THE PROBLEM OF THE BLAST DISEASE OF RICE*

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DESPITE much work done on the blast disease of rice caused by *Piricularia oryzæ* Cav. there is still a lacuna in our knowledge on the physiology of the fungus and its host-parasite relationships.

Our investigations and those of others indicate that the vitamins thiamine and biotin and the heavy metals Fe, Zn, Mn and, to a certain extent, Cu are indispensable for growth and sporulation of the fungus *in vitro*[1] and considerably greater amounts of the nutrilites are needed for sporulation than for growth.[2] Taking thiamine alone, the fungus does not need the intact molecule but only the pyrimidine fraction on a sucrose-nitrate medium. Curiously, however, the biosynthetic abilities of the organism towards thiamine seems to depend upon the nature of the substrate sugar. With maltose, pyrimidine is equivalent to the whole thiamine molecule, whereas with glucose as the carbon source, pyrimidine is not fully effective thus indicating that pyrimidine is probably active only when present with the labile γ form of glucose. The utilization of pyrimidine under these restricted conditions appears to be a temperature phase when disaccharides are hydrolysed.[3,4] Inorganic nitrogen metabolism of the pathogen *in vitro*[5] shows that while the fungus uses NO_3 nitrogen with ease, inorganic NH_4 nitrogen is not assimilated due to the development of a high physiological acidity in the case of ammonium salts of strong acids like ammonium sulphate. Should this acidity be neutralized with $CaCO_3$ or if certain organic acids of the Kreb's cycle like succinic, fumaric and citric acids are added in small amounts, normal growth of the fungus is evident with ammoniacal nitrogen. Thus, the action of the organic acids appears to be two-fold: either they act as buffers or enter the metabolic cycle to combine with the ammonium ions to form the primary amino acids.

Among the metabolic products of interest synthesized by this fungus *in vitro* is the identification of the toxin piricularin and α-piconilic acid.[6] What role thiamine and the specialized nitrogen sources this fungus seems to prefer play in the synthesis of these toxins is a point of interest and offers great scope for future investigations.

Little is known of the biologics of parasitism of *Piricularia oryzæ* and normal suscepts fail to take infection under temperatures of 24-26° C. and above 95% humidity which have been found optimum for infection. Quite recently we have succeeded in demonstrating that a low night temperature (about 20° C.), is intimately connected with host susceptibility in altering the nitrogen metabolism of the host and favouring amide synthesis especially glutamine, by facilitating greater nitrate reduction.[7] At high nycto-temperatures, nitrate reduction is possibly low and the photosynthates are mainly utilized in the building up of complex cell-wall materials which might combine with high concentrations of silicon observed in rice plants and form organo-silicon complexes which are relatively resistant to attack by extra-cellular enzymes of *P. oryzæ*.[8] Earlier results on the nitrogen metabolism of the rice plants, resistant and susceptible to the blast disease,[2] viewed in light of our recent findings indicate that the susceptible types possess a more keyed up enzyme system(s) for the efficient utilization of the absorbed N than the resistant ones. This appears to be true of glutamine synthesis in the two types.

Earlier investigations on the cuticular excretions of the rice plant in relation to disease incidence showed that a variety of amino and organic acids are found on the leaf blades of rice.[9] Recent studies have, however, revealed that among the metabolites, glutamine crystallizes on the leaf surfaces in sizeable quantities under conditions of heavy nitrogenous manuring and markedly stimulates the germination of *Piricularia* spores.[10]

Current investigations on the resistance of rice to *Piricularia* indicate that resistance can be broken down with maleic hydrazide, but only if the plants have been subjected to a low nycto-temperature (20° C.).[11] This only strengthens our view that the resistance-susceptibility mechanisms in relation to the blast disease though primarily gene controlled, is intimately interrelated with the physiology of the host as influenced by the environment, particularly low nycto-temperatures.

All these experimental findings indicate exacting growth requirements of the fungus

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in vitro and possibly *in vivo*. It is, therefore, logical to consider the blast fungus as one with a higher level of specialization than a mere facultative saprophyte.

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A VERSATILE RESEARCH REACTOR WITH A NEW TYPE OF CORE

THE TRIGA, an American multi-purpose research reactor has been specially designed for research laboratories and academic institutions. It can be used for research and training, as well as for isotope production, and its makers, General Dynamics, claim that it is accident-proof.

The fuel elements consist of a solid mixture of uranium of 20% enrichment and zirconium-hydride moderators. Zirconium hydride is a remarkable substance because it has as much hydrogen per unit volume as water and at the same time has metallic properties.

The core is at the bottom of a well 20′ deep and 6′ in diameter. Shielding is provided by about 16′ of water above the core, which gives sufficient protection from radiation and allows the removal of specimens while the reactor is operating. The water also allows the visual observation of the core and control rods during operation and provides a large volume of irradiation space.

Two safety rods and one regulating rod are used to control the power level and shut off the reactor. The driving mechanism for them is located on a steel grating at ground level.

A graphite reflector about 1′ thick is provided on all sides and the bottom of the core. It is sealed in a welded aluminium can to prevent water from entering the graphite. Six inches of graphite are also included in the top end of the fuel elements to provide a top reflector directly over the core.

Because of the inherent safety of the reactor, there is no need for an air-tight containment building.

TRIGA produces radio-isotopes of 62 of the first 82 elements and is particularly useful for making short-lived isotopes. There are many uses for these isotopes as in medicine where they can replace those with longer lives. For example, the 25-minute iodine-131 to lower the effective dose received by the patient for an equivalent amount of treatment. In industry, short-lived isotopes are valuable in process control.

Radiochemical work, including hot atom chemistry, can also be carried out with TRIGA.

According to the makers, TRIGA is capable of supporting a broad programme of teaching and research, including such subjects as reactor engineering, the study of isotope production and application, instrumentation through the use of isotopes, in addition to its wide range of medical and industrial applications. (*Atoms for Peace Digest*, Aug. 22, 1958.)

CHROMIUM "BULLETS" FOR CANCER

TINY "bullets" of radioactive chromium metal to fight against cancer are now available to medical science as a result of U.S. Bureau of Mines research in metallurgy.

The "bullets" are actually small metal cylinders, a tenth of an inch long and only a thirtieth of an inch in diameter, cut from strands of high-purity chromium wire. The wire is produced at the North-west Electro-development Laboratory of the Bureau of Mines in Albany, Oreg., with techniques developed by Bureau metallurgists.

Exposed to neutrons, some of the atoms in the chromium cylinder change to the radioactive isotope chromium 51. Tests indicated that chromium 51 offers many advantages over previously used radioactive "bullets" made from radiogold, radiocobalt or radiotantalum. Radiochromium is eminently suitable for permanent implantations in tissue for the treatment of cancer. The "bullet" can either be shot into the cancerous tissue by an "implantation gun", or they are sown into the malignant area.—*SASLO Science News Selections*—285.