MORPHOLOGICAL AND PHYSIOLOGICAL STUDIES ON SEEDS TREATED WITH FUNGICIDES

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INTRODUCTION

Traditionally the objectives of fungicide dressings were to destroy pathogenic organisms on the seed and to protect germinating seedling from attack by soil borne pathogens. Systemic fungicides have added further possibility to control diseases using the dressing as a reservoir of fungicide during the growth of the crop. Seed dressing provides most economic and convenient method of control. When prolonged systemic protection is required the dilution effect of growth and the eventual breakdown of the active ingredient demand that larger amount of chemical have to be applied to the seed.

The mechanisms of systemic compounds to control disease have been discussed from differing points of view on earlier occasions (Dimond 1965, Dimond and Horsfall 1959; Grossmann, 1960; Oart and Van Andel, 1960; Woodcock 1971).

As systemic compounds enter the plant, they encounter a variety of active biochemical systems and they are often altered in this encounter. Some compounds are converted into fungitoxic molecules after relatively minor modification. Others enter as raw materials for biosynthesis of fungitoxic structures. Yet others alter the physiology of the plant or features of its anotomy. Some treatments mimic the mechanisms of natural resistense to disease.

One cannot discuss treatments that affect physiology of the host without dealing with those that alter pathogenesis. Thus this work aimed to study the morphological features of bean plants and tomato seedlings as well as their nitrogen content treated with four systemic fungicides. The effect upon disease control with these systemic compounds and their distribution in plant organs were also studied.

REVIEW OF LITERATURE

Fusarium wilt :

Armstrong and Armstrong (1963) reported that the occurrence of *Fusarium oxysporum* f. sp. *phaseoli*, causing vascular wilt of various bean varieties.

Armstrong and Armstrong (1963) found the pathogen on pole bean in South Carolina, seed of which had come from California.

Nigmanova (1964) found that forms of *Fusarium oxysporum* and *Fusarium solani* isolated from cereals were pathogenic also to bean and cotton, and those isolated from cotton proved pathogenic to cereals. Armstrong and Joanne (1965) reported that inoculation of several varieties of alfalfa with *Fusarium oxysporum* f.sp. *medicaginis* or *Fusarium oxysporum* f.sp. *vasinfectum* resulted in similar sympcoms of wilt. No external or internal symptoms of wilt occurred when alfalfa was inoculated with 34 forms or races of *F. oxysporum* different from the preceding ones, and only slight vascular discoloration was evident when it was inoculated with *Fusarium oxysporum* f.sp. *phaseoli*.

Darwish (1967) isolated *Fusarium oxysporum* from bean seeds and the fungus was pathogenic to the seedlings.

Bloomberg (1971) found that the isolates of *Fusarium oxysporum* were obtained from roots of Douglas-fir seedlings with or without disease symptoms such as the postemergence damping-off, root rot, or corky root.

Disease :

Fungal control :

Zimmer (1967) reported that the treatment of safflower seed with

75% WP formulation of the oxathiim fungicide (DCMOD), at 24 and 48 OZ/100 lb of seed effectively controlled seed borne rust spores and markedly reduced rust infection of 2 week old seedlings. Application of non phytotoxic concentrations of 2 and 4 lb /acre directly in the row of planting also greatly reduced rust infection of seedling 2 weeks old. Bell (1966) found that 13 fungicides in powder formulation applied singly or as blends of two materials were assay.d for effectiveness as peanut seed treatments in the categories of reducing seed borne fungi. The blends were generally superior to single fungicide in all categories.

Borum and Sinclair (1968) found that protection against pre-and post emergence damping-off occurred when seedlings were grown in soil treated with 250 ppm Vivatex, used as seed treatment (8 oz/100 lb of seeds). Results in vitro showed that vitavax was fungistatic to Rhizoctonia solani at 1 ppm. Kirk and Sinclair (1960) found that vitavax and Demosan protected cotton seedlings against R. solani.

Mathre (1968) showed that uptake of Vitavax (DCMD) and Plantvax (DCMOD) by R. solani and Ustilago maydis was rapid with maximum uptake occurring 30-60min. after initial exposure, DCMD was absorbed more rapidly by R. solani and U. maydis than Plantvax.. Snel and Edginton (1968) found that Vitavax and Plantvax gave systemic control of Uromyces phaseoli on Phaseolus vulgaris plants. Allam et al., (1969a) evaluated 4 systemic fungicides in the green house and in laboratory for their effectiveness in controlling cotton infection by R. solani. These fungicides were Vitavax, Benlate TH 7462 and TBZ. Vitavax gave the best protection a gainst R. solani followed by Benlate, TBZ and TH 7462. Vitavax inhibited fungus growth to significantly greater degree than the other three fungicides. llam et al., (1969b) found that the uptake of DCMO by germinating cotton seed depended upon the seed treatment rate, the significance of these funcides may favour DCMO both a pre- and post emergence systemic fungicides.

Biehn and Dimond (1969) reported that benomyl applied by sub-irrigation to tomato plants 2-3 day after inoculation with Fusarium oxysporum f.sp. lycopersici reduced symptoms by 70% in 18-21 days. Cessac and Dodel (1969) found that benomyl was very efficient in the control of vascular disease caused by Fusarium and Verticillium spp.

Metcalfe and Brown (1969) reported that when benomyl, DCT, DCMO and DCMOD applied to seed or soil controlled flag smut and loose smut.

Fuchs et al., (1970) tested benomyl against Fusarium wilt of pea and tomato plants. They found that 1 µg benomyl in liquid media or on ager plate inhibited Fusarium oxysporum f.sp. Pisi and lycopersici, seed treatment (1 mg/50 seed or soil drenchs) (10 mg/50 seedlings applied on each 3 consecutive days after infection) protected pea plants effectively. It seems that fungistatic activity of benomyl is primarily due to the benzimidazole nucleus which affect all energy production and nuclic acid synthesis. Gould and Miller (1970) reported that benzimidazoles were usually effective and less phytotoxic than Hg against _F. oxysporum_ f.sp. _gladioli_ in Iris bulb stocks. Sanz (1970) reported that Vitavax gave moderate control against damping-off of tomato but it was phytotoxic.

Thanassoulopoulos _et al._, (1970) reported that benomyl controlled _Fusarium_ wilt of tomato and watermelon and he noticed that benomyl had no apparent phytotoxic effects on potted tomato and watermelon, when applied as a soil drench at rates up to 10,000 ppm active ingredients Edgington _et al._, (1971) examined the fungitoxicity of three benzimidazole compound _in vitro_. Benomyl was extremely toxic to a wide spectrum of fungi, but was non-toxic to certain taxonomic groups, as _Alternaria_ _Stemphylium_ and _curvularia_. The selective toxicity of all three compounds depends on the benzimidazole portion of the molecule.

Gould and Miller (1971) found that both benomyl and thiabendazole effectively controlled Fusarium basal rot of Iris bulbs but benomyl gave significantly better results. Dusting bulbs was usually more effective than soaking or spraying them. Effectiveness of soaking bulbs in benomyl was improved by increasing the temperature from 10^{o}C to 40^{o}C and the time period from 10 to 30 min. in contrast to previous results.

Decallonne and Meyer (1972) reported that benomyl was rapidly absorbed by the conidia of _Fusarium oxysporum_ which inhibited their germination.

William (1972) found that the fine structure of pathogenic fungal hyphae was examined in the vascular tissue of tomato plants inoculated with Fusarium wilt, Fusarium oxysporum f.sp.lycopersici. Three to 5 days after inoculation the hyphae were found in the vessels of the tomato stems. Biehn (1973) stated that the three foliar sprays of acidified benomyl, applied approximately 1,5 and 9 days after inoculation of tomato plants with Fusarium oxysporum f. sp. lycopersici, reduced Fusarium wilt symptoms about 50%. A single foliar spray of acidified benomyl applied 3-4 days after inoculation did not noticeably reduce Fusarium wilt symptoms. Foliar sprays of benomyl plus hydrochloric acid were reported to have a curative effect against Verticillium wilt of cotton.

Biehn and Dimond (1973) found that tomato plants showed less Fusarium wilt when compounds that injured roots were applied before root inoculation with Fusarium oxysporum f. sp. lycopersici. Tests of 272 compounds showed that the severity of Fusarium wilt and root injury were negatively correlated to significant degree. Results from studies in which a split-root technique was used suggested that, with the exception of plant growth regulators, compounds which caused root injury or can inhibition of root elongation generally had a localized effect.

McRitchic (1973) found that Fusarium oxysporum was isolated from wilted variegated Pyracantha. The fungus proved pathogen to the variegated but not to the more common non variegated from benomyl provided complete control when applied as a soil drench either 8 days or 1 day a ter root inoculation.

Distribution and Metabolism of fungicides :

Kirk and Sinclair (1968) reported that the dried tissues treated with Demosan and Vitavax showed that the two fungicides moved systemically upward when applied as a seed treatment or varmiculate drenchs and where seedlings were placed in labelled hypotonic nutrient medium. Their results indicated that the compounds were detected in the lysignous glands of cotton seedling hypocotyls. This result, plus seed and tissue bioassay indicated that these compounds moved systemically in cotton seedlings. Snel and Edington (1968) reported that when the plants treated with Vitavax (DCMO) or Plant vax (DCMCD) via roots and foliage, these compounds were transported acropettaly, accumulating at the tip sand margins of leaves.

Gray and Sinclair (1970) found that 5 systemic fungicides , i.e. (Benlate, Demosan, Chloroneb, Plantvax and Vitavax) were fungitoxic to the soybean pathogen Cephalosporium gigegatum in vitro. Some fungitoxic compounds of benomyl, chloroneb and TBZ moved systemically in soybean seedlings after seedling roots were exposed to chemicals.

Fuchs et al., (1970) reported that bean (Phaseolus vulgaris) roots absorbed benomyl and MBC which were transported in the xylem and accumulated in leaf tips and margins. Its distribution among plant organs is dependant on the rate of transpiration of organ.

Pellissier *et al.*, (1971) tested the presence of a fungitoxicant in leaves of bean one day after treatment with 10, 20, 40, 80 and 160 ppm benomyl in Hoagland's solution.

When beans were grown on benomyl treated soil, bioassay tests revealed the presence of fungitoxicant at 2 days after treating soil with the concentrations of 200, 250, 300 ppm., and 3 days after treatment with 160 ppm.

Peterson and Edington (1971) applied benomyl to the roots of flowering geranium and poinsettia plants. Fungicidal activity was later detected in the leaves, but none could be found in the geranium petals or in poinsettia bracts. Studies carried out with bean and tomato plants bearing fruits showed that the fungicide was transported primarily to the foliage. The concentration in tomato fruits ranged from 0.03 to 2% of that in the foliage.

In been the concentration in the fruits tended to be greater (0.3 to 3%) than in foliage. Malcolm (1973) reported that the distribution an d metabolism of methyl 2-benzimidazole carbamate (MBC) in strawberry plants which grown in hoagland's solution and root treated with ^{14}C fungicide. There was a little accumulation of labil ^{14}C in mature fruit when plants were treated either prior to or at the start of flower initiation. When non fruiting plants were treated the label ^{14}C accumulated in the roots and foliage produced before and during the treatment period.

Much less label ^{14}C was found in the foliage produced after cessation of treatment. While MBC and 2-aminobenzimidazole (2 AB) were present in both root and foliage tissues of treated plants, MBC was most concentrated in the foliage. The amount of ^{14}C MBC in whole plants treated for 36 and 89 days was 54 and 32% respectively.

Bolkan and Milne (1975) found that benomyl, Carboxin and thiabendazole, applied as dust (2.5% active ingedient to potatu seed tubers, were absorbed and translocated in growing shoots. The chemicals were detected in the base of shoots and leaves produced from treated tubers. Concentrations were considerably lower in leaf than in shoot tissue. The shoot base contained high amounts of fungitoxicant for as long as 30 days after treatment. With the exception of benomyl which broken down into two products, all compounds appeared to move unaltered in plant tissue.

Ellis and Sinclair (1975) tested Methyl 2-benzimidazole carbamate (MBC) in the seed coat and cotyledones of soybean seeds from plants sprayed with benomyl (MBC). The compound moved through the pod-walls and into seeds and was absorbed through stem tissues and translocated upward into seets.

Kirk and Sinclair (1976) found that when soybean tissues were bioassayed by an agar diffusion method against Penicillium atroventum the size of inhibition was greater following a 24-hr. root exposure to BD 18654 and thiaphanate (TM) than with a 12-hr. exposure. Inhibition zones were greater around all tissues. The higher concentration of