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CONTROL OF COWPEA SEEDLING MORTALITY IN SOUTHERN NIGERIA

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ABSTRACT

In 12 field plantings in southern Nigeria during 1972 and 1973, four fungicides and four fungicide combinations were tested as seed dressings for the control of seedling mortality of cowpea. The greatest and most stable control was obtained with 1,4-dichloro-2,5-dimethoxybenzene (chloroneb) used as a dry seed dressing at rates of 2 and 4 g/kg seed. The combination of other fungicides with chloroneb, and the use of glycerol and kaolin to coat the seed with the fungicide, did not significantly improve its performance.

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Additional key words: *Rhizoctonia solani*, *Pythium aphanidermatum*, benomyl, carboxin, thiram.

Legumes are particularly vulnerable to attack by unspecialized soilborne pathogens such as *Pythium* spp. and *Rhizoctonia solani* Kuehn (*Thanatephorus cucumeris* (Frank) Donk) during the first 2 to 3 weeks of their development. The soils in the forest region of southern Nigeria have abundant inocula of these pathogens and the humid environment is favorable for their activity. In September 1969 at Ibadan, 75% mortality of cowpea (*Vigna unguiculata*) seedlings was obtained within 21 days after planting (DAP). The two major pathogens were *R. solani* and *Pythium aphanidermatum* (Edson) Fitzp. (1). During 1971, 13 fungicides were tested as seed dressings in greenhouse pot tests with pure cultures of the pathogens. Those fungicides most effective in the control of seedling mortality were further tested in 12 field plantings during 1972 and 1973. This paper presents the results of the field trials and discusses their applicability in peasant farming systems.

MATERIALS AND METHODS

The 12 plantings were made in three series of experiments. Modifications were made in treatments in the second and third series based on the results of the previous series. Six plantings in the first series and two plantings in the second series were all at the International Institute of Tropical Agriculture (IITA), Ibadan, and four plantings in the third series were at IITA, Ife, Ikenne and Nsukka. Hand-sorted seed of the cowpea cultivar Prima was used in all plantings. Plots consisted of three 3-m-long rows 75 cm apart in all plantings. Control of seedling mortality, which includes both pre- and postemergence damping-off, was indicated by percent seedling survival 22 DAP.

Planting Series 1: The following fungicides were used singly at a rate of 2 g product/kg seed:

Methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate (benomyl)
1,4-Dichloro-2,5-dimethoxybenzene (chloroneb)
5,6-Dihydro-2-methyl-1,4-oxathiin-3-carboxanilide (carboxin)
Bis(dimethylthiocarbamoyl) disulfide (thiram)

Thiram was also used in combination with each of the other fungicides (at a rate of 1 g each product/kg seed). Seed was shaken with the dry product(s) in a polyethylene jar (dry-coated), or was first coated with glycerol (12 ml/kg seed), then shaken with the fungicide(s) and finally coated with kaolin (60 g/kg seed) (wet-coated). Seed for "check" plots was either untreated (check for dry-coated seed) or treated with glycerol and kaolin (check for wet-coated seed). Plantings were made at the beginning of each month from April through September 1972. At each planting each fungicide-coating method combination was represented in two plots (180 seeds per plot) in a split-block design with fungicide as main treatment and coating method as subtreatment.

Because of a dry period in July and early August sprinkler irrigation was used just before and during the first week after the August planting.

Planting Series 2: Seed was dry-coated with benomyl, chloroneb and thiram singly (2 g/kg seed) and in all paired combinations (1 g each product/kg seed). Plantings were made on September 22 and October 12, 1972. Treatments were represented in four plots (270 seeds per plot) in a randomized complete block design.

Planting Series 3: Seed was dry-coated with chloroneb and thiram singly (each at 2 and 4 g/kg seed) and together in all paired combinations of rates. Plantings were made in 1973 at the University of Nigeria, Nsukka (October 6), the University of Ife (October 9), Ikenne (October 11), and IITA (October 18). Ninety-three seeds were planted per plot. There were four replications at IITA an two replications at the other locations. Design was a randomized complete block.

RESULTS

Planting Series 1: Seedling mortality in check plots varied from 8% in the April planting, at the onset of the rainy season, to 40% during the cool wet weather of the September planting. In April, May and July when seedling mortality in check plots was low there were no statistically significant differences between treatments. In June, August and September when seedling mortalities in check plots were high, significant differences were observed between fungicides but not between coating methods. In Table 1 the mean and minimum percent stand data for each fungicide over all six plantings indicate that chloroneb and carboxin were the most effective fungicides for control of seedling mortality. Carboxin, however, caused a yellowing of margins of unifoliate and first trifoliate leaves and for this reason was not used in subsequent tests.

Planting Series 2: Mortalities of 54% and 44% in check plots in September and October, respectively, indicate a favorable environment for the activity of the seedling pathogens during these tests. The stand data summarized in Table 2 indicate a high degree of control of seedling mortality with chloroneb and chloroneb combined with thiram. Thiram alone was more effective in the September planting than in the October planting. The greatest mortality in both plantings occurred in plots planted with benomyl-treated seed.

Table 1. Mean and minimum percent stand of cowpea seedlings 22 days after planting seed treated with various fungicides in six plantings, April through September 1972 at Ibadan, Nigeria.

Fungicide(s)	Rate (g/kg)	Minimum	Mean[a]
chloroneb	2	84.3	88.6 a
carboxin	2	80.0	88.2 a
chloroneb + thiram	1 + 1	74.2	84.8 ab
carboxin + thiram	1 + 1	64.6	84.3 ab
benomyl + thiram	1 + 1	71.5	84.0 ab
thiram	2	65.4	79.7 b
benomyl	2	63.4	74.8 c
Check	-	60.7	72.6 c

[a]Values followed by the same letter are not significantly different (P = 0.05).

Table 2. Mean percent stand of cowpea seedlings 22 days after planting seed treated with various fungicides in two plantings in September and October 1972 at Ibadan, Nigeria.

Fungicide(s)	Rate (g/kg)	September[a]	October[a]	Mean
chloroneb + thiram	1 + 1	89.2 a	82.5 a	85.8
chloroneb	2	84.1 b	78.9 ab	81.5
thiram	2	86.4 ab	75.4 ab	80.9
chloroneb + benomyl	1 + 1	77.1 c	72.9 ab	75.0
thiram + benomyl	1 + 1	79.1 c	71.3 b	75.2
Check	-	46.0 d	56.3 c	51.1
benomyl	2	30.0 e	50.6 c	40.3

[a]Values within planting followed by the same letter are not significantly different (P = 0.05).

Table 3. Mean and minimum percent stand of cowpea seedlings 22 days after planting seed treated with chloroneb and or thiram at four locations in southern Nigeria, October 1973.

Fungicide(s)	Rate (g/kg)	Minimum	Mean	(Standard deviation)
chloroneb	4	83.9	86.6	(2.3)
chloroneb	2	81.2	83.8	(2.2)
chloroneb + thiram	4 + 2	81.2	86.3	(3.7)
chloroneb + thiram	2 + 4	80.1	86.3	(3.6)
chloroneb + thiram	4 + 4	79.5	84.9	(4.7)
chloroneb + thiram	2 + 2	79.5	85.4	(5.3)
thiram	4	76.4	84.9	(5.6)
thiram	2	73.2	78.9	(5.5)
Check	-	49.5	68.0	(14.5)

Planting Series 3: At Nsukka and Ikenne there was a good stand of seedlings in all plots (all more than 80%) and there were no significant differences between treatments at these locations. At IITA and Ife mortalities in the check plots were 42% and 50%, respectively, and thus there was a good test of treatments at these locations. The mean and minimum stand data summarized in Table 3 indicate that chloroneb gave the greatest and most stable control of seedling mortality over the four locations and that there was no significant advantage in the combination of thiram with chloroneb at the rates used.

DISCUSSION

In the tropics, unlike the temperate regions, the soil at the beginning of the growing season is hot and dry and gets wetter and cooler as the season progresses. At Ibadan at the beginning of April the soil has been subjected to almost 5 months of dry season and the high incident radiation at this time quickly dries surface moisture and raises soil surface temperature to more than 40° C for several hours a day. As the rains become more regular, skies become overcast, soil temperature falls and soil moisture content rises. Ibadan, with its bi-modal rainy season, has a peak of rainfall in June, a short dry season in July and early August, and the rains again become heavy with overcast skies in September and early October. The variability in the incidence of seedling mortality in the eight plantings in 1972 (Fig. 1) indicates a probable buildup of inocula of the seedling pathogens throughout the season, with the low incidence of disease in July corresponding with a dry period following planting and the mid-September peak reflecting a combination of high inoculum potential and ideal environmental conditions for pathogen activity.

The poor performance of benomyl is probably due to its ineffectiveness against Phycomycetes (3) and thus a failure to control P. aphanidermatum. The increased seedling mortality with benomyl-treated seeds, indicated in Series 2 results (Table 2) may be an effect of suppression of competitors and antagonists of P. aphanidermatum by the broad spectrum benzimidazole fungicide, thus allowing this nonsensitive pathogen greater activity. The incidence of Pythium stem rot also increases when adult cowpea plants are sprayed with benzimidazole fungicides (8).

The yellowing of margins of unifoliate and first trifoliate leaves following seed treatment with carboxin suggests an accumulation of this compound or its breakdown products in the margins of transpiring cowpea leaves similar to that reported for bean (7).

Chloroneb has been effectively used in several crops for the control of seedling diseases caused by various fungi including R. solani and P. aphanidermatum (4, 5, 6). The consistent high level of control of cowpea seedling mortality by chloroneb in the present study indicates its effectiveness against these pathogens in the high rainfall tropical regions. The combination of thiram with chloroneb slightly increased the stand values in some of the plantings, but the differences were statistically significant in only one planting. The overall mean and minimum stand values for chloroneb alone are superior to those for the combinations of chloroneb and thiram.

The dusting of small quantities of cowpea seed with a fungicide such as chloroneb is a simple operation requiring little skill and no special equipment. The tolerance of cowpea to high rates of chloroneb (R. J. Williams, unpublished data), and its low mammalian toxicity (2)

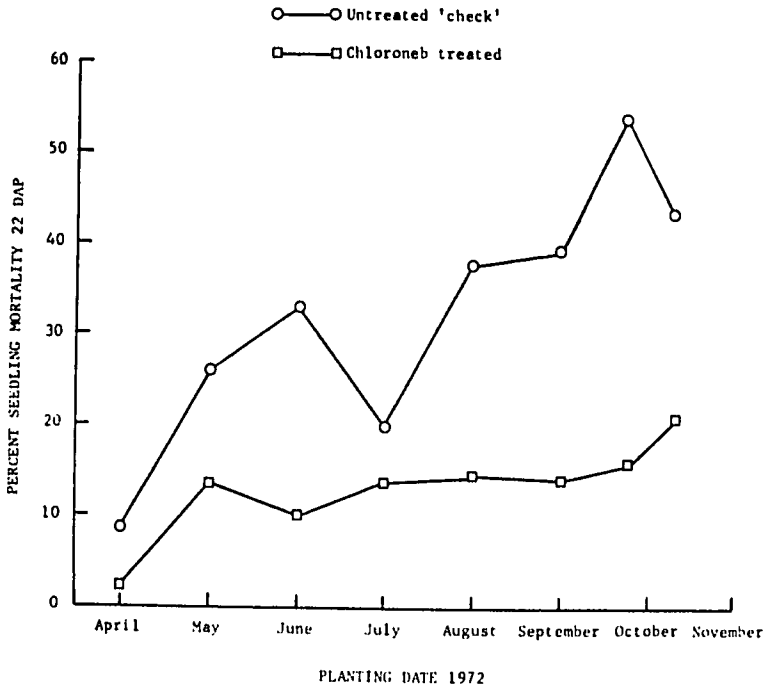

FIGURE 1. Percent seedling mortality 22 days after planting cowpea seed treated with chloroneb at 2 g/kg and nontreated in eight field plantings April through October 1972, at Ibadan, Nigeria.

make it a safe compound for use by peasant farmers. The main factors that will determine usage in the tropics, however, are availability and cost. The provision of small sachets containing enough fungicide to treat small seed lots would probably be an effective way to bring the seed dressing fungicides within the economic reach of tropical peasant farmers.

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