

SHORT COMMUNICATIONS

Chemical control of *Puccinia horiana* in *Chrysanthemum morifolium*

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In 1964, when *Puccinia horiana* P. Henn. was first found in The Netherlands, the possibilities of chemical control were investigated immediately.

On August 21, 1964, in a greenhouse an infected crop of potted chrysanthemums, cv. 'Yellow Delaware' was sprayed until run-off with one of the fungicides mentioned in Table 1. Treatments were repeated at weekly intervals. Eighty plants per treatment were arranged in four randomized blocks of seven plots each. Before each treatment, the number of sporulating lesions on two leaves, chosen at random, were counted on every plant used in the experiment. Table 1 shows that the fungicides did not stop the attack, with exception of the maneb/ $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$ mixture. With the maneb/ NiCl_2 mixture the number of infected leaves and the average number of sporulating lesions per leaf slowly increased during the first fortnight of the experiment and thereafter decreased to a relatively low level. All fungicides left an unacceptable spray residue. The maneb/ NiCl_2 mixture, furthermore, caused stiff leaves with marginal curling and necrotic lesions at the place where teliosores were found earlier.

In a second experiment, carried out simultaneously in the same greenhouse, rooted cuttings of cv. 'Yellow Delaware' were treated as mentioned above on August 21. After treatment the plants were inoculated by placing a number of heavily infected plants among the treated plants during 3 days. Fungicide treatments were repeated at weekly intervals. Eighty plants per treatment were arranged as in the first experiment. The effect of the fungicides must be regarded mainly as a preventive one. The fungicides were about equally effective, with the exception of copper-oxycarbonate, which showed a poor control (Table 2). The maneb/ NiCl_2 mixture again showed phytotoxic effects.

A third experiment was started on July 1, 1966, using artificially infected plants of cv. 'Indianapolis White G 4'. The plants were defoliated but for two leaves and arranged in three groups:

- (a) Leaves with large sporulating lesions.
- (b) Leaves in the 'flecking' stage (lesions just visible, small, and not yet sporulating).
- (c) Leaves without visible symptoms.

Table 1. Mean number of sporulating lesions on the infected leaves in an experiment with curative control

Treatment	Dosage (%)	Mean number of sporulating lesions per infected leaf				
		Date of observation				
		21/8	28/8	4/9	11/9	18/9
Ferbam	0.3	8.4	16.3	13.8	17.3	18.8
Maneb	0.3	5.7	8.3	8.6	10.7	14.9
Zineb	0.35	7.1	11.2	12.7	12.1	16.6
Mancozeb	0.3	5.7	12.2	15.3	16.8	18.4
Maneb + NiCl ₂ .4H ₂ O	0.2	3.5	4.7	4.9	4.4	4.1
Wettable sulphur	0.5	4.7	8.2	8.9	13.4	16.0
Copperoxycarbonate	0.35	4.4	9.6	12.3	11.3	15.6

Tabel 1. Gemiddeld aantal sporulerende vlekken op de aangetaste bladeren in een proef met curatieve bestrijding

Table 2. Mean number of sporulating lesions per infected leaf in an experiment on preventive control

Treatment	Dosage (%)	Mean number of sporulating lesions per infected leaf							
		Date of observation							
		11/9	18/9	25/9	2/10	9/10	16/10	23/10	30/10
Untreated		2.8	1.9	4.8	4.9	—	—	—	—
Ferbam	0.3	—	1.0	1.3	1.2	1.3	1.0	1.1	1.1
Maneb	0.3	—	—	2.0	2.0	1.0	1.0	—	1.0
Zineb	0.35	—	2.5	1.9	1.9	2.0	2.0	2.4	1.9
Mancozeb	0.3	—	—	1.4	1.1	1.7	1.6	1.2	1.0
Maneb + NiCl ₂ .4H ₂ O	0.2	—	—	1.2	1.2	1.3	1.0	1.0	1.0
Wettable sulphur	0.5	—	—	2.2	1.8	1.6	1.0	1.3	1.8
Copperoxycarbonate	0.35	—	3.5	10.8	9.8	10.2	9.7	10.1	9.0

Tabel 2. Gemiddeld aantal sporulerende lesies op de aangetaste bladeren in een proef over preventieve bestrijding

Table 3. Percentage of infected leaf area in plants with large sporulating lesions (a), with flecks (b) and without symptoms (c) at the day of treatment and a fortnight afterwards

Treatment	Dosage (%)	Percentage of leaf area infected					
		a		b		c	
		1/7	15/7	1/7	15/7	1/7	15/7
Untreated		11.8	7.4	3.3	26.5	0	22.6
Maneb	0.3	10.1	9.0	5.0	30.3	0	24.8
Mancozeb	0.25	12.9	6.4	5.4	26.5	0	22.3
Maneb + organotin	0.25	10.7	3.5	4.3	28.8	0	23.5
Maneb + NiCl ₂ .4H ₂ O	0.2	17.4	6.2	7.0	4.1	0	12.0
Tetrachloor-iso-ftalonitril	0.25	11.2	5.2	5.9	32.0	0	22.8
Zineb + metiram	0.2	12.3	6.5	5.2	32.3	0	17.3

Tabel 3. Percentage aangetast bladoppervlak bij planten met grote sporulerende lesies (a), met vlekken (b), en zonder symptomen (c) op de dag van de behandeling en 14 dagen later

Per treatment ten plants were used. The leaves were sprayed once until run-off with one of the fungicides mentioned in Table 3. The percentage of sporulating leaf area was determined at the day of treatment and a fortnight later. The decrease in the percentage of attack in group *a* is due to the growth of the leaves, as is shown by the untreated control. Large sporulating lesions are not affected by any of the fungicides used. In the flecking stage (group *b*) the maneb/NiCl₂ mixture gives good control. During the incubation period, between inoculation and flecking, even the mixture maneb/NiCl₂ shows little effect. None of the fungicides used has an eradivative effect except the maneb/NiCl₂ mixture, which is more effective in the flecking stage than in other stages of infection.

In a final experiment the preventive and eradivative properties of "mancozeb" and the maneb/NiCl₂ mixture were compared. Plants of cv. 'Indianapolis White G 4' were inoculated on August 6, 1966. Fungicide treatments were given at definite dates before and after inoculation. Only one treatment was given per plot of 10 plants. Table 4 shows that 'mancozeb' was active when applied before or on the date of inoculation; its action is preventive only. The maneb/NiCl₂ mixture was also preventive, but in addition showed an eradivative effect. This eradivative effect was most pronounced when the fungicide was applied two days after inoculation; but the eradivative effect remained visible when the application was postponed up to the tenth day after treatment.

Table 4. Mean number of sporulating lesions per plant on various dates after inoculation

Treatment	Dosage (%)	Date of treatment in days before or after inoculation	Mean number of sporulating lesions per plant		
			Days after inoculation		
			12	16	20
Maneb + NiCl ₂ .4H ₂ O	0.2	— 4	2.6	5.5	6.0
		— 2	0.5	1.2	1.4
		0	0.7	1.3	1.3
		+ 2	8.1	15.6	19.0
		+ 4	37.5	95.5	88.7
		+10	37.3	85.6	97.4
Mancozeb	0.25	— 4	0.4	1.0	1.0
		— 2	1.0	1.2	1.6
		0	1.9	2.5	2.5
		+ 2	88.9	147.1	148.7
		+ 4	65.0	127.4	165.2
		+10	47.1	130.7	137.0
Water		— 4	22.9	31.5	33.4
		— 2	11.5	16.6	17.7
		0	9.2	15.1	17.0
		+ 2	89.4	171.1	184.6
		+ 4	32.8	120.7	133.6
		+10	53.0	154.8	199.9

Tabel 4. Gemiddeld aantal sporulerende lesies per plant op verschillende dagen na inoculatie

The following conclusions are drawn:

- (1) Ferbam, maneb, zineb, mancozeb, wettable sulphur and the maneb/ $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$ mixture show moderate to good preventive control of *Puccinia horiana*.
- (2) Maneb, mancozeb and the maneb/ NiCl_2 mixture are slightly more effective than the other fungicides mentioned above.
- (3) $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$ mixture is the only fungicide tested showing a good eradicant action, which was most pronounced just after inoculation and in the flecking stage; however, it is rather phytotoxic.
- (4) None of the fungicides gave complete control and in this respect the results were less satisfactory than those obtained by Umgelter (1966) or Bohnen and Schloz (1967).
- (5) In view of spray deposits and phytotoxicity, only "mancozeb" can be recommended for use in chrysanthemums to control *Puccinia horiana*.

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Samenvatting

Chemische bestrijding van Puccinia horiana bij Chrysanthemum morifolium

In een aantal proeven werd nagegaan of een bestrijding van *Puccinia horiana* met fungiciden mogelijk was. Een preventieve bespuiting met ferbam, zineb en spuitzwavel kon een aantasting van de roest vrij redelijk voorkomen. Met maneb, mancozeb en het mengsel van maneb met $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$ waren deze resultaten iets beter. Het mengsel van maneb met $\text{NiCl}_2 \cdot 4\text{H}_2\text{O}$ bleek, vooral bij een bespuiting korte tijd na de inoculatie, een curatieve werking te hebben. Het bleek niet mogelijk de roest door een bespuiting afdoende te bestrijden.

References

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