BAYCOVIN—AN EXPERIMENTAL MATERIAL FOR STERILIZING PROPAGATING MEDIA

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Baycovin, more properly known in research as DEPC, or the diethyl ester of pyrocarbonic acid, has been used as a sterilizing agent for the preservation of fruit juices both fermented and nonfermented. It has shown anti-fungal properties when used as a post-harvest dip on strawberries (3), and is also toxic to a wide spectrum of microorganisms, including mycelial fungi which affect greenhouse crops.

A characteristic of the chemical is that it hydrolyzes readily to carbon dioxide and alcohol. The possibility of using the material as a sterilizing agent for greenhouse soils or plant propagation media seemed of interest and utility in view of its toxicity to fungi and the fact that its use would not give rise to residue problems as do other biocidal materials.

Baycovin or DEPC was first manufactured by Farbenfabriken Bayer A.G., Leverkusen, Germany. Its solubility in water is 0.6%, and in 96% ethyl alcohol 50% with hydrolysis. Baycovin is harmless to humans under most conditions of use (2), but should be handled with care. Eyes should be protected at all times, and washed well with water if any of the material has contacted them. Wash exposed skin with soap and water immediately and change clothing on which concentrated liquid is spilled. As it is a volatile chemical, allow good air circulation during application where vapors may arise.

The chemical should be stored in closed bottles in a cool place. In the concentrated form, gloves and face masks should be worn when handling, as with other agricultural chemicals.

MATERIALS AND METHODS

To ensure uniform mixing, Baycovin was dissolved first in 95% ethyl alcohol, then suitably diluted with water. In all tests, the chemical was applied with a watering can.

Initial tests using the material were made on unsterilized soils taken from fields known to contain soil-borne fungal diseases of several types. Seeds of tomato, lettuce, salvia, kochia, alyssum, bellis and nemesia were planted in random rows in the unsterilized field soil. These plants were selected as ones commonly propagated in flats and susceptible to damping-off diseases. Seeds were planted in the soil 24 hours after drenching and immediately before drenching.

Rates of application of Baycovin to the seed flats were 1000 ppm and 2000 ppm. Follow-up treatments were applied 9 and 16 days following the initial treatment on some flats to determine the effect of the material on growing seedlings.

RESULTS

From the standpoint of disease control, 2000 ppm drench applied prior to seed planting was most satisfactory. Salvia appeared to be stimulated in growth. At 1000 ppm lettuce and tomato appeared to be stimulated. However, the supplementary treatment, whether at 1000 or 2000 ppm appeared to retard growth somewhat without affecting the health of the plants.

Post seed-planting drenches were almost as effective in disease control, though some slight damping-off disease occurred with the 1000 ppm treatment. In all cases control or untreated flats showed a high incidence of damping-off disease.

Samples of the soil used in the drench treatments were cultivated in petri plates under laboratory conditions. No treatment revealed rapid growth of moulds and bacteria. The populations were reduced proportionately to the concentration of Baycovin used, 100 and 200 ppm being inhibitive, and 500 ppm restricting growth almost entirely. Other tests at 1000 and 2000 ppm showed similar reduction in microbial counts.

Molin *et al.* (3) showed that lethal concentration of DEPC for various genera of fungi varied from 100 ppm for *Botrytis cinerea, Aspergillus niger* and *Fusarium* to 500 ppm for *Trichoderma*. In this laboratory, the amount of DEPC required to inhibit growth of plant pathogens (1) was also seen to vary. For example, a *Verticillium* species responsible for wilt of tomatoes was inhibited by 100 ppm, an isolate of *Diplocarpon* (strawberry leaf spot) did not tolerate 200 ppm, while growth of *Fusarium* was inhibited markedly at 500 ppm.

In commercial greenhouses, suitable atomizing units are available for injecting DEPC (suitably dissolved in ethyl alcohol) into a stream of water for use in a watering program or as a soil drench treatment. In research, or for special purposes requiring only small amounts of soil, DEPC can be emulsified first in a small amount of ethyl alcohol then diluted with water to the required volume. Experimentally DEPC costs about 5 cents per gallon, which is minimal considering the cost of steam and the related costs of labor and equipment.

Tests using Baycovin as a drench on propagating benches consisting of 60% perlite, 40% peat by volume proved quite successful. No statistical report is available yet, but from the practical standpoint, excellent results were obtained. *Taxus* and *Juniperus* cuttings were drenched in the bench with no injury to the cuttings. The incidence of

rot on the portion of the cutting in the rooting medium was reduced to almost zero. An untreated section of the same bench containing similar material showed a fairly high incidence of rot. The propagating medium had been in constant use for 2 years.

Tomato seedlings transplanted to *Verticillium* and *Fusarium* inoculated soil grew well where Baycovin treatment preceded planting, but showed some incidence of disease where treatment followed transplanting. Plants were not affected by the treatment but apparently the disease entered the plant in the period following transplanting and before treatment (2 or 3 days).

DISCUSSION

Greenhouses represent large commercial investments and are major sources of agricultural revenue. These crops include not only fruits aand vegetables but ornamental crops such as flowers and nursery stock. Soil sterilization, imperative if the best yields are to be obtained, continues to be one of the most time-consuming tasks related to production, and is accomplished now by fumigating or steam treatment or a combination of both. Rarely is bacteriological sterility ever achieved nor, for the most part, is it necessary since basically the purpose of the treatment is to reduce the fungal pathogens to the point where the activity of the surviving organisms does not adversely affect the germination, growth and later development of seeds and seedling plants.

Emphasis continues to be placed on the synthesis of new biocides for use in both primary and secondary industries. These new biocidal products are initially developed and introduced to serve very specialized roles in the protection of one or several closely related products. However, it would seem reasonable that sometimes a material primarily designed as a fungicide for field applications might also be useful for other purposes, e.g. as a mould inhibitor in damp cellars of breweries and wineries or in warehouses of canning plants. Similarly, DEPC originally introduced for the beverage and food industry is shown here to be of value in another production area. Greenhouse operators and plant propagators might profitably use this chemical not only as described above but in other ways where temporary reduction of soil fungi is desirable.

LITERATURE CITED

1. Adams, A. M. The diethyl ester of pyrocarbonic acid as an antimicrobial agent. *Rep. Hort. Exp. Sta. and Prod. Lab. for 1965.* p. 138-145
2. Hecht, G. 1961. Zur Toxikologie des Pyrokohlensaurediathylesters. *Untersuch. u. Forsch* 114:292-297.

3. Molin, N., L. Satmark, and M. Thorell. 1963. Pyrocarbonic acid diethyl-ester as a potential food preservative. *Food Tech.* 17:119-123.

MODERATOR PINNEY: Is Baycovin commercially available?

R. A FLEMING: Yes, the material is available through Stauffer Chemical, or Pfizer Chemical, or any place that sells supplies for home winemakers.

MODERATOR PINNEY: What diseases will this material control?

R. A. FLEMING: Baycovin apparently controls all soil-born diseases. We especially like the easy application of this material.

MODERATOR PINNEY: The next speaker is no stranger to this group; he comes from Minnesota and this afternoon will tell us about "The Storage of Conifer Scions and Cutting Material"; Mr. Dick Cross.

STORAGE OF CONIFER SCIONS AND CUTTING MATERIAL

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In the area where we have our nursery in Minnesota most conifer propagation is done during the winter months. If it were possible I would start in November and December, but because of pressures from tree and shrub digging and from Christmas business, it is usually about the first of the year before we get into greenhouse propagation.

Quite a few years ago, when I was new at making cuttings and grafts I read all the material I could find on the subject of propagation. I was under the impression I should take cuttings and scions and use them in a very short time, certainly within several days. This would be fine if we were in a mild climate where we would be able to go to the field and take fresh propagation materials daily.

About 6 years ago I began to wonder about the difficulty we were encountering in gathering cuttings and scions in January, February and March to get fresh material for our use. Also some winters there was winter damage to the cuttings, showing up after these later cut materials were used and put in the greenhouse benches.