Effects of Foliar Applications of a Benomyl-Oil-Water Emulsion on the Epidemiology of Cercospora Leaf Spot on Peanuts

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ABSTRACT

Foliar applications of a benomyl-oil-water emulsion suppressed the development of peanut leaf spot epidemics more effectively than foliar applications of a benomyl-water suspension. Foliar applications of an oil-water emulsion were ineffective. The benomyl-oil-water emulsion treatment delayed the progress of the epidemic by arresting development of established lesions induced by *Cercospora arachidicola*, suppressing sporulation of *C. arachidicola* on peanut leaflets, and reducing the rate of peanut leaflet abscission.

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Additional key words: sporulation, systemic fungicide, synergism.

Epidemics of peanut leaf spot diseases occur annually, when control practices are not utilized. Annual crop losses of 10% or more are common in the peanut-growing areas of the United States (10). At least three organisms are involved in the peanut leaf spot complex, but *Mycosphaerella arachidicola* Jenk. (*Cercospora arachidicola* Hori) is the most frequently occurring and devastating leaf spot organism in the Southeastern United States.

Although the progress of peanut leaf spot epidemics can be delayed with sanitation practices, including crop rotation and deep burial of debris, the only effective method of achieving satisfactory economic control is with the application of fungicidal sprays or dusts. In 1968, a new fungicide named benomyl was introduced (5). Since then, its effectiveness as a peanut leaf spot fungicide has been recognized by several workers (6, 7, 8, 9). We previously demonstrated the systemic activity of benomyl against *C. arachidicola* with soil drench applications (9). The present study was initiated to compare the effect of foliar applications of a water suspension of benomyl and a benomyl-oil-water emulsion on the development of peanut leaf spot epidemics. The hypothesis was that perhaps the addition of oil would result in a synergistic fungicidal effect, as is the case with the addition of oil to some copper fungicides (2).

MATERIALS AND METHODS.—*Arachis hypogaea* 'Argentine' peanuts were planted in 30.5-m (100-ft) rows evenly spaced at 9.7 cm (38 inches) in 3 consecutive years. The planting dates were 24 April 1969, 11 May 1970, and 4 May 1971. The experimental design consisted of randomized blocks, with four replicates/treatment. Herbicides and insecticides were applied as needed to maintain satisfactory control. Peanuts were harvested on 2 September 1969, 10 September 1970, and 27 August 1971.

Benomyl and Ortho Volck oil (petroleum, 97%; inert ingredients, 3%; minimum U.R., 91%) were applied at the rate of 170.1 g (6.0 oz) and 1.9 liters (0.5 gal) per acre, respectively. Benomyl-water suspensions and oil-water emulsions were prepared separately and then combined for the benomyl + oil treatment. Applications were made on 1, 15, and 25 July and 11 August 1969; 1, 14, and 28 July and 11 and 25 August 1970; 29 June, 12 and 29 July, and 12 August 1971.

To determine the seasonal progress of the leaf spot epidemic, quantitative disease observations (hereafter referred to as percentage defoliation) were obtained at periodic intervals in 1969, 1970, and 1971. The

percentage defoliation was determined with a random sample of five central stems from each replicate, and it was computed by determining the number of abscinded leaflets as a percentage of the total leaflets produced. This provided an estimate of plant growth as well as epidemic progress.

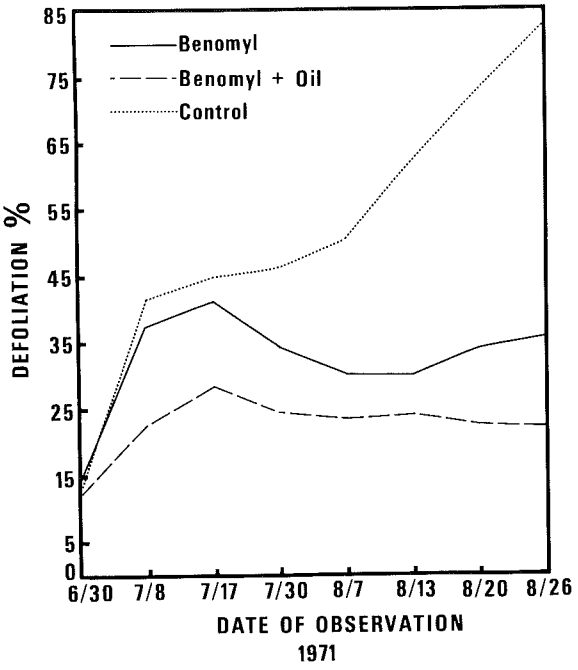
Four days after the first fungicide application on 1 July 1970, and 6 days after the first fungicide application on 29 June 1971, leaflets with macroscopically visible lesions were collected from each replicate. Leaflets were placed on moistened filter paper in petri dishes and incubated for 3 days at 28 C. Then all lesions were examined microscopically and scored as sporulating or nonsporulating. In 1970, the number of lesions observed for each treatment ranged from 289 to 389, and in 1971 it ranged from 114 to 123.

RESULTS.—Since the epidemic progress curves for 1969, 1970, and 1971 were similar, only the 1971 curves are presented (Fig. 1). It is evident that foliar sprays with a water suspension of benomyl and a benomyl-oil-water emulsion suppressed epidemic development. During 1969 and 1970, foliar sprays of an oil-water emulsion did not result in statistically significantly superior disease control or higher yields when compared with the unsprayed control. Consequently, the oil-water emulsion foliar spray treatment was not included in the 1971 experiment.

During all 3 years, the benomyl-oil-water emulsion treatment resulted in significantly less peanut leaflet abscission than did treatment with a water suspension of benomyl. However, the peanut yield from the benomyl-oil-water emulsion plots was significantly higher than the yield from plots treated with a water suspension of benomyl in only 1 of 3 years (Table 1). In a 1971 test at another location in Georgia, the yield after four foliar applications of a benomyl-oil-water emulsion was significantly higher than the yield following four foliar applications of a suspension of benomyl in water.

Sporulation of *C. arachidicola* on established lesions was significantly less after treatment with a benomyl-oil-water emulsion than after treatment with a water suspension of benomyl (Fig. 1). In addition, the benomyl + oil treatment virtually arrested the enlargement of established lesions on peanut leaflets (Fig. 2).

DISCUSSION.—Calpouzos (1, 2) thoroughly reviewed the literature on the use of oils as spreader-stickers, carriers for conventional fungicides, and as direct agents for preventing disease. Several plant diseases have been controlled with oil sprays, the most notable example being the Sigatoka disease of bananas caused by *Cercospora musae* (4). Although several Cercospora diseases have been controlled with mineral oil sprays, several others including Cercospora



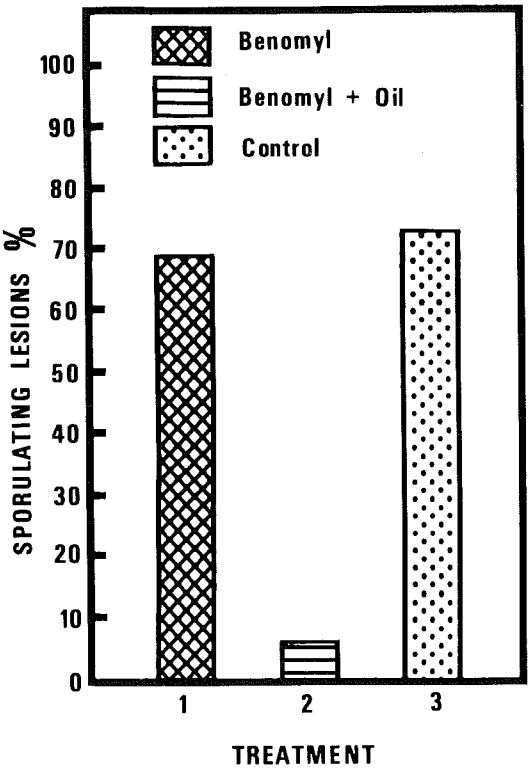


Fig. 1. (Above) Effect of foliar applications of a water suspension of benomyl and a benomyl-oil-water emulsion on abscission of Argentine peanut leaflets. Peanuts planted on 4 May and harvested 12 August 1971. Water suspension of benomyl and benomyl-oil-water emulsion applied on 29 June; 12 and 29 July; and 12 August 1971. Control was unsprayed. (Below) Effect of a water suspension of benomyl and a benomyl-oil-water emulsion on sporulation of *Cercospora arachidicola* on Argentine peanut leaflets. Control was unsprayed.

TABLE 1. Effect of foliar applications of a benomyl-water suspension and a benomyl-oil-water emulsion on the yield of Argentine peanuts

Treatment[a]	Yield in kg/hectare		
	1969[b]	1970[c]	1971[d]
Benomyl-water suspension	3,678 a[e]	2,867 a	1,970 a
Benomyl-oil-water emulsion	3,493 a	3,029 b	2,185 a
Unsprayed control	2,817 b	1,716 c	1,340 b

[a] Benomyl and Ortho Volck oil applied at the rate of 170.1 g (6.0 oz) and 1.9 liters (0.5 gal) per acre, respectively.
[b] Application dates were 1, 15, and 25 July; 11 August.
[c] Application dates were 1, 14, and 28 July; 11 and 25 August.
[d] Application dates were 29 June; 12 and 29 July; 12 August.
[e] Small letters in common adjacent to yield data denote Duncan's multiple range test groupings of treatments which do not differ significantly at the 5% level of significance.

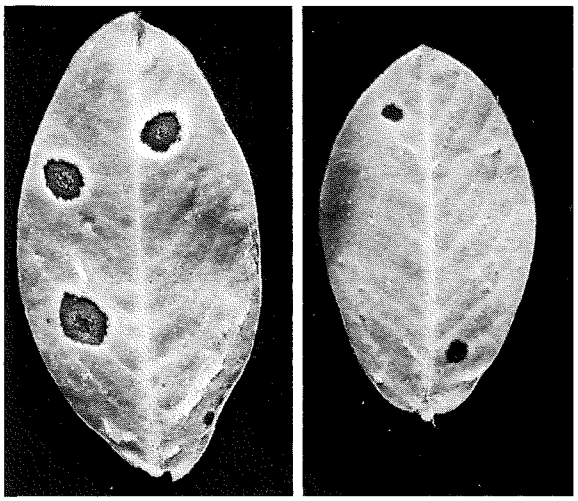


Fig. 2. (Left) Argentine peanut leaflet treated with a water suspension of benomyl. (Right) Argentine peanut leaflet treated with a benomyl-oil-water emulsion, showing arrested lesions and absence of characteristic halo.

leaf spot on peanuts were not controlled with mineral oil sprays (3). Our results with oil-water emulsions corroborate those of Calpouzos.

Although a water suspension of benomyl is very effective against peanut leaf spots, it is clear from our results that the addition of oil enhances the efficacy of benomyl. The mode of synergistic activity exhibited by the benomyl-oil-water emulsion requires further study. However, our observations of suppressed sporulation, arrested lesion development, and reduced leaflet abscission indicate that oil may enhance the therapeutic activity of benomyl by increasing the dispersion of benomyl on the surface of peanut leaflets, and by increasing the penetration of benomyl into the plant tissues.

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