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An evaluation of some fungicides in the management of fruit and leaf spot (*Phaeoramularia Angolensis)* of citrus

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Abstract

Four fungicide treatments viz Benlate (Benomyl), Cupravit (Copper oxychloride), Dithane M45 (Mancozeb), and Benlate alternated with Dithane M45 were applied to control *Phaeoramularia angolensis* in a block of the variety "Valencia" in the citrus orchard at Kiige, Uganda. No fungicide was applied to the control. Benlate, Cupravit and Benlate alternated with Dithane M45 kept the disease level to about 50% compared to the 90% disease in the control. Dithane M45 alone performed poorly with disease level of up to 80%. Therefore, the use of suitable fungicide can be effectively integrated in the overall disease control strategy.

Key word: Citrus, fungicides, fruit spot, leafspot.

Introduction

Fruit and leaf spot disease of citrus is caused by a fungus called *Phaeoramularia angolensis* (Cavalho & Mendes) Kirk [=*Cercospora angolensis* (Cavalho & Mendes)]. The disease affects all citrus species; grape fruits, orange and tangerine are very susceptible while lemon is less susceptible and lime is least (Seif 1995). Fruits and leaves are more susceptible than stems which rarely show symptoms.

On leaves, the fungus produces circular, mostly solitary spots with a light brown or greyish centre and are usually surrounded by a prominent yellow halo. Generalised foliar chlorosis caused by coalescence of several lesions results in premature defoliation. Young fruits show nipple-like swellings without a yellow halo. On bigger fruits, spots are circular to irregular, discrete or coalescent and are surrounded by a yellow halo. Severely infected fruitlets turn into mummies. Spots on mature fruits are normally flat and often surrounded by a dark brown to black sunken margin of anthracnose. The spot area of the fruit is harder than the uninfected area.

Serious effects of the disease include premature fruit fall and making spotted fruits unmarketable. A yield loss of 50 - 100% has been reported in Kenya (Seif 1995). Surveys done in Uganda have shown that this disease is widespread in all citrus growing areas and possess a big threat to citrus production (Ssekyewa 1995). It was against this back ground that studies on *P. angolensis* were initiated to evaluate the various disease management options in order to develop packages for the Ugandan farmers.

Materials and methods

A study using four fungicides to control *Phaeoramularia* fruit and leaf spot was conducted at Kiige Citrus Scheme on Valencia oranges from August 1996 to July 1997. The field was divided into three replicate blocks each containing five plots. Each plot was further split into two subplots each containing six trees.

The treatments used in the experiment were as follows

1. Dithane M45 (Mancozeb 80% WP)applied at 40g/15L water (T1)
2. Benlate 50WP (Benomyl) applied at 20g/15L water (T2)
3. Cupravit(Copper Oxychloride) applied at 50g/15L water (T3)
4. Benlate alternated with Dithane applied at 20g and 40g/15L water respectively (T4)
5. No fungicide (control) (T5).

Each treatment was split into 2 parts (periods of fungicide application) and applied to the sub plot. During period 1 fungicides were applied from flushing, flowering and fruit set until fruits were at 4 cm diameter. During period 2 fungicides were applied from fruit size 4 cm in diameter to fruit ripening. Treatments were applied as follows: Dithane M45 at a two weekly interval, Benlate at a one month interval, Cupravit at a two weekly interval and Benlate alternated with Dithane M45 at a two weekly interval. The treatments were applied to the plots starting from August 1996 but the subplot treatments were not started until end

of January 1997 after the mature crop had been harvested and new flush had appeared. Thereafter treatments were carried out according to the application periods in the subplots until end of July 1997.

The whole experiment was a randomised complete block design for factor A (fungicide treatments) with factor B (period of fungicide application)a split on A.

The trees were all properly pruned and weeded at the start of the trial and subsequent weeding was done whenever it was necessary. Fungicide treatments were applied by spraying the citrus trees with the chemicals using knapsack sprayers.

The disease recording was done from August 1996 to August 1997. Disease assessment dates were 2/8/96, 22/1/97, 11/4/97, 24/6/97 and 28/7/97. Disease severity on leaves and fruits was assessed using the following parameters:

1. Percentage leaf spots per tree per plot on a score basis of 0 - 5 (0=0%; 1=1- 20%; 21- 40%; 3 = 41 - 60%; 4 = 61 - 80%; 5 = 81 - 100%).
2. Number of prematurely fallen fruits per tree per plot.
3. Percentage of marketable fruits per tree per plot per season.

At the end of the trial, analysis of variance was carried out using Mstatc computer package.

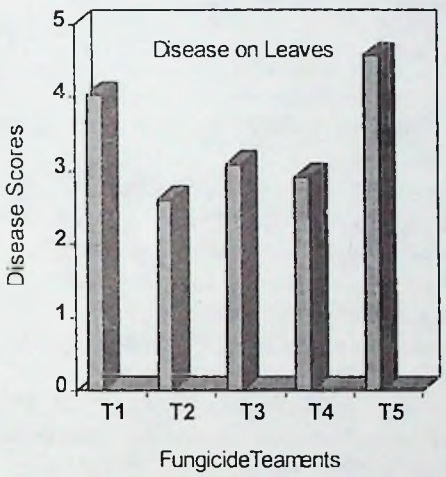


Fig. 1.1 Mean disease scores under different fungicide treatments

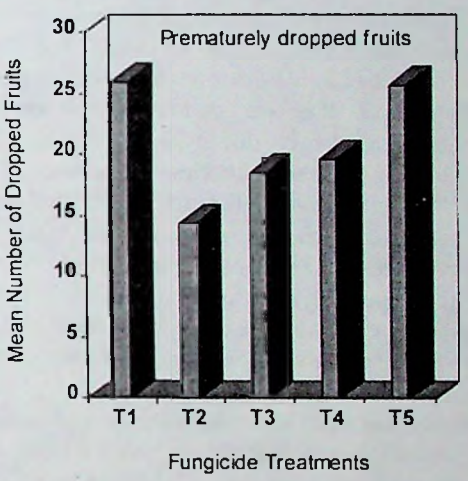


Fig. 1.2 Mean number of dropped fruits under different fungicide treatments

The disease level varied between the fungicide treatments; being kept to about 50% in Benlate (T2), Copper oxychloride (T3) and Benlate alternated with Dithane M45 (T4) but reaching above 60% in Dithane M45 (T1) and over 80% in the control (T5) (Fig 1.1). There were significant differences between T2 and T1 and T5 ($P<0.05$). However there were no significant differences between T2, T3 and T4.

There were more premature fruits dropping with Dithane M45 (T1) and the control (T5) than with Benlate (T2), Copper oxychloride (T3) and Benlate alternated with Dithane M45 (T4) (Fig 1.2). No significant differences were observed between T2, T3 and T4 but significant differences were noticed between T2 and T1 and T4 ($P<0.05$).

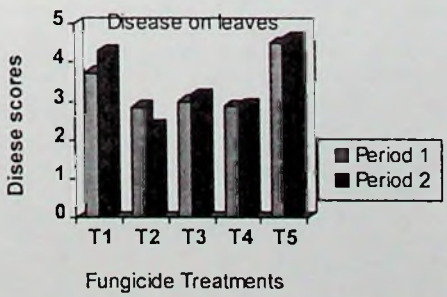


Fig. 2.1 Mean disease scores under different fungicide treatments at different application periods

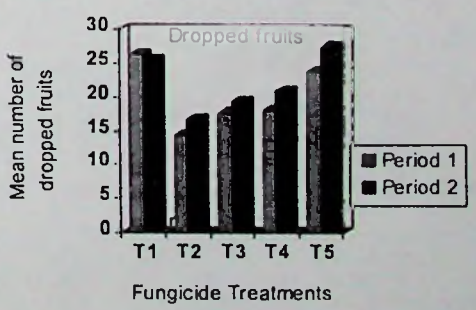


Fig. 2.2 Mean number of dropped fruits under different different fungicide treatment at different application periods

There were observed differences within the treatments between the periods of fungicides application. Generally, there was less disease and proportionately less fruit drop if the treatments were applied from flushing to fruit size 4cm diameter (period 1) than from fruit size 4 cm to fruit ripening (period 2) (Figs 2.1 and 2.2). However the differences observed were not statistically significant when different periods under individual treatments were compared.

The data on percentage of marketable fruits could not be obtained because piecemeal harvesting was carried out as big markets for harvested fruit were not available.

Discussion

Benlate (T2) gave the best overall disease control followed by Benlate alternated with Dithane M45 (T4) and then copper oxychloride (T3). Dithane M45 alone (T1) gave poor disease control. It appears that the disease control experienced in T4 was largely due to the effect of Benlate. The best level of disease reduction was about 50% achieved in T2. This was still quite high possibly because the overall period to which the crop was exposed to any of the treatments was short (12 months i. e August 1996 to July1997). It is hoped that if the fungicide treatments were to be carried out over several seasons, the disease would reduce much further where effective chemicals were applied.

Application of fungicides during period 1 (from flowering until fruits reach about 4cm diameter) generally gave better disease control than during period 2 (fruits of 4cm diameter until fruit ripening). The reason might be that bigger fruits and older leaves resist infection better than the young ones and therefore leaves and fruits need to be protected while still young.

Conclusions

Benlate gave the best disease reduction and therefore it is recommended to control *P. angolensis* in citrus. Although it was generally expensive it was applied less frequently than other fungicide treatments. Dithane M45 gave poor results in this trial and it might not be useful to incorporate it in the disease control programme either singly or alternated with Benlate. Since copper oxychloride was fairly good and was cheap, it could also be used either singly or alternated with Benlate to control the disease.

Alternating fungicides is highly recommended as it minimises development of pathogen resistance to a particular fungicide as well as reduces costs on fungicides. There is need to do cost benefit analysis to determine the most profitable treatments. It is further recommended that more fungicides be screened for incorporation into the disease management strategy.

References

Emechebe A.M. 1981. Brown spot disease of citrus caused by *Phaeoisariopsis sp.* *Annals of Applied Biology* 97, 257 - 262

Kagorora,J.P. and Sekyewa C.1997 An evaluation of the efficacy of fungicides and cultural practices against *Phaeoramularia angolensis* Leaf and fruit spot of citrus. Research report to NARO

Owera, S. and Ssekyewa, C.1990 Plant Pathology survey results. UGA/87/003 Report.

Seif A.A. 1995. *Phaeoramularia* fruit and leaf spot of citrus in Kenya. *Kenya Agricultural Research Institute Information Bulletin* No. 15, 1 - 3.

Seif, A.A. and Whittle A.M 1984. Diseases of Citrus in Kenya. *FAO Plant Protection Bulletin* Vol. 32, No. 4 ,122 - 126

Ssekyewa C 1995 Survey of extent and effects of Citrus woolly white fly in Uganda. Research Report to NARO