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CHEMICAL CONTROL OF CERCOSPORA LEAF SPOT DISEASE OF COWPEA (*VIGNA UNGUICULATA* (L.) WALP.)

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ABSTRACT

Three fungicides, benlate (methyl -1- (butylcarbamoyl) - 2 - benzimidazole carbamate), dithane M -45 (zinc and magnesium ethylene bisdithiocarbamate) and difolatan (5 Cis - N - 1,1,2,2 - tetrachloroethyl) thio - 4 - cyclohexane - 1, 2 - di-carboximide) were tested in the field for *Cercospora* leaf spot control. The test fungicides were differentially effective in controlling *Cercospora* leaf spot in cowpea. Benlate controlled the disease more effectively than any of the other fungicides tested. Out of the three spraying intervals tested, weekly, fortnightly and triweekly spraying, weekly spraying commencing three weeks after planting with each of the test fungicides was the most effective. The level of disease control achievable was also affected by the time of application. Cowpea grain yield was significantly ($P = 0.05$) enhanced when spraying started three weeks after planting.

INTRODUCTION

The numerous diseases afflicting cowpea crop constitute a part of the constraints in cowpea production especially in the tropics. In a survey of agro-ecological zones, Raheja (1986) identified diseases as the major problem associated with cowpea production. Three fungal diseases found to be particularly devastating in the northern guinea savanna include scab (*Sphaceloma* spp.) brown blotch (*Colletorichum truncatum)* and *Septoria* leaf spot *(Septoria vignae)* (Raheja, 1986).

Emechebe and Shoyinka (1985) reported that Africa was demarcated into four ecological zones of cowpea production. Different diseases prevail in these zones and in all, sixteen major diseases (bacterial and fungal) afflict cowpea in all the zones put together. *Cercospora* leaf spot (CLS) was listed among the important diseases of cowpea in the field. Two species of *Cercospora, C. cruenta* and *C. canescens* have been associated with leaf spot diseases in cowpea.

Cercospora leaf spot disease of cowpea is world-wide in distribution. According to Butler (1973), *C. cruenta* was first reported in the United States on a species of *Phaseolus,* or *Dolichos* and has since been reported on other legumes. Bird and Maramorosch (1975) reported that *C. cruenta* and *C. canescens* caused severe leaf spotting and defoliation in cowpea at Ibadan. *Cercospora* leaf spot has also been reported in Nigeria by Williams (1975) and in India by Verma and Patel (1969). Studies on the control of CLS have mostly centred on the use of host resistance.

According to Agrios (1978), host plant resistance has frequently broken down as a result of emergence of new strains of pathogens and changes in environmental conditions. However, Williams (1975) reported that two field trials were carried out at the International Institute of Tropical Agriculture (IITA), Ibadan using two fungicides, benomyl and kocide 101. Biweekly application of 0.2% a.i. benomly almost completely controlled *Cercospora* leaf spot. The aim of this study is to investigate a wider use of fungicides to achieve control of CLS taking into consideration the spraying intervals and timing of fungicide application.

MATERIALS AND METHODS

SPRAYING INTERVALS AND TIMING FUNGICIDE APPLICATION

Three fungicides earlier evaluated in the greenhouse (Amadi, 1990) were further tested in

the field. Three spraying intervals of one, two and three weeks and five application periods, 14,21,28,35 and 42 days after planting (DAP) were tested with each fungicide against CLS on cowpea. The test fungicides were benlate (methyl -1-(butylcarbamoyl) -2-benzimidazolecarbamate), dithane M-45 (zinc and magnesium ethylene bisdithiocarbamate) and difolatan (5 Cis-N-1,1,2,2 - tetrachloroethyl) thio-4- cyclohexane - 1,2, - di-carboximide). The cowpea variety used was a very susceptible variety, IT84S-2246-4 obtained from the Genetic Resources Unit (GRU) of the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Randomized complete block design was used with replicate plot size of 4 x 2.25m.

Test fungicides were prepared as aqueous suspensions in plastic bowls, mixed vigorously and transferred into a CP-3 knapsack sprayer with a nozzle diameter of 1 mm. For the spraying intervals, test plants were sprayed to run off starting three weeks (Amadi,1990) after planting and repeatedly at the appropriate test intervals. The control plots were not sprayed. Both the test and the control plots were sprayed 35 and 56 DAP with an insecticide to reduce insect damage.

Spraying with fungicides was stopped in all plots 6 weeks after the first spraying. For the application periods, experiments covered two cowpea-growing periods. Spraying was commenced at the different test periods and repeated fortnightly until pod maturity. The control plots were not sprayed but all the plots were sprayed twice with an insecticide.

In both experiments, mature, dry pods were harvested and grain yields recorded per plot. Results were analysed using the analysis of variance (ANOVA) and the Duncan's multiple range test.

DISEASE RATING

Rating of disease severity (percentage diseased area on infected leaves) was carried out 9 days after the last spraying as used earlier (Ahmad, 1985), based on a rating scale (Table 1).

Disease severity indices (DSI) were also calculated for the different treatments (Silbernagel and Jafri, 1974).

$$DSI = \frac{On_0 + 1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5 \times 100}{nt\ (nc - 1)}$$

where

n = Number of diseased plants in each category

nt = Total number of plants

nc = Total number of disease categories

Grain yields were obtained per plot and results analysed by ANOVA.

RESULTS

The three fungicides tested were effective in controlling *Cercospora* leaf spots in the field during the two growing periods of this study. Benomyl was, however, most effective, while the efficacy of dithane M-45 was the least under the conditions of this study. Cowpea grain yield was best in benomyl - controlled plots in both of the growing periods tested. The analysis of the data for grain yield revealed that yields were significantly ($P = 0.05$) higher in benomyl - controlled plots and that there was no significant difference in grain yield in the second growing period between difolatan - or dithane M - 45 - controlled plots. However, yields were significantly higher in plots sprayed with benomyl, than with dithane M - 45. The least grain yield per plot was recorded in the control plots in both growing periods.

The tested spraying intervals were differentially effective in controlling CLS in cowpea. Weekly spraying of each of the tested fungicides gave highest level of disease control and this level corresponded to the highest grain yield (Fig.1). Grain yields were significantly different ($P = 0.05$) between the three spraying intervals tested. The plots sprayed every 3 weeks gave the least grain yield among the sprayed plots.

Table 1:Rating Scale for *Cercospora* leaf spot disease of cowpea (*Vigna unguiculata* L.)

Table 1: Rating Scale for Cercospora leaf spot disease of cowpea (*Vigna unguiculata L.*)

* Scale	Description
0	No spot on leaf
1	1 -10% leaf lamina covered by spots.
2	11-25% leaf lamina covered by spots
3	26 - 50% leaf lamina covered by spots.
4	51 - 75% leaf lamina covered by spots.
5	76% and above leaf lamina covered by spots

Source : Oladiran, A.O 1983, Studies on the diseases of Cowpea *(Vigna unguiculata* (L.) Walp.) Ph.D Thesis, University of Ibadan, Nigeria. 225 pp.

Grain yield from the control plots was 11% lower than from the plots sprayed every 3 weeks. Interaction between fungicide and spraying intervals did not produce any significant difference on the level of disease control achievable.

TIMING FUNGICIDE APPLICATION

Results of this study revealed that the efficacy of benomyl in controlling CLS in cowpea was affected by the time of application. The best level of disease control was achieved when spraying commenced 3 weeks after planting. Grain yield was significantly different (P = 0.05) among the test application periods, and decreased progressively as the commencement of fungicide application was delayed. The control plots produced the least grain yield followed by the plot sprayed 6 weeks after planting. Results of this study showed that *Cercospora* disease severity increased as commencement of spraying was delayed (Fig.2).

DISCUSSION

Studies showed that benomyl was the best of the three fungicides tested and that spraying intervals and time of commencement of spraying were important factors in the chemical control of *cercospora* leaf spot in cowpea.

Benomyl has been widely reported to be very effective in the control of foliar diseases in a wide variety of crops (Rodriguez and Melendez, 1984). Mcdoncald (1970) had reported that spraying with dithane M-45 reduced *cercospora* leaf spot in peanut. In combination with other fungicides, benomyl has also been reported to be effective against certain foliar diseases (Smith and Crosby, 1972; McDonald and Fowler, 1976; Gopal; and Sreenivasulu, 1983).

In this study neither phytotoxicity nor any other deleterious effects were observed with any of the fungicides in the field. But Oke (1986) has reported phytotoxicity in tobacco plants sprayed with 500 ppm benomyl at weekly intervals. Khaleaq and Klatt (1986) have also reported that in some wheat cultivars, benomyl reduced seedling emergence. These reactions are, however, thought to be part of the greenhouse effects as different from the conditions in the field.

The better control of disease and increased grain yield achieved with closer spraying intervals could possibly be as a result of less chances of recovery of causal organism from the initial spray before subsequent sprays were applied. It is likely also, that over an extended spraying interval, the chances are that fresh inoculum could get deposited on the surfaces of sprayed leaves and initiate fresh infections as fungicide effect wears off most especially under our tropical heavy rainfall conditions. Under this circumstance, the amount of fungicide residue absorbed by sprayed leaves might not be enough

to suppress the development of fresh propagules.

According to Brenneman (1994), thifluzamide applied from 30 - 100 days after planting (DAP) in 1992 and 30 - 70 DAP in 1993 significantly reduced stem rot and increased yield in peanut. Crop value was increased and the best disease control (74%) was from the 50 DAP application. Smith *et al.* (1994) have reported that fluazinam applications resulted in a significant increase in peanut yield reaching 29% over untreated peanut.

Lateness in commencing spraying was found in this study to increase the magnitude of crop loss in terms of grain yield. It has been reported (Keinath, 1994) that three application intervals of chlorothalonil plus benomyl reduced the areas under disease progress curves (AUDPC) compared to no fungicide in the gummy stem blight (Didymella *bryoniae* and *Phoma cucurbitacearum)* of a watermelon cv. However, the best disease control was obtained when watermelon was sprayed all through the season (six times) than when sprayed three times either during early (First half) or late (last half) growth period. The optimal time for the applications of propiconazole on spring wheat against foliar diseases had been reported (Duzcek and Jones-Flory, 1994) to be between the extension of the flag leaf growth stage to the medium milk growth stage corresponding to growth stage (G.S)
41 -75.

The role of time of fungicide application is believed to be related to the life cycles of causal organisms. In the present study, 21 days after planting was found to be best for commencing spraying. *Cercospora* leaf spot symptoms usually appear first on cowpea leaves within four weeks after planting, coinciding with the on set of flowering (Williams, 1975). It is plausible to infer that commencement of spraying late allows the pathogen ample opportunity to be properly established in the host thereby making spraying less effective. Similar to the results obtained in this study, Rattan and Kang (1982) reported best control of *cercospora* leaf spot in peanut when bavistin (a systemicfungicide of the Benzimidazole group as benomyl is) spraying was initiated at 45 days rather than at 55 or 65 days after planting.

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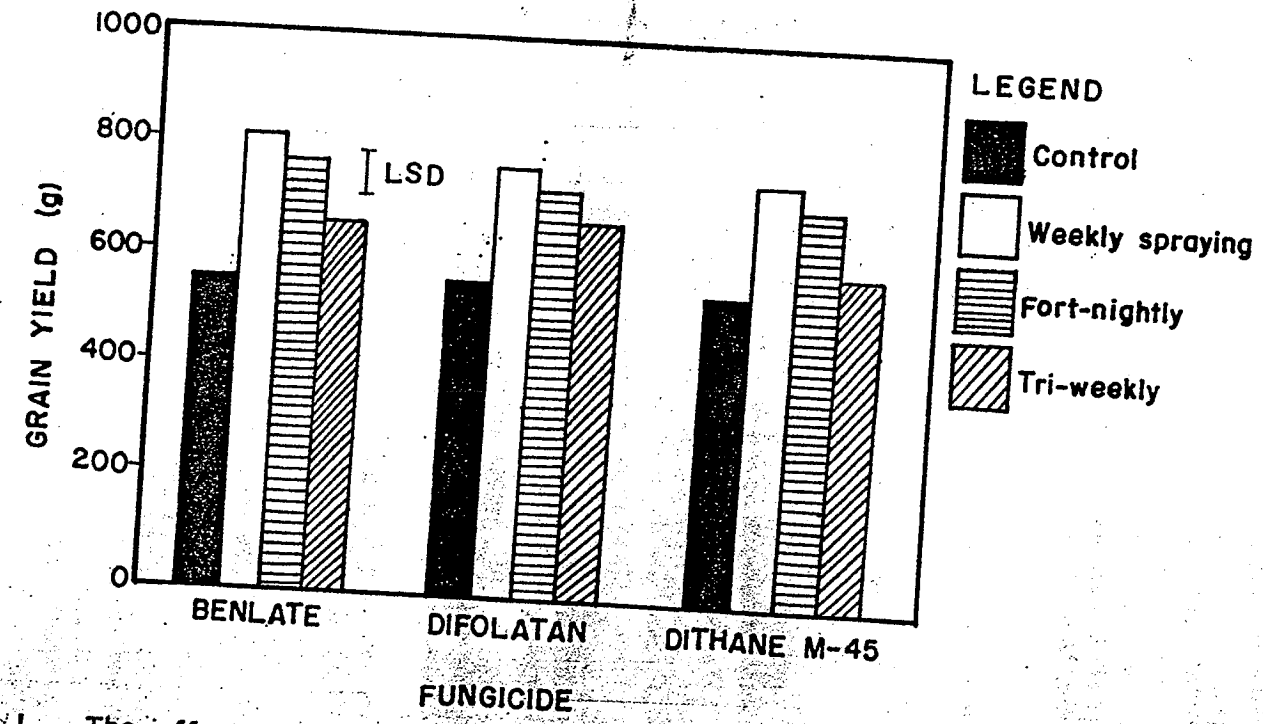

Fig. 1 The effects of fungicides and spraying interval on Cercospora leaf spot disease control in cowpea.

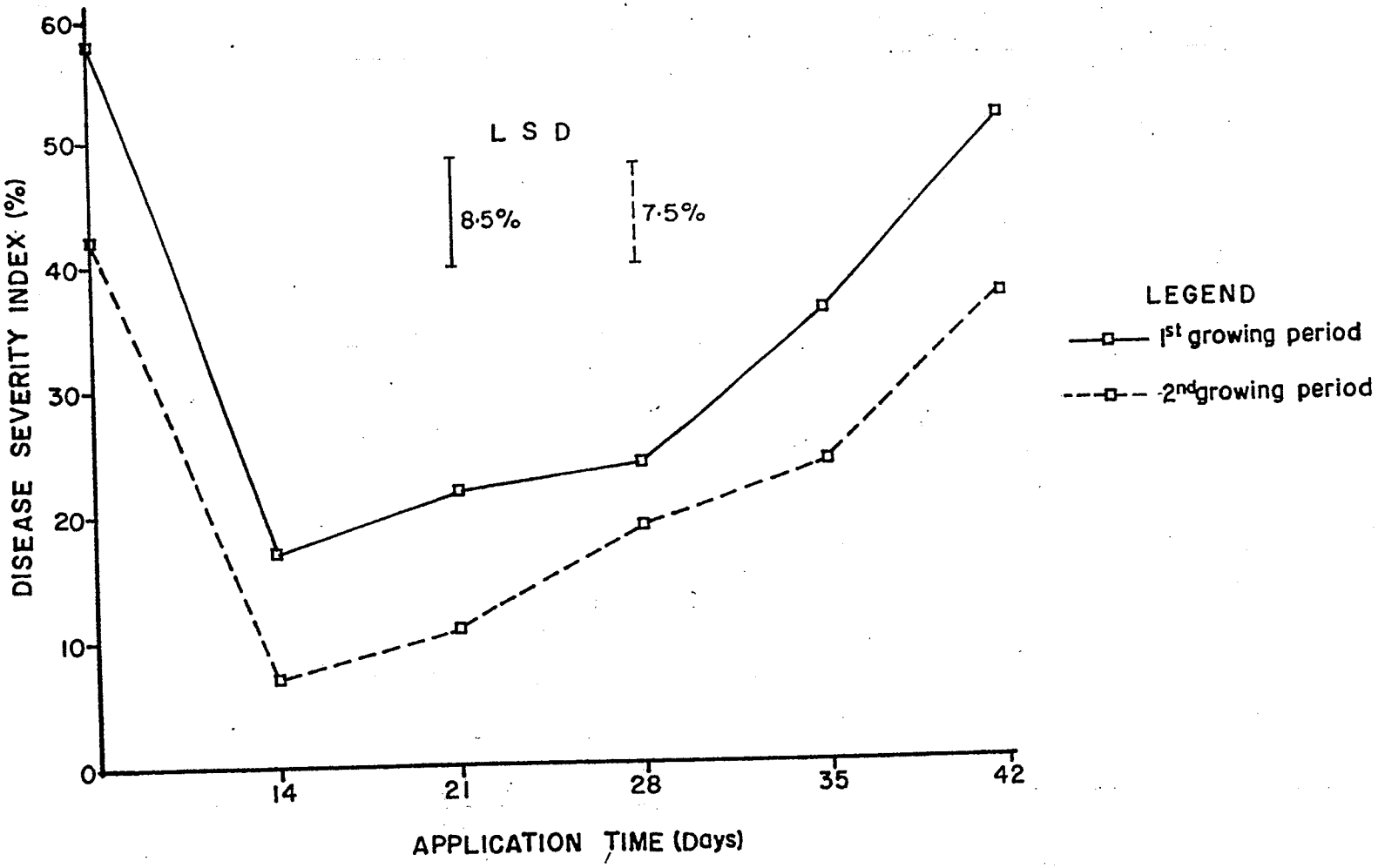

Fig. 2 The effect of time of fungicide application on the severity of Cercospora leaf spot disease in cowpea.