Agronomy Research **4**(Special issue), 303–306, 2006

Efficacy of seed treaters on the germination of ergot (*Claviceps purpurea* (Fr.) Tul.) sclerotia and stroma formation

R. Mikaliūnaitė and Z. Dabkevičius

Šiauliai University, Višinskio 19, Šiauliai, 77156, Lithuania; e-mail: OIKOS@fm.su.lt

Abstract. The effects of the fungicidal seed treaters Baitan-Universal 19,5 WS and Divident Star 036 FS, Divident Star with bioactivator Penergetic-p and Penac as well as biopesticide Bionature R2000 applied alone on the germination of ergot (*Claviceps purpurea* (Fr.) Tul.) sclerotia and stroma formation were studied in the laboratory and field conditions in 2004 and 2005. Rye (*Secale cereale* L.) seed, contaminated with ergot sclerotia, was used for the tests. The rates recommended for rye seed treatment were applied.

In the experiments 45.5–79.0% of untreated sclerotia germinated, and each sclerotium formed on average 3.7–7.5 stromas. The fungicidal seed treaters tested inhibited and delayed sclerotia germination. In the laboratory conditions Baitan-Universal and Divident Star gave 86.1-100% suppression of sclerotia germination and 90.1–100% of stroma formation. Under the field conditions this suppression was lower: 46.2–68.8 % and 57.4–84.3%, respectively. Bioactivators did not exert any effect on sclerotia germination and stroma formation in the laboratory conditions, but they increased sclerotia germination by 3.3–15.3% and stroma formation by 19.5–96.0 units per 100 sclerotia in the field conditions. The biopesticide Bionature significantly inhibited stroma formation only in 2005.

Key words: *Claviceps purpurea*, ergot, sclerotia, stroma, seed treaters

INTRODUCTION

Of all cereals, winter rye and winter triticale are most severely affected by ergot (Dabkevičius & Semaškienė, 2001). Experimental evidence suggests that a cleaned winter rye seed can contain up to 24.5% of ergot sclerotia formed in the ears (Soroka et al., 2002). One of the ways to suppress sclerotia germination is through the application of fungicidal seed treaters. The efficacy of chemical and biological agents under field conditions has been tested before; the results suggest that Baitan is suitable for seed treatment and reduces ergot sclerotia germination, especially stroma formation (Dabkevičius & Semaškienė, 2002).

However, recent recommendations suggest supplementing seed treaters with one of the bioactivators Penac, Penergetic-p (the Lithuanian Agricultural Advisory Centre, 2005). The biopesticide Bionature R2000 can be used in integrated plant protection, and also in organic farming (Duchovskienė et al., 2005).

The aim of our research was to compare the effects of the fungicidal seed treaters Baitan-Universal 19,5 WS and Divident Star 036 FS, Divident Star with bioactivator Penergetic-p and Penac as well as biopesticide Bionature R2000 applied alone on the germination of ergot (*Claviceps purpurea* (Fr.) Tul.) sclerotia and stroma formation.

MATERIALS AND METHODS

The laboratory and field trials were conducted in 2004 and 2005. Rye (*Secale cereale* L.) seed, contaminated with ergot sclerotia, was treated with Baitan-Universal 19,5 WS (a. i. triadimenol 15g kg^{-1}, fuberidazole 2 g kg^{-1} and imazalil 2.5 g kg^{-1}) and Divident Star 036 FS (a.i. difenoconazole 30 g l^{-1} and cyproconazole 6.25 g l^{-1}), Divident Star with bioactivator Penergetic-p (revitalised water) and Penac (activated calcium carbonate) as well as biopesticide Bionature R2000 (a.i. *Azadirachta indica* 210g l^{-1}, *Pinus resinosa* 180g l^{-1} and *Ricinus communis*) applied alone. The rates recommended for rye seed treatment were applied: Baitan-U -1.5 g kg^{-1}, Divident Star - 1.5ml kg^{-1}, Penergetic - 0.5ml kg^{-1} and Penac - 0.5g kg^{-1}. The water solution of Bionature at a ratio of 50 to 1 was used for soaking rye seed for one hour. In the laboratory trials, sclerotia were collected from the untreated seed as well as from the seed treated with various seed treaters, and were placed on the surface of moist sand 25 mm deep in plastic boxes; 100 ergot sclerotia were sown per treatment. The boxes were placed in a controlled climate chamber at 2–4°C for low-temperature treatment. After 60 days the boxes were removed from the low temperature and were kept at 18–20°C. Assessments were started 20 days later at the stage when the sclerotia had started to form the stromas. In the field trials, sclerotia were placed in the soil at a depth of 1 cm in the first week of October. A total of 400 ergot sclerotia were sown per treatment. Assessments were started the following spring when stroma began to form. In both experiments the dynamics of ergot sclerotial germination and stroma formation was assessed every 6 days till sclerotia had ceased forming new stromas.

The least significant difference (LSD) procedure was used to compare treatments when the F-test for treatments was significant (P = 0.05). The data was analysed by ANOVA (Statistica version 6.0).

RESULTS AND DISCUSSION

In the laboratory conditions sclerotia started to germinate 20 days after removal from low temperature. In both years, sclerotia untreated and treated by Bionature were the first to start stroma formation. No significant differences between the two treatments were found and by the end of the experiment 63–90% of sclerotia had germinated (Table 1). In 2004 sclerotia untreated and treated by Bionature formed the same amount of stromas, but in 2005 Bionature-treated sclerotia formed half as many stromas. Baytan-Unversal exhibited the highest efficacy. Sclerotia treated with this fungicide did not germinate in 2004, and in 2005 only 2% of sclerotia germinated and formed 8 stromas. The fungicide Divident Star in 2004 was slightly less effective, by the end of the experiment 11% of sclerotia germinated and 100 sclerotia formed 56 stromas. In 2005 this treater fully inhibited the germination of sclerotia. The bioactivator Penergetic-p used together with Divident Star significantly increased sclerotia germination and showed a trend of increased stroma formation in 2004. This effect was very low in 2005. The bioactivator Penac used together with Divident Star had no effect on germination and stroma formation in either year. In the field trials ergot sclerotia started germinating on 5 June 2004 and on 26 May 2005. By the end of the experiment 45.5% and 57.8% of untreated sclerotia had germinated, respectively (Table 2). In 2004, 100 sown untreated sclerotia formed on average 169.8 stromas, 2.5

times less than in 2005. The fungicidal seed treaters Baitan-Universal and Divident Star provided a significant delay and 46.2–68.8% reduction in sclerotia germination and 57.4–85.9% in stroma formation, but were less effective than in the laboratory conditions. Penac and Penergetic-p, which are generally used to activate seed germination, also significantly stimulated formation of ergot stroma..

Table 1. The effects of seed treaters, bioactivators and biopesticide on the dynamics of ergot sclerotia germination and stroma formation in the laboratory conditions in 2004 and 2005.

Trade name of seed treater	Days after removal of sclerotia from low temperature						
	20	26	32	38	44	50	56
Percent of germinated sclerotia in 2004							
Untreated (control)	3^{a}	34^{a}	59^{a}	70^{a}	79^{a}	79^{a}	79^{a}
Baytan-Universal	0^{b}	0^{b}	0^{c}	0^{d}	0^{d}	0^{d}	0^{d}
Divident Star	0^{b}	0^{b}	5^{b}	8^{bc}	11^{bc}	11^{bc}	11^{bc}
Divident Star & Penergetic-p	0^{b}	0^{b}	4^{b}	11^{b}	16^{b}	17^{b}	17^{b}
Divident Star & Penac	0^{b}	0^{b}	4^{b}	4^{c}	7^{c}	9^{c}	10^{c}
Bionature R2000	3^{a}	30^{a}	66^{a}	79^{a}	86^{a}	90^{a}	90^{a}
Percent of germinated sclerotia in 2005							
Untreated (control)	2^{a}	16^{a}	33^{a}	46^{a}	58^{a}	62^{a}	63^{a}
Baytan-Universal	0^{b}	0^{c}	0^{c}	0^{c}	1^{c}	2^{b}	2^{b}
Divident Star	0^{b}	0^{c}	0^{c}	0^{c}	0^{c}	0^{b}	0^{b}
Divident Star & Penergetic-p	0^{b}	0^{c}	0^{c}	0^{c}	0^{c}	1^{b}	1^{b}
Divident Star & Penac	0^{b}	0^{c}	0^{c}	0^{c}	0^{c}	0^{b}	0^{b}
Bionature R2000	1^{ab}	7^{b}	14^{b}	22^{b}	38^{b}	52^{a}	59^{a}
Number of stromas from 100 sclerotia in 2004							
Untreated (control)	7^{a}	84^{a}	292^{a}	382^{a}	487^{a}	536^{a}	564^{a}
Baytan-Universal	0^{b}	0^{b}	0^{b}	0^{c}	0^{c}	0^{c}	0^{c}
Divident Star	0^{b}	0^{b}	11^{b}	32^{b}	44^{b}	47^{b}	56^{b}
Divident Star & Penergetic-p	0^{b}	0^{b}	9^{b}	34^{b}	63^{b}	83^{b}	88^{b}
Divident Star & Penac	0^{b}	0^{b}	13^{b}	30^{b}	43^{b}	54^{b}	59^{b}
Bionature R2000	5^{ab}	84^{a}	296^{a}	406^{a}	449^{a}	551^{a}	600^{a}
Number of stromas from 100 sclerotia in 2005							
Untreated (control)	2^{a}	60^{a}	153^{a}	213^{a}	328^{a}	414^{a}	433^{a}
Baytan-Universal	0^{b}	0^{c}	0^{c}	0^{c}	2^{c}	5^{c}	8^{c}
Divident Star	0^{b}	0^{c}	0^{c}	0^{c}	0^{c}	0^{c}	0^{c}
Divident Star & Penergetic-p	0^{b}	0^{c}	0^{c}	0^{c}	0^{c}	3^{c}	4^{c}
Divident Star & Penac	0^{b}	0^{c}	0^{c}	0^{c}	0^{c}	0^{c}	0^{c}
Bionature R2000	1^{ab}	16^{b}	31^{b}	62^{b}	100^{b}	159^{b}	203^{b}

Means followed by different letters indicate significant differences using LSD (P =0.05)

In the field trials the biopesticide Bionature only insignificantly reduced the germination of sclerotia and stroma formation. In 2005 Bionature inhibited sclerotia germination by 20.3% and stroma formation by 145.3 units per 100 sclerotia.

CONCLUSIONS

Based on our experimental findings we suggest that the fungicidal seed treaters Baitan-Universal 19,5 WS and Divident Star 036 FS can be used for ergot - contaminated rye seed treatment in conventional farming and the biopesticide Bionature, in organic farming, until more effective biological agents are available on

the market. The bioactivators Penergetic-p and Penac cannot be used for ergot-infected seed treatment.

Table 2. The effects of seed treaters, bioactivators and biopesticide on the dynamics of ergot sclerotia germination and stroma formation in the field conditions in 2004 and 2005.

Trade name of seed treater	Days after the first untreated sclerotia germinated						
	1	7	13	19	25	31	37
Percent of germinated sclerotia in 2004							
Untreated (control)	1.0^{a}	6.0^{a}	20.0^{a}	35.0^{a}	45.3^{a}	45.5^{a}	45.5^{a}
Baytan-Uiversal	0^{a}	0.3^{d}	3.3^{cd}	4.3^{c}	12.8^{d}	16.3^{c}	17.0^{d}
Divident Star	0^{a}	0.5^{cd}	1.8^{d}	7.3^{c}	15.8^{cd}	23.8^{bc}	24.5^{bcd}
Divident Star & Penergetic-p	0^{a}	1.5^{c}	2.8^{cd}	14.3^{b}	20.3^{bc}	24.8^{bc}	27.8^{bc}
Divident Star & penac	0^{a}	3.3^{ab}	6.5^{c}	18.5^{b}	25.3^{b}	30.8^{b}	31.8^{b}
Bionature R2000	0^{a}	3.8^{ab}	15.3^{ab}	30.3^{a}	41.3^{a}	43.5^{a}	43.5^{a}
Percent of germinated sclerotia in 2005							
Untreated (control)	1.0^{a}	18.0^{a}	42.0^{a}	51.3^{a}	55.3^{a}	56.8^{a}	57.8^{a}
Baytan-Universal	0.3^{a}	1.0^{c}	1.5^{c}	6.0^{d}	8.5^{d}	17.5^{c}	19.0^{c}
Divident Star	1.0^{a}	2.0^{c}	3.0^{c}	10.5^{cd}	13.0^{cd}	17.0^{c}	18.0^{c}
Divident Star & Penergetic-p	0.5^{a}	7.0^{b}	10.8^{b}	12.8^{c}	15.3^{c}	20.8^{c}	22.3^{c}
Divident Star + Penac	1.0^{a}	5.5^{b}	8.5^{b}	19.8^{b}	27.5^{b}	31.0^{b}	33.3^{b}
Bionature R2000	0^{a}	2.0^{c}	11.0^{b}	26.0^{b}	27.5^{b}	35.0^{b}	35.5^{b}
Number of stromas from 100 sclerotia in 2004							
Untreated (control)	1.0^{a}	16.3^{ab}	74.3^{a}	138.3^{a}	165.5^{a}	169.8^{a}	169.8^{a}
Baytan-Universal	0^{b}	0.8^{c}	6.8^{c}	16.0^{d}	39.5^{e}	59.0^{e}	61.5^{e}
Divident Star	0^{b}	0.5^{c}	5.3^{c}	31.5^{c}	57.5^{de}	69.5^{de}	72.3^{de}
Divident Star & Penergetic-p	0^{b}	2.8^{c}	9.5^{c}	41.5^{c}	71.5^{cd}	87.5^{cd}	91.8^{cd}
Divident Star + Penac	0^{b}	10.5^{ab}	32.5^{b}	75.8^{b}	95.5^{bc}	114.0^{bc}	115.3^{bc}
Bionature R2000	0^{b}	19.8^{a}	55.8^{a}	95.0^{b}	119.3^{b}	146.3^{ab}	148.5^{ab}
Number of stromas from 100 sclerotia in 2005							
Untreated (control)	3.0^{a}	101.5^{a}	228.3^{a}	349.5^{a}	406.3^{a}	427.3^{a}	431.8^{a}
Baytan-Universal	1.5^{a}	2.8^{c}	5.5^{d}	23.0^{d}	37.0^{d}	72.0^{d}	81.5^{d}
Divident Star	2.5^{a}	4.5^{c}	7.0^{d}	38.0^{d}	50.5^{d}	63.0^{d}	68.0^{d}
Divident Star & Penergetic-p	1.5^{a}	22.8^{b}	41.8^{bc}	86.3^{c}	117.0^{c}	133.8^{c}	139.3^{c}
Divident Star & Penac	1.0^{a}	15.0^{b}	30.8^{c}	81,3^{c}	124.0^{c}	151.5^{c}	164.0^{c}
Bionature R2000	0^{b}	14.0^{bc}	76.0^{b}	207.5^{b}	225.0^{b}	282.5^{b}	286.5^{b}

Means followed by different letters indicate significant differences using LSD (P =0.05)

REFERENCES

Dabkevičius, Z. & Semaškienė, R 2001. Occurrence and harmfulness of ergot (*Claviceps purpurea* (Fr.) Tul.) in cereal crops of Lithuania. *Biologija* **3**, 8–10.

Dabkevičius, Z. & Semaškienė, R. 2002. Control of ergot (*Claviceps purpurea* (Fr.) Tul.) ascoscarps formation under the impact of chemical and biological seed dressing. *Plant Protection Science* **38**, (special issue 2), 681–683.

Duchovskienė, L. Raudonis, L. & Bulovienė V. 2005. The effect of biopesticides Neemazal-T/S and Bionature R2000 to reduce the harmful organisms in greenhouse cucumber. *Sodininkystė ir Daržininkystė* **24**, 98–108.

Soroka, S. V.et al., 2001. Main phytosanitary problems in Belarus and methods of their solution. *Archives of Phytopathology and Plant Protection* **34**, 73–83.

The data from the demonstration crop production trials, conducted in 2004. The Lithuanian Agricultural Advisory Service, 2005 (in Lithuanian).