizes the disease on older plants varies considerably. If the branches grow to a moderate length before growth is terminated, the tendency is toward the development of a root system composed of short, stubby, sometimes slightly swollen branches (Fig. 2). If the laterals are killed almost as soon as they break through the cortex, the result may be an open root system, with the few roots present largely devoid of branches or with short, knoblike branches. Some plants, like tomatoes, may be severely stunted, yet the roots show no obvious abnormality other than a dearth of small, feeding rootlets. Various intermediate conditions and deviations

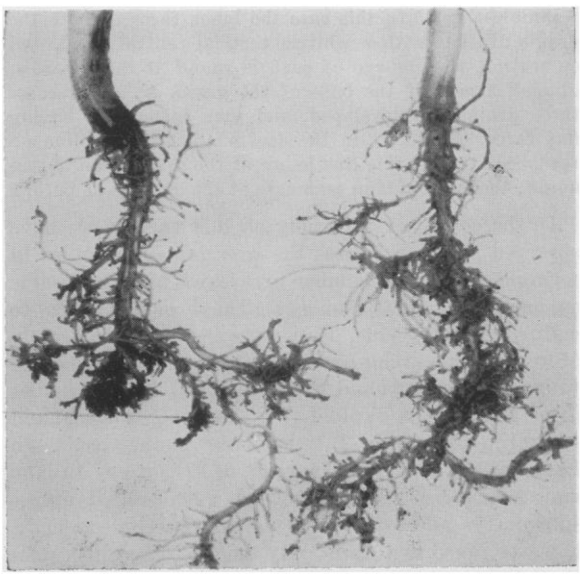

FIG. 2. Severe stubby-root on Lima beans (field-grown plants).

from these types may occur, depending on the growth characteristics of the plant, the severity of the injury, and the stage to which the plant has developed before it is attacked. Swellings or galls, comparable to those caused by the root-knot nematodes *Meloidogyne* spp.,[1] do not occur.

The aboveground symptoms are essentially the same as those caused by any condition that deprives a plant of an adequate root system. Growth is retarded, the foliage wilts easily, and the plant has little ability to withstand drought. The foliage of severely stunted plants frequently turns yellow, a condition that may be quite pronounced on corn. It seems probable that such a chlorotic condition is not caused directly by the nematode but is due to some soil deficiency or other condition that is aggravated in the plant through lack of a normally functioning root system.

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[1] Formerly *Heterodera marioni* (Cornu) Goodey.

Attempt to Show Diffusion of Essential Growth Factors from an Induced Penicillin-resistant Culture to the Parent Penicillin-sensitive Strain

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In 1940 Woods (*1*) showed that PABA, an essential growth factor for many bacteria, was competitively replaced by sulfanilamide, thus inhibiting the susceptible organism. He also demonstrated that bacteria capable of synthesizing PABA were resistant to sulfanilamide, indicating the production of a diffusible metabolic substance to inhibit a chemotherapeutic agent.

Bailey and Cavalitto (*2*) stated that penicillin acts by blocking essential sulfhydryl and possibly amino groups, producing a metabolic block.

Gale and Rodwell (*3*) believe that penicillin-sensitive organisms cannot synthesize many amino acids, especially glutamic acid, whereas resistant organisms can synthesize them from inorganic constituents; penicillin thus acts to impair the ability to assimilate glutamic acid from the medium.

Plough and Grimm (*4*) converted a naturally penicillin-resistant heterotrophic strain of *Salmonella typhimurium* to a penicillin-sensitive cysteine-requiring mutant, indicating that penicillin blocks assimilation of certain amino acids required by the susceptible strain.

Hunter and Baker (*5*) objected to the assimilation-blocking theory of Gale by revealing that a penicillin-sensitive *Bacillus subtilis* may synthesize and not assimilate amino acids, and that some strains of *Escherichia coli,* which synthesize but do not assimilate amino acids, are inhibited by penicillin in high concentration.

In the present study an attempt was made to determine whether an induced penicillin-resistant strain of *Staphylococcus aureus* could synthesize a diffusible product that might supply the parent (penicillin-sensitive) strain with the essential nutrilites to grow in the presence of a lethal amount of penicillin.

The culture used was *Staph. aureus* strain L obtained from Boston University School of Medicine and did not produce penicillinase. The penicillin used was sodium penicillin G (Commercial Solvents Corporation). Resistance was induced as previously described (*6*) by transferring 0.5 ml from the tube of the lowest concentration of penicillin that inhibited to 10 ml of plain broth. After 24 hr of growth the broth culture was used in a penicillin titration of a higher range.

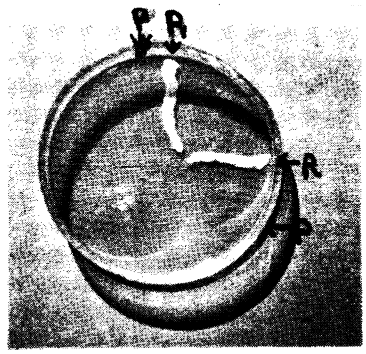

FIG. 1. Penicillin-agar plate. *P,* culture sensitive to penicillin; *R,* culture resistant to penicillin.

To determine possible diffusion of essential nutrilites from the resistant to the sensitive strain, a method described by Davis (*7*), which he used to show diffusion of synthesized products from one culture to a biochemically deficient mutant, was employed. A typical plate is shown in Fig. 1. Nine ml of plain agar at 45°–50° C was added to 1.0 ml of the appropriate concentration of penicillin in a Petri dish. The agar and penicillin were mixed by rotating, and the agar was allowed to harden. Streaks of 24-hr broth cultures of resistant and parent strains were made adjacent to each other to test for diffusion of vital materials from the resistant culture to the sensitive culture. Controls of parent and resistant strains were prepared on the same plate by making streaks at distant parts of the plate.

It appears that generally no essential nutrient was supplied by diffusion to enable the penicillin-sensitive strain to reproduce adjacent to the penicillin-resistant strain. These results favor the theory of Gale and Rodwell (*3*) that penicillin impairs the ability of the culture to assimilate an essential nutrient from the medium, whereas the resistant strain is able to synthesize the substance within its cell. It must also be considered, however, that other mechanisms may be taking place, such as the "learned" ability of the resistant