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Update on Pest Management and Crop Development

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INSECTS

ICE OUT

THE GOOD OLD WINTERTIME

(Art Agnello, Entomology, Geneva)

❖❖ This winter, I was asked to give a presentation at some grower meetings on how global climate change might be expected to impact NY tree fruit arthropod pests. Actually, the topic originally specified the impact of warmer-than-normal winters, but that was suggested back in January, before our winter weather had really started. At any rate, I knew next to nothing about this topic, never having collected any real data on such things, so it provided me with the chance to dig through the literature to see what other researchers might have found out along these lines.

Naturally, it's easy to confuse climate with weather, and both can impact insects. Of all the factors that can possibly have an effect on the development of a given pest population, the weather must certainly be one of the most critical. Nearly every discussion of how moderate or how severe an insect or mite problem is, was, or might be in a given season, starts with a general estimation of the temperature, wind, humidity and rainfall conditions to which that pest is subjected. We all have numerous anecdotal evidence of how the spring rains of one year prevented one insect from taking off, or how the summer heat encouraged another. However, these tend to be relatively "plastic" responses: that is, short-term and non-permanent. For instance, for European red mite, winter mortality can range from 15–60%, depending on temperatures. In the spring, periods of high rainfall can retard mite population development, and in summer, more generations can occur (7–8+) during hot summers. Another example would be woolly apple aphid, which exhibits better survival of aerial colonies (in the canopy) during mild winters. Less obvious is the fact that winters with less snow cover are more detrimental to ground-wintering insects, such as internal leps and apple maggot, whose larvae and pupae, respectively, overwinter on the ground.

Weather impacts on population survival have been examined for other insects, with some surprising results. In one study (Williams et al. 2003), gall wasp larvae were taken from two different areas of Canada, one with relatively cold winters, and another milder locale. These were subjected to 4-month periods of different

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temperatures. The cold-climate larvae showed 66% more mortality from 50° than 32° exposure, and the females that did survive the higher exposure temperature had 32% fewer eggs than those from the lower temperature. In contrast, wasps from the milder locale showed no difference in survival or egg production among temperature treatments. The researchers concluded that mild overwintering temps may be detrimental for insects by raising their metabolism, and thereby reducing energy reserves needed for development and egg production. Another study (Irwin & Lee 2000) showed similar results for the goldenrod gall fly: it was concluded that low temperatures and even freezing during the winter can be beneficial, by allowing conservation of the insects' energy reserves.

When we consider climate (vs. weather) impacts on insects, we need to consider more long-term and evolutionary responses to these factors, which can take the form of things like extended geographical ranges of populations; altered developmental cycles; differences in mating habits, oviposition behavior, and fecundity; and shifts in developmental timing. This can ultimately be evidenced in a genetic basis for more generations during the year. We are already familiar with some fruit arthropods that have more generations in warmer climates, such as:

- Plum Curculio: 1 gen in NY; 2 south of VA
- Codling Moth: 2 gens in NY; 3.5 in southeastern US
- Oriental Fruit Moth: 3 gens in NY; 6 in southeastern US
- Apple Maggot: 1 gen in NY; 1.5 in southeast

A couple of recent studies can illustrate these factors actually causing a change. In one (Ellis et al. 1997), a large sample was taken of the most common Microlepidoptera (small moths) in the Netherlands. During the period from 1975–1994, the flight peak had shifted to an average of 11.6 days earlier, due mostly to a rise in spring temperatures. The authors saw this as support for the hypothesis that a warming of the global climate will cause accelerated insect larval development, causing a gradual shift to an earlier timing of the generations. In another study (Parmesan et al. 1999), large samples taken of 35 non-migratory European butterfly species showed that 63% had ranges that had shifted to the north by 22–150 miles during the 1900s, and only 3% had shifted to the south. This supported the theory that in some (non-migratory) species that cannot respond to rises in global temperatures by altering their migration timing or destination, one should see poleward shifts of their range.

One final (and maybe more observable) aspect of insect biology that may be impacted by climate change is diapause, which is the period of dormancy in insects that allows them to survive unfavorable conditions (such as low temperatures, or lack of food/moisture). Daylength is an important indicator of the season; that is, shortening days herald the coming of unsuitable conditions. Fortunately for insects, this usually occurs early enough to allow them to prepare physiologically, by laying down increased reserves of fat. For most insects having a winter diapause, long days sustain development and short days induce diapause. So during late summer, individuals perceive shortening day

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length and switch from active development and reproduction to a diapause mode. In a given geographic location, the length of the growing season and the timing of winter onset determines the best time for insect populations to make this switch.

Because of the earth's tilt on its axis, summer daylengths on a given day are longer in New York than in, let's say, Florida. (You can verify this by recalling that, as you approach the North Pole, you eventually – e.g., on June 21 – get to a day when the sun never sets.) So, NY insects need a longer daylength than FL insects to stay out of diapause; this is called their "critical photoperiod". Winter arrives earlier in NY than in FL, and when days start getting shorter in late summer, NY insects are using a longer "critical photoperiod" than FL insects as a cue to time the start of their diapause. Now (to set up the basis for the final case study I'm going to cite), IF insects have been adapting to longer growing seasons and later onsets of winter because of global warming, THEN NY insects should be starting to act more like FL insects when it comes to diapause. That is, their critical photoperiod should get shorter over time.

Bradshaw & Holzapfel (2001) made a long-term study of the pitcher-plant mosquito, which develops as a larva in water-filled leaves of the pitcher plant throughout North America. During 4 widely spaced years – 1972, 1988, 1993, and 1996 – they made a series of collections of pitcher-plant mosquitoes from a range of northern and southern locations in the US and Canada. On each date, they ran developmental trials on the individuals from all populations, and determined their critical photoperiods. They found that these decreased significantly from 1972 to 1996. In the northernmost populations (Manitoba), it had shifted from 15.79 hr to 15.19 hr (i.e., 36 minutes). While this may not sound like much, it corresponds to 9 days later in the fall of 1996 than 1972, or about 5 degrees latitude further south (~350 mi). This is about the same as the distance between Kingston, NY and Richmond, VA; or, Plattsburgh, NY, and Philadelphia. So, how would you like to be growing apples in Plattsburgh, and the insects in your orchard are developing as though they were living 350 miles further south (where OFM have maybe 4 generations per year)?

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What does this mean for NY tree fruit pests? First of all, most "single-occurrence" weather anomalies should be expected to have an impact only during the year they occur. Also, I believe that in-season weather patterns have by far a more dominant influence on insect populations than overwintering conditions (e.g., cool wet springs, hot dry summers). It's my opinion that extreme weather patterns would need to occur repeatedly for a number of years to effect climate shifts that are associated with changes in tree fruit insect biology. Which ones is a hard thing to predict, but we already know of fruit arthropods in which diapause has been altered through artificial selection in the lab (i.e, exposure to non-natural environmental conditions). These include: plum curculio, oriental fruit moth, European corn borer, gypsy moth, codling moth, apple maggot, twospotted mites, and predacious lacewings.❖❖

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HORTICULTURE

(PLANT) FOOD FOR THOUGHT

SPRING FERTILIZERS

(Steve Hoying, Horticultural Sciences, Highland)

❖❖ With the increase in the price of gas and oil, fertilizer prices have also gone through the roof. It is more important than ever to carefully assess your tree fruits' fertility needs. Leaf and soil analysis and careful observations of last year's tree vigor combined with crop load, fruit quality and other orchard circumstances can be used to craft a program that will satisfy the nutritional needs of your orchards and maximize their performance.

Mature apple orchards require nitrogen, potassium, and boron on an annual basis. Nitrogen needs vary according to the N carrying capacity of the soil and the variety. In New York, 20–40 lbs of additional N are needed to sustain tree growth and fruiting. Leaf analysis values should be between 1.8–2.0 for soft varieties and 2.0–2.2 for hard varieties, with average terminal shoot growth between 8–12 inches. Nonbearing trees should have leaf analysis values about 2.4 with 12–18 inches of terminal shoot growth. Apply 10% more or less nitrogen for every 0.10 analysis values are above or below recommended levels. If leaf analysis values and shoot growth are adequate, early ground applications of N can be reduced or eliminated and if conditions dictate, foliar urea can be used to boost early growth and strengthen flowers and fruit set. Foliar N can be applied at 3 lbs/100 gallons at pink and/or 5 lbs/100 gallons at petal fall for this early boost.

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Apples are a heavy user of potassium and a full crop removes 70–80 lbs of K2O per acre per year which must be replaced annually. Muriate of potash or sulpomag are the most common fertilizers and can be applied in either late fall or early spring. Soil boron is also important and should be applied in addition to foliar boron since this nutrient does not easily move from foliage to roots where it is also needed. The easiest and most economical way to apply the 2 lbs of B needed per acre is to have it mixed with your nitrogen and potassium for a single spring application. Your fertilizer supplier should be able to make custom mixes that satisfy N, K, and B needs for each of your orchard blocks. These mixes should be in a 1-0-2 ratio for fresh fruit and closer to a 1-0-1 for processing fruit.

Complete fertilizers are unnecessary and a waste of money since phosphorous does not move through the soil to established tree roots. Phosphorous should only be applied pre-plant and mixed deeply into the soil.

Special fertilizer applications may be needed where winter injury has occurred. The so-called "Tonic Applications" are applied to the tree and foliage at Green tip and consist of 1 lb Boron (such as Solubor), 1 qt zinc chelate, and 3 lbs feed grade low biuret Urea.

Stone fruit nutrient needs are similar to apple but have important differences. The common orchard fertilizer mix suggested above is not recommended for stone fruit. Stone fruit do not use the same large amount of potassium that apples do and careful analyses of leaf samples are important to judge the amount of potassium needed. In addition, stone fruit are very sensitive to chlorides and large applications of the muriate form should be substituted with the sulfate form when applications of K2O is called for in the leaf analysis. Both excess and deficiency of Boron can reduce fruit quality in stone fruit. Rates of boron for soil application in stone fruit orchards should not exceed 1/2 of the rate indicated for apples and pears unless both soil and leaf analysis results indicated that greater amounts are required.

Nitrogen needs for stone fruit are generally higher than for pome fruit. Desired leaf analysis levels for cherries, plums and apricots should be between 2.4–3.4% and peaches which set fruit on one year old wood and require more annual growth for maximum fruiting potential should exceed 3.0%, and be closer to 4.0%. Healthy pencil sized shoot growth produces the best peaches.❖❖

ERRATUM

GUTHION/ AZM

AP-PEAR-ENTLY NOT

(Art Agnello, Entomology, Geneva)

❖❖ A correction to last week's article on the Guthion/AZM phaseout dates: Yearly seasonal maximum amounts of formulated product allowed on pears should be:

2007: 6 lb
2008: 3 lb
2009–10: 2 lb
2011–12: 1.5 lb

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PHENOLOGIES

Geneva: All dormant

Highland:
Apple (Ginger Gold) - silver tip
Peach - swollen bud
All others dormant

UPCOMING PEST EVENTS

	43°F	50°F
Current DD accumulations (Geneva 1/1–3/26/07):	67	24
(Geneva 1/1–3/26/2006):	73	19
(Geneva "Normal"):	51	19
(Highland 3/1-3/26/07):	29	11

Coming Events:	Ranges(Normal±StDev):	
Green fruitworm 1st catch	50–122	12–54
Pear psylla adults active	2–121	0–49
Pear psylla 1st oviposition	25–147	1–72
McIntosh at silver tip	53–103	15–41

PEST FOCUS

Highland:
Pear psylla egg laying has begun.
San Jose scale DD base 50 from March 1 = 10.8

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