

Vol 70(3) 1-514 (2005)

**COMMUNICATIONS IN AGRICULTURAL AND
APPLIED BIOLOGICAL SCIENCES**

formerly known as

**MEDEDELINGEN FACULTEIT LANDBOUWKUNDIGE
EN TOEGEPASTE BIOLOGISCHE WETENSCHAPPEN**

PUBLISHERS

Professoren
Pascal Boeckx
Peter Bossier
Guy Smagghe
Walter Steurbaut
Els Van Damme
Erick Vandamme
Niko Verhoest

EDITORIAL ADDRESS

Coupure links 653
9000 Gent (Belgium)

Website: <http://www.fbw.ugent/>

ISSN 1379-1176

ACTIVITY OF PLANT AND MINERAL OILS IN THE CONTROL OF *PUCCINIA PELARGONII-ZONALIS*

A.T. WOJDYŁA

Research Institute of Pomology and Floriculture
Pomologiczna 18, PL-96 100 Skierniewice, Poland

ABSTRACT

Effectiveness of plant oils from corn, olive, rape, soya and sunflower, oils recommended for plant protection (Dedal 90 EC, Olejan 80 EC) and mineral oils (Atpolan 80 EC, Ikar 95 EC, Olemix 84 EC and Promanal 60 EC) in the control of pelargonium rust (*Puccinia pelargonii-zonalis*) was studied. Oils were applied curatively as a plant spray at concentration 1%, 4 times at 7-day-intervals. After 4-week experiment more than 11 uredia per leaf were noted on control plants. At the same time, on plants protected with oils from olive or soya, Ikar 95 EC or Olemix 84 EC uredia number decreased at least 50%. The other oils were not effective in a suppression of uredia formation. On control plants no uredia were destroyed as compared to 11 to 71% destruction on plants protected with the tested oils. Oils from olive, soya and also Atpolan 80 EC, Ikar 95 EC, Olemix 84 EC caused drying off more than 50% uredia. Furthermore, some oils inhibited germination of urediospores on PDA medium (potato dextrose agar). Fourteen days after the last spraying more than 83% of germinating urediospores were found on control leaves. At the same time spores collected from protected plants germinated in 17 to 70%. Among tested products oils from rape, corn, sunflower and Dedal 90 EC, Ikar 95 EC, Olemix 84 EC were the most effective.

In the next part of experiment, plants with visible sporulation of *P. pelargonii-zonalis* were sprayed with 1% oils. After 1 and 7 days of incubation, total number of spores and number of germinating spores were counted. One day after treatment, urediospores collected from leaf blades protected with oils germinated in 20 - 60%. Oils from olive, corn, Atpolan 80 EC and Ikar 95 EC caused inhibition of spore germination at least in 40%. Whereas urediospores from nontreated plants germinated in 86%. After 7 days, urediospores collected from untreated plants germinated in 65% whereas from plants sprayed with tested oils in 23 - 68%. Oils from olive, sunflower and Dedal 90 EC, Atpolan 80 EC were the most effective in suppressing urediospores germination.

Key words: *Puccinia pelargonii-zonalis*, pelargonium, oils, spore, germination, effectiveness

INTRODUCTION

Pelargonium rust caused by *Puccinia pelargonii-zonalis* is one of the most frequent and serious diseases on pelargonium. The most effective control of the pathogen is possible by use of fungicides. In other experiments on the control of *Puccinia pelargonii-zonalis*, azoxystrobin, tebuconazole + triadimefon, tebuconazole + tolylfluanide and triadimefon gave over 90% effectiveness in suppression of new uredia formation (Wojdyła 2004). Also, in the case of this compounds all (azoxystrobin) or majority of already present uredia were browned and destroyed. In the recent years, oils became popular as a new, plant protection agent with anti-virus (Ramadan *et al.* 1995) and anti-fungal activity (McGrath and Shishkoff 2000, Wojdyła 2003). Oils can be used as an alternative to conventional fungicides, and become integrated into protection

programs including other products, thereby reducing the frequency of each product use and the risk of resistance to all fungicide groups in the program (Northover and Schneider 1996). Among others the prospect of using plant oils as fungicides is very appealing, because refined oils are now readily available and they are safe for human consumption and commonly used in baked goods, salad dressings and deep-frying. Their use as natural alternative to synthetic fungicides would be especially attractive to home gardeners and producers of organically grown produce (Northover and Schneider 1996). In experiments, oils have proven to be effective against *Alternaria solani* (Babus *et al.* 2000), *Botrytis cinerea* (Bourbos *et al.* 1994, Wojdyla 2003), *Diplocarpon rosae* (Osnaya-Gonzales and Schlosser 1998), *Venturia inaequalis* (Northover and Schneider 1993). Oils had particularly good effectiveness against pathogens causing powdery mildew on different plant species (Clement *et al.* 1994, Wojdyla 2000, Wojdyla 2002). When used curatively, some oils gave good control of pathogens causing rust on bean (Locke and Stave 1992), wheat (Sajid *et al.* 1995, Zekaria-Orenet *et al.* 1991), willow (Wojdyla and Jankiewicz 2004). In the control of *Puccinia menthae* and *P. dracunculina* on *Mentha x piperita* the neem (*Azadirachta indica*) oil applied with an adjuvant exhibited a fungicidal activity similar to that of the chemical control - propiconazole (D'Aulerio *et al.* 1988). Also Sajid *et al.* (1995) obtained good results when neem oil was applied as a spray against *Puccinia recondita* on wheat.

The aim of research was to evaluate effectiveness of plant oils from corn, olive, rape, soya and sunflower, oils recommended for plant protection (Dedal 90 EC, Olejan 80 EC) and mineral oils (Atpolan 80 EC, Ikar 95 EC, Olemix 84 EC and Promanal 60 EC) in the control of pelargonium rust.

MATERIALS AND METHODS

The following compounds were used in the experiments:

Mineral oils: Atpolan 80 EC (76% SN oil) - produced by Agromix Niepolomice Poland, Ikar 95 EC (95% SAE petroleum oil) - produced by Danmark Łódź Poland, Olemix 84 EC (84% DSA petroleum oil) - produced by Danmark Łódź Poland, Promanal 60 EC (60% petroleum oil) - produced by Neudorff

Plant oils recommended for plant protection: Dedal 90 EC (90% vegetable oil) - produced by Danmark Łódź Poland, Olejan 80 EC (85% rape oil) - produced by Danmark Łódź Poland

Plant oils used as a food: corn oil (seeds), olive oil (fruits), rape oil (seeds), soya oil (seeds), and sunflower oil (seeds),

Fungicide: Amistar 250 SC (250 g azoxystrobin/dm³) produced by Syngenta

Surfactant: Tergitol (TM) 15-S-9 produced by Dow Chemical C/O.

The experiment was carried out on pelargonium cv. Pulsar F1 Salmon grown in pots on benches in a greenhouse. When the first disease symptoms (uredinia of fungus on the lower side of leaves) were noted, plants were sprayed 4 times at 7 day intervals with tested oils at 1% concentration (Table 1). Citowett AL at concentration 0.02% was added to spray mixture of Amistar 250 SC (standard). A special kind of surfactant recommended for plant oils -

Tergitol (TM) 15-S-9 at conc. 0.3% was added to suspensions of edible plant oils. The observation of severity of disease symptoms was conducted before treatment of plants and after 4 weeks of protection. During observation a number of uredia per leaf, diameter of uredia, percentage of diseased leaves and destroyed pustules were counted and height of plants was determined. After 1 or 2 weeks from the end of protection, spores from leaves were collected and percentage of germinating spores was found using the same method as in the next experiment (Table 2).

In the next trial, plants of the same cultivar with visible disease symptoms were sprayed with 1% solution of tested compounds (Table 3). The experiments were done during the summer time. One and 7 days after treatment leaves with visible disease symptoms were sampled. In the laboratory a droplet of sterilized water was put on the leaf surface and urediospores were scraped with razor blade into potato-dextrose agar (PDA) medium. A second droplet of water was added to the suspension of spores and than it was spread over the medium surface. For reduction of bacteria development, rose bengal 0.5 mg/dm³ and 80,000 units penicillin per dm³ were added to the medium. After 18 h of incubation at 18-20°C, total number of urediospores and number of germinating spores were counted in the observation field of light microscope at magnification of 125x. For counting, places with 30-60 urediospores in the observation field were selected. In the case of high number of urediospores they were counted only from a half or 1/4 of observation field and next the percentage of germinating spores was calculated.

The experiment was set in randomised block design with 4 replicates and each replicate consisted of 4 plants or plates of PDA.

RESULTS AND DISCUSSION

In the trial the results collected after 4 weeks revealed an average of about 11 uredia per leaf on control plants (Table 1). At the same time, on plants protected with Ikar 95 EC, Olemix 84 EC, Olejan 85 EC, olive and soya oil significantly less pustules per leaf were found compared to control. There was not statistically significant difference in mean number of pustules on plants protected with Atpolan 80 EC, Promanal 60 EC, Dedal 90 EC, corn, rape and sunflower oil, ranging from 7.8 to 8.5 pustules per leaf. On unprotected plants no uredia were dried. On the leaves of plants protected with oils, from 11 to about 71 % of pustules were dried up. Out of the tested oils, the most effective in drying up of uredinia were Atpolan 80 EC, Ikar 95 EC, Olemix 84 EC, olive and soya oils where, on average, from 51 to about 71% of dried up uredia were noted. Average diameter of pustules on the leaves of control plants was ca. 3.6 mm. At the same time on plants protected with Dedal 90 EC, Olejan 85 EC and corn oil diameter of pustules was from 4.5 to about 5.4 mm i.e. even more than on control plants. In the case of most of the tested oils diameter of spots was significantly lower than on control pe-largonium plants. Except of Dedal 90 EC, no influence of the used oils on growth of plants was found. Also diameter of plants did not differ between control plants and ones protected with tested oils. Similarly, Picton and Hummer (2003) showed that mineral oil used for control of *Cronatium ribi-cola* on black current cultivars significantly reduced rust infection comparing to the unsprayed control.

Table 1. Effectiveness of oils, applied curatively, in the control of *Puccinia pelargonii-zonalis* on pelargonium. First spraying: 08.10.2004, (4 sprayings at 7 day intervals).

Treatments	Conc. in %	Mean number of uredia/leaf	% of dried up uredia	Height of plants in cm	Diam. of plants in cm	Diam. of spots in mm
Control	-	11.4 d	0.0 a	30.6 ab	29.2 a-c	3.6 c
Amistar 250 SC	0.1	3.5 ab	99.68 h	30.5 ab	30.0 a-c	2.6 ab
Mineral oils						
Atpolan 80 EC	1.0	7.8 cd	51.4 ef	26.3 a	26.9 ab	2.5 ab
Ikar 95 EC	1.0	5.5 a-c	58.7 fg	28.8 ab	26.1 a	2.1 a
Olemix 84 EC	1.0	1.6 a	70.7 g	26.1 a	27.3 a-c	2.4 ab
Promanal 60 EC	1.0	8.5 cd	11.0 b	30.9 ab	31.4 c	3.1 bc
Plant oils recommended for plant protection						
Dedal 90 EC	1.0	10.5 d	33.8 cd	39.5 c	27.5 a-c	5.4 d
Olejan 80 EC	1.0	6.0 bc	23.1 c	34.6 bc	31.0 bc	4.9 d
Plant oils used as a food						
Corn oil	1.0	8.3 cd	40.5 de	33.4 bc	29.3 a-c	4.5 d
Olive oil	1.0	5.5 a-c	55.1 e-g	31.2 ab	26.0 a	3.6 c
Rape oil	1.0	7.8 cd	29.8 cd	29.8 ab	27.7 a-c	2.4 ab
Soya oil	1.0	3.3 ab	59.0 fg	30.6 ab	26.6 ab	2.4 ab
Sunflower oil	1.0	8.1 cd	32.8 cd	34.2 bc	28.3 a-c	2.2 ab

Note: Means, within the column, followed by the same letter are not significantly different at $p=0.05$.

Analysis of *P. pelargonii-zonalis* spore germination showed, that 7 days after the end of experiment, spores taken from control plants germinated in about 98% (Table 2). At the same time spores taken from plants sprayed with oils germinated in about 86 to 96%. Statistically similar percentage of germinated spores, to that in control, was found on pelargonium protected with Promanal 60 EC. Spores taken from plants sprayed with azoxystrobin (standard) germinated only sporadically.

Fourteen days after the last spraying, more than 83% of germinating urediospores were found on control leaves (Table 2). At the same time spore collected from protected plants germinated in 17 to 71%. Among the tested products, oils from rape, corn, sunflower and Dedal 90 EC, Ikar 95 EC, Olemix 84 EC were the most effective.

One day after treatment, urediospores of *P. pelargonii-zonalis* collected from leaf blades protected with oils germinated in 20 to 61% (Table 3). Oils from olive, corn and Atpolan 80 EC, Ikar 95 EC caused inhibition of spore germination by at least 40%. On untreated leaves more than 86% of germinating spores were found. After 7 days urediospores collected from untreated plants germinated in 65% whereas from plants sprayed with the tested oils in 23 to 68%. Oils from olive, sunflower and Dedal 90 EC, Atpolan 80 EC were the most effective in suppressing spores germination. Also Sajid *et al.* (1995) in the *in vitro* trials found that neem oil completely inhibited germination of urediniospores of *P. recondite*, while Letessier *et al.* (2001) showed that essential oil of hyssop (*Hyssopus officinalis*) reduced germination of urediniospores of *Uromyces viciae-fabae* and rust infection of broad bean.

Earlier experiments of Wojdyła (2003) showed that the oils tested in this trial strongly suppressed germination of *Botrytis cinerea* spores and germ tube development on roses.

Table 2. Effectiveness of oils in the control of *Puccinia pelargonii-zonalis* on pelargonium: Percentage of germinating urediospores. First spraying: 08.10.2004

Treatments	Conc. in %	Days after the end of experiment	
		7	14
Control	-	98.2 f	82.9 j
Amistar 250 SC	0.1	2.0 a	0.0 a
Mineral oils			
Atpolan 80 EC	1.0	90.4 c	55.0 gh
Ikar 95 EC	1.0	89.6 bc	38.6 ef
Olemix 84 EC	1.0	90.5 c	34.0 de
Promanal 60 EC	1.0	96.4 ef	70.9 i
Plant oils recommended for plant protection			
Dedal 90 EC	1.0	95.0 de	34.7 de
Olejan 80 EC	1.0	95.5 de	60.0 h
Plant oils used as a food			
Corn oil	1.0	86.3 b	23.5 bc
Olive oil	1.0	93.4 cd	49.1 g
Rape oil	1.0	95.5 de	17.2 b
Soya oil	1.0	93.0 cd	45.4 fg
Sunflower oil	1.0	91.2 c	28.3 cd

Note: Means, within the column, followed by the same letter are not significantly different at $p=0.05$.

Table 3. Effectiveness of oils in the control of *Puccinia pelargonii-zonalis* on pelargonium: Percentage of germinating urediospores. Mean values from 2 series - 22.11.2004 and 29.11.2004

Treatments	Conc. in %	Days after spraying	
		1	7
Kontrola	-	85.8 e	64.3 bc
Amistar 250SC	0.1	2.7 a	14.6 a
Mineral oils			
Atpolan 80 EC	1.0	20.0 ab	38.8 a-c
Ikar 95 EC	1.0	22.9 a-c	53.9 bc
Promanal 60 EC	1.0	59.9 de	57.7 bc
Olemix 84 EC	1.0	60.9 de	47.8 a-c
Plant oils recommended for plant protection			
Olejan 80 EC	1.0	54.2 c-e	59.0 bc
Dedal 90 EC	1.0	40.7 b-d	36.0 a-c
Plant oils used as a food			
Corn oil	1.0	34.1 b-d	68.1 c
Olive oil	1.0	26.2 b-d	23.6 ab
Rape oil	1.0	45.2 b-d	58.7 bc
Soya oil	1.0	55.2 c-e	53.0 a-c
Sunflower oil	1.0	55.2 c-e	39.8 a-c

Note: Means, within the column, followed by the same letter are not significantly different at $p=0.05$.

CONCLUSIONS

Number of *Puccinia pelargonii-zonalis* uredia per leaf noted on plants protected with oils from olive, soya, Ikar 95 EC or Olemix 84 EC was reduced by at least 50% compared to nontreated plants.

Oils from olive, soya and additionally Atpolan 80 EC, Ikar 95 EC, Olemix 84 EC caused drying of more than 50% of uredia.

One day after pelargonium spraying with oils, germination of urediniospores ranged from 20 to 60% as compared to 86% on untreated control plants.

The tested oils were not phytotoxic to pelargonium.

REFERENCES

- BABU S., SEETHARAMAN K., NANDAKUMAR R. & JOHNSON I. (2000). Effect of selected extracts/oils against tomato leaf blight. *International Journal of Tropical Agriculture* **18**(2):153-157.
- BOURBOS V.A., SKOUDRIDAKIS M.T., HAITAS V.C. & FOTIADIS K.S. (1994). The possible control of *Botrytis cinerea* Pers. using paraffinic oils, Brighton Crop Protection Conference, Pest and Diseases (2):797-800.
- CLEMENT D.L., GILL S.A. & POTTS W. (1994). Alternatives for powdery mildew control on lilac. *Journal of Arboriculture* **20**(4):227-230.
- D'AULERIO A.Z., ZAMBONELLI A., BIANCHI A., CATELLANIA P.L. & BIFFI B.S. (1998). Rust control trials on *Mentha x piperita* and *Artemisia dracunculus* with natural products. Proceedings of Giornate Fitopatologiche, held at Scicli e Ragusa, Italy, from 3-7 May 1998:667-670.
- LETESSIER M.P., SVOBODA K.P. & WALTERS D. (2001). Antifungal activity of the essential oil of hyssop (*Hyssopus officinalis*). *Journal of Phytopathology* **149**(11-12):673-678.
- LOCKE J.C. & STAVE J.R. (1992). Efficacy of neem seed extraction products and two petroleum oils against bean rust. *Fungic. Nematicide Tests* **47**:76.
- MCGRATH M.T. & SHISHKOFF N. (2000). Control of cucurbit powdery mildew with JMS Style-Oil. *Plant Disease* **84**(9):989-993.
- NORTHOVER J. & SCHNEIDER K.E. (1993). Activity of plant oils and diseases caused by *Podosphaera leucotricha*, *Venturia inaequalis*, and *Albugo occidentalis*. *Plant Disease* **77**(2):152-157.
- NORTHOVER J. & SCHNEIDER K.E. (1996). Physical modes of action of petroleum and plant oils on powdery and downy mildew of grapevines. *Plant Disease* **80**(5):544-550.
- OSNAYA-GONSALEZ M. & SCHLOSSER E. (1998). Effect of vegetable oils on black spot of roses. *Med. Fac. Landbou. Univ. Gent* **63**(3b):995-998.
- PICTON D.D. & HUMMER K.E. (2003). Oil application reduces pine blister rust severity in black currants. *Small Fruits Review* **2**(1):43-49.
- RAMADAN N.A., AL-MALLAH M.K. & KASSIM N.A. (1995). Control of lettuce mosaic diseases by mineral oil. *Arab Universities Journal of Agricultural Sciences* **3**(1):185-191.
- SAJID M.N., IHSAN J., NASIR M.A. & SHAKIR A.S. (1995). Comparative efficacy of neem products and Baytan against leaf rust of wheat. *Pakistan Journal of Phytopathology* **7**(1):71-75.
- WOJDYLA A.T. (2000). Influence of some compounds on development of *Sphaerotheca pannosa* var. *rosae*. *J. Plant Protection Res.* **40**(2):106-122.
- WOJDYLA A.T. (2002). Oils activity in the control of rose powdery mildew. *Med. Fac. Landbou. Univ. Gent* **63**(3b):995-998.
- WOJDYLA A.T. (2003). Biological activity of plant and mineral oils in the control of *Botrytis cinerea*. *Bull. Pol. Ac.* **67**(2):369-376.
- WOJDYLA A.T. (2004). Pelargonium rust. *OWK* **14**:32-33.
- WOJDYLA A.T., JANKIEWICZ D. (2004). Oils activity in the control of willow rust. *Comm. App. Biol. Sci. Ghent University* **69**(4):695-705.
- ZEKARIA-OREN J., EYAL Z. & ZIV O. (1991). Effect of film-forming compounds on the development of leaf rust on wheat seedlings. *Plant Dis.* **75**:231-234.