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SHORT COMMUNICATION

STABILITY OF BENOMYL IN PLANTS

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Key Word Index—*Phaseolus aureus*; Leguminosae; mung bean; benomyl metabolism; methyl-1-(butylcarbamoyl)-2-benzimidazole carbamic acid.

Abstract—Unchanged benomyl and its breakdown product have been found in seedlings of mung (*Phaseolus aureus*) treated with benomyl.

THE FUNGICIDE benomyl is translocated upwards in plants on application to the soil. Technical samples of benomyl may be separated into two toxic components on silica gel thin layer chromatograms,[1] consisting of benomyl and a second toxic compound which was found to be benzimidazole carbamic acid methyl ester (BCM), formed by the loss of the butylcarbamoyl group from benomyl.[1,4] Benomyl was not detected in the crude extract of the sap of cotton plants treated with benomyl.[4] It was therefore suggested that benomyl rapidly decomposes to BCM in dilute aqueous solutions and hence within the plant tissue, and it was only the BCM which was passively taken up by the roots.[2,3] However, the present work reports the presence of benomyl in its original form in the seedlings of mung (*Phaseolus aureus*).

It is proposed that the hydrolysis of benomyl to its toxic derivative in aqueous solution and in plant tissues is not as rapid and complete as has been believed before. The toxicity of the original compound and the modified compound is almost the same and this explains the long term effectiveness of this compound. The systemic toxicity on uptake of benomyl by the plant cannot be attributed only to BCM but is also due to benomyl. The reason for the complete hydrolysis of benomyl into BCM in the previous studies[2,3] was possibly due to the method employed during extraction.

EXPERIMENTAL

Mung seedlings were grown in an enamelled tray in sterilized garden soil. When the seedlings were 21 days old, 500 ppm of a solution of benomyl (total 500 mg) was added to the soil. After 4 days all the seedlings were harvested and the roots were removed giving approximately 350 g fr. wt. of tops. This tissue was crushed

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[1] C. P. CLEMONS and H. D. SISLER, *Phytopathol.* **59**, 705 (1969).
[2] C. A. PETERSON and L. V. EDGINGTON, *Phytopathol.* **60**, 475 (1970).
[3] C. A. PETERSON and L. V. EDGINGTON, *Phytopathol.* **61**, 91 (1971).
[4] J. J. SIMS, H. MEE and D. C. ERWIN, *Phytopathol.* **59**, 1775 (1969).

and repeatedly extracted with MeOH (6 × 50 ml). The decanted extract was filtered and the MeOH removed under vacuum at 40 ± 5°. The greenish residue was analysed by TLC. The plates were coated with silica gel (slurry was prepared in MeOH–$CHCl_3$, 1:1). Benzene was used as an eluent. After developing the chromatograms, the plates were dried and spots were developed in iodine vapour. Benomyl in its original form and its hydrolysed product (BCM) were both present in this extract. The R_f value of the original compound and the modified compound was 0·56 and 0·36 respectively. Complete hydrolysis of benomyl was achieved with methanolic HCl. A solution of benomyl (5 g) in MeOH (100 ml) and HCl (5 ml) was heated to 50–60° for 1 hr and the solvent removed under reduced pressure. On adding aq. NaOH, the white ppt was collected. TLC revealed only the presence of BCM.