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CHEMICAL CONTROL OF POSTHARVEST DISEASES OF AVOCADOS

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SUMMARY

Agral imporved distribution of copper oxychloride on leaves, but with Nu-Film and Triton the distribution was patchy. Nu-Film, enhanced the tenacity of copper oxychloride on leaves when compared with Agral and Triton; Nu-Film also increased the fungicida! effect of benomyl ***in vitro.*** *As an additive to fungicidal sprays for avocado fruit diseases Nu-Film was the superior* product.

OPSOMMING

Agral het die verspreiding van koperoksichloried op blare verbeter in vergelyking met Nu-Film en Triton, in welke geval die residue oneweredig in kolle verspreid was. Nu-Film het wel die kleefbaarheid van koperoksichloried op blare verbeter in vergelyking met Agral en Triton. Nu-Film het ook die ***in vitro*** *swamdodende effek van benomil verhoog. Nu-Film was die beste produk waar byvoegmiddels verlang word vir die chemiese beheer van swamsiektes op avokadovrugte.*

INTRODUCTION

Chemical control of post-harvest diseases is mainly achieved by pre-harvest sprays which are primarily applied for the control of Cercospora spot *(Pseudocercospora purpurea).* The pre-harvest sprays, particularly copper oxychloride and captafol result in visable spray residues on harvested avocados. These deposits are usually present at the stylar end of fruit and are not easily removed by standard packhouse procedures. One approach to this problem would be to find suitable additives which enhance full coverage of the fruit during spraying but reduce the residues. In order to evaluate this approach, formulations with wetting, spreading and sticker characteristics were compared to reduce the residues, without reducing the efficacy of the fungicide. Avocado leaves were used as a model.

The purpose of the present study was to evaluate the effect of spray additives (Agral 90, Nu-Film-17 and Triton-1956-B) on surface tension and on coverage and retention, especially when exposed to "artificial rain".

MATERIALS AND METHODS

Measuring surface tension

The drop weight method of Adamson (1973) was used to determine the surface tension of Agral 90, Nu-Film-17 and Triton-1956-B at concentrations of 0.03, 0.06, 0.125, 0.25, 0.5, 1 and 2% prepared in distilled water. A microsyringe was used to determine the volume of the droplets at the moment of falling when they were slowly squeezed out. All treatments were replicated five times and the whole experiment was repeated three times.

(90 ml/500 ℓ a.i) Triton -1956-B (25 ml/100 ℓ) and Nu-Film-17 (50 ml/100 ℓ) respectively. Copper oxychloride without surfactant served as control. The leaves were allowed to dry and were then washed in a bucket(500 x 250 x 150 mm) containing tap water by drawing each leaf through the water either 0, 1, 4, 8, 16 or 24 times (Heuberger, 1941). After the leaves had dried the copper oxychloride residues on the leaves were determined according to the rubeanic-acid method (Briscoe & Matthews, 1934). Greenish-gray prints of copper oxychloride deposits were obtained on filter paper discs.

Chemical and biological determination of the initial and weathered deposits of copper oxychloride and benomyl

Chemical method

The copper residues of copper oxychloride were determined by means of a Dry-Ashing-Zincon method (Chapman & Pratt, 1961). Leaves were treated and washed as previously described. Four leaves per treatment were used. The Zincon-reagent reacts with copper to give a blue complex.

Biological method

Leaves were treated and washed as previously described, with the exception that benomyl was used instead of copper oxychloride, PDA plates were inoculated with 40 /μl of a conidial suspension of *C. gloeosporioides* containing 2.3 X 10^5spores ml^{-1}. Treated leaf discs were placed on the seeded plates at a rate of three discs per plate. All treatments were replicated five times. Resulting sones of complete inhibition were noted after 3 d incubation at 25°C.

RESULTS

Measuring surface tension

All three surfactants reduced the surface tension (Table 1). Agral had a lower surface tension than Nu-Film or Triton.

Coverage and retention

Visual estimates of deposits lost by "artificial rain" are presented in Fig. 1. Copper oxychloride retention on the abaxial of leaves differed significantly from the adaxial only where copper oxychloride was used without surfactant. The amount of copper oxychloride retained on the adaxial of leaves did not differ visually with or without the use of surfactant. However, the distribution of copper oxychloride plus Agral was significantly finer and better distributed compared to other treatments, in which case the residues were patchy.

Chemical method

The amount of copper oxychloride residues left on Agral 90 and Triton-1956-B treated leaves did not differ significantly from that retained without surfactants (Table 2). However, Nu-Film significantly enhanced retention. The initial and final deposits of Nu-Film were higher compared to the other treatments.

Biological method

Nu-Film-17 increased the fungicidal effect of benomyl to a significantly greater extent than

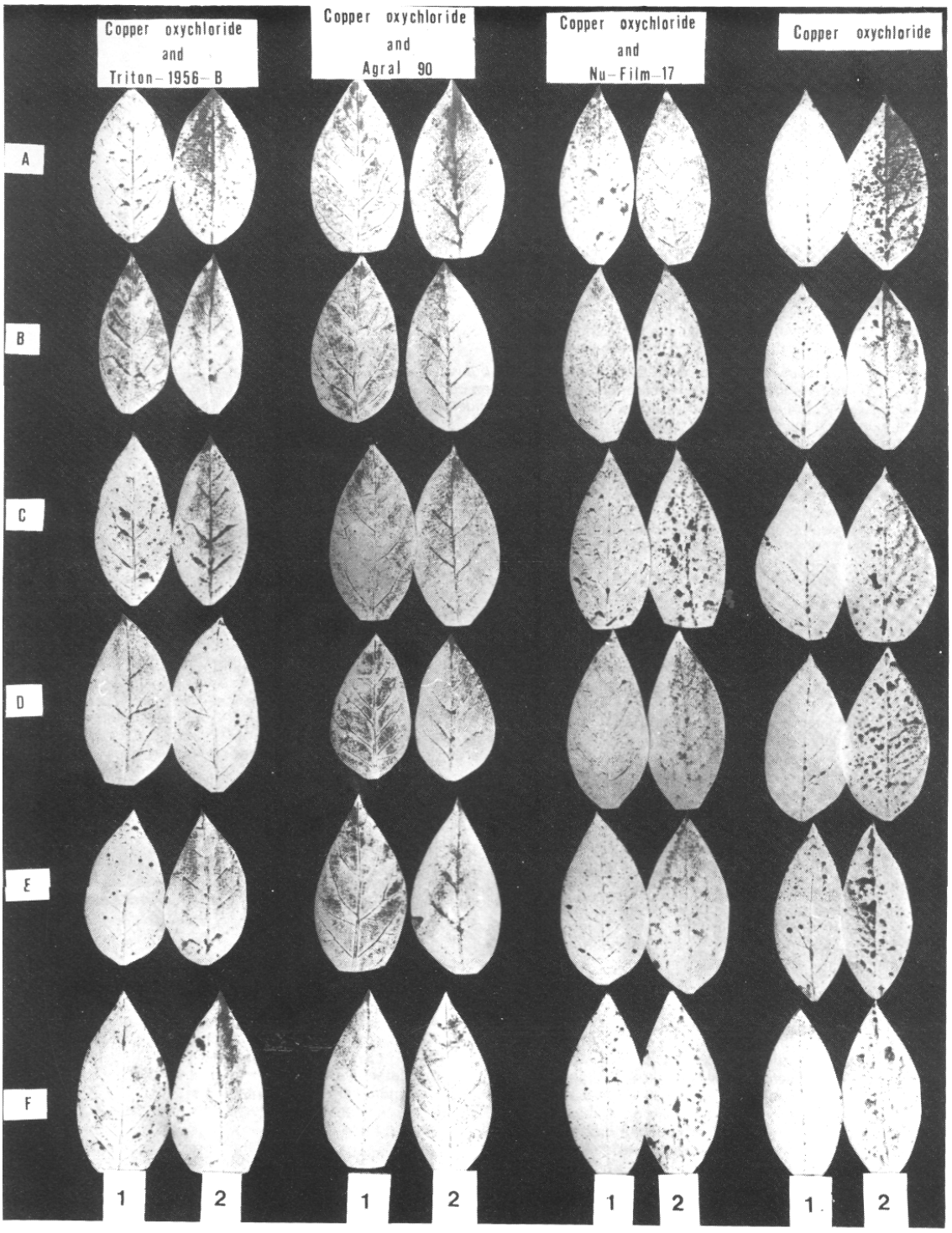

Fig. 1. Effect of Agral 90, Nu-Film-17 and Triton-1956-B on coverage and retention of copper oxychloride on leaves after exposure to "artificial rain". A-F: washed 0,1,4,8,16 and 24 times respectively.

1 = abaxial
2 = adaxial

TABLE 1

Effect of different concentrations of surfactants on the surface tension of Agral 90, Nu-Film-17 and Triton-1956-B.

Surfactant	Mean surface tension (x 10^{-2} Nm^{-1})						
	0.03 %	0.06 %	0.125 %	0.25 %	0.50 %	1.0 %	2.0 %
Agral 90	2.94 a	2.95 a	2.94 a	2.90 a	2.89 a	2.86 a	
Nu-Film-17	5.88 a	5.93 a	5. 51 b	4.89 c	4.61 d	3.83 e	3.47 f
Triton-B	5.74 a	5.47 b	4.84 c	4.31 d	3.86 e	3.48 f	3.22 g

TABLE 2

Effect of Triton-1956-B, Agral 90 and Nu-Film-17 treatments on the initial and weathered deposits of copper oxychloride.

Number of washes	Copper residue (ppm)			
	Copper-oxy chloride + Triton-1956-B	Copper-oxy-chloride + Agral 90	Copper-oxy-chloride + Nu-Film-17	Copper-oxy-chloride
0	10.2 a	14.7 a	31.3 a	15.2 a
1	8.0 c	9.3 c	18.7 b	15.0 a
4	9.4 b	8.2 d	17.6 c	10.6 b
8	9.3 b	10.6 b	18 9 b	6.3 d
16	8.3 c	10.4 b	16.3 d	6.3 d
24	6.6 d	9.2 c	14.7 e	9.8 c

Means followed by the same letter do not differ significantly (p= 0.05), using LSMeans from SAS.

TABLE 3

Effect of Triton-1956-B, Agral 90 and Nu-Film-17 on the initial and weathered deposits of benomyl evaluated by means of a bio-assay.

Number of washes	Mean inhibition sone (mm)			
	Benomyl + Triton-1956-B	Benomyl + Agral 90	Benomyl + Nu-film-17	Benomyl
0	6.4 a	3.9 a	17.0 a	2.2 b
1	2.1 b	1.5 b	11.0 b	0 c
4	0 b	1.3 b	6.4 c	3.5 c
8	2.0 b	0.7 b	6.6 c	1.8 b
16	1.9 b	0.7 b	7.0 c	0 c
24	1.1 b	0 b	0.6 d	0 c

Means folowed by the same letter do not differ significantly (p = 0.05), using LSMeans from SAS.

DISCUSSION

A comparison of the surfactants Agral 90, Nu-Film-17 and Triton-1956-B revealed that the surface tension of Agral was lower than that of Nu-Film of Triton. A low surface tension is associated with the ability of a liquid to wet and spread over a surface. The visual estimates of copper oxychloride residues made on filter paper showed that Agral improved the distribution of this compound on leaves, compared with Nu-Film or Triton. In the case of the latter two compounds, the residues were patchy. By using bio-assay methods to determine the quantity of fungicide deposits on leaves after exposure to a weathering test, it was found that Nu-Film enhanced the tenacity of copper oxychloride on leaves and increased the fungical effect of benomyl *in vitro.* The greater fungicidal effect of benomyl could have been due to higher residual levels of this fungicide on leaves, as was previously reported by Me Millan (1973). Triton and Agral did not enhance the tenacity of the fungicides. Both products are known for their wetting characteristics.

The increased residue levels of copper oxychloride obtained with Nu-Film may contribute to residue problems in the packhouse. In order to lower residue levels, more effective application methods should be investigated, like low-volume and ultra-low-volume spraying. These techniques could reduce the residues, since the fungicide is more evenly distributed and will not accumulate in big drops which dry and leave unsightly deposits.

It is fashionable to add additives like Nu-Film to fungicide sprays. As Nu-Film may improve the overall fungicidal effects of copper oxychloride, it may be considered for the first spray in November December. For the second spray (January) the chances of unsightly residues at picking time are much greater.

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