

EFFICACY OF FUNGICIDES IN THE CONTROL OF *SPHAEROTHECA*
PANNOSA VAR. *ROSAE* ON GREENHOUSE ROSE CULTIVARS
AND THEIR INFLUENCE ON THE GROWTH OF PLANTS

ADAM T. WOJDYŁA

RESEARCH INSTITUTE OF POMOLOGY AND FLORICULTURE, POMOLOGICZNA 18,
96-100 SKIERNIEWICE, POLAND

Abstract. The effectiveness of 25 fungicides in the control of *Sphaerotheca pannosa* var. *rosae* were tested on 10 cultivars of roses. Also their influence on plant growth and eventual phytotoxicity were assessed. The treatments were performed 4 times at weekly intervals. Shrubs treated with Folicur BT 225 EC, Sportak Alpha 380 EC, Systhane MZ 61 WP, Systhane 125 EC, Tango 500 SC and Topas MZ 61 WP did not show disease symptoms. Bravo 500 SC, Folpan 80 WG, Funaben 50 WP, Penncozeb 80 WG and Sapro 190 EC were slightly less effective than the other tested fungicides. The influence of chemicals on plant growth was closely correlated with cultivar – showing stimulatory, inhibitory or neutral effects. Out of tested preparations Afugan 30 EC, Opus 125 SC and Tango 500 SC were strongly phytotoxic at used doses toward all rose cultivars. The intensity of damage depended on cultivar.

Key words: roses, cultivars, powdery mildew, fungicides, control, phytotoxicity, growth

I. INTRODUCTION

Powdery mildew caused by *Sphaerotheca pannosa* (Wallr. ex Fr.) Lev. var. *rosae* Wor. is one of the most frequent and serious diseases occurring on roses growing under field or greenhouse conditions (Horst 1983). Cobb et al. (1978) showed that reduction of powdery mildew symptoms may be achieved by careful environmental manipulation. Mence and Hildebrandt (1966) have not reported rose cultivars completely immune to *S. pannosa* var. *rosae* although differences in susceptibility are common. Till now chemical control of powdery mildew is the most important method in protection of roses.

Effectiveness of fungicides in the control of powdery mildew depends on many factors, among them the most important are: spray methods, spray-liquid temperature, period of leaf wetness, adjuvant addition (Wojdyła 1998a; Wojdyła 1998b). In available literature there are no information on the influence of fungicides on plant growth and their phytotoxicity to different rose cultivars. Roses grown under covering have more favourable conditions than in open air. Fast growth makes their tissues more vulnerable and sensitive to *S. pannosa* var. *rosae* and easier to be damaged by fungicides. In available papers authors dealt mostly with single or few preparations applied to one cultivar (Hagan et al. 1991). In the first part of study on rose protection the effectiveness of 24 fungicides was tested against *Sphaerotheca pannosa* var. *rosae*. on cv. Mercedes. Also, phytotoxicity and residual action was evaluated (Wojdyła 1999).

The presented investigations aimed to evaluate the effectiveness of 25 fungicides in the control of *S. pannosa* var. *rosae* on 10 rose cultivars and their influence on the growth and eventual phytotoxicity.

II. MATERIAL AND METHODS

Ten rose cultivars from in vitro propagation, grown in greenhouse were included to the experiment. Plants, about 10-11 cm high, were planted into 10 cm diameter pots filled with peat + composted pine bark and sand in ratio 1:1:0.5 and pH 6.5, and amended with 2 g/dm³ of "Azofoska". The pots were placed on parapets cushioned with fibre mat. In the course of the experiment air temperature ranged from 23 to 26°C and relative air humidity was maintained at 70-90%. In March – April plants were illuminated from dusk till 9⁰⁰ p.m. At 7-day-intervals fertilizes "Nowokont" 0.25% was applied in amount of 50 ml/pot. Water was given directly to the pots or on fibre mat. The efficacy of the following fungicides in pathogen control was evaluated: Afugan 30 EC (30% pyrazofos), Baycor 300 EC (27.8% bitertanol), Bayfidan 250 EC (250 g/dm³ triadimenol), Bayleton 5 WP (5% triadimefon), Bravo 500 SC (500 g/dm³ chlorothalonil), Domark 100 EC (100 g/dm³ tetraconazole), Dorado 200 EC (200 g/dm³ pyrifenoxy), Folicur BT 225 EC (125 g/dm³ tebuconazole + 100 g/dm³ triadimefon), Folpan 80 WG (80% folpet), Funaben 50 WP (50% carbendazim), Nimrod 25 EC (25% bupirymate), Opus 125 SC (125 g/dm³ epoxiconazole), Penncozeb 80 WG (80% mancozeb), Rubigan 12 EC (12% fenarimol), Saprol 190 EC (20% triforine), Score 250 EC (250 g/dm³ difenoconazole), Sportak 45 EC (450 g/dm³ prochloraz), Sportak Alpha 380 EC (300 g/dm³ prochloraz + 80 g/dm³ carbendazim), Systhane MZ 61 WP (1.25% myclobutanil + 59.75% mancozeb), Systhane 125 EC (125 g/dm³ myclobutanil), Tango 500 SC (375 g/dm³ tridemorf + 125 g/dm³ epoxiconazole), Tiowol K 500 SC (470 g/dm³ sulphur + 30 g/dm³ carbendazim), Topas MZ 61 WP (1.25% penconazole + 59.75% mancozeb), Topsin M 70 WP (70% tiofanate-methyl) and Trifmine 30 WP (30% triflumizole). The compounds were applied as plant spray, ten liters of fungicide suspension/solution per 100 m² were used. First treatment was performed after the appearance of first disease symptoms, followed by 3 subsequent treatments applied at 7-day-intervals with attention to thorough coverage of both sides of leaves. Sandovit 0.01% was added to spraying liquids. Observations of disease development were made before treatment and after 4 weeks, according to the following grading scale: 0 – no symptoms, 1 – up to 1% leaf surface covered with mycelium, 2 – 1.1-5%, 3 – 5.1-10%, 4 – 10.1-20%, 5 – above 20% leaf surface covered with mycelium. After this period phytotoxicity was evaluated using the following 4 grades scale: 0 – no damage, 1 – scarce leaf deformations, 2 – up to 10% leaves deformed, 3 – above 10% leaves strongly deformed. Then, the height of plants was measured.

The experiment was set in randomized block design with 4 replicates, where 1 shrub was considered as a replicate, repeated twice at 2 months interval. The results were subjected to analysis of variance. Mean differences were compared with Duncan's "t" test at 5% significance.

III. RESULTS AND DISCUSSION

1. Degree of rose infection in relation to applied fungicide

Four weeks after treatments the intensity of infection on control leaves varied depending on a cultivar (Tab. 1). The highest degree of disease severity was recorded on cv. Rafae-

Degree of rose leaves infection by *Sphaerotheca pannosa* var. *rosae* after 4 weeks protection in relation to cultivars and fungicides: values from 2 trials
Initial disease index determined: 1995.03.14 = 0.5 and 1995.05.15 = 0.3 First spraying: 1995.03.14 and 1995.05.15

Fungicide	Conc. in %	Arianna	Celica	Escimo	Frisco	Gabriela	Lambada	Paulina	Presto	Prophyta	Rafaela
Check	–	3.65 j	3.24 g	3.83 h	3.93 i	4.16 k	3.29 g	3.81 i	3.68 g	1.84 d	4.20 i
Afugan 30 EC	0.1	0.03 a-f	0.00 ab	0.34 c-c	0.36 c-h	0.42 f-i	0.14 b-d	0.18 c-f	0.28 b-c	0.05 a-c	0.41 gh
Baycor 300 EC	0.1	0.10 a-h	0.00 a	0.17 a-c	0.37 d-h	0.64 ij	0.24 cd	0.35 d-f	0.26 a-c	0.08 a-c	0.27 c-h
Bayfidan 250 EC	0.05	0.16 c-i	0.02 a-c	0.31 c-c	0.13 a-g	0.11 c-h	0.05 a-c	0.09 a-d	0.22 a-c	0.02 ab	0.18 b-g
Bayleton 5 WP	0.2	0.06 a-h	0.02 a-c	0.05 a-d	0.06 a-f	0.03 a-g	0.02 ab	0.01 a-c	0.10 a-d	0.00 a	0.04 a-c
Bravo 500 SC	0.2	0.28 f-i	0.23 d-f	1.06 fg	1.04 h	1.52 j	0.92 f	1.80 h	1.10 f	0.03 ab	0.29 f-h
Domark 100 EC	0.05	0.01 a-c	0.00 a	0.00 a	0.00 a	0.03 a-f	0.00 a	0.00 a	0.00 a	0.00 a	0.02 a-d
Dorado 200 EC	0.025	0.00 a	0.00 a	0.01 ab	0.00 ab	0.02 a-c	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Folicur BT 225 EC	0.1	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Folpan 80 WG	0.1	0.44 hj	0.46 ef	0.42 d-f	0.38 c-h	0.42 g-i	0.32 de	0.49 ef	0.51 c-f	0.08 a-c	0.28 c-h
Funaben 50 WP	0.1	0.30 g-i	0.48 ef	0.35 c-c	0.34 b-h	0.46 hi	0.34 de	0.33 d-f	0.64 d-f	0.10 bc	0.24 c-h
Nimrod 25 EC	0.2	0.12 b-i	0.00 ab	0.18 a-c	0.27 a-h	0.27 e-i	0.17 b-d	0.14 b-e	0.28 a-c	0.03 ab	0.20 b-g
Opus 125 SC	0.05	0.01 a-d	0.00 a	0.00 a	0.00 a	0.00 ab	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Pencozeb 80 WG	0.2	0.63 i	0.62 f	1.34 g	0.79 gh	1.31 j	0.68 ef	1.11 gh	1.29 f	0.32 c	0.77 h
Rubigan 12 EC	0.03	0.07 a-h	0.00 ab	0.01 ab	0.05 a-c	0.03 a-g	0.09 a-d	0.01 a-c	0.02 ab	0.00 a	0.00 ab
Saprol 190 EC	0.15	0.20 e-i	0.14 b-c	0.52 ef	0.59 f-g	0.75 ij	0.72 ef	0.56 fg	0.74 ef	0.00 ab	0.28 d-h
Score 250 EC	0.05	0.00 a	0.00 a	0.00 a	0.01 a-c	0.03 a-g	0.00 a	0.00 a	0.02 ab	0.00 a	0.00 a
Sportak 45 EC	0.05	0.00 a	0.00 a	0.00 a	0.02 a-d	0.03 a-g	0.02 ab	0.00 ab	0.00 a	0.00 a	0.02 a-c
Sportak Alpha 380 EC	0.05	0.00 ab	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Systhanc MZ 61 WP	0.1	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Systhanc 125 EC	0.03	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Tango 500 SC	0.05	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Tiowol K 500 SC	0.75	0.02 a-c	0.18 c-c	0.25 b-c	0.18 a-g	0.22 d-i	0.16 b-d	0.14 b-c	0.23 a-c	0.01 ab	0.23 c-h
Topas MZ 61 WP	0.2	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a-c	0.00 a	0.00 a	0.00 a	0.00 a	0.00 a
Topsin M 70 WP	0.1	0.04 a-g	0.03 a-d	0.18 a-c	0.09 a-f	0.01 a-d	0.08 a-d	0.12 a-c	0.19 a-c	0.04 ab	0.07 a-f
Trifminc 30 WP	0.05	0.19 d-i	0.00 a	0.02 a-c	0.00 a	0.04 b-g	0.00 a	0.00 a	0.05 a-c	0.00 a	0.15 a-g

Note: Means followed by the same letter do not differ at 5% level of significance (Duncan's multiple range test). Means separated for each cultivars.

Table 2

Influence of tested fungicides on the growth of rose cultivars: mean height of plants in cm

Fungicide	Conc. in %	Arianna	Celica	Escimo	Frisco	Gabriela	Lambada	Paulina	Presto	Prophyta	Rafaela
Check	–	26.3 b-d	19.2 a-j	31.6 b-c	26.0 c-g	16.2 a	21.1 a-c	28.4 c-c	30.0 a-c	27.3 op	25.5 b-c
Afugan 30 EC	0.1	25.6 b-d	21.5 c-n	30.1 a-c	25.0 c-g	26.8 d-g	18.8 a-c	25.3 b-d	32.4 a-c	20.4 c-m	26.0 b-f
Baycor 300 EC	0.1	34.2 de	23.1 l-q	35.9 de	31.3 g	25.4 d-f	29.1 ef	26.8 b-c	36.2 bc	24.3 k-p	28.4 c-f
Bayfidan 250 EC	0.05	30.7 c-e	22.2 j-q	29.9 a-c	27.7 d-g	26.3 d-f	23.5 a-f	28.0 b-c	37.1 bc	19.9 c-k	27.5 c-f
Bayleton 5 WP	0.2	28.0 b-d	27.1 o-q	31.8 b-c	23.0 b-f	28.9 d-g	24.5 a-f	27.6 b-c	34.9 a-c	17.8 a-d	22.6 a-d
Bravo 500 SC	0.2	40.6 e	21.8 g-p	27.0 a-d	25.2 c-g	26.1 d-f	25.4 c-f	29.7 c-c	38.7 c	27.1 n-p	28.0 c-f
Domark 100 EC	0.05	31.6 c-c	18.5 a-g	37.0 c	28.1 c-g	28.2 d-g	19.7 a-d	28.0 b-c	36.0 bc	20.3 d-l	23.7 b-e
Dorado 200 EC	0.025	28.6 b-d	22.7 k-q	34.7 c-c	20.8 a-d	27.2 d-g	29.9 f	29.4 c-c	36.6 bc	21.4 g-p	32.1 d-f
Folicur BT 225 EC	0.1	11.3 a	13.2 ab	27.6 a-c	15.4 a	16.9 ab	17.3 ab	26.3 b-c	29.3 a-c	10.4 a	18.3 a-c
Folpan 80 WG	0.1	27.0 b-d	26.1 n-q	29.7 a-c	28.2 c-g	26.8 d-g	23.5 a-f	30.3 c-e	37.3 bc	18.3 a-c	32.0 d-f
Funaben 50 WP	0.1	22.6 bc	20.8 d-m	32.3 b-c	27.9 c-g	32.0 c-g	25.0 c-f	33.1 c-e	33.9 a-c	19.1 a-g	30.5 d-f
Nimrod 25 EC	0.2	31.0 c-e	18.7 a-j	29.0 a-c	25.3 c-g	28.8 d-g	23.8 a-f	31.2 c-e	36.0 bc	24.0 j-p	32.6 d-f
Opus 125 SC	0.05	25.1 b-d	15.0 a-c	22.0 a	18.6 ab	21.8 b-d	22.1 a-f	19.0 ab	34.9 a-c	14.8 ab	16.7 ab
Penncozeb 80 WG	0.2	29.9 c-e	18.0 a-f	31.8 b-c	28.4 c-g	31.5 c-g	25.5 c-f	29.0 c-c	36.5 bc	26.6 m-p	38.1 f
Rubigan 12 EC	0.03	26.5 b-d	16.0 a-d	27.4 a-c	24.7 b-g	28.7 d-g	27.7 d-f	24.2 a-c	34.0 a-c	23.1 i-p	25.1 b-c
Saprol 190 EC	0.15	30.2 c-c	21.6 f-o	30.3 a-c	24.3 b-g	27.1 d-g	25.5 c-f	24.0 a-c	36.8 bc	19.6 b-j	34.6 cf
Score 250 EC	0.05	30.5 c-e	18.5 a-h	26.1 a-d	26.0 c-g	31.8 e-g	22.4 a-f	30.0 c-c	37.8 c	18.6 a-f	28.9 d-f
Sportak 45 EC	0.05	31.6 c-c	17.3 a-c	28.1 a-c	20.4 a-c	30.1 e-g	25.1 c-f	24.0 a-c	29.8 a-c	19.5 a-i	27.3 c-f
Sportak Alpha 380 EC	0.05	27.3 b-d	29.7 q	25.7 a-c	28.8 c-g	24.8 c-c	23.1 a-f	28.4 c-c	25.7 a	19.0 a-f	27.9 c-f
Systhane MZ 61 WP	0.1	28.3 b-d	22.1 i-q	27.3 a-c	24.1 b-g	34.4 g	29.7 f	36.0 de	30.8 a-c	19.4 a-h	22.3 a-d
Systhane 125 EC	0.03	25.5 b-d	19.3 b-k	24.3 ab	22.5 b-c	25.1 d-f	24.4 a-f	30.4 c-e	26.6 ab	20.5 f-o	25.7 b-c
Tango 500 SC	0.05	20.0 b	11.1 a	24.9 a-c	16.1 a	18.8 a-c	17.1 a	16.6 a	26.6 ab	15.5 a-c	14.1 a
Tiowol K 500 SC	0.75	28.7 b-d	23.8 m-q	31.7 b-c	29.9 fg	32.6 fg	26.7 c-f	29.5 c-c	35.4 a-c	20.5 f-n	25.7 b-e
Topas MZ 61 WP	0.2	30.3 c-c	22.0 h-q	26.1 a-d	24.5 b-g	28.6 d-g	30.5 f	36.8 e	35.2 a-c	28.4 p	21.4 a-d
Topsin M 70 WP	0.1	33.5 c-c	28.0 pq	29.2 a-c	28.3 c-g	21.8 b-d	25.6 c-f	34.1 c-	34.9 a-c	21.7 h-p	26.4 b-f
Trifminc 30 WP	0.05	27.6 b-d	19.7 c-l	31.3 b-c	30.7 g	22.8 b-d	24.8 b-f	28.8 c-c	36.6 bc	24.5 l-p	29.8 d-f

Note: see Table 1.

Table 3

Mean scale (0-3) of rose cultivars damage by tested fungicides

Fungicide	Conc. in %	Arianna	Celica	Escimo	Frisco	Gabriela	Lambada	Paulina	Presto	Prophyta	Rafacla
Check	-	0.02 ab	0.06 a-c	0.56 a-c	0.14 a-d	0.06 ab	0.02 ab	0.02 ab	0.00 a	0.00 a	0.06 ab
Afugan 30 EC	0.1	3.00 f	3.00 h	3.00 g	2.86 f	3.00 c	1.82 d	3.00 d	2.73 c	2.47 f	2.86 c
Baycor 300 EC	0.1	0.06 ab	0.73 c-f	1.17 c-g	0.25 b-c	0.25 ab	0.06 a-c	0.00 a	0.02 a	0.00 a	0.02 a
Bayfidan 250 EC	0.05	0.02 ab	0.00 a	0.14 ab	0.02 ab	0.25 ab	0.00 a	0.02 ab	0.00 a	0.00 a	0.02 a
Baylcton 5 WP	0.2	0.06 ab	0.00 a	0.02 a	0.00 a	0.02 ab	0.00 a	0.00 a	0.02 a	0.00 a	0.02 a
Bravo 500 SC	0.2	0.14 a-c	0.00 a	0.39 a-d	0.00 a	0.14 ab	0.06 a-c	0.02 ab	0.14 ab	0.00 a	0.25 a-d
Domark 100 EC	0.05	0.25 a-c	0.25 a-c	0.02 a	0.14 a-d	0.06 ab	0.00 a	0.14 ab	0.14 ab	0.02 ab	0.02 a
Dorado 200 EC	0.025	0.25 a-c	0.06 a-c	0.25 a-c	0.06 a-c	0.06 ab	0.00 a	0.14 ab	0.14 ab	0.02 ab	0.06 ab
Folicur BT 225 EC	0.1	0.39 b-d	0.56 c-f	0.77 a-f	0.06 a-c	0.00 a	0.06 a-c	0.14 ab	0.06 ab	0.06 a-c	0.06 ab
Folpan 80 WG	0.1	0.06 ab	0.02 ab	0.25 a-c	0.02 ab	0.06 ab	0.02 ab	0.06 ab	0.25 ab	0.02 ab	0.14 a-c
Funaben 50 WP	0.1	0.00 a	0.02 ab	0.14 ab	0.02 ab	0.02 ab	0.00 a	0.02 ab	0.06 ab	0.00 a	0.06 ab
Nimrod 25 EC	0.2	0.06 ab	0.39 b-c	0.56 a-c	0.14 a-d	0.39 ab	0.02 a-c	0.53 a-c	0.06 ab	0.14 b-d	0.06 ab
Opus 125 SC	0.05	2.35 cf	2.20 gh	2.47 fg	2.47 f	2.20 c	2.04 d	2.73 d	2.60 c	1.97 f	2.47 c
Penncozcb 80 WG	0.2	0.00 a	0.00 a	0.14 ab	0.06 a-c	0.06 ab	0.00 a	0.02 ab	0.25 ab	0.00 a	0.14 a-c
Rubigan 12 EC	0.03	0.25 a-c	1.22 c-g	0.39 a-d	0.06 a-c	0.06 ab	0.06 a-c	0.39 a-c	0.25 ab	0.00 a	0.14 a-c
Saprol 190 EC	0.15	0.06 ab	0.02 ab	0.25 a-c	0.00 a	0.06 ab	0.39 bc	0.25 a-c	0.06 ab	0.02 ab	0.14 a-c
Score 250 EC	0.05	1.33 d-f	0.86 d-g	0.56 a-c	0.77 c	0.30 ab	0.14 a-c	0.14 ab	0.06 ab	0.02 ab	0.25 a-d
Sportak 45 EC	0.05	0.30 a-d	1.11 c-g	1.33 d-g	0.46 c-c	0.14 ab	0.46 c	0.64 bc	0.25 ab	0.77 c	0.39 b-d
Sportak Alpha 380 EC	0.05	0.46 b-d	1.00 c-g	1.06 b-g	0.77 c	0.46 b	0.39 bc	0.14 ab	0.25 ab	0.39 de	0.14 a-c
Systhanc MZ 61 WP	0.1	0.02 ab	0.14 a-d	0.82 a-f	0.14 a-d	0.06 ab	0.02 ab	0.14 ab	0.00 a	0.02 ab	0.06 ab
Systhanc 125 EC	0.03	0.96 c-e	1.72 f-h	1.46 c-g	0.56 de	0.36 ab	0.56 c	0.53 a-c	0.39 ab	0.25 cd	0.56 cd
Tango 500 SC	0.05	2.86 f	3.00 h	3.00 g	3.00 f	3.00 c	2.60 d	3.00 d	2.86 c	2.60 f	3.00 c
Tiowol K 500 SC	0.75	0.30 a-d	0.39 b-c	0.69 a-f	0.39 c-c	0.53 b	0.46 c	1.46 cd	0.73 b	0.39 de	0.86 d
Topas MZ 61 WP	0.2	0.14 a-c	0.25 a-c	1.11 b-g	0.25 b-e	0.39 ab	0.14 a-c	0.39 a-c	0.25 ab	0.25 cd	0.39 b-d
Topsin M 70 WP	0.1	0.06 ab	0.02 ab	1.00 b-g	0.02 ab	0.00 a	0.25 a-c	0.14 ab	0.06 ab	0.00 a	0.06 ab
Trifmine 30 WP	0.05	0.06 ab	0.14 a-d	0.25 a-c	0.02 ab	0.25 ab	0.06 a-c	0.25 a-c	0.14 ab	0.02 ab	0.14 a-c

Note: see Table 1.

la (4.20) and Gabriela (4.16) leaves, the slightest on cv. Propphyta (1.84) foliage (Tab. 1). No disease symptoms were observed on all rose cultivars sprayed with Folicur BT 225 EC, Sportak Alpha 380 EC, Systhane MZ 61 WP, Systhane 125 EC, Tango 500 SC and Topas MZ 61 WP. Besides, all the remaining pesticides inhibited disease development, although their effectiveness was strictly correlated with individual cultivar susceptibility. Bravo 500 SC, Folpan 80 WG, Funaben 50 WP, Penncozeb 80 WG and Sapro 190 EC were slightly less efficient than the other tested fungicides. These results confirm earlier findings on Mercedes cv. in greenhouse conditions (Wojdyła 1999). Sapro 190 EC was the only exception: its effectiveness in the control of *S. pannosa* var. *rosae* in the presented experiment differed from earlier findings (Wojdyła 1998a). However, on Propphyta cv. the least sensitive of all tested cultivars, all the fungicides were of the same efficacy, with the exception of Penncozeb 80 WG. Besides its proper fungicidal action, its high efficacy was due to thorough coverage with spraying liquid, proper timing i.e. just after first symptoms appearance and watering on substrate eliminating washing off the fungicides from leaf surface. Relatively low degree of infection on plants protected with Penncozeb 80 WG could be caused by abundant residual deposit of the fungicide on leaves disguising true development of the fungus (Wojdyła 1999). The presented results proved close relationship between fungicide effectiveness and cultivar sensibility to the pathogen. It was shown that resistant varieties, such as for example Propphyta, can be protected with all registered fungicides. It should be recommended to protect extremely sensitive cultivars with assessed fungicides as being very effective. Evaluation of effectiveness of new fungicides introduced to the market should be tested on very sensitive cultivars and pesticides of low and medium action withdrawn.

2. Influence of fungicides on rose growth

Tested cultivars differed in height which depended on fungicide – cultivar relationship (Tab. 2). Afugan 30 EC strongly inhibited the growth of Propphyta plants and stimulated the growth of Gabriela. Earlier data by Meeus (1980), reporting strong inhibition of Baccara rose growth in greenhouse treated with triadimefon (Bayleton 5 WP), were not confirmed in our study with other cultivars. Out of 10 tested cultivars only Propphyta showed significant retardant growth after treatment with this fungicide. The growth of Celica and Gabriela was stronger. The other tested cultivars did not react to treatment with Bayleton 5 WP. Bayfidan 250 EC stimulated the growth of Gabriela but had an inhibitory effect on cv. Propphyta. Bravo 500 SC significantly favoured the growth of Arianna and Gabriela cvs but did not affect the other tested cultivars. Domark 100 EC also significantly stimulated Gabriela rose growth. Bushes of Celica, Gabriela and Lambda protected with Dorado 200 EC grew significantly faster. Folicur BT 225 EC inhibited the growth of Arianna, Frisco and Propphyta cvs. Then, Folpan 80 WG and Funaben 50 WP stimulated the growth of Gabriela and inhibited Propphyta's. Penncozeb 80 WG had beneficial effect on vigor of Gabriela and Rafaela but has no influence on other tested cultivars. Sapro 190 EC, Score 250 EC and Sportak 45 EC stimulated Gabriela's growth but inhibited Propphyta's. Sportak Alpha 380 EC stimulated Celica and Gabriela cvs shoot growth but has an inhibitory effect on Propphyta.

The presented results showed that the effect of fungicides on rose growth should be regarded individually as relationship between fungicide applied and treated cultivar. Each of them reacted in a different manner to each fungicide. Gabriela responded to all tested fungicides with growth stimulation, except Folicur BT 225 EC and Tango 500 SC. The results on this cultivar confirm the earlier findings (Kochman 1967) reporting strong growth inhibition of roses infected with powdery mildew. Growth inhibition caused by Opus 125 SC and Tango 500 SC was probably due to leaf damage.

3. Phytotoxic effect of tested fungicides

With the exception of Presto and Prophyta cvs only the youngest leaves of unprotected plants were sporadically deformed (Tab. 3). It could be attributed to residues of some chemicals used to protect plants before selling. The following fungicides: Afugan 30 EC, Opus 125 SC and Tango 500 SC were highly toxic to all tested cultivars, which was shown as deformation of the youngest leaves and dark green coloration. These kind of symptoms was earlier described on Mercedes cv. (Wojdyła 1999). Opus 125 SC and Tango 500 SC have caused dying of leaf blades edges. Phytotoxicity of tested fungicides was diversified and depended on cultivars. Baycor 300 EC was phytotoxic toward Escimo cv. but was safe to Paulina and Prophyta. Rubigan 12 EC appeared to be phytotoxic to Celica but not to Prophyta. Data on phytotoxicity (above grade 1 of employed rating scale) of fungicides on tested cultivars are given in Table 3. Afugan 30 EC, Opus 125 SC and Tango 500 SC phytotoxic to all tested rose cultivars caused anomalies higher than 1 degree on: Arianna, Celica, Escimo and Paulina. They can serve as models to test phytotoxicity of newly registered fungicides. From practical point of view it can be accepted that phytotoxicity above grade 1 decreases marketable value of cut flowers. All tested fungicides which were applied 4 times and induced phytotoxicity below 1 grade can be recommended alternatively in rose protection. The presented results show that phytotoxicity of fungicides should be regarded in relation to plant cultivar. Folicur BT 225 EC, highly phytotoxic to Mercedes (Wojdyła 1999), was entirely safe to Gabriela and on the other tested cultivars caused changes below grade 1. It is worth to mention that in field conditions all fungicides tested in the described here experiment were not phytotoxic (Wojdyła 1999).

IV. CONCLUSIONS

1. The effectiveness of tested fungicides depended on cultivar protected.
2. Among 25 tested fungicides Bravo 500 SC, Folpan 80 WG, Funaben 50 WP, Penncozeb 80 WG and Saprol 190 EC were slightly less effective as compared to the others.
3. Strong phytotoxicity toward tested rose cultivars showed Afugan 30 EC, Opus 125 SC and Tango 500 SC.

V. LITERATURE

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Adam T. Wojdyła

SKUTECZNOŚĆ FUNGICYDÓW STOSOWANYCH DO OCHRONY ODMIAN RÓŻ W SZKLARNI PRZED *SPHAEROTHECA PANNOSA* VAR. *ROSAE* ORAZ ICH WPŁYW NA WZROST KRZEWÓW

STRESZCZENIE

W warunkach szklarniowych oceniano skuteczność 25 fungicydów w zwalczaniu *Sphaerotheca pannosa* var. *rosae* na 10 odmianach (Arianna, Celica, Escimo, Frisco, Gabriela, Lambada, Paulina, Presto, Prophyta oraz Rafaela) róż, jak również ich wpływ na wzrost oraz ewentualną fitotoksyczność. Doświadczenia prowadzono na różach otrzymanych z rozmnażania w warunkach in vitro uprawianych w doniczkach o średnicy 10 cm. W czasie prowadzenia doświadczeń utrzymywano temperaturę 23-26°C, a wilgotność powietrza wahała się pomiędzy 70-90%. Fungicydy stosowano czterokrotnie w formie opryskiwania co 7 dni.

Po upływie 4 tygodni stwierdzono bardzo zróżnicowany stopień porażenia krzewów. Do odmian szczególnie podatnych na mączniaka prawdziwego należały Rafaela i Gabriela, natomiast mało podatną odmiana Prophyta. Objawów chorobowych nie stwierdzono na krzewach róż opryskiwanych fungicydami Folicur BT 225 EC, Sportak Alpha 380 EC, Systhane MZ 61 WP, Systhane 125 EC, Tango 500 SC oraz Topas MZ 61 WP. Fungicydy Bravo 500 SC, Folpan 80 WG, Funaben 50 WP, Penncozeb 80 WG i Saprol nieznacznie ustępowały swoją skutecznością pozostałym fungicydom.

Wpływ stosowania fungicydów na wzrost róż był ściśle uzależniony od odmiany. W zależności od odmiany fungicydy stymulowały, hamowały lub były obojętne dla wzrostu. Silnie fitotoksycznymi fungicydami dla wszystkich badanych odmian były Afugan 30 EC, Opus 125 SC oraz Tango 500 SC. Nasilenie uszkodzeń przez preparaty było uzależnione od odmiany. Szczególnie silnie uszkadzającymi przez fungicydy były odmiany Arianna, Escimo i Rafaela.