POSTBLOOM FRUIT DROP OF CITRUS IN BELIZE: II. DISEASE CONTROL BY AERIAL GROUND SPRAYING[1] /

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Resumen

Se logró un buen control de la enfermedad con una sola aplicación de benomyl con captafol (0.78 kg a 0.99 kg: 4.5 a 6.0 l/ha de formulación) con bomba de mochila o de motor o por avión. El captafol usado por si solo (7.7 – 11 l/ha) tuvo gran efectividad cuando se aplicó dos veces, con un intervalo de 14 días; el benomyl solamente fue efectivo después de cuatro aplicaciones (a 0.99 kg/ha) por avión, y no tuvo ningún efecto cuando se aplicó desde el suelo en la dosis de 0.78 kg/ha. El captafol tuvo un efecto residual bastante largo, siendo más efectivo en el tratamiento de la enfermedad de la caída de la fruta que el benomyl. El control de la enfermedad y la retención de la fruta mediante aplicación aérea fue comparable al resultado del método de aplicación terrestre.

Introduction

Even before the cause of postbloom druit drop disease (*Colletotrichum gloeosporioides*) was known, there were attempts to control it by application of hormone (because it was thought the disease might be physiological) and fungicide sprays (because histological studies also suggested the involvement of fungi) (8)

In these exploratory tests, Weir and Phelps (10) considered the hormone treatment (2.4–D) at 10 ppm to be more effective in increasing fruitset than Perenox (cuprous oxide) or Maneb (dithiocarbamate) each at 2 g/l.

In subsequent studies, Fagan (2, 3) showed the involvement of a fungus in the disease, and preliminary test both *in vitro* and in the field showed a number of fungicides to be effective against the disease. Field application of the fungicides on whole trees was made by means of mistblowers. However, commercial application of fungicides by mistblowers and other ground equipment suffers limitations which can be serious, particularly on the rough terrains of many citrus groves in Belize. The alternative method of spraying by aircraft was therefore considered.

This paper describes experiments to test the comparative efficacies of (a) ground spraying versus aerial spraying of various fungicide treatments; (b) various schedules of spraying, against postbloom fruit drop disease

Materials and methods

Fungicide application

Three fungicide trials were conducted on Valendia orange at different sites in the Stann Creek Valley, during the main blossoming season of 1972. The objectives of these trials were:

a) to discover the minimum number of applications of various fungicides required for satisfactory disease control and improvement of fruitset;

b) to compare the effectiveness of aerial spraying with that of ground spraying and estimate the economic feasibility of the former

Five fungicide treatments involving four chemicals were tested in the ground spraying experiments and four treatments (two chemicals) in the aerial experiment (Table 1). In the ground spraying experiment,

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Table 1. **Chemicals used in aerial and ground spraying against postbloom fruit drop of sweet orange in Belize (1972).**

Treatment[a]		GROUND APPLICATION Rate of formulation/ha	AERIAL APPLICATION Rate of formulation/ha
I	Benomyl +	0.78 kg	0.99 kg
	Captafol	4.50 l	6.00 l
II	Benomyl +	1.55 kg	1.98 kg
	Captafol	4.50 l	6.00 l
III	Captafol	7.70 l	11.10 l
IV	Benomyl	0.78 kg	0.99 kg
V	Captan +	2.47 kg	–
	Thiabendazole	0.78 kg	–

a Spreader/sticker was used in treatments I, II & III, at the rate of 0.1% v/v; albolineum oil was used in IV and V at 5% v/v. Benomyl (Benomyl 50 w, E. I. du Pont de Nemours & Co., USA); Captafol (Difolatan 4F, Chevron Chemical Co., Ortho Division USA); Captan (Captan 50 w Chevron Chemical Co., Ortho Division USA); Thiabendazole 60 w = Tecto 60, Merck & Co., Inc., Merck Chemical Div., USA).

treatments were applied to individual trees by means of a motorised knapsack sprayer (mitsblower), so that each tree received approximately 3.0 l of fungicide mixture, giving a spray volume of 722 l/ha (1 ha = c.240 trees). In the aerial spraying experiment, fungicide application was by means of a fixed wing Piper Commander aircraft fitted with Tee-Jet nozzles and 46, D8 orifices. Spray volume was 112 l/ha, delivered under a pressure of 198 g/cm^2 and at c. 153 km/h relative groung speed. The aircraft flew as low as possible between the rows of citrus during spray delivery, the treatments being marked with flags of different designs and colours fixed at both ends of the plot (Figure 1).

The first application was sprayed when 30-50% of the trees were blossoming and less than 15% of the blossoms were at the opening stage.

Three schedules of application were used: a) single application, at the beginning of the experiment; b) two applications at intervals of 14 days and four applications at intervals of 8 days.

A split-plot design was employed in both the ground and aerial experiments. In the former, there were four replicates of three schedules, split for treatments; each plot consisted of two trees. In the aerial spraying experiment there were three replicates, and plots consisted of two rows of 25 trees; the central 10 of the 50 trees in each plot were used for disease assessment. Guard rows provided distances between plots of approximately 27.5-36.5 m.

Two-four branches/tree were selected (depending on abundance of flowers) and 1 500-1 600 blossoms/plot were tagged, the blossoms being well distributed on the constituent trees. As a rule, branches towards the tops of the trees were not selected because fruit-set was generally better (due to lighter infection) than on lower branches. The number of blossoms (flower buds) on the tagged branches were recorded at the beginning of the spray schedules and the numbers of healthy fruitlets and disease buttons resulting from these flowers were recorded between 4 and 6 wks. after application of the final spray. At this stage, healthy fruitlets are approximately 1.5-2.7 cm diameter and the majority of affected fruitlets have abscised leaving the typical buttons on the branches; affected fruitlets which have not yet abscissed are usually discoloured and always noticeably smaller than healthy fruitlets. These abnormal fruitlets are recorded as buttons since they either drop shortly or remain undeveloped.

Persistence of fungicides: Samples were taken in a low volume spray experiment (122 l/ha), in which the fungicide treatments were: captafol 80W, 0.84 kg/ha; benomyl, 0.45 kg/ha and thiabendazole (Tecto 60), 0.45 kg/ha, the last two figures being an average of two higher and two lower doses of those fungicides.

Samples were also taken from a separate experiment where the above fungicides were applied by high volume sprayer at rates approximately twice those used in the low volume spraying. The high volume spraying was conducted on oranges in a high rainfall are a and the low volume in an area experiencing moderate to low rainfall. The samples

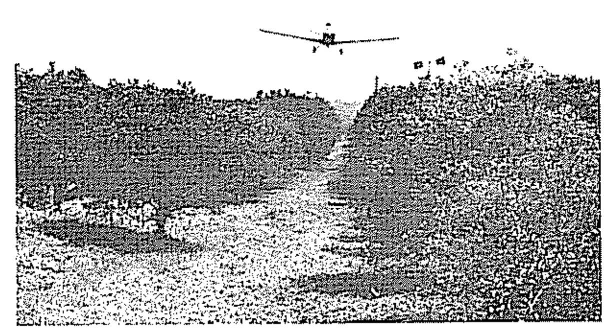

Fig. 1 Spraying of citrus plots by fixed-wing aircraft, against postbloom fruit drop disease: aircraft flying low between rows of trees

consisted of 15-20 flower buds and a similar number of young fruitlets/treatment, selected into clean plastic bags The flower buds were picked just prior to the stage of budburst and the fruitlets, within 2 wk of petal fall Samples were taken at 3, 8, 14, 21 and 28 days after final spray application.

Portions of the flower buds and fruitlets were plated out on potato dextrose agar previously seeded with conidia of *Colletotrichum gloeosporioides*, and incubated at ambient temperature Plates were examined after 3-6 days for zones of inhibition around the portions; inhibition was rated a follows: no inhibition, (–); fairly weak inhibition – a narrow zone c. 0.5 – 2.0 mm wide, (±); strongly positive inhibition – zones c 4.5 mm – 10 mm wide. (+ +)

Results

Effect of fungicides and methods of application

Preliminary experiments. Preliminary fungicide tests on infected branches by Weir and Phelps (10) produced little evidence of disease control In subsequent *in vitro* tests with three of the chemicals used, namely maneb (manganeous ethylene-bis-dithiocarbamate), Perenox (cuprous oxide), and 2, 4-D (2,4-dichlorophenoxyacetic acid) against the associated form of *Colletotrichum gloeosporioides*, inhibition of fungal growth was weak (maneb) or lacking (Perenox and 2, 4-D) Perenox at 17.5 and 35.0 g/l spectacularly enhanced sporulation in the seeded plates (Figure 2, A2) In similar culture tests using another copper-containing fungicide – Cheshunt Compound (a mixture of 2% copper sulphate and 11% ammonium carbonate) – sporulation of *C gloeosporioides* was also stimulated (Figure 2, A3); like Perenox, Cheshunt Compound was ineffective against postbloom fruit drop disease

In other fungicide tests using whole flowering trees sprayed by mistblowers, various levels of disease control were obtained with different chemicals (2). In two such tests, it was found that albolineum oil (5%) in treatments containing captafol (1.25 – 4.0 g/l) or captan (2.5 – 4.0 g/l) produced phytotoxic effects; this was particularly evident in captafol On foliage, symptoms varied from moderate crinkling of young leaves in the mildest cases, to gross deformity of young and maturing leaves; on flowers they varied from slight deformity to gross distortion, extensive browning and premature opening of flower buds; brown patches formed on exposed areas of young fruits, and severe russetting occurred on maturing and ripening fruits Phytotoxic effects did not occur to any extent in the present experiments in which oil was omitted from treatments containing captafol

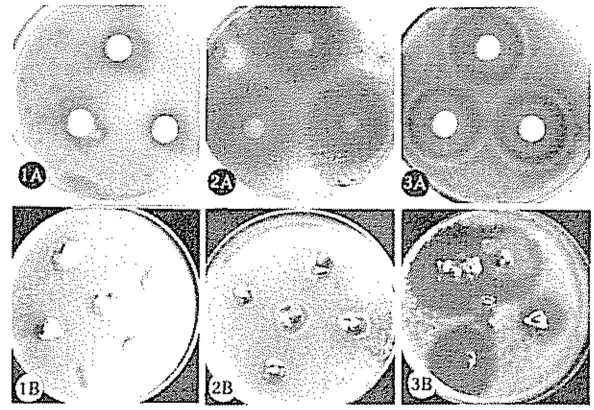

Fig. 2(A) Effect of copper fungicides on sporulation of Colletotrichum gloeosporioides from citrus inflorescence: (A1) control; (A2) enhanced sporulation by Perenox in older cultures; (A3) zonate growth preceding enhancement of sporulation by Cheshunt compound, in younger cultures.

Fig 2(B) Relative persistences of benomyl and captafol on Valencia oranges fruitlets and flowers, eight days after spraying of trees: (B1) absence of inhibition of *C. gloeosporioides* by benomyl in petals; (B2) weak inhibition by benomyl, in fruitlets; (B3) strong inhibition by captafol, in fruitlets

Present experiments: In so far as the experiments were designed to test the comparative efficacies of applying treatments by air and by ground equipment, it was considered desirable to present the relevant data in one table Since the ground trials involved two separate sites, it was also considered more convenient to combine the results of the two sites; the possibility of being able to do so on statistical principles was first investigated It was found that although fruitset was higher (and buttons were lower) at one ground site than the other, there was a general evidence (from computer analysis) of a similarity in response of schedules, treatments (Table 2) and treatments v schedules at both ground sites; it was thus possible to combine the data from the two sites In addition, the control means for each site were pooled in the comparison of results

Disease control may be assessed by two, complementary parameters: (1) improvement of fruitset and (2) reduction of buttons For practical purposes, emphasis is placed on the more important parameter of fruitset

Effect of ground-applied treatments: In general, there was a very highly significant difference in fruitset ($P = 0.001$) between treated and untreated plots The best treatment was the mixture of captafol with the lower concentration of benomyl (Treatment 1, Tables 2 and 3); this produced a highly significant ($P = 0.01$) improvement in fruitset at all schedules:

Table 2. Effect of fungicides and frequencies of application by ground equipment, on fruitset of Valencia orange at two sites affected by postbloom fruit drop disease in Belize (1972).

		FRUIT PER THOUSAND BLOSSOMS					
		One Application		Two Applications		Four Applications	
Treatment[a]		Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
I	Benomyl (L)/Captafol	66.6	158 8**	91 3	136.9*	134.8**	101 5**
II	Benomyl (H)/Captafol	41.5	69.5	73 9	161.7**	112.9**	141 8**
III	Captafol (H)	54.7	54.2	105.9	129 0	106.8	108.1**
IV	Benomyl (L)	37 8	70.8	47.6	93.7	67.3	93 6*
V	Thiabendazole/Captan	18.4	51 3	33.7	90 4	29.9	76 6
VI	Control	40.7	70 4	74 8	74 3	29 6	14.9

			Site 1 (Canada Hill)	Site 2 (False Creek)
L.S.D.	Treatments:	P = 0 05	48 4	63.8
		0 01.	64 7	85.3
L.S.D.	Schedules:	P = 0 05.	50.9	67 4
		0 01.	70 0	92.7

*, ** Treatments within schedule are significantly different from control at P = 0.05 and 0 01 respectively.

a Benomyl (L), 0.78 kg/ha; Benomyl (H), 1.55 kg/ha; Captafol, 4 5 l/ha; Captafol (H), 7 7 l/ha; Thiabendazole, 0.78 kg/ha; Captan 2.47 kg/ha

122% increase in Schedule A, 124% in Schedule B, and 133% in Schedule C (Table 3) The higher concentration of benomyl with captafol (Treatment II) was highly effective (P = 0 01) at two and four applications (132% and 152% increase in fruitset respectively -- Table 3) A single application of captafol alone was not effective (8% increase in fruitset), but a highly significant (P = 0.01) improvement of fruitset (131% increase) was obtained with two applications Benomyl alone was not significantly effective at any of the schedules when the results of the two sites were combined (Table 3); the thiabendazole/captan treatment also was generally ineffective

Effect of aerial treatments: In this trial, as in the ground trials, there was a very highly significant (P = 0 001) improvement of fruitset in treated plots compared with control The best treatment on average was the mixture of captafol with the higher concentration of benomyl (Treatment II) which produced a highly significant (P = 0.01) increase in fruitset (107%) using a single application, and a very highly significant (P = 0 001) increase with two and four applications (194% & 189% respectively: Table 3). At the lower concentration of benomyl-with-captafol a highly significant (P = 0.01) increase in fruitset (119%) was obtained with a single application (Table 3, Schedule A), and a very highly significant increase (139%), in Schedule C One application of captafol alone produced a significant increase in fruitset (96%), and a very highly significant (P = 0.001) increase was achieved with two and four applications (156% & 167% , respectively). Benomyl applied alone was the least effective of the treatments applied by air (Table 3) Only after four applications did a highly significant (P = 0 01) increase of fruitset (125%) result

In the very effective treatments, there was generally no significant difference between schedules In Treatment II (Table 3), there was a significant difference only between the single application and the other schedules. In the benomyl treatment (IV) there was a significant (P = 0 05) difference between the results of Schedule C, and those of A and B, which did not differ significantly.

Comparison of methods of spraying: Except for Treatment I at all applications and Treatment IV at two applications, aerial application appeared more effective than ground application This is illustrated particularly in the increase of fruitset and reductions of buttons in the following cases (Table 3): Treatments II and III in Schedule A, Treatment II in Schedule B; Treatment III and IV in Schedule C The difference was greater at a single application than after repeated applications

Residual activity of fungicides: Benomyl had a very low residual activity in developing citrus inflores-

Table 3. Comparative effects of fungicides, frequencies of application by ground and aerial spraying, on postbloom fruit drop disease of Valencia orange in Belize (1972).

		GROUND APPLICATION b			AERIAL APPLICATION c		
Treatment[a]		Fruitset/10^3 blossoms	Buttons/10^3 blossoms	% Increased in fruitset over mean controls (50.8)[d]	Fruitset/10^3 blossoms	Buttons/10^3 blossoms	% Increased in fruitset over mean controls (28.9)[d]
				A. ONE APPLICATION			
I	Benomyl (L)/Captafol	112.7**	283.2*	121.8	63.3**	260.6*	119.0
II	Benomyl (H)/Captafol	55.5	461.3	9.2	59.9**	196.1**	107.2
III	Captafol (H)	54.8	546.7	8.2	56.7*	257.4*	96.1
IV	Benomyl (L)	54.3	424.5	6.9	32.2	395.0	11.4
V	Thiabendazole/Captan	34.9	489.2	31.3	–	–	–
VI	Control	55.6	414.7	–	24.7	433.2	–
				B. TWO APPLICATIONS			
I	Benomyl (L)/Captafol	114.0**	362.3	124.4	55.4*	208.6	91.6
II	Benomyl (H)/Captafol	117.8**	212.5**	131.6	84.9**	151.7***	193.7
III	Captafol (H)	117.5**	370.3	131.2	74.0***	168.0***	156.0
IV	Benomyl (L)	70.7	392.2	39.1	39.3	346.0	35.9
V	Thaibendazole/Captan	62.0	405.0	22.0	–	–	–
VI	Control	74.6	431.3	–	33.7	347.0	–
				C. FOUR APPLICATIONS			
I	Benomyl (L)/Captafol	118.2**	117.5***	132.6	69.0***	107.4***	138.7
II	Benomyl (H)	127.8**	127.3***	151.5	83.4***	54.5***	188.5
III	Captafol (H)	107.5*	269.3**	111.6	76.8***	136.1***	165.7
IV	Benomyl (L)	80.5	223.6**	58.4	65.0**	211.5**	124.9
V	Thiabendazole	53.3	367.0	4.9	–	–	–
VI	Control	22.2	538.4	–	28.2	301.2	–

L.S.D. (Aerial trial) Treatments: P = 0.05, 21.1 (fruitset); 99.8 (buttons)
Schedules: P = 0.05, 23.9 (fruitset); 118.5 (buttons)

*, **, ***,: P = 0.05, 0.01, and 0.001 respectively

a Benomyl (L), 0.78 kg/ha; Benomyl (H), 1.55 kg/ha; Captafol, 4.5 l/ha Captafol (H), 7.7 l/ha; Thiabendazole, 0.78 kg/ha; Captan, 2.47 kg/ha

b Means of two sites (see Table (2), each approx. 5 ha

c One site, approx 61 ha

d Percentages are primarily for ease of reference, rather than for further direct statistical comparisons

cences, in tests against *Collectrotrichum gloeosporioides* in culture (Figure 2.B1, B2). Even at eight days after its application to the trees, there was no indication of its presence on older flower buds, and its presence was only weakly indicated in fruitlets (Table 4). In contrast, captafol had long and effective residual activity both on flower buds and on fruitlets (Figure 2 B3); this activity persisted for 3 wk on flowers and 4 wk on fruitlets.

Discussion

The high and consistent effectiveness of a single application of benomyl (L)/captafol (Treatment I, Tables 2 and 3) in the ground spraying method, compared with the other treatments containing benomyl or captafol, was an unexpected occurrence. The fact that this trend was repeated (albeit to a lesser extent) in the aerial spraying experiment

Table 4. **Comparative antifungal activities of benomyl, thiabendazole and captafol residues in citrus blossoms and fruitlets[a] against spores of *Colletotrichum gloeosporioides***

Days after final sprays	LOW VOLUME						HIGH VOLUME					
	Benomyl		Captafol		Thiabendazole		Benomyl		Captafol		Thiabendazole	
	Petals	Fruitlets	Petals	Fruitlets	Petals	Fruitlets	Petals	Fruitlets	Petals	Fruitlets	Petals	Fruitlets
3	–	±	±	+	–	–	–	+	+ +	+ +	–	–
8	–	–	–	+	–	–	–	+	+ +	+ +	–	–
14	–	–	–	+	–	–	–	+	+ +	+ +	–	–
21	–	–	–	+	–	–	–	+	+ +	+ +	–	–
28	–	–	–	–	–	–	–	–	–	+	–	–

a: From one experimental site
– No inhibition
± Activity fairly weak
+ Positive inhibition
+ + Strongly positive inhibition

indicates that the result is not a fortuitous one; it suggests a synergistic action between the two chemicals at that concentration. The outstanding performance of that treatment in the ground trials (particularly in site 2), also suggests an interplay between synergistic action and correct timing of application. Such timing would prevent the usually rapid build-up of inoculum which accompanies the progress of the blossoming season.

Although benomyl failed to significantly improve fruitset after four applications by ground, it significantly ($P = 0.05$) reduced the number of buttons formed (Table 3); this reduction is attributed to the therapeutic effect of the fungicide. It apparently fails to prevent fruitlet abscission once the early stages of blossom infection have passed, but arrests fungal growth and/or production of the substance(s) promoting the persistence and swelling of buttons (3).

The results of these trials suggest that, except for benomyl applied alone (by air), four applications of the effective treatments were excessive and at most, two applications seemed quite adequate; although a single application of some treatments gave satisfactory disease control, the precise timing on which such successes depended may be safely (and economically) avoided in practice by the use of two applications. The results have indicated that as single chemicals, captafol is more effective against postbloom fruit drop disease than benomyl. This greater effectiveness appears to lie in the demonstrated persistence of the former on the citrus trees, a factor also reported by Whiteside (11) for citrus and Gibbs (5) for coffee. This persistence is considered to be the main contributory factor in the high effectiveness of benomyl/captafol mixtures at the lower frequencies of application. Similarly, the non-persistence of benomyl on the citrus tissues explains its ineffectiveness at such frequencies.

Although the concentrations of chemicals were higher in the aerial than in the ground spraying experiments, the often better results of the former method are not explained by this fact. The actual amounts of fungicide deposited on individual trees were considered comparable, allowing for the open spaces within plots sprayed by the aerial method. The observed higher effectiveness of aerial spraying is believed to result from the more efficient distribution of the fungicides. This difference between methods was reduced as more material was deposited on the trees in two or more applications. However, in terms of relative effectiveness of method and speed of operation, the use of aircraft should be the obvious choice for fungicide application against postbloom fruit drop disease. The cost of this method was found to be moderately higher (by approximately 1.96 ha in 1973) than for ground application – a price which was justified in the valuable time gained covering citrus areas or difficult terrain at the critical time.

The expected effect of the various schedules is that increased disease control (and fruitset) would be obtained with repetition of treatment applications. While this was so in most cases, there were instances where a single application was more effective than two or four (Table 3, Treatment I, Aerial; Table 2, Treatment I), and two applications were more effective than four (Table 2, Treatment III, Site 2; Table 3, Treatment III, **Ground**). Although these differences were not significant statistically, they were nevertheless surprising; the reasons for such results are not clear.

The existence (and availability) of two effective chemicals for the control of postbloom fruit drop disease is an advantage, in that it reduces the probability of early development of fungal resistance, such as might be produced by the continual use of a single fungicide. Nonetheless, occasional monitoring of the mycological effects of these chemicals on the microflora of citrus is desirable.

Nutman and Roberts (7) reported that certain fungicides, including copper (Perenox), stimulated both the growth of an unidentified fungus on coffee and perithecium production of a form of *Colletotrichum coffeanum* on that host. Gibbs (6) reported that copper (Perenox) stimulated sporulation of the CBD strain of *C. coffeanum* and of *Phoma* sp. on coffee and suggested that "early-season sprays of copper, formerly used to control CBD, may have contributed to an increase in disease hazards by affecting the primary level of the pathogen." The inefficacies of copper sprays indicated by Firman (4) may be explained by these effects of copper on some microflora of the coffee tree: the results of seeded-plate tests on the *C. gloeosporioides* associated with postbloom fruit drop of citrus confirms this stimulatory effect of copper on *Colletotrichum*.

During a recent visit to Belize (1981-1982) it was found that despite the promising results of the above experiments, there was no established programme for spraying against postbloom fruit drop disease. Two main reasons for this might be (a) the low effectiveness of benomyl and its relatively high cost were economically unattractive to growers; (b) although captafol proved effective and persistent, its demonstrated toxicity to fish in streams close to citrus orchards sprayed by a large grower probably posed an ethical problem to the rural community. The development of a control programme against the disease was desirable, but efforts towards this end (1) did not appear to have materialized.

I thank the Citrus Company of Belize for use of the area at Pomona for the aerial trial, Crop Culture Limited whose aircraft did the spraying, Salada Belize Limited and Mr. D. Longford for use of the False Creek and Canada Hill sites respectively for the ground trials, Mr. Roy Locke for assistance in preliminary tests, Mr. H. Aldana for field assistance, the Citrus Growers Association of Belize in whose employment most of the work was conducted and for their permission to publish the results; Mrs. J. Sanchez, C.A.R.D.I., Trinidad, for statistical analysis of the results of the fungicide experiments.

Summary

Good disease control was obtained with a single application of a mixture of benomyl with captafol (0.78 – 0.99 kg; 4.5 – 6.0 l/ha, of formulation), applied either by ground or by air. Captafol alone (7.7 – 11.1 l/ha) was highly effective when applied twice at intervals of 14 days, but benomyl alone was significantly effective only after four applications (at 0.99 kg/ha) by air; it was not significantly effective at this schedule when applied by ground at 0.78 kg/ha.

Captafol had long residual activity on citrus trees, unlike benomyl, thus resulting in its greater effectiveness against postbloom fruit drop disease.

Disease control and increase of fruitset obtained by aerial spraying were at the least comparable to those of ground spraying.

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Reseña de libros

LABAN, P. Proceedings of the workshop on land evaluation for forestry The Netherlands ILRI Public No 28 1981 355 p.

El libro incluye los trabajos presentados en un Taller de Trabajo Sobre Evaluación de Tierras con Fines Forestales, auspiciada por el International Union of Forestry Research Organization (IUFRO) y el grupo de Trabajo en Evaluación de Tierras de la Sociedad Internacional de Ciencia del Suelo (ISSS) La reunión se llevó a cabo en Holanda en noviembre de 1980.

Los 17 trabajos presentados se agrupan en dos secciones; la primera resume la situación actual con sesiones sobre 1) Dinámica de los sistemas forestales, 2) Técnicas de reconocimiento y clasificación de tierras y 3) Clasificación de sitios. La segunda sesión trata sobre "un enfoque integral de clasificación de tierras" e incluye sesiones sobre: 1) Conceptos y procedimientos, 2) Calidad de la tierra y sus relaciones con los requerimientos de su uso y 3) Otros aspectos de relación y aplicación de sistemas de clasificación.

Comentar cada artículo sería una labor importante pero que caería en la situación de evaluar el bosque como la suma de sus partes en vez del conjunto. Quizás, entonces, sea mejor resumir los aspectos más sobresalientes del texto. En primer lugar, debe mencionarse que la clasificación de tierras para uso forestal aún permanece en un nivel cualitativo; no se llega a integrar un sistema numérico quizá por la discrepancia de las escuelas de pensamiento representadas en la reunión Vale la pena enfatizar en un segundo aspecto, los autores están concientes de la necesidad de lograr el cometido del primer punto y presentan numerosa información que deberá ser evaluada posteriormente con este fin

En el texto se discuten varios sistemas de explotación forestal, lo que hace que los requisitos de las tierras, para que se ajusten a las diferentes situaciones, sean muy variadas. Es mi opinión que ni aún con la propuesta de Bailey para los Estados Unidos (Enfoque integral de clasificación de tierras como ecosistemas) se logra llenar el contenido a nivel mundial.

En el contenido del libro se observan trabajos descriptivos, críticos y de resumen. La obra representa una buena recopilación de la información disponible hasta que debe formar parte de las bibliotecas de escuelas forestales y de especialistas en planificación y clasificación de recursos físicos

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