

THE STATUS OF DODINE RESISTANCE OF *VENTURIA INAEQUALIS* POPULATIONS IN POLAND

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Abstract

The monitoring of *Venturia inaequalis* resistance to dodine was conducted in 2008 season in 232 commercial orchards situated in different regions of Poland, where apple scab symptoms were observed. The isolates have been classified into four categories (very high, high, medium and low level of resistance). The low level (L) of resistance was noted in 60 orchards (26% of all tested orchards), medium (M) and high (H) levels were observed in 54 orchards for each resistance level (23%) and very high resistance (VH) of *V. inaequalis* forms to dodine in 64 orchards (28%). According to questionnaire fulfilled by growers, in majority of orchards, during the last eight years dodine was not used or used only ones or twice in a season.

Key words: apple scab, chemical control, dodine, resistance

Introduction

Dodine was introduced into Polish orchards in the late 1960s as a protective, curative and eradicator fungicide against *Venturia inaequalis* (apple scab). The good antifungal activity of dodine in control of apple scab resulted in fungicides with this active ingredient (Syllit 65 WP, Carpene 65 WP, Efuzin 500 SC) intensive use in commercial orchards for many years. The first dodine-resistant forms of *V. inaequalis* in Poland were detected in late 1980s (Nowacka 1991). After that, the presence of dodine resistance was noted in different regions of Poland (Meszka and Bielenin 2001, Broniarek-Niemiec and Bielenin 2008). Development of tolerance to dodine in the State of New York followed its intensive use for about 10 years (Szkolnik and Gilpatrick 1973). Usually, the more resistant strains survive in the orchards in which the fungicide is being applied and their population increases so long as the fungicide is used (Uesugi 1983). In the last years, some Polish growers have returned to dodine use for one or two applications, particularly in seasons

with high severity of apple scab and when other fungicides were unavailable. Most of the orchards with dodine resistance 20 to 30 years ago do not exist any more, replaced with new trees (Koller and Wilcox 1999).

The aim of the study was to assess the current status of dodine resistance in Polish apple orchards.

Material and methods

The monitoring of *V. inaequalis* resistance to dodine was conducted in 2008 season in 232 commercial orchards situated in different regions of Poland, where apple scab symptoms were observed. From each orchard 50 scabbed leaves or/and fruits were collected. Conidia from a single scab lesion from each leaf/fruit were placed directly onto potato dextrose agar (PDA) medium with addition of 1 ppm (mg/ml) dodine and on fungicide-free PDA medium for control. After 24 h of incubation, the germination of conidia was checked under microscope. From each orchard 1000 conidia (100 from 10 lesions) were screened. According to the number of lesions with conidia germination, the level of resistance was classified to four categories, which where:

VH – very high level of resistance (4 and more lesions with conidia germination above 50%),

H – high level of resistance (2–3 lesions with conidia germination above 50%),

M – medium level of resistance (1 lesion with conidia germination above 50% or/and more than 3 lesions with germination less than 50%),

L – low level or absence of resistance (1–3 lesions with germination less than 50%).

Results

The monitoring conducted in 2008 season showed that the problem of *V. inaequalis* resistance to dodine has still existed in Polish orchards, although the number of dodine applications decreased. According to questionnaire data, dodine is not used or is used rarely, usually one or two times per season. In 1998 and 2000 there were still orchards in which dodine was up to four times but since 2001 the number of dodine fungicides sprayings has decreased and only in 7% of orchards more than two applications are made (Fig. 1). The data obtained indicate that resistant forms of *V. inaequalis* can persist in population although dodine fungicides are not used at all or are used only one time during a season.

Our results showed that the low level of dodine resistance (L) occurred in 60 orchards (26% of all tested commercial orchards), medium (M) and high (H) levels were observed in 54 orchards for each level (23%) and very high level of dodine resistance (VH) in 64 orchards (28%) (Fig. 2). It means that in these orchards, al-

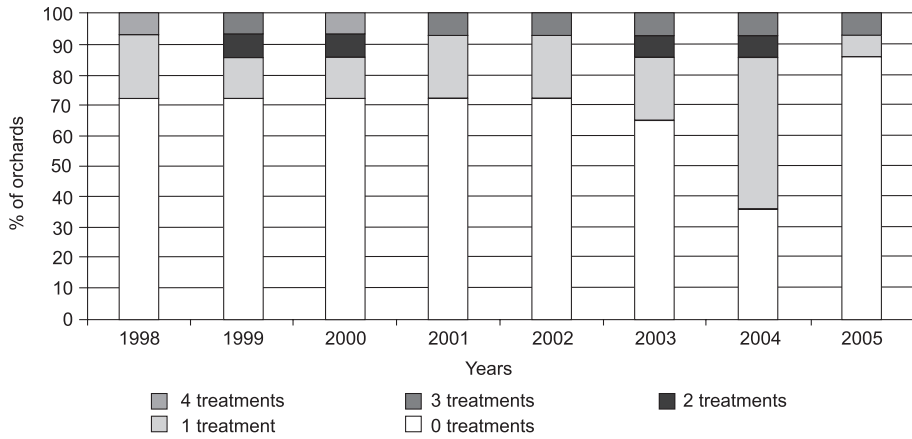


Fig. 1. Questionnaire data – number of dodine fungicides applications in apple orchards in Poland

most 30% of lesions produced above 50% conidia resistant to dodine. The analysis of protection programs indicated that in none of the investigated orchards dodine was used more than two times per season. It should be pointed out that only in 12 monitored orchards *V. inaequalis* forms resistant to dodine were not found and in 15 cases germination of conidia on medium with dodine was less than 1% per lesion. Our monitoring data demonstrated that the distribution of dodine resistance of *V. inaequalis* was rather uniform within all regions of the country.

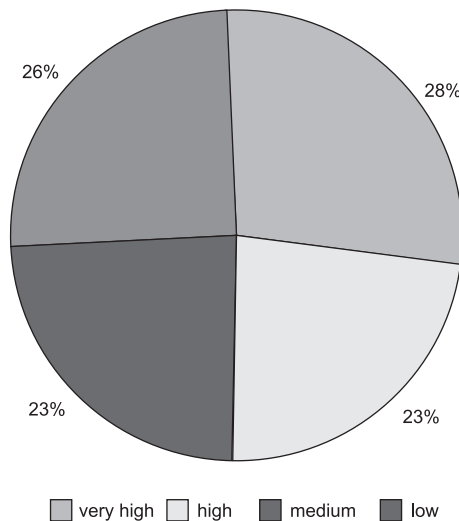


Fig. 2. Percent of orchards in each level of dodine resistance in 2008 season

Discussion

Resistance of *V. inaequalis* to dodine in apple orchards has been always induced by uncontrolled use of fungicides from the same group. The first dodine resistant forms of *V. inaequalis* in Poland were detected in late 1980s (Nowacka 1991). The monitoring conducted in orchards in different parts of Poland in 1998 and 1999 by Mieszka and Bielenin (2001) showed that in some cases even more than 50% of conidia in the *V. inaequalis* population were resistant to dodine and only in one orchard no resistant strain was found. Similar results were obtained in 2004. The conidial germination tests showed very high level of resistance in four out of 15 monitored orchards, medium level in five orchards and low in the remaining six orchards (Broniarek-Niemiec and Bielenin 2008). The intensive use of fungicides has been responsible for more or less rapid development of resistance to several classes of specific fungicides (Jones 1981). Mechanism details of dodine resistance have not been clearly elucidated. Resistance development progressed through a pattern typical of polygenic resistance, with resistant phenotypes comprising the least sensitive part of a continuous distribution of isolate sensitivities in baseline populations (Koller and Wilcox 1999). Evaluation of field *V. inaequalis* isolates resistance to dodine in culture can be used to predict whether dodine would fail in the orchard because of the pathogen's tolerance (Ross and Newbery 1977). Our results showed that a very high level of resistance can exist also in orchards, where dodine was not used or was used only rarely in the last years. Also Yoder and Klos (1976) obtained tolerant isolates in orchards with good scab control. In some orchards dodine fungicides are still used in a mixture with a fungicide with different mode of action and according to Fungicide Resistance Action Committee (FRAC) recommendations on limited number of treatments (Dux et al. 2004). Dodine is a good protectant and eradicant fungicide for apple scab control, very often used to burn out established scab lesions. The effect of tolerance on its eradicative and burning out properties is not known (Ross and Newbery 1977). Knowledge of dodine resistance level in orchard helps to choose the best programme of apple scab control. Dodine fungicides can be used only in orchards, in which forms resistant to dodine are not observed or present at a low level.

Streszczenie

OCENA WYSTĘPOWANIA FORM GRZYBA *VENTURIA INAEQUALIS* ODPORNYCH NA DODYNĘ

W pracy przedstawiono ocenę występowania form grzyba *Venturia inaequalis* odpornych na dodynę. Wysoka efektywność fungicydów dodynowych, działających zapobiegawczo, interwencyjnie i wyniszczająco w zwalczaniu parcha jabłoni, spowodowała ich intensywne stosowanie przez wiele lat. Wynikiem tego było pojawienie się form grzyba odpornych na dodynę. Monitoring przeprowadzony w 2008

roku w 232 sadach towarowych położonych w różnych rejonach Polski wykazał, że problem odporności cały czas istnieje, mimo że liczba wykonywanych preparatami dodynowymi zabiegów wyraźnie się zmniejszyła. Niski poziom odporności stwierdzono w 60 sadach, co stanowiło 26% wszystkich badanych obiektów, średni i wysoki poziom odporności – w 54 sadach (każdy po 23%), a bardzo wysoki poziom odporności – w 64 sadach, co stanowiło 28% ocenianych sadów.

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