リンゴ褐斑病菌におけるベンズイミダゾール系薬剤耐性菌の出現と対策

／Occurrence of benzimidazole resistance in apple blotch and countermeasures for disease control

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第 11 回殺菌剤耐性菌研究会シンポジウム講演要旨(2001, P1-7) ／ Abstracts of the 11th Symposium of Research Committee on Fungicide Resistance

秋田県ではチオファネートメチル水和剤を 7 月中旬から 8 月中旬に 1～2 回、主剤（有機銅・キャプタン剤、有機銅剤、キャプタン剤等）に加用して散布する体系が確立し、広く普及してきた。本県においても、リンゴ黒星病菌やオウトウ灰星病菌でベンズイミダゾール系殺菌剤耐性菌が確認されているが、褐斑病菌においては 1995 年までの感受性検定でチオファネートメチル耐性菌は検出されなかった。しかし 1998 年、褐斑病の多発が県南部で見られ、一部の生産者からはチオファネートメチル耐性菌の出現を疑う声もあった。

そこで、多発園を中心に菌の薬剤感受性検定を行ったところ、1 園地から耐性菌とみられる菌株が検出された（佐藤・水野、1999）。これは我が国では、山口県（亀川ら、1999）とともに初めての検出例であった。ここでは、褐斑病菌の薬剤感受性の検定法と検定結果、耐性菌対策等を紹介したい。

ブドウ晩腐病の防除と病原菌の薬剤感受性の変化

／Control of grapevine ripe rot and fluctuation of fungicide sensitivity of the pathogen

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Dormant spray applications of benomyl suppressed grapevine ripe rot in subsequent growing seasons. Fungicide sensitivity of the pathogen was annually monitored between 1992 and 2000 in an experimental vineyard in Akita Prefecture. In 1994, isolates of Colletotrichum showing insensitivity to benomyl were frequently detected from infected grapevine, which had previously been treated with the fungicide, although the field performance of benomyl was still maintained. The negative cross-resistance to diethofencarb was not seen in benomyl-insensitive isolates thus obtained despite that those isolates were first regarded as *Glomerella cingulata*, the teleomorph of *C. gloeosporioides*. Intensive studies showed that grapevine ripe rot is caused either by *G. cingulata* or *C.acutatum* and that the latter fungus is inherently insensitive both to benzimidazoles and diethofencarb. In 2000, nine years after starting the field trial, control efficacy of benomyl treatment suddenly dropped in the vineyard suggesting that the application of benzimidazole fungicides may increase populations of *C. acutatum*.

High efficacy against ripe rot control was achieved by spray applications of either iminoctadine-albesilate, chlorothalonil (TPN), or the mixture of benomyl with thiuram in dormant periods.

花き灰色かび病菌における薬剤耐性菌の発生実態

／Occurrence of fungicide-resistant isolates in gray mold fungus on flowers

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第 11 回殺菌剤耐性菌研究会シンポジウム講演要旨(2001, P17-22) ／Abstracts of the 11th Symposium of Research Committee on Fungicide Resistance

Botrytis cinerea Persoon:Fries による灰色かび病は多くの花きに発生し、しばしば大きな被害をもたらしている。青森県の花き栽培は夏季の比較的冷涼な立地条件を利用した夏秋切り栽培が主体である。これらの多くは簡易パイプハウスなどの施設で栽培されているが、気象条件によっては灰色かび病によって思わぬ被害を受けることがある。花きでは暖房機あるいは除湿器の使用やマルチング等による病害発生環境の改善も行われているが、薬剤防除への依存度は依然として大きいものがある。

ところが、花きでは灰色かび病の防除剤は登録薬剤が少なく、灰色かび病に限らないが新規薬剤の登録も滞りがちである。現在の花き灰色かび病に対する主要薬剤は、普及されてから年月を経ているものが多いため、これらに対する薬剤耐性菌の発生が懸念されてきた。そこで、花きにおける薬剤耐性灰色かび病菌の発生実態を把握し、今後の防除指導に役立てるため、1998 年及び 2000 年に薬剤耐性灰色かび病菌の発生実態調査を実施したのでここに紹介したい。

フェンヘキサミド（パスワード）感受性の検定法とベースラインデータ ／Monitoring methods for sensitivity of Botrytis cinerea to fenhexamid and baseline data in Japan

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第 11 回殺菌剤耐性菌研究会シンポジウム講演要旨(2001, P23-30) ／ Abstracts of the 11th Symposium of Research Committee on Fungicide Resistance

Fenhexamid was introduced in Japanese market in 2000. Baseline sensitivity of *Botrytis cinerea* to fenhexamid was monitored since 1990 to 1999 by evaluating sensitivity of mycelia. Most of wild populations have lower EC50 than 0.1 ppm. However, less sensitive subpopulations have been found even at very beginning of the testing phase. Nevertheless fenhexamid showed good control efficacy in the field where these isolates are existing or even dominant. The author proposes to distinguish these "less sensitive" isolates from "resistant" isolates, which show lower sensitivity in *vivo*.

バレイショ疫病菌のシアゾファミド(ランマン R)に対する感受性検定法

／Methods to determine the sensitivity of Phytophthora infestans to cyazofamid (Ranman)

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第 11 回殺菌剤耐性菌研究会シンポジウム講演要旨(2001, P31-39) ／Abstracts of the 11th Symposium of Research Committee on Fungicide Resistance

Cyazofamid, 4-chloro-2-cyano-N,N-dimetyl-5-(4-methylphenyl)-1H-imidazole-1-sulfonamide (Ranman8), is a new fungicide active against a broad spectrum of *Oomycete* species. The mode of action of cyazofamid is at the Qicenter of mitochondrial b hemes. No cross resistance to cyazofamid has been observed by any field pathogen which has developed resistance to other commercial fungicides. It is important to know the original sensitivity of plant pathogenic fungi to cyazofamid before it is widely used. We investigated several methods for testing the sensitivity of *Phytophthora infestans* to cyazofamid including a zoospore motility assay, a tuber disc assay and a dilution plate assay. All methodologies used in this study were simple and precise for investigating the sensitivity of *P. infestans*. Among them, the zoospore motility assay required the shortest assessment time and enables us to identify the sensitivity of *P. infestans* to cyazofamid at the minimum dose rates. Therefore, this method is recommended for the monitoring of fungal population responses. Using this assay, the baseline sensitivity of 48 field isolates of *P. infestans* to cyazofamid gave MIC values ranging from 0.0005-0.05 μg/ml with a mean of 0.012 μg/ml. The median peak was in the range 0.005-0.01 μg/ml. High sensitivity to cyazofamid was observed in all of the field populations of *P. infestans* isolates collected from various areas in Hokkaido, Japan.

DMI 剤耐性菌問題の経過と現状ーイネ、ムギ、野菜 ／Progress and present state of DMI resistance in rice, cereals, and vegetables

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第 11 回殺菌剤耐性菌研究会シンポジウム講演要旨(2001, P41-50) ／ Abstracts of the 11th Symposium of Research Committee on Fungicide Resistance

ステロール生合成過程の脱メチル化を阻害する DMI 剤(ステロール脱メチル化阻害剤)は世界的に広く使用されている殺菌剤である。日本でも 1980 年代初頭から多くの作物、病害で使用されている。DMI 剤は特に、うどんこ病、さび病や果樹の黒星病などに卓効を示すほか、水稲の主要な種子消毒剤としても使用され、国内における殺菌剤出荷額の約 10%を占めると推定されている。

DMI 剤は当初、耐性菌は発達しにくいと考えられていた。しかし現在までに、コムギ、ウリ類及びイチゴのうどんこ病、ナスすすかび病などで菌の薬剤感受性低下が確認されている。ここでは、日本における DMI 剤耐性の経過と現状を取りまとめた。

DMI 剤耐性菌問題の経過と現状(果樹) ／ Progress and present state of DMI resistance in fruit tree pathogens

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第 11 回殺菌剤耐性菌研究会シンポジウム講演要旨(2001, P51-54) ／Abstracts of the 11th Symposium of Research Committee on Fungicide Resistance

This paper covers a brief history, the current status, and future management of resistance to sterol demethylation inhibitors (DMIs) in fruit tree pathogens. For scab control in Japanese pear and apple, DMIs have become a major group of fungicides since the mid-1980s, when benzimidazoles lost their efficacy. Baseline sensitivity data for fenarimol were obtained using fungal isolates, collected from non-DMI-treated orchards.

Subsequently, monitoring for fenarimol sensitivity has been carried out. In *Venturia nashicola*, the cause of scab on Asian pears, a shift to lower fenarimol sensitivity has been found in isolates collected from DMI-treated orchards. Distribution of less fenarimol-sensitive isolates in commercial orchards was also occasionally reported in apple scab fungus *V. inaequalis*. In both cases, however, the performance of DMIs was still maintained in the field with detection of resistant isolates remaining low. To avoid potential problems of DMI resistance, it is still necessary to reduce disease pressure and to keep the frequency of applications as low as possible. Currently, DMIs are recommended for use up to three times per year in apple and pear orchards.

Resistance in apple scab to DMI and strobilurin fungicides

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Scab caused by *Venturia inaequalis* on leaves and fruits is the economically most important disease of apples. Because commercially acceptable apple cultivars with high levels of scab resistance have not yet been developed, the disease continues to be controlled with fungicides.

The unexpected change toward problems with fungicide resistance became evident with dodine introduced in the late 1950s. The

first round of resistance was counteracted by replacing dodine with the benzimidazole fungicide benomyl which was introduced in 1970. However, benomyl resistance developed after only 2-4 seasons and, more rapidly than for dodine. The third round of resistance development was initiated with the introduction of the DMI fungicides in 1987. In the US, first cases of DMI resistance under commercial orchard conditions were diagnosed in 1995. Kresoxim-methyl and trifloxystrobin belonging to the class of strobirulin-related fungicides were introduced in 1999 and might initiate the fourth round of resistance development.

The results summarized in this paper describe the dynamics of population responses to the various fungicides and several tested options for the management of fungicide resistance.

耐性菌検定を現場に生かすには ／How to use results from fungicide-sensitivity tests in practice

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第 11 回殺菌剤耐性菌研究会シンポジウム講演要旨(2001, P67-72) ／Abstracts of the 11th Symposium of Research Committee on Fungicide Resistance

耐性菌の検定、特にモニタリングは、農薬メーカー及び国公立研究機関や都道府県病害虫防除所等で進められている。しかし、その検定結果が、的確な情報として生産者まで伝達されない等、十分に検定結果が生かされていない場合も多い。また、いざ検定を実施しようとすると、サンプルの採取後、検定手法、耐性菌の判別法等、さまざまな問題が浮上してくることが多々ある。このように、耐性菌という問題を扱っていく場合に生じてくる種々の問題点をここで取り上げるとともに、その解決策の方向性を考えてみたい。