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CHOICE OF CHEMICALS FOR DISEASE CONTROL

T H DE WET
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OPSOMMING

Verskeie faktore wat belangrik is in die keuse van 'n swamdoder word bespreek. 'n Vergelyking word getref tussen benomil, koperoksichloried en captafol. Alternatiewe beheerprogramme word kortliks bespreek.

SUMMARY

Several criteria which are important for the selection of a fungicide are discussed. A comparison is made between Benomyl, copperoxy-chloride and captafol. Alternative control programmes are discussed briefly.

INTRODUCTION:

According to Toerien, Meyer and Milne (1984) R450/ha is spent annually for the control of Fruit spot *(Pseudocercospora purpurea)* and R200/ha for the control of root rot in mature avocado orchards in the Tzaneen area. Mean packhouse cull figures as high as 5,1% for fruit spot and 3, 5% for sooty blotch *(Akaropeltopsis sp.)* were recorded in previous years (Smith, 1984). Bezuidenhout & Kuschke (1983) found that a mean of 28,9% of South African avocados examined at Rungis in 1982 showed external anthracnose symptoms. Comparable figures for internal anthracnose and stem-end rot were 8,8% and 13,7% respectively. These figures illustrate the importance of effective disease control measures to ensure optimum yield and maximum marketable fruit. The choice of chemicals with emphasis on pre-harvest application of fungicides to control fruit diseases will be discussed here.

SELECTION CRITERIA

In avocado production chemical control of diseases can be defined as the use of fungicides to prevent or reduce the occurrence and effects of the disease symptoms.

Influencing the decision on whether or not to use a fungicide, and which one to use, is an intricate relationship of a number of factors as shown in Figure 1 .This requires each grower to ha vean intimate knowledge of his production unit and its problems as well as products available. By acknowledging and studying these factors the economic and other implications of disease control will be considered and sound decisions will be made.

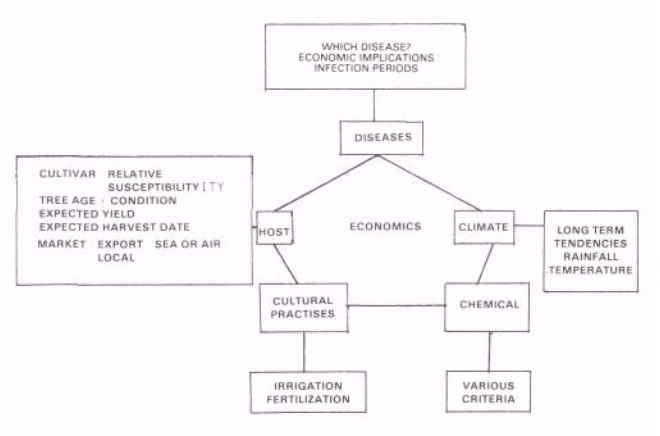

FIG. 1: Factors influencing disease control measures.

A number of products are currently available to the avocado grower and more may become available in future. Criteria important in the selection of a fungicide are:

1. Fully tested and approved

The fungicide must provide adequate and consistent disease control and must be registered under Act 36/1947 for use on avocados. This ensures that toxicological properties of the product are acceptable, that phytotoxicity is not a problem and that efficacy has been proved.

2. Spectrum of control

In some instances a very specific spectrum of activity may be required to avoid repercussions on other diseases or pests. In other cases a broad spectrum of activity may be required to control a number of maladies simultaneously.

3. Crop tolerance

No phytotoxic effects should occur at dose rates used to provide protection. Aspects such as fruit finish, effect on leaves and effect on yield in subsequent years should be considered.

4. Environmental impact

Harmful effects on the environment, users and consumers should be minimal or non existant. Toxicity to bees, birds and fish and the relative toxicity to mammals and the effect thereof on handling procedures should be considered.

5. Formulation

The active ingredient of a fungicide must be formulated into a product that can be easily transported, stored and applied. It should be stable in dilution, provide proper coverage of fruit, be relatively stable to wash-off by rain, photodecomposition and general climatic effects. The effect of the product on spraying apparatus e.g. corrosiveness should also be known and taken into account.

6. Residues

The fungicide break-down pattern should be such that acceptable disease control will be maintained but residue levels at harvest will be low enough not to pose any danger to consumers. In this respect the with-holding period between last application and harvest, as indicated on the product label, must be borne in mind.

7. Miscibility

The product should be miscible with other products, such as pesticides or foliar fertilizers, used in conjunction with it and compatible with products used shortly before or after application of the fungicide.

8. Spray intervals

The number of and intervals required between spray treatments and the effect thereof on economics and general husbandry practices on a production unit must be considered.

9. Supplier

Chemical suppliers that are reliable, reputable and provide technical advice and back-up service can be very valuable, and, depending on the technical expertise available on the farm, even be indispensable.

10. Price

The price of the fungicide per tree or per hectare unit should be considered in the light of the quality of the product and benefits provided by the product and/or supplier.

ECONOMY

The application of disease control measures must yield an adequate economic return on investment. Bradbury and Loasby (1977) suggest that the criterion to he used may be close to $B/C \geq 4$ or at least > 1 where

B = expected benefits from treatment (damages prevented)

C = costs of treatment (material plus application)

Due to the importance of the export market to South African avocado growers it is imperative that all fruit be treated to ensure consistently high quality, marketable fruit. For the avocado grower the above formula may then rather be:

$^{B}A + {}^{B}E / {}^{C}A + {}^{C}E > 1$ where

^{B}A = Direct benefits from controlling a disease

^{B}E = Benefits of side effects e.g. simultaneous control of other diseases, prevention of disease build up, improved shelf-life, impact on overseas consumer etc.

^{C}A = Direct costs of product and application

^{C}E = Costs of effects associated with the treatment e.g. spray deposits on fruit, loss of interest on investment etc.

AVAILABLE FUNGICIDES

When fungicides for root and trunk rot control are excluded, only 4 fungicides are currently registered in South Africa for use on avocados. One of these, thiabendazole, is only registered as a post-harvest treatment. The other 3 chemicals Benomyl, copper oxychloride and captafol are compared in Table 1.

ALTERNATIVES

In comparison with other crops such as citrus and pome fruit, the avocado industry is relatively small and disease free. Chemical companies therefore tend not to evaluate fungicides routinely on avocados. A number of products and spray programmes have been evaluated since the early 1970's. None of these are however registered for use in South Africa.

Bordeaux mixture (calcium hydroxide + copper sulphate) has been used in other countries to provide disease control. The product is highly corrosive on metal and not compatible with alkaline sensitive pesticides.

A number of other copper formulations such as cupric hydroxide are available that leave less visible residues, are less corrosive on metals and are much easier to apply. Control afforded by these chemicals will probably be similar to that obtained with copper oxychloride. No real advantage can therefore be seen to switch to other copper formulations.

In trials conducted by Agricura (personal communication) mancozeb gave good control of fruit spot but inferior control of anthracnose when applied 4 times at monthly intervals. It also controlled sooty blotch. (Kotzé, Kuschke & Durand 1981). To obtain results similar to copper oxychloride more sprays will therefore be needed and in high rainfall years poor control could result. Good results were obtained with 2 copper oxychloride sprays in November and December followed by a Benomyl spray (100 g Benlate/100ℓ) in early February. It is considered that this programme affords control of anthracnose, fruit spot, certain stem-end rot pathogens and Sooty Blotch (SAAGA, 1981). Agricura

results from 1984 (personal communication) show good control of fruit spot and anthracnose with a mixture of 144 g a.i captafol + 10 g a.i. Benomyl / 100ℓ spray mixture applied early in December and early in February. Captafol followed by Benomyl and captafol (even at half rate) followed by copper oxychloride also gave good control of fruit spot (Darvas, 1982). This type of programme may reduce problems such as visible spray deposits on fruit at harvest. It may be a viable alternative but further work needs to be done to register an approved programme.

CONCLUSION

Careful planning and judicious use of fungicides can result in a better, more profitable crop. To obtain complete control of diseases such as fruit spot and anthracnose will however be a costly exercise. Pre-harvest application of fungicides are therefore aimed at providing economic disease control and should be regarded as such with adjustments to the disease control programme being made for each avocado producing region.

TABLE 1: A comparison of different chemicals registered for use as pre-harvest sprays on avocados in South Africa

PROPERTY	CHEMICAL		
Common or trivial name (Active Ingredient)	Benomyl	Copper oxychloride	Captafol
Trade name + Reg. no Act 36/1947	Benlate (L 1)	Virikop (L 1054) and various others	Difolatan (L 2685)
Chemical name	Methyl 1 - (butylcarbamoyl)-Benzimidazol-2-ylcarbamate	Di-copperchloride trihydroxide	1,2,3,6-tetrahydro-N-(1,1,2,2 tetrachloroethylthio) phthalimide.
Formulation	500g/kg Wettable Powder	850g/kg Wettable Powder (500g Copper metal/kg)	800 g/kg Wettable Powder
Mode of action	Systemic fungicide. Translocated upwards. Can act preventatively and curatively.	Protective fungicide. Can be washed-off by rain.	Protective fungicide. May have transcuticular movement. Redistributed by rain.
Registered to control	Fruit spot *Pseudocercospora purpurea)* Until May 1983 also registered for the control of Anthracnose *(Dothiorella/ Collectotrichum* complex) and as a post-harvest treatment for the control of Anthracnose and stem-end rot.	Fruit spot and Anthracnose	Fruit spot and Anthracnose
Other crops registered on (R.S.A.)	Apples, pears, apricots, peaches, plums, groundnuts, wheat, cucurbits, bananas, roses, citrus, mangoes, brussel sprouts, sugarcane, gladioli, tobacco seedlings table and wine grapes, tomatoes, green peppers.	Seedlings, strawberries, potatoes, carnations, apricots, apples, pears, flowers and ornamentals, beans, boysen and young berries, granadilla, cotton, coffee, crucifers, walnuts, olives, cucurbits, peaches, plums, roses, celery, citrus, gladioli, tobacco, tomatoes, mangoes and vines	Pine-apples, coffee, potatoes, tomatoes and citrus.

Other Diseases (Genera only) Registered on (R.S.A.)	Venturia, Podosphaera, Penicillium, Monilinia, Fusicladium, Cercospora, Cercosporidium, Phoma, Ustilago, oidium, Fusarium, Thielaviopsis, Verticillium, Actinonema, Diplodia, Trichoderma, Guignardia, Mycosphaerella, Botrytis and Oidiopsis. Also active on Nectria, Colletotrichum, Sclerotium, Sclerotinia, Rhizoctonia and various other genera. Resistant strains may develop	Mycosphaerella, Phytophthora, Sphaeropsidales, Pseudomonas, Stigmina, Venturia, Peronospora, Alternaria, Phyllosticta, Epicoccum, Uromyces, Puccinia Phragmidium, Xanthomonas, Sphaceloma, Colletotrichum, Rhizoctonia, Hemileia, Peronospora, Cycloconium, Pseudoperonospora, Taphrina, Actinonema, Septoria, Cercospora, Guignardia, Plasmopara, Phomopsis. Also active on Akaropeltopsis (Kotzé *et al,* 1981) and various other genera.	Phytophthora, Hemileia, Alternaria. Also active on Akaropeltopsis (Kotzé *et al,* 1982) and various other genera.
Crop safety	Very well tolerated by plants.	Well tolerated by plants. May leave visible spray deposits.	Slightly phytotoxic on leaves and leave white residue on fruit. (Kotzé *et al,* 1981)
Effect on spray apparatus	Safe.	Corrosive to metals.	Corrosive to metals.
Compatibility and stability	Compatible with most commonly used pesticides and foliar fertilizers except highly alkaline materials such as Bordeaux mixture or Lime Sulphur. Decomposed by strong acids and alkalis. Decomposes slowly in the presence of moisture.	Compatible with most non-alkaline plant protection products that do not form sparingly soluble Copper salts. Very stable in neutral media. Decompose on heating in alkaline media.	Compatible with most commonly used pesticicides except highly alkaline materials. Should not be used in combination with or closely following oil sprays. Slow hydrolytic cleavage in aqueous suspension. Rapidly hydrolyzed in acidic and alkaline media.
Toxicity:			
Acute Oral LD50 (rats)	> 9590 mg/kg	700-1000 mg/kg	4600-6200 mg/kg
Acute Dermal LD50 (rabbits)	> 10000 mg/kg	-------	> 15000 mg/kg
LC 50 (Rainbow trout)	0,17 mg/ℓ	20-30 mg/ℓ	0,5 mg/ℓ
Bees	Not toxic	Not toxic	Not toxic
Birds	LC50(8-d) (Bobwhite quail) 500mg/kg diet	Unkown	LC50(10-d) Pheasants > 23070 mg/kg diet.
Poison group	IV	III	IV
Maximum residue limit on avocados (R.S.A.)	3,0	20,0	5,0
Withholding period (days)	14	14	60
Other	Slight irritation of eyes	Oral intake may cause gastroenteritis, vomiting and heavy metal poisoning.	May cause eye and skin irritation and swelling of eyes. Some people may be allergic. People in contact with the chemical may become sensitised and suffer from allergic contact dermatitis.
Registered rate on avocados/100ℓ water	50g Product + 0,5ℓ narrow distillation range oil or 20mℓ Pinolene. Apply end November + end January.	300g Product. May add 20mℓ Pinolene. Apply mid to end November + 2 follow-up applications at 4 week intervals.	200 g product. Apply mid to end November + again 6-8 weeks later.
Price/100ℓ mixture (as on 28/09/1984)	R 2,15 + R0,68 = R 2,83 OR R 2,15 + R0,28 = R 2,43	R 0,77 OR R 0,77 + R0,28 = R 1,05	R 2,73
Chemical cost/ha/season (177 trees/ha; 33ℓ/tree)	R330,60 OR R283,87	R134,93 OR R183,99	R318,92
Application cost/ha/season (R100/application)	R200,00	R300,00	R200,00

Information obtained partly from:

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