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PROTECTION OF PEDUNCULATE OAK AGAINST POWDERY MILDEW AND ITS EFFECT ON PLANT GROWTH

OCHRONA DĘBU SZYPUŁKOWEGO PRZED MĄCZNIAKIEM PRAWDZIWYM I JEJ WPŁYW NA WZROST ROŚLIN

Abstract: Eleven synthetic and five biotechnical preparations were tested in experiments carried out in the experimental field of the Research Institute of Pomology and Floriculture in Skierniewice. The experiments were conducted in two series. After symptoms of powdery mildew had been noticed, oak plants were sprayed 4 times at 7-day intervals. Observations of the degree of intensity of the disease symptoms were carried out after 2 and 4 treatments, and additionally after 12 weeks from the beginning of the experiment.

The results have shown that the applied protection reduced the intensity and extent of infection. Among the 16 products tested, the best protection was achieved with the fungicides Falcon 460 EC, Bumper 250 EC and Systhane 12 EC, and also Domark 100 EC. Biotechnical preparations and plant extracts also reduced the degree of infection, but significantly less than the synthetic fungicides. The applied treatments also had an effect on plant growth rate. Measurements of plant height revealed statistically significant differences between the experimental combinations. The tallest plants were found in the combinations where Nimrod 250 EC and Bio-Blat 25 EC had been used, and the shortest ones in the control.

Keywords: powdery mildew, *Microsphaera alphitoides*, plant protection

Powdery mildew of oak (*Microsphaera alphitoides* Griff. et Maubl.) causes particularly extensive damage among young plants in nurseries. It affects European oak trees causing injuries to their leaves, buds, and the top, non-woody shoots [1]. A severe infection, manifesting itself in the form of a white coating of mycelium, lowers the decorative value on one hand, while on the other, by reducing assimilative processes and the total chlorophyll content, it can contribute to plant growth inhibition and defoliation.

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Under the influence of stress, to which plants infected with the fungus are subjected, many physiological processes in tree tissues become disrupted, and this in turn weakens photosynthesis and the transport and storage of assimilates [2–4].

Mildew-infected shoots are not generally able to reach the so-called winter maturity in time and for that reason succumb to autumn frosts [5].

So far, if there was a risk of infection, protection against this pathogen has consisted in spraying plants with preparations containing sulphur [6], which at the predominantly high temperatures in summer could result in phytotoxicity symptoms. For that reason, many other preparations are being tested at present, both synthetic fungicides and those based on plant extracts, as well as biotechnical preparations, which could be recommended for plant protection, especially in parks and gardens.

Materials and methods

The experiments with the means of controlling *Microsphaeria alphitoides* on oak trees were carried out in the experimental field of the Research Institute of Pomology and Floriculture in Skierniewice on one-year-old seedlings of pedunculate oak *Quercus robur*. In order to increase air humidity around the plants, and thus to guarantee near optimal conditions for the development of disease symptoms, the plants were covered with agro-fibre suspended at a height of about 1 m above ground. In addition, to make disease symptoms appear quickly, the plants were sprinkled with water, and were often left like that overnight. Also, a few shoots with symptoms of powdery mildew were put into containers with water and placed between the combinations of oak plants to serve as inoculum. The preparations tested included 11 synthetic preparations and 5 biotechnical preparations.

Two series of tests were carried out in 2005. As soon as the symptoms of powdery mildew of oak had appeared, the plants were sprayed 4 times at 7-day intervals. The amount of working solution used per 1 m^2 was about 100 cm^3. The treatments were carried out in the morning between 8 and 10 o'clock. During the course of the experiments there was a one-off application of Confidor 200 SL at 0.125 % to control aphids *Phylloxera coccinea*.

Observations of the degree of intensity of the disease symptoms were carried out before any control measures were taken, and after 2 and 4 spray treatments, and additionally after 12 weeks from the beginning of the tests to ascertain and measure the effect of the agents applied. The assessment of infection was carried out according to a 6-point scale given by Wojdyla [8], where: 0 – no symptoms, 5 – more than 20 % of shoot/leaf surface area covered by mycelium.

Results and discussions

The assessment of the extent of infection carried out after 2, 4, and 12 weeks from the beginning of the tests indicated a better health status of the plants protected by synthetic fungicides. The extent of infection in the protected combinations was significantly lower than in the control combination in both series of the tests (Tables 1 and 2).

As the final assessment of the degree of infection had shown, the best protective action was that of Falcon 460 EC, which gradually inhibited the development of mycelium on the leaves until it had been completely eliminated by the last date of the analysis (Table 1).

Table 1

Effectiveness of some compounds applied curatively in the control of *Microsphaeria alphitoides* on common oak *Quercus robur*; beginning of experiment – 18 July 2005, initial infection level – 0.4, height of plants before experiment = 25.1 cm

Treatments (Active ingredient)	Concentration [%]	Mean degree of plants infection after weeks			Height of plants after 4 weeks [cm]
		2	4	12	
Control	—	3.15 i	4.65 m	5.0 j	35.40 a
Control (water)	—	3.00 h	4.50 l	5.0 j	40.18 ab
Fungicides					
Amistar 250 SC (250 g azoxystrobin per 1 l)	0.1	1.15 d	0.35 de	0.35 c	35.75 a
Bumper 250 EC (250 g propiconazole per 1 l)	0.05	1.10 d	0.00 a	0.10 ab	37.68 a
Falcone 460 EC (167 g tebuconazole, 250 g spiroxamine, 43 g triadimenol per 1 l)	0.1	0.65 b	0.10 ab	0.00 a	38.15 a
Discus 500 WG (500 g kresoxim-methyl per 1 kg)	0.03	1.05 d	0.30 c–e	0.20 b	39.35 ab
Folicur Multi 50 WG (40 % tolylfluanid + 10 % tebuconazole)	0.1	0.85 c	0.25 cd	0.15 b	37.98 a
Dithane M 45 80 WP (80 % mancozeb)	0.2	1.50 ef	1.45 j	1.70 f	44.45 a–d
Domark 100 EC (100 g tetraconazole per 1 l)	0.05	0.50 a	0.25 cd	0.10 ab	40.38 ab
Nimrod 250 EC (250 g bupirimate per 1 l)	0.2	1.40 e	0.40 ef	1.55 e	50.85 cd
Score 250 EC (250 g difenoconazole per 1 l)	0.05	0.60 ab	0.20 bc	0.40 c	48.68 b–d
Sportak 450 EC (450 g prochloraz per 1 l)	0.05	0.85 c	0.50 f	0.55 d	43.15 a–d
Systhane 12 EC (125 g myclobutanil per 1 l)	0.03	0.80 c	0.30 c–e	0.20 b	44.15 a–d
Biotechnical preparations					
Bio Blatt 25 EC (25 % soybean lecithin)	0.15	1.60 fg	1.30 i	4.05 g	52.45 d
Biochikol 020 PC (20 g microcrystalline chitosan per 1 l)	1	1.40 e	0.80 g	4.20 h	37.35 a

Table 1 contd.

Treatments (Active ingredient)	Concentration [%]	Mean degree of plants infection after weeks			Height of plants after 4 weeks [cm]
		2	4	12	
Bioczos BR (10 g of crushed garlic coated with paraffin)	by instruc.	1.40 e	1.05 h	4.45 i	39.55 ab
Biosept 33 SL (33 % grapefruit extract)	0.1	1.65 g	1.50 jk	4.55 i	39.25 ab
Grevit 200 SL (200 g grapefruit extract per 1 l)	0.2	1.70 g	1.60 k	4.55 i	41.85 a–c

Explanation: Mean values marked with the same letter do not differ at the significance level p = 0.05 according to the Duncan's test; * Disease index: no symptoms, 1 – up to 1 % of shoot area covered with mycelium, 2 – 1.1 up to 5 %, 3 – 5.1 up to 10 %, 4 – 10.1 up to 20 %, 5 – over 20 % of shoot area covered with mycelium.

Table 2

Effectiveness of some compounds applied curatively in the control of *Microsphaeria alphitoides* on common oak *Quercus robur*; beginning of experiment – 01 August 2005, initial infection level – 0.7, height of plants before experiment = 27.3 cm

Treatments	Concentration [%]	Mean degree of plants infection after weeks			Height of plants after 4 weeks [cm]
		2	4	12	
Control	—	3.50 j	5.00 i	4.90 i	38.70 a–c
Control (water)	—	3.40 j	4.85 i	4.80 i	41.23 a–c
Fungicides					
Amistar 250 SC	0.1	1.45 e	0.65 de	0.25 b	33.85 a
Bumper 250 EC	0.05	1.15 d	0.50 b–d	0.15 ab	38.08 ab
Falcone 460 EC	0.1	0.65 a	0.25 a	0.10 a	38.45 ab
Discus 500 WG	0.03	1.40 e	0.70 e	0.20 ab	41.15 a–c
Folicur Multi 50 WG	0.1	0.85 b	0.35 ab	0.10 a	38.48 ab
Dithane M 45 80 WP	0.2	2.00 i	1.45 h	1.15 d	47.55 b–d
Domark 100 EC	0.05	0.80 b	0.25 a	0.15 ab	44.93 a–d
Nimrod 250 EC	0.2	1.00 c	0.60 de	0.55 c	56.18 d
Score 250 EC	0.05	0.75 ab	0.40 a–c	0.20 ab	49.43 b–d
Sportak 450 EC	0.05	1.40 e	0.70 e	0.55 c	46.20 b–d
Systhane 12 EC	0.03	0.80 b	0.55 c–e	0.10 a	50.15 cd
Biotechnical preparations					
Bio Blatt 25 EC	0.15	1.60 fg	1.15 f	3.55 e	46.83 b–d
Biochikol 020 PC	1	1.50 ef	1.20 fg	3.65 ef	39.45 a–c
Bioczos BR	by instruc.	1.60 fg	1.45 h	3.90 h	43.55 a–c
Biosept 33 SL	0.1	1.70 gh	1.35 gh	3.70 fg	38.05 ab
Grevit 200 SL	0.2	1.80 h	1.35 gh	3.80 gh	43.50 a–c

Explanation – see Table 1.

The results of the second series of tests also confirmed its high efficacy (Table 2). It is likely that this fungicide has a longer systemic action in plants. Liovic and Zupanic [7], while testing a few fungicides, had shown high effectiveness, of more than 90 %, of triazoles. And there are two such compounds in the composition of Falcon 460 EC – tebuconazole and triadimenol. Similarly high efficacy was also shown by the other two fungicides from the triazole group: Bumper 250 EC and Systhane 12 EC (Tables 1 and 2). Good effectiveness was shown by strobilurin fungicides, which had also been confirmed in the experiments by those authors. According to the above-mentioned authors, full protection can be achieved with the fungicides from this group only if the product is present on the leaves before infection has started, whereas in our experiments they were used only after infection had been detected.

Our study has shown that biotechnical preparations and those containing natural compounds do not protect as effectively as synthetic fungicides. The degree of infection in those cases was significantly lower than in oak from control combinations, but also higher than in the plants from other protected treatments (Tables 1 and 2). The tests have shown that the plant protection products used had an effect on plant growth rate. The largest height was achieved by the plants treated with Bio-Blatt 25 EC and Nimrod 250 EC. It turned out, however, that the fungicides Falcon 460 EC and Bumper 250 EC, showing the best effectiveness in controlling powdery mildew, can somewhat inhibit plant growth (Tables 1 and 2).

To sum up the obtained results it can be concluded that the fungicides used to spray the oak plants with reduce the surface area for the development of *Microsphaera alphitoides* mycelium.

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OCHRONA DĘBU SZYPUŁKOWEGO PRZED MĄCZNIAKIEM PRAWDZIWYM I JEJ WPŁYW NA WZROST ROŚLIN

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Abstrakt: Mączniak prawdziwy dębu (*Microsphaera alphitoides* Griff. et Maubl.) wyrządza szczególnie duże szkody wśród młodych roślin w szkółkach. Poraża dęby europejskie, powodując uszkadzanie liści, pąków oraz szczytowych, niezdrewniałych pędów. Silne porażenie widoczne w postaci białego nalotu grzybni z jednej strony obniża walory dekoracyjne, z drugiej natomiast może powodować zahamowanie wzrostu

roślin. Do tej pory ochrona przed tym patogenem ograniczała się do opryskiwania roślin w okresie zagrożenia preparatami zawierającymi siarkę, co przy wysokich temperaturach panujących latem mogło prowadzić do objawów fitotoksyczności. Stąd testuje się obecnie również inne preparaty, tak z grupy fungicydów syntetycznych, jak i z wyciągów roślinnych oraz preparaty biotechniczne, które mogą być wykorzystywane głównie do stosowania w ogrodach i parkach. W badaniach przeprowadzonych na polu doświadczalnym Instytutu Sadownictwa i Kwiaciarstwa w Skierniewicach testowano 11 preparatów syntetycznych oraz 5 biotechnicznych. Doświadczenia przeprowadzano w dwóch seriach. Po wystąpieniu objawów mączniaka prawdziwego rośliny opryskiwano 4-krotnie co 7 dni. Obserwacje stopnia nasilenia objawów chorobowych prowadzono po wykonaniu 2 i 4 opryskiwań oraz dodatkowo po 12 tygodniach trwania doświadczenia.

Wyniki wskazują, że ochrona zmniejsza intensywność oraz stopień porażenia roślin. Spośród 16 testowanych preparatów rośliny dębu były najlepiej chronione przez fungicydy Bumper 250 EC, Falcon 460 EC, Domark 100 EC. Preparaty biotechniczne i wyciągi roślinne ograniczały porażenie, lecz istotnie słabiej niż fungicydy syntetyczne. Prowadzona ochrona miała również wpływ na tempo wzrostu roślin. Pomiary wysokości roślin wykazały istotne statystycznie zróżnicowanie pomiędzy kombinacjami doświadczenia. Najwyższe rośliny stwierdzono w kommbinacjach, w których zastosowano Nimrod 250 EC oraz Bio-Blat 25 EC, a najniższe w obiektach kontrolnych.

Słowa kluczowe: mączniak prawdziwy dębu, *Microsphaera alphitoides*, ochrona