

# Managing Apple Scab Resistance in Nova Scotia Orchards

## Introduction

Apple scab (*Venturia inaequalis*) resistance to a fungicide is not a new phenomenon for Nova Scotia apple growers. In 1974, tolerance to dodine (at that time known as Cyprex and presently sold as Equal/Syllit) was first detected in Nova Scotia orchards, some 15 years after it was first recommended for use. This was followed by resistance to benomyl (formally known as Benlate) fungicide in 1982 when two Nova Scotia commercial orchards were identified with resistance. The resistance developed within eight years of Benlate's introduction to Nova Scotia producers. In other growing regions where Benlate was used more frequently, resistance was detected within three years of its introduction. Most recently, resistance has been detected for the Sterol Inhibiting (SI) fungicide, Nova, which became available for scab control in the mid 1990's. Full resistance to the strobilurin fungicide, Flint, has yet to be detected in Nova Scotia. However, there are orchards where the scab population has started to shift towards resistance to this fungicide.

Commercial apple growers still have a fairly wide range of fungicides to select from to control scab. Growers should however be concerned as the range could diminish because of deregistration of older fungicides resulting from pesticide re-evaluations, the additional development of resistance to some of the presently registered fungicides and the lack of new fungicide registrations.

Over time the efficacy of a fungicide or class of fungicides can diminish to the point where it no longer provides effective control of scab. Naturally within a given population of scab spores there will be a small number of spores that have the capability of resisting the killing

action of the fungicide. The surviving spores pass on the resistance by means of reproduction and over time this population of resistant spores increases with additional applications of the fungicide. This population builds to the point where the fungicide can no longer be relied upon to provide effective control. This loss of sensitivity to a fungicide can be quite rapid or occur over a longer period of time.

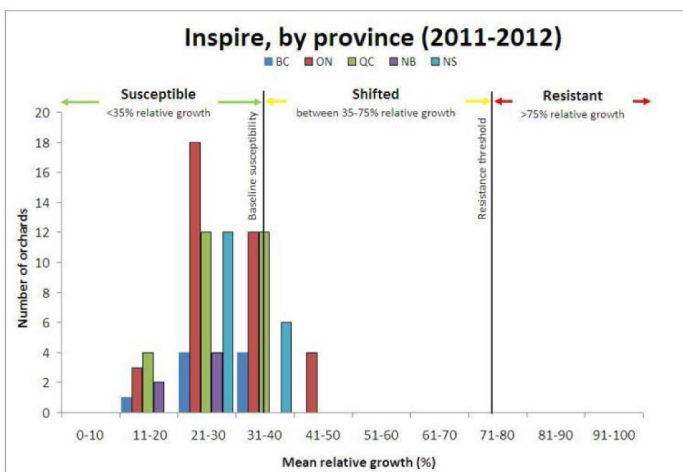
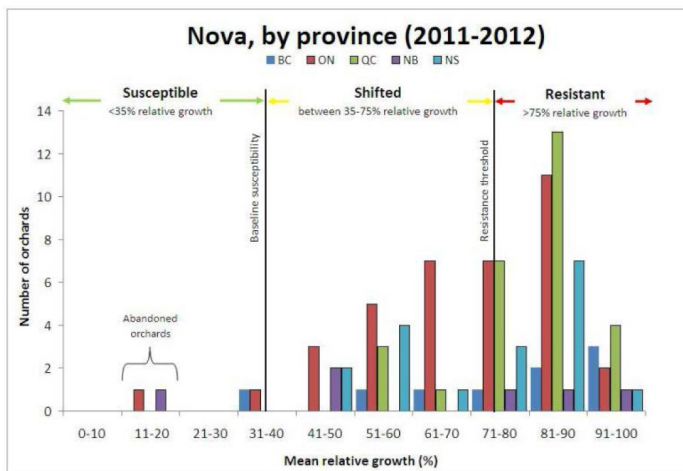
The mode of action of a fungicide and use pattern will determine when and if resistance occurs. Resistance will develop more rapidly for those fungicides that are single site in their mode of action compared to those that are multi-site. Most of the older fungicides such as Captan and Manzate act on several functions of the organism (multi-site activity) and have been used for over 30 years without resistance developing. Most of the fungicides that have been introduced over the past 30 years such as Nova, Flint, Scala, Senator and Equal/Syllit target a specific function (single site) and are more prone to resistance development. The families of fungicides that are more prone to resistance development are the SI (DMI) – class 3 (Nova, Inspire, Nustar), the strobilurins – class 11 (Sovran, Flint), Anilinopyrimidins – class 9 (Vanguard, Scala), Guanidine – class 7 (Equal, Syllit) and MBS – class 1 (Senator).

## National Scab Survey

Poor scab control in some Ontario orchards in 2009 created suspicion that resistance may have contributed to the problem. Prior to 2009, some apple growing regions in the United States were reporting resistance to the SI and strobilurin classes of fungicides. A national survey was

conducted in 2011 and 2012 to determine if resistance to the SI and strobilurin classes of fungicide was present in Canadian orchards and if so to what extent. Funding for the survey was provided by the AAFC-PMC and administered by the Ontario Apple Growers. Resistance testing was conducted by the University of Guelph. Over the two year period, 98 orchards were sampled across Canada with 18 orchards sampled within Nova Scotia's Annapolis Valley. Scab from the orchards was analyzed for resistance to Nova, Inspire, and Flint. A smaller number of orchards were tested for resistance to Equal/Syllit to determine what level of resistance still existed with its limited use since the early 1980's.

The results for the two years survey are presented in the following histograms provided by OMAFRA:

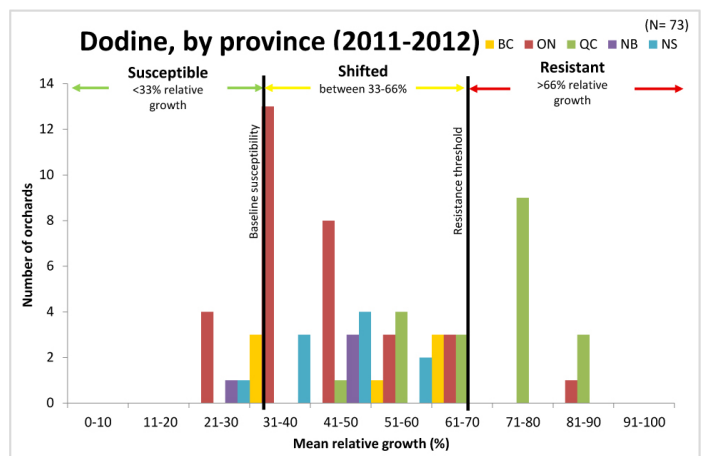
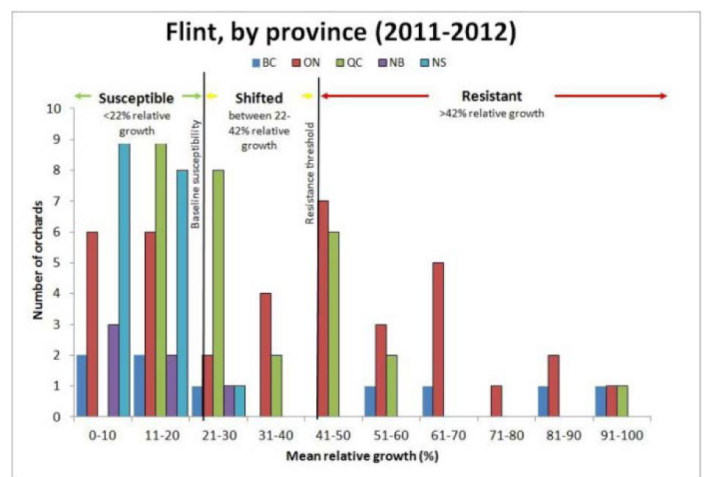


In Nova Scotia, 11 of the 18 orchards surveyed had scab populations that were considered to be resistant to Nova and 7 had populations that were shifting towards resistance. Over time and with continued use of Nova, the scab populations in these orchards would become resistant.

The survey results indicate that there is no existing resistance to Inspire, which belongs to the same class

of fungicides as Nova. Six of the 18 orchards had scab populations which were just at the baseline for a susceptible and shifting population. Although Nova and Inspire are in the same chemical class, Inspire is a second generation SI fungicide with greater efficacy compared to the first generation SI fungicides. Inspire became available to control scab in 2011 and to date has had limited use by Nova Scotia apple growers. One would expect the development of resistance to Inspire would be fairly rapid given that resistance to that chemical class has already been established with Nova.

The survey did not detect any orchards in Nova Scotia with resistance to Flint. Eleven of the 18 orchards however had scab populations that were shifting towards resistance. The strobilurins have not been in use as long as the SI fungicides, with Flint being introduced in 2006 which was preceded by Sovran in 2000. Nova Scotia growers have not made as extensive use of the strobilurin fungicides as with the SI class which could explain the lack of resistance in Nova Scotia orchards in comparison to Ontario. Over time with continued use, the population would shift towards resistant and at some point resistance would be established.



Resistance to Equal/Syllit (dodine) was not detected in the 10 orchards sampled in Nova Scotia, however nine of ten did have a scab population that was shifting towards resistance. Unfortunately there is no baseline for the number of orchards with resistance in Nova Scotia in the late 1970's to compare with the 2011-2012 results. The survey does however indicate that Equal/Syllit is an option for scab control provided it is used in a manner that does not encourage the development of resistance.

There is some encouraging news resulting from the survey in that Nova Scotia does not face as serious a problem with fungicide resistance as growers in Quebec and Ontario do. It does however point out that if growers do not take steps resistance will continue to develop to the point where these classes of fungicide are no longer viable options for scab control.

## Resistance Management

Steps that growers can take to prevent or delay the development of fungicide resistance are: Obtain early season scab control which means starting a fungicide program at green tip.

1. Make sure that your sprayer is calibrated at the beginning of the spray season so that good coverage is obtained and spray material is applied at the recommended rate.
2. Spray according to stage of tree development/ weather conditions and not by the calendar.
3. When possible use a fungicide with multi-site activity, those in the M group.
4. When using a fungicide with a single site activity apply it with a half-rate or even full-rate of a multi-site fungicide.
5. Do not apply more than two back to back sprays of a fungicide class with a single site activity and try to limit application of that class to no more than four per growing season.
6. When possible avoid applying fungicides for post infection or curative activity.
7. Do not apply reduced rates of fungicides with single site activity.
8. Avoid every other row application of fungicides with single site activity.
9. Make use of sanitation methods to reduce overwintering inoculum.

## Orchard Sanitation

The use of urea sprays to reduce overwintering inoculum (spores) is not a new concept. Research in the 1960's indicated that foliar application of urea did reduce the number of over-wintering spores by accelerating the breakdown of leaves and reducing the development of spores. Some of this research was conducted at the Kentville Agricultural centre by Dr. Bob Ross in the 1960's. The theory however was not put into practice by Nova Scotia growers. The concept of fall foliar application of urea just prior to leaf fall or post leaf fall is now being encouraged to deal with orchards that are going into the winter with a high incidence of apple scab. Spring time, prior to bud break, provides another opportunity to apply a urea spray to apple leaves on the orchard floor. The recommended rate of urea is 45 kg per hectare with an application rate of 1,000 L per hectare. Flail mowing in the fall after leaf drop or in the spring prior to bud break has also reduced the overwintering spore load. Mowing accelerates leaf breakdown and the destruction of spores. The combination of mowing and urea sprays has proven to be the most effective in reducing spore numbers. Field trials in the USA have reported overwintering spore reduction of upwards of 90% using either method or a combination of the two.

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