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Fungicidal Inhibition of Pollen Germination and Germ-tube Elongation in Muskmelon

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Abstract. **Four fungicides were evaluated for their effects on in vitro pollen germination of muskmelon *(Cucumis melo* L.) cultivars TAM-Uvalde and Magnum 45. Cupric hydroxide, mancozeb, and chlorothalonil reduced the percentage of pollen that germinated and rate and length of germ-tube elongation, regardless of cultivar. Benomyl had very little overall effect on pollen germination or germ-tube elongation. With the effective pollination period of ≈ 10 to 14 days in commercial production, each day is critical for maximum crown set. Based on our results. some fungicides may be contributing to reduced fruit set in muskmelon.**

Poor fruit set is common in cucurbits in general and muskmelon in particular. As few as 10% of female muskmelon flowers set fruit under normal conditions (Brewbaker and Kwack, 1963; Rosa, 1925). Muskmelon flowers remain open for 1 day only (Rosa, 1925) and, therefore, must be adequately pollinated within a relatively short time.

In addition to pollen deposition, the rate of pollen tube growth is equally important for successful fertilization. Suzuki (1969) studied the rate of pollen tube growth in muskmelon and found that at 26 to 30C, fertilization normally occurred within 24 h. If pollen tube growth is delayed, the result could be no fertilization, or if fertilization does occur, the quality of the seed may be reduced, adversely affecting fruit quality and yield (Davis et al., 1987; Mulcahy, 1974; Winsor et al., 1987).

Environmental conditions in some muskmelon growing regions require applications of fungicides throughout the season to maintain adequate disease control (Oklahoma State Univ., 1988). The application of several fungicides labeled for use on muskmelon routinely coincides with full bloom. Several researchers have demonstrated that some

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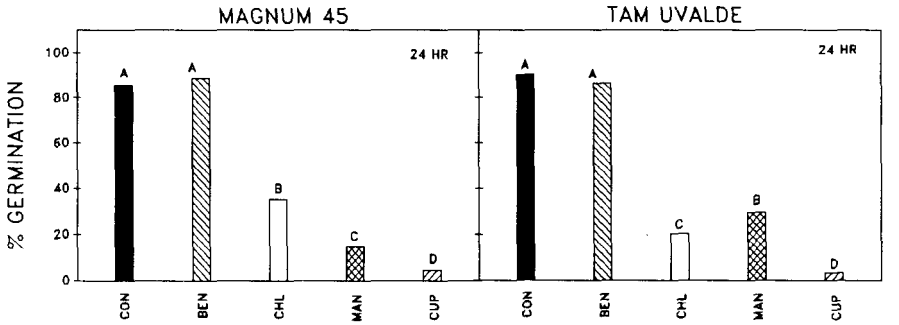

Fig. 1. Influence of various fungicides on muskmelon pollen germination. Each bar is the mean germination percentage of 0.25,0.5, l. 0, and 2.0 times the recommended rates for each fungicide. CON = control; BEN = benomyl; CHL = chlorothalonil; MAN = mancozeb; and CUP = cupric hydroxide. Mean separation for each cultivar at P = 0.05.

fungicides inhibit pollen germination and slow the rate of germ-tube growth in various fruit crops, both in vivo and in vitro (Bristow and Shawa, 1981; Church and Williams, 1977; Eaton, 1961). Thus, fungicide application could play a role in the erratic fruit set and development often experienced in muskmelon production.

The objective of this study was to determine the in vitro effects of four commonly used fungicides on muskmelon pollen germination and germ-tube elongation.

Pollen germination and germ-tube elongation were evaluated on 1.5% (w/v) sucrose agar amended with 100 ppm boric acid, 300 ppm $Ca(NO_3)_2 \cdot 4H_2O$, 200 ppm $MgSO_4 \cdot 7H_2O$ and 100 ppm KNO_3 prepared in distilled water (Brewbaker and Kwack, 1963). The fungicides tested were: cupric hydroxide (Kocide 101, 77WP), benomyl (Benlate, 50WP), mancozeb (Dithane M-45, 80W) and chlorothalonil (Bravo, 500 F). The recommended concentrations for the fungicides are: Kocide 1900 ppm, Dithane M-45 2900 ppm, Benlate 300 ppm, and Bravo 2500 ppm. Media were made with final concentrations of 0.0, 0.25, 0.5, 1.0, and 2.0 times the recommended rates for each fungicide.

Forty plants of each of 'Magnum 45' and 'TAM-Uvalde' muskmelon were grown in the greenhouse. After 8 weeks, 150 male blossoms were collected at anthesis from each cultivar on 28 Apr. 1987 at =1000 HR. The blossoms were immediately placed within a moisture chamber and held at 21C. Following the harvest of blossoms, the petals were removed and pollen was collected using a camel hair brush. Glass microscope slides were coated with a thin layer (≈ 0.5 to 1 mm) of fungicide-enriched medium and allowed to solidify. Pollen from male-flower anthers was brushed evenly across the surface of the medium (one flower per slide). The slides were incubated for 6, 12, or 24 h at 21 ± 1C, as a preliminary study had indicated that these periods were adequate for evaluating pollen germination and germ-tube elongation under the conditions of this study. After incubation for each period, the pollen was killed and stained with phenolic-rose bengal [1% rose bengal, 5% phenol, and 0.01% calcium chloride (w/v)] (Bristow, 1981) that was applied to the medium surface in a fine mist from an aspirator at ≈ 21 kPa.

Three single-slide replicates of each fungicide × rate × cultivar × incubation period were used. Pollen germination and germ-tube length were examined microscopically using an eyepiece micrometer. Every pollen grain was evaluated in three passes across the slide. Pollen was considered to have germinated when the pollen tube had extended to a minimum length of 3 µm. The data were analyzed by an analysis of variance and regression using least square means.

Muskmelon pollen germination was significantly *(P* = 0.05) reduced by chlorothalonil, mancozeb, and cupric hydroxide (Fig. 1). Although there were significant differences in germination among fungicide rates, the trends were very similar in that the 0.25 multiple of the recommended concentrations generally was as toxic as the higher concentrations. Since time of examination did not exert a significant effect, only the data for the 24-h interval are presented. Germination was not hindered by benomyl. There was no significant difference (P = 0.05) in germination between 'Magnum 45' and 'TAM-Uvalde'.

A reduction in pollen germination with cupric hydroxide and mancozeb was previously reported in cranberry (Bristow and Shawa, 1981). Church and Williams (1977) also found that benomyl was one of the least toxic fungicides among those tested on apple pollen. Fungicides are often applied in early morning hours to alleviate problems with coverage and drift due to wind. The bulk of commercial muskmelon harvest occurs from the crown set or the first two or three fruit that are fertilized on each plant (Rosa, 1925). The crown fruit are set within a short time interval of ≈ 10 days in which as many as two fungicide treatments could be applied. The average yield in commercial production is 1.5 melons per plant. Many factors may interfere with effective fruit set, such as low pollinator activity because of inclement weather and flower or fruit abortion because of drought or poor nutrition. Consequently, each day of potential pollination is critical to commercial fruit yield. Based on the results of this study, a fungicide application during early female flowering could contribute to reduced fruit set. These data may suggest altering fungicide schedules to minimize pollination problems. Field studies are needed to verify the conclusions suggested by this study.

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