New York Berry News

CORNELL UNIVERSITY

Volume 08, Number 12 December 10, 2009

What's Inside

Best Wishes for a Berry Happy, Healthy, and Prosperous 2010!

CURRANT EVENTS

January 6, 2010. *NE IPM Berry Webcast Series #9*: **Bramble Production: High tunnels, RCA trellis.** More information: Laura McDermott, lgm4@cornell.edu, 518-746-2562, http://www.fruit.cornell.edu/Berries/webinarindex.htm.

January 20, 2010. *NE IPM Berry Webcast Series #10*: **Bramble Weed Management: cultural weed management, using herbicides effectively**. More information: Laura McDermott, lgm4@cornell.edu, 518-746-2562, http://www.fruit.cornell.edu/Berries/webinarindex.htm.

January 25-27, 2010. *Empire State Fruit and Vegetable EXPO/NYS Farmer's Direct Marketing Association Annual Conference*. OnCenter, Syracuse, NY. Mark your calendars – berry session Wednesday January 27th.

February 3, 2010. *NE IPM Berry Webcast Series #11*: **Bramble Disease Management: root and crown diseases, viruses**. More information: Laura McDermott, lgm4@cornell.edu, 518-746-2562, or go to: http://www.fruit.cornell.edu/Berries/webinarindex.htm.

February 2-4, 2010. *Mid-Atlantic Fruit and Vegetable Convention*, Hershey Lodge, Hershey, PA. For more information visit http://www.mafvc.org/html/.

February 17, 2010. *NE IPM Berry Webcast Series #12*: **Bramble Insect Management: crown/cane borers, TBA**. More information: Laura McDermott, lgm4@cornell.edu, 518-746-2562, http://www.fruit.cornell.edu/Berries/webinarindex.htm.

Feb 5-12, 2010. *North American Farmers Direct Market Association 25th Anniversary Convention*, Lancaster PA. More information to follow.

February 24-26, 2010. *North American Raspberry & Blackberry Conference,* Monterey, California, preceded by preconference tour. More information: http://www.raspberryblackberry.com/.

June 22-26, 2011. *10th International Rubus and Ribes Symposium, Zlatibor, Serbia*. For more information contact: Prof. Dr. Mihailo Nikolic, Faculty of Agriculture, University of Belgr, Belgrade, Serbia. Phone: (381)63 801 99 23. Or contact Brankica Tanovic, Pesticide & Environment Research Inst., Belgrade, Serbia. Phone: (381) 11-31-61-773.

GILLIBRAND URGES FEDERAL SUPPORT FOR SYRACUSE-BASED NEW YORK FARM VIABILITY INSTITUTE

During Economic Downturn, Funding For The Institute At Risk When Farmers Need Services The Most

November 12, 2009. Washington, D.C. U.S. Senator Kirsten Gillibrand today urged the U.S. Department of Agriculture (USDA) to include the New York Farm Viability Institute in their "Know Your Farmer, Know Your Food" Initiative. The Institute was created as one of the original "Agriculture Innovation Centers" within the 2002 Farm Bill. Out of the 10 states funded in this program, only New York and Minnesota continue to have fully functioning innovation centers. However, since 2005, the Institute has not received federal dollars. During this economic downturn, funding for the Institute is at risk at a time when farmers need its services the most. Inclusion of the Institute in the "Know Your Farmer, Know Your Food" Initiative would provide crucial support to programs that benefit underprivileged farmers, increase research and education capabilities that maximize farm profits and provide economic models for other farms.

"New York's farmers are a critical part of our economy and we must ensure their success," Senator Gillibrand said. "In this economic crisis, we can't afford to let our family farms be pushed any farther to the brink. If we're going to rebuild this economy, we need to keep families on their farms. The New York Farm Viability Institute helps farms increase profits and provide models for other farms. It is critical that they be included in the 'Know Your Farmer, Know Your Food' Initiative."

"The New York Farm Viability Institute shares Senator Gillibrand's interest in expanding USDA programs and outreach to better connect consumers with farmers through the "Know your Farmer, Know your Food" initiative," said Tom Sleight, Executive Director of the New York Farm Viability Institute. "Expanding interest in fresh, locally produced food is creating new and exciting opportunities and marketing channels for farmers. An essential part of USDA's campaign is empowering farmers to develop new enterprises and products to reconnect with consumers. The New York Farm Viability Institute has been doing this and much more. By instituting creative new production and management strategies, the Institute has become a vital link to helping farmers stay competitive and meet ever-changing consumer needs."

Located in Syracuse, the New York Farm Viability Institute is a farmer-led nonprofit group that works with farms to foster a vibrant agriculture business sector in New York State. They help farmers expand their businesses by providing support through applied research, outreach education, information transfer, adoption of technology, business planning and market analysis.

In her letter to Secretary of Agriculture Tom Vilsack, Senator Gillibrand wrote, "The Institute's work fits perfectly within the 'Know Your Farmer, Know Your Food' Initiative's central mission of creating new economic opportunities by connecting consumers with local producers. Investing millions of dollars over the years, the Institute has started and supported farm-based projects that boost farm sales and profits by increasing consumer demand for New York farm products and by strengthening the farmers' positions in local, national and global agricultural markets. The Institute's priorities are clearly in line with the Initiative's goals, making it a logical program to be funded by 'Know Your Farmer, Know Your Food.'"

Wednesday, January 6, 2010 Bramble Production, Dr. Marvin Pritts from Cornell University will present *Growing Brambles in High Tunnels* and Dr. Fumiomi Takeda of the USDA research station in Kearneysville, WV will present his work on the *Rotating Cross Arm Trellis for Brambles*.

Wednesday, January 20, 2010, Bramble Weed Management, Dr. David Handley of the University of Maine will discuss the *Cultural Weed Control Options for Brambles* and Dr. Rich Bonanno of the University of Massachusetts will instruct growers on *Using Herbicides Effectively in Bramble Plantings*.

Wednesday, February 3, 2010, Bramble Diseases, Dr. Pam Fisher of the Ontario Ministry of Agriculture in Canada will discuss *Controlling Root and Crown Diseases in Brambles* and Dr. Kerik Cox of Cornell University will speak on *Managing Bramble Viruses*.

Wednesday, February 17, 2010, Bramble Insects, Dr. Hannah Burrack of the University of North Carolina will talk about *Controlling Crown and Cane Borers*, TBA

Group viewing sites for these webinars: CCE Oneida County, to register by phone: Jeff Miller, 315-736-3394 ext 120, CCE Chautauqua, by phone Virginia Carlberg, 716-664-9502 ext 202.

Ontario Berry Growers Association – Ontario Fruit and Vegetable Convention Berry Program

Tuesday, February 23, 2010 - Four Points Sheraton Suites, St. Catharines

9:30 am	Using Chateau and Aim Herbicides	Kristen Callow OMAFRA
9:45 am	Weed Management in Plasticulture & Organic Weed Management with Mulches	Ron Nurse Agriculture Canada, Harrow
10: 15 am	Grower Profile	Calvin Dentz Dentz Orchard and Berry Farm Iroquois, ON
11:00 am	Blueberry and Raspberry Viruses	Annemiek Schilder Michigan State University
11:30 am	OBGA Annual Meeting & Lunch 11:30 – 1:30 pm	
1:30 am	Value Added Markets and Opportunities for Berries	John Kelly Erie Innovations and Commercialization
2:00 pm	Modified Poly-Tunnels for Raspberries	Jean-Pierre Privé Agriculture Canada, New Brunswick
2:30 pm	Berry Industry Trends in British Columbia	Mark Sweeney BC Ministry of Agriculture and Lands
3:00 pm	Round Table Discussions: 1. Marketing New & Unusual Berry Crops 2. Promoting Health Benefits of Berries 3. Weed Management 4. Day Neutral Strawberries 5. Raspberries Under Cover 6. Frost Protection	Join 4 of the 6 discussions, 30 minutes per round
7:30 pm	OBGA Social Time	

Ontario Berry Growers Association – Ontario Fruit and Vegetable Convention Berry Program

Wednesday, February 24, 2010 - Brock University, St. Catharines

9:30 am	Dealing with the Media in Difficult Times	Kevin Schooley OBGA
10:00 am	The Evolution of Cane Management in Raspberries	Jean-Pierre Privé Agriculture and Agri-Food Canada New Brunswick
10:30 am	Day Neutral Strawberries In and Out of Tunnels	Becky Hughes University of Guelph
11:00 am	Growing Blueberries on Marginal Soils	Mark Sweeney BC Ministry of Agriculture and Lands, British Columbia
11:30 am	New Products for Berry Growers	Industry Representatives
12:00 -2:00	Lunch & Trade Show	
2:00 pm	Organic Berries: A Conventional Future?	Graham Moore Farm Advisory Services Team Ltd. United Kingdom
2:30 pm	Small Farm, Big Ideas	Sue Hilborn Red Barn Berries, Woodstock
3:00 pm	Management Options for Black Root Rot	Annemiek Schilder Michigan State University
3:30 pm	Cyclamen Mite Management	Pam Fisher OMAFRA

News from the NYS Berry Growers Association

WHAT DO YOU WANT YOUR ASSOCIATION TO DO FOR YOU?

Dale Ila Riggs, Chair, The Berry Patch, Stephentown NY

It's that time of year again - the time to pay dues for the various organizations that you belong to. Each year, before I decide if I will "re-up", I try to closely look at what each organization is doing and how it has benefitted my business. Although the NYSBGA has a small budget, we give a big bang for the buck.

In the last year we have received a grant that will allow us to hire a graphic designer to update our logo and make it one that says LOCAL BERRIES! to anyone that sees it.

We have provided input and ideas that resulted in our New York Farm Viability Institute grant to be funded again, maintaining the excellent statewide berry extension program that was started two years ago.

And we still provide the best advertising for the buck with the NYSBGA website providing listings for any member that submits material. More and more people tell us "I found you on the web", and it is often through the Berry Growers Association website that then allows them to link to our farm website.

We continue to be an integral part of the planning team for the NYS Fruit and Vegetable Expo, and through member pricing surveys, we can learn how other members of the industry are pricing their product.

And we still continue to direct member-donated research dollars to Cornell faculty and other researchers that directly address issues identified by NYS berry growers. These grower-directed dollars help researchers leverage much greater funds from other sources to address NY challenges in the berry industry.

But now the Board of Directors needs something from you. We want to know from our members if we are headed in the right direction.

Is there something we are missing for needs of the berry industry?

Should we emphasize promotion of the NYS berry industry, or should we emphasize research?

Or can we do both effectively? Is there a need that has totally passed us by but that you think is important?

Please let us know what you think. Contact a board member listed below and bend our ears a little.

The Board works hard to come up with projects that benefit the industry, but we do need to hear from more of the industry to know if we are on the right track.

Current Board members include Bob Brown, Bruce Carson, Tony Emmi, John Hand, Craig Michaloski, Terry Mosher, Dale Ila Riggs, Jim Smith, and Alan Tomion.

Contact us:

Dale Ila Riggs
Stonewall Hill Farm
15370 Rt. 22
Stephentown NY 12168
Phone: 518-733-6772

Bob Brown
Brown's Berry Patch
14264 Roosevelt Highway
Waterport, NY 14571
Phone: 585-682-5569

Alan Tomion
Tomion Farms
3024 Ferguson Corners Rd.
Penn Yan NY 14527
Phone: 585-526-5852

Terry Mosher
RD 1-Box 69
Mosher Farms
Bouckville NY 13310
Phone: 315-893-7173

Craig Michaloski
3480 Latta Road
Rochester NY 14612
Phone: 585-455-4788

Tony Emmi
1572 South Ivy Trail
Baldwinsville NY 13027
Phone: 315-638-7679

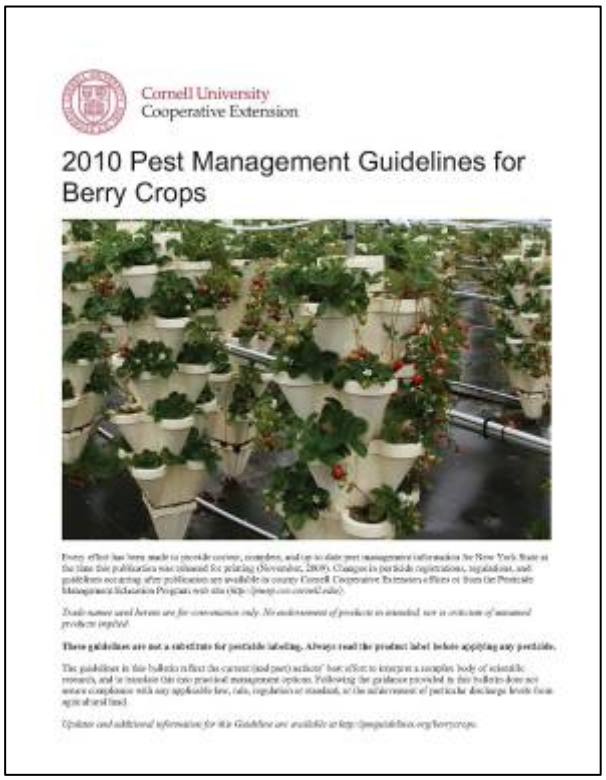
John Hand
533 Wilber Ave.
Greenwich NY 12834
Phone: 518-692-2376

Bruce Carson
2328 Reed Road
Bergen NY 14446
Phone: 585-494-1187

Jim Smith
8183 Rt. 20
Manlius NY 13104
Phone: 315-682-9315

2010 CORNELL PEST MANAGEMENT GUIDELINES FOR BERRY CROPS NOW AVAILABLE

The 2010 edition of the *Pest Management Guidelines for Berry Crops* is now available. This annual publication provides up-to-date pest management information for blueberry, bramble (raspberry and blackberry), strawberry, ribes (currant and gooseberry), cranberry, and elderberry production in New York State. Supplemental information on wildlife management and harvesting, handling, and transporting berry crops is also included. This publication has been designed as a practical guide for berry crop producers, crop consultants, ag chemical dealers, and others who advise berry crop producers.


Cornell University
Cooperative Extension

2010 Pest Management Guidelines for Berry Crops

In addition to the annually revised pesticide and crop production information, several significant updates have been made to the 2010 edition of the *Berry Guidelines* including:

- Revised pesticide regulatory information.
- New nutrient guidelines and disease management options for cranberry and elderberry.
- Revised soil testing procedures.
- Prominently identifying pesticides acceptable for use in organic production systems.

The 2010 *Pest Management Guidelines for Berry Crops* can be obtained through your local Cornell Cooperative Extension office or directly from the Pesticide Management Education Program (PMEP) Educational Resources Distribution Center at Cornell University. To order from PMEP, call (607) 255-7282 or send an email to patorder@cornell.edu. Cost for the *Guide* is $25, shipping included.

POLLINATION ISSUES IN BLUEBERRY PRODUCTION

Sonia Schloemann, UMass Extension Fruit Specialist, Dept. of Plant, Soil & Insect Sciences, UMass, Amherst, MA 01003

Growers can prune, fertilize, irrigate, control pests and otherwise care well for their blueberry plantations, but without proper pollination their efforts would be in vain. Highbush blueberries are capable of setting fruit on 100 percent of the flowers produced by the bushes, although 80 percent set is considered a full crop. Once set, some fruit may succumb to injury from insects, birds, diseases or environmental conditions. But, the high initial set of fruit is key to the profitability of the crop. Understanding the anatomy of blueberry flowers and the behavior of some of the pollinating agents will help the grower make good decisions that promote optimal conditions for pollination. This presentation will cover the information growers will need in order to make good pollination decisions.

The Blueberry Flower - Blueberry flowers are 'perfect' and 'complete'. That is, they have calyx, corolla, stamen and one or more pistils (complete). And they have actively functioning organs of both sexes (perfect). The male parts are the anthers and filaments, which comprise the stamen and the female parts are the stigma, style and ovary, which comprise the pistil. This means that blueberry flowers are theoretically capable of being self-fertile. However, the structure of the flowers is such that the pollen will not make contact with the stigma without active pollination by insects. Thus, pollinating insects are a must for attaining the high level of fruit-set growers expect. This is accomplished by insects visiting blueberry flowers foraging for nectar and pollen. Pollen adheres to their bodies and is carried with them as they move from flower to flower. Then when bees probe for nectar inside another flower, they brush against the stigma and unwittingly leave behind some of the pollen they are carrying.

Pollinators - There are many species of pollinating insects, both wild and domesticated. In the wild the wide variety of pollinators includes bumble

bees (*Bombus* spp.), mason bees (*Osmia* spp.), leafcutting bees (*Megachile* spp.), and feral, or wild, honey bees (*Apis mellifera*). Another species of wild bees can be found foraging in blueberry plantings, but does little to promote pollination is carpenter bees (*Xylocopa* spp.). Commercially, there are two types of pollinator available, domesticated honey bees (*A. mellifera*) and domesticated bumble bees (*Bombus impatiens*). Other pollinators (e.g., mason and leafcutter bees) are also commercially available, but are less common.

Domesticated honey bees have, by far, been the most important pollinators of highbush blueberries for decades. However, with the decline in availability of commercial hives following the epidemic of colony collapse disorder, parasitic mite infestations and disease problems, growers are turning to conservation of wild pollinators and alternative domesticated pollinators.

Pollination Needs - Whether or not a grower will need to import domesticated pollinators into a blueberry planting as well as the number of colonies needed, will depend on several factors:

1) the number of surviving wild pollinators in the area of the planting in a given year
2) the number of other plants that compete for the attention of the pollinating insects during the bloom period
3) flower-set in a given year
4) attractiveness of individual cultivars to the pollinators.
5) the weather conditions during the bloom period

It has long been observed that bees work different cultivars preferentially. That is, they like some cultivars more than others. Some suggest that this is because some cultivars produce more nectar or pollen. Others have observed differences in the size or shape of the corollas in different cultivars making it easier or harder for pollinators to reach the nectaries of the flowers. Yet others have observed the tendency in some cultivars (e.g., 'Stanley' and 'Bluecrop') to have the corollas separate slightly from the ovaries allowing bees to gain access to the nectar from the base of the corolla, bypassing the pollen altogether.

Blueberry flowers are open and receptive to pollen for 5-8 days. However, research shows that if a blueberry flower is not pollinated within 2-3 days after opening, it is unlikely to set fruit. So, another benefit of high numbers of pollinators is that the most attractive flowers are pollinated first and drop off, thus forcing the pollinators to work the less attractive flowers and increasing the overall level of pollination.

Cross Pollination - Blueberry flowers, while 'perfect' and 'complete' as described above, frequently have pollen that is self-sterile. Many cultivars are parthenocarpic, or capable of forming fruit without pollination, However, parthenocarpic fruit is distinctly smaller and ripens later with less flavor. The use of giberellic acid can increase fruit size of parthenocarpic fruit, but is reported by growers to be unreliable. It is, therefore, very important for the formation of fully sized, ripe, flavorful fruit, that cultivars be cross–pollinated with pollen from other cultivars. For this reason blueberries should not be planted in large uniform block of one cultivar, but broken up into smaller sections with a mix of 2 or more cultivars.

How Many Pollinators Are Enough? - How can a grower tell if pollinators (domestic or wild) are doing an adequate job? One method is to assess the "buzz" level in the field. During sunny warm periods of the day during bloom (>60˚F), there should be an audible "buzz" in the field. Another rule of thumb is that 4 - 8 bees should be foraging on each blueberry plant at any one time during the warmest part of the day during bloom. When wild pollinators are not abundant, domesticated honeybees can be introduced.

Once pollinated, the corolla separates from the ovary of the blossom and is easily knocked off the plant. One indication of good pollination is a carpet of white corollas lying beneath the blueberry bush. If in doubt, a grower may gently shake a few branches and observe whether or not the corollas fall to the ground. Brown corollas on the plant or on the ground usually indicate frost damage.

Protecting Your Pollinators - Pollinating insects have a host of natural enemies. Hives are an irresistible attraction for some mammals, especially bear. Electric fencing is often required to protect honey bee hives from predation by mammals that go after both brood and honey. Nesting shelters for solitary bees may need protection from mammals. There are also some parasitic insects and colonies should be closely monitored for infestations. More importantly though, is conserving pollinators, both wild and domestic, by taking great care with the use of pesticides in and around the blueberry planting, especially during bloom. Always protect the water supply from contact with pesticides. If contaminated, replace the water with water from a clean source. Insecticides should never be used during the bloom period unless absolutely necessary to avoid major losses. If needed, insecticide sprays should always be made at night when pollinators are not active and materials should be chosen that have the lowest bee toxicity. Charts with this information are usually found in spray guides and recommendations. Always have hives moved out of the planting before resuming the use of insecticides.

Editor's note: More on this topic is available in a webinar recently presented by the author as part of the NEIPM Berry Webinar series. The archived webinar may be viewed at: http://breeze.cce.cornell.edu/p93697317/.

Volume 1, Issue 1

2008

Bumblebees Increase Revenues in Blueberries

KOPPERT BIOLOGICAL SYSTEMS, INC.

Pollination Bulletin

In the spring of 2006 Koppert Biological Systems, Inc., in conjunction with two growers, examined the effectiveness of Bumblebees (*Bombus impatiens*) versus Honeybees (*Apis mellifera*) in pollinating high-bush blueberries in New Jersey and North Carolina. The objectives set forth in the study were to determine the pollination effects of the bumblebee versus the honeybee, and to calculate a return on investment for the two species of bee.

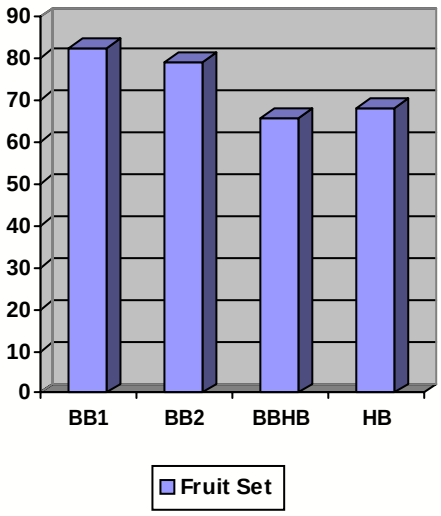
Trial Methods

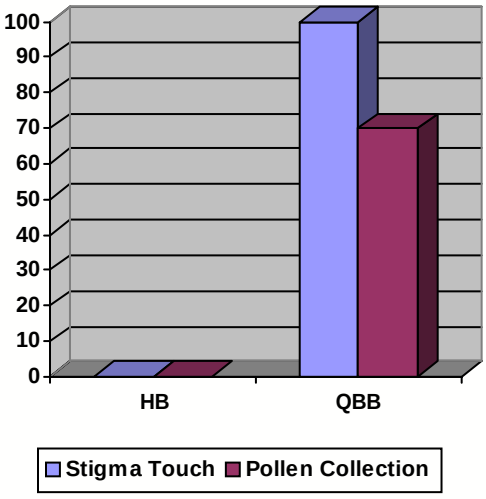
The first site of the trial was set up in North Carolina ,and New Jersey was the location for site number two. In both locations plots of land were chosen and farmed with specific pollinators. Each area was monitored through regular observations for both pollinator density and the effectiveness of each visit to the flower. The results of this experiment were conclusive and remarkable.

Return on Investment

Following the observation period, the return on investment, fruit-set difference, and yield increase were calculated for the various trials on the two sites. The bumblebee laden fields in North Carolina (BB1) had an average fruit-set of 80.86 whereas the fruit-set in the honeybee (HB) fields had an average of 65.89. This amounts to over a 14% difference in the fields. The individual growers also provided yield data from previous years to determine the amount of growth that was evident in the trial. In the high density bumblebee plot in New Jersey (BB2) a 39% increase in yield was recorded whereas the honeybee high density plot in the same state only recorded a 5% annual increase. The return on the growers investment also produced significant numbers. Assuming a grower pays the highest price for a QUAD (containing 4 hives), and implements them at the recommended rate of three hives an acre the cost would be on average $185 per acre. Factoring in an average price for berries, to break even, an acre would at most require 150lbs. of extra yield, as compared to an acre without bumblebees present. Based on the results of this trial there was a return on investment in plot 1 of $7.77 per dollar invested and in plot 2 of over ten dollars per dollar invested.

Up to Ten Dollars Earned For Every Dollar Spent!





Pollinator Efficiency

In North Carolina it was observed that due to the presence of carpenter bees, and the flower injury they create, honey bees would start feeding nectar through the slit in the side of the flower thus not touching the stigma, and preventing pollination. Bumblebee queens (QBB) and workers however, were observed collecting pollen and touching the stigma. This is due to fact that bumblebees extract pollen from flowers through buzz pollination, a fact that is extremely important because high-bush blueberries rely on proper pollination to enhance fruit size, and set. This further reinforces bumblebees as an effective pollination option.

QUAD Bumblebees

Guarantee a Flying Start to Good Pollination

KOPPERT BIOLOGICAL SYSTEMS

Nature's Perfect Pollinator

Bumblebees are less sensitive to low temperatures, low light intensities, unfavorable weather conditions, and use a method known as "buzz pollination" when visiting flowers. Bumblebees are capable of improving fruit-set and fruit-quality. Successful fruit set is essential in agricultural crops. Good pollination and fruit-set depend on a number of factors, including plant structure, nutrition, pollen yield, environmental conditions, and the presence of sufficient numbers of pollinating insects. The effective period for pollination and fruit-set only lasts a short while, and during this time an active efficient pollinator, such as bumblebees, is a must.

QUAD bumblebees from Koppert enable growers to utilize the benefits of this outstanding pollinator.

What is QUAD Pollination?

QUAD pollination units are developed by Koppert Biological Systems specifically for open-field crops. Each QUAD contains 4 large bumblebee colonies enclosed in a weather-resistant outer unit. QUAD units are designed with the appropriate ventilation & insulation required to allow bumblebees to acclimate to environmental conditions, enabling the bumblebees to dedicate their time foraging, providing for superior pollination.

"They get the job done. With our cold springs, Koppert bumblebees are out there flying and visiting flowers when nothing else will."

-Jon Antil owner of Harmon Mountain Farms, a wild blueberry grower from Maine

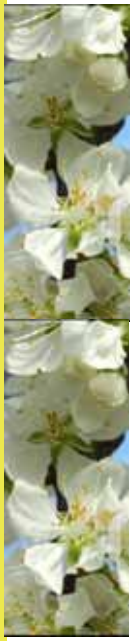



QUAD Bumblebees from Koppert; the Best Choice!

- Koppert bumblebees are available year-round and are shipped to your facility, ready to pollinate. No waiting for migratory beekeepers!
- Availability is guaranteed when orders are placed 14-16 weeks prior to delivery.
- Koppert bumblebees are certified by the Michigan Department of Agriculture to be disease- & pest-free.
- Koppert QUAD units are light weight, easy to handle, and can be moved between crops to maximize your investment.
- Koppert QUAD units are equipped with “bee-home” doors which allows growers to collect the workers in the unit and safely remove the bees from the field when chemical applications are necessary.
- Koppert’s technical staff is readily available to answer any question on general pollination or use of the QUAD units.

Top Reasons for Using Bumblebees:

- Bumblebees are active at temperatures near 40°F (5°C), honeybees become active at temperatures near 60-65°F (15-18°C).
- Bumblebees are active on cloudy, foggy, and rainy days. Honeybees are less active at low light levels.
- Bumblebees will fly in winds of up to 40mph (64km/hr).
- Bumblebees pollinate flowers through a method called “buzz pollination”, a rapid vibrating motion which releases large amounts of pollen onto the bee. In most situations, “buzz pollination” will allow a bumblebee to pollinate a flower in a single visit. A honeybee typically needs to visit a flower between 7-10 times before it is fully pollinated.
- Bumblebees lack the sophisticated communication system of honeybees, and are less likely to leave your crop for more attractive flowers.
- Unlike honeybees, bumblebees are attracted to flowers with narrow corolla tubes, such as blueberries and cranberries.
- Bumblebees are much more efficient pollinators than honeybees. They mainly forage for pollen rather than nectar, and transfer more pollen to the pistils with each visit.
- Bumblebees promote higher rates of cross-pollination, as they forage between plants more randomly than honeybees.
- Bumblebees visit many more blooms per minute than honeybees.
- Bumblebees work earlier in the morning and later into the evening hours.
- Bumblebees work better in tunnels, as they have a better sense of direction.
- Bumblebees are safer for you and your employees. Bumblebees are non-swarming and much less aggressive than honeybees.
- Bumblebees can be used in conjunction with honeybees to enhance pollination.



Koppert Biological Systems, Inc.
28465 Beverly Road
Romulus, MI 48174
(800) 928-8827 Phone
(734) 641-3799 Fax
AskTheExpert@koppertonline.com
www.koppertonline.com

KOPPERT BIOLOGICAL SYSTEMS

Koppert Canada Limited
50 Ironside Crescent Unit #2
Scarborough, ON M1X1G4
(416) 291-0040 Phone
(416) 291-0902 Fax
Info@koppert.ca
www.koppertonline.com

"How many flowers can the bumblebees from one QUAD unit visit each day?"

Pollination Capacity of QUAD Bumblebees

The degree of bumblebee activity depends on the weather conditions, the time of day, and the crop. A handy table listed below shows the pollination potential of a QUAD unit. For example, under average conditions, if 27 bumblebees return to a QUAD every 10 minutes, an estimated 390,000 flowers are visited per day.

Pollination Capacity of 1 QUAD

Number of bumblebees returning per 10 minutes	*Estimated number of flowers visited per day*
9	130,000
18	260,000
27	390,000
36	520,000
45	650,000

In Which Crops Can QUADS be Used?

Almond	Cranberry	Raspberry
Apple	Cucumber	Squash
Blackberry	Melon	Strawberry
Blueberry	Pear	Tomato
Cherry	Pumpkin	Many more...

NEMATODES – A MINI SERIES

Cathy Heidenreich, Berry Extension Support Specialist, Cornell University CALS Dept. of Horticulture, Ithaca, NY 14853

I recently had the opportunity to attend an excellent all day workshop on plant parasitic nematodes, sponsored by Northeast SARE. This program was developed and led by plant pathologist/nematologists from across the NE region including Drs. George Abawi from Cornell, Beth Gugino from The Penn State University, Jim LaMondia from the Connecticut Agricultural Experiment Station, and Deborah Neher from the University of Vermont. The workshop included a3 ring binder for participants with nematode resources, a series of presentations that discussed nematode biology and ecology, symptoms and diagnosis in vegetable, fruit, and perennial crops, strategies for nematode management, techniques for nematode sampling and simple on farm methods for evaluating nematode levels in soil.

One of the key features of the workshop for me was the hands on opportunities. We saw nematodes of various types and life stages under the microscope and observed their damage and symptoms on infected plant materials. Another highlight of the workshop was the opportunity to interact with some of the world's leading nematologists and other participants and discuss nematode issues in the Northeast. Yet another highlight was to have the opportunity to observe a demonstration of how to set up the simple on farm nematode bioassays, and evaluate sample test plants provided. They even gave each participant a do-it-yourself nematode sampling/bioassay kit complete with pail, trowel, sample bags, test plant seeds, pots, and labels!

This workshop was so informative and inspiring that I wanted to share some of the knowledge I gained with berry growers across the state. Thus a nematode mini series is born…

PART I: NEMATOLOGY 101

If you were like me before I attended the workshop, you may have had a vague idea that nematodes are some sort of microscopic soil worms (yuck!) which may or may not be important to small fruit operations (aren't they more of a problem in vegetable crops really?!).

What follows is a brief introduction to the fascinating world of nematodes, gleaned from the workshop, a brief look at how nematodes may impact small fruit production, and with the gracious permission of the organizers, resources reprinted from the workshop I think you will find both interesting and useful as you delve into the wide, wide world of nematology!

What is a nematode, anyway?

The word "nematode" comes from the Greek words '*nematos*', meaning thread, and '*eidos*', meaning form. A nematode's body is long and narrow, resembling a tiny thread in many cases, thus it's name. Nematodes belong to the phylum *Nematoda* or roundworms. This group includes unsegmented worms having cylindrical elongated bodies without appendages. Nematodes have well developed digestive, reproductive, excretory, and sensory systems, but lack circulatory and respiratory systems. Their head structures range from the very simple to the complex, depending on their food source. They are aquatic, living freely in soil or water, or as parasites of plants or animals.

Nematodes are the most numerous multicellular animals on earth and have successfully adapted to nearly every ecological niche. They are found in locations as diverse as the polar regions to the tropics, the highest to the lowest of elevations, and Antarctica to the oceanic trenches. They are capable of tolerating harsh habitats – pHs ranging from 1.6 to 11.0, temperatures between sub-zero and 60C +. They are also capable of living in oxygen-deprived environments, tolerating O_2 ranges between 5% and 100 %. This adaptability allows them to avoid interspecific competition and many environmental selection pressures.

Nematodes play an important role in decomposition of organic matter and recycling of nutrients (soil food web). Predatory (free-living) species of soil nematodes may feed on other nematodes, protozoa, bacteria, fungi etc. Some nematode species are also biological control agents, esp. for insects.

Their relatively simple "tube within a tube" anatomy and physiology makes some nematodes, such as *Caenorhabditus elegans*, useful model systems for biological research studies on aging, neurology, and ectotoxicology. *C. elegans* has had its entire genome sequenced, the developmental fate of every cell determined, and every neuron mapped.

Nematodes may cause diseases of animals and humans including heartworm, Trichinosis, hookworm, pinworm, etc. The largest nematode ever observed is *Placentonema gigantisma*, discovered in the placenta of a sperm whale, measuring 8 meters in length. The smallest is 0.3 mm in length. Nematodes are also important plant pathogens. Plant parasitic nematodes (PPN) are small in size, usually less than 1 mm in length.

Plant parasitic nematodes

PPN, like other nematodes, have well developed chemosensory systems and respond to CO_2 & root exudates in soil as a means of locating and identifying potential feeding hosts. PPN use a stylet (or spear), protruded through their oral opening to penetrate plant cells like a hypodermic needle and remove cell contents. Their movement in soil is limited, usually restricted to a few cm per day. PPN lifecycles range from 3 weeks (Root-Knot Nematode) to 2 yrs + (Dagger Nematode).They may be generalists or specialists with hosts ranging number from 1 into the 100's. Most PPN are root parasites but some species have adapted to parasitize other plant tissues, including leaves, stems, buds, flowers and bulbs. PPN damage is most frequently associated with coarser textured soils – sands. Larger pore spaces in these soils allow for better ease of PPN movement.

PPN are divided into two feeding types, ecto-parasites and endo-parasites. Ecto-parasites feed outside the root, using their stylets to puncture cells on the root surface and draw out cells contents. Ecto-parasites are further divided based on their feeding habits. Migratory ecto-parasites move through soil, feeding from plant to plant (i.e. Dagger Nematode). Sedentary ecto-parasites remain on same plant (i.e. Spiral Nematode).

The second PPN feeding type is endo-parasites. They also are further divided based on feeding habit. Migratory endo-parasites penetrate the root and migrate from cell to cell leaving a trail of damaged tissue behind (i.e. Lesion Nematode). Sedentary endo-parasites penetrate roots and establish permanent feeding sites inside root tissue (i.e. Root-Knot Nematode).

How do PPN affect plants?

All crop plants are susceptible to at least one nematode species. Effects on plants include direct feeding, malformation of host tissues (morphological & physiological), and predisposition of host plants to physical stress. Other negative impacts on plants include providing entry for secondary pathogens (disease complexes), breakdown of resistance to other pathogens, vectoring of plant pathogens (viruses & bacteria) and suppression of beneficial organisms.

General field symptoms of PPN infestation on plants may include reduced growth, yellowing of foliage (nutrient deficiency-like), excessive wilting in hot or dry weather, reduced yields, and poor quality produce. Accompanying root symptoms vary depending on nematode species involved but may include galls, stubby roots, excessive root branching, necrotic lesions, general discoloration, and rots.

PART II: NEMATODES AND SMALL FRUIT: THE REST OF THE STORY…

Next in the mini series is a brief review of PPN and the role they potentially may play in small fruit production. Sections are organized by small fruit crop and include short crop specific descriptions of nematode symptoms, hints on nematode sampling, and notes on management strategies. A more broad-spectrum section on nematode management in small fruit plantings rounds off the article.

STRAWBERRIES

Several species of PPN attack strawberries. The majority of these feed on strawberry roots, weakening plants. Others may feed on strawberry leaves and stems. Another, sometimes more serious injury occurs when nematodes transmit virus diseases to strawberries. Nematode-infested strawberry fields show uneven growth. Stunted and/or weak plants occur next to apparently healthy vigorous plants.

Symptoms of Nematode Damage on Strawberries. Symptoms of nematode injury on strawberries may include malformation of flowers, leaves, stems, and roots. Strawberry plants may be dwarfed; flowers, leaves and roots may be poorly developed. Not all nematode diseases of strawberry have obvious symptoms that allow them to be easily identified. Root knot nematode has conspicuous root galling symptoms on the roots. Root-lesion, dagger, sting and foliar nematodes are more difficult to diagnose, having symptoms very similar to those caused by nutrient deficiencies, moisture stress or other abiotic disorders. In addition, dieback and/or nutrient deficiency symptoms on leaves may occur as a result of nematode damage to roots.

Spring Dwarf Nematode (SDN), *Aphelenchoides fragariae*. Symptoms of SDN include stunting and deformation of leaves, buds, and flowers. Puckering and distortion of newly formed leaves is often evident in spring, hence the disease name spring dwarf. These ecto-parasitic nematodes congregate in the crown, living on leaves and buds, as well as in soil. They are transported from one point to another through rain splash or moisture films from dew or high humidity. Infestations may spread from mother plants to runners unless foliage dries between wetting events. SDN is most often transmitted through infested planting stock; use only certified nematode-free plants for new plantings. Heat therapy is effective in control of SDN in planting materials. Roguing out infested plants as soon as symptoms are observed in the spring may help reduce spread in the field.

Northern Root-Knot Nematode (NRKN), *Meloidogyne hapla*. **N**RKN is the most common soil nematode in the northeast region. Galls caused by this sedentary endo-parasite are relatively small in size. Adventitious roots commonly grow from these galls giving roots a 'hairy' appearance. NRKN disrupts normal formation and function of roots and allow easier entry into the roots for many fungi and bacteria which can cause disease or decay of the roots. Management strategies for NRKN include fumigation, crop rotation (corn and/or small grains), planting of nematode free planting stock, and use of resistant cultivars. Good weed management practices in strawberry plantings is important because many weeds serve as hosts for NRKN.

Root Lesion Nematode, (RLN) *Pratylenchus penetrans*. RLN is probably the most common and most important nematode causing damage to strawberries. This migratory endo-parasitic nematode, considered the most important plant pathogenic nematode in much of the US and Canada, has a wide host range attacking more than 400 other host plants apart from strawberry. Such a wide host range makes RLN difficult to manage with crop rotation. Fields with histories of lesion nematode problems should be kept clean fallow before planting; many weeds also serve as RLN hosts. Utilizing sorghum or sudax as a rotational crop may help to reduce population densities of RLN.

In addition to direct feeding damage, RLN is associated with development of strawberry black root rot complex. See the article that follows by Jim LaMondia for more information on nematodes and their role in this important strawberry disease complex. The best way to manage lesion nematodes is to prevent their introduction into a field. Control with nematicides is not always successful.

Dagger Nematode (DN), *Xiphinema americanum*. DN, as a migratory ecto-parasite, feeds primarily at the root tips of roots, stopping root extension. Galls sometimes are formed at root tips. These injuries often result in stunted plant growth and reduced runner production. DN is more sensitive to soil moisture and soil types in terms of survival; soils high in organic matter do not support large populations of DN. They also do not survive well in extremely wet or extremely dry soils. DN transmits nepoviruses such as Tomato Ringspot Virus (ToRSV) and Tobacco Ringspot Virus (TRV). Symptoms of ToRSV on strawberry include dwarfing along with chlorotic patterns, rings, lines, streaks, or blotches on leaves.

Needle Nematode (NN), *Longidorus elongates*. NN, another ecto-parasitic nematode, causes symptoms similar to *X. americanum* on strawberries. It also may be a vector of nepoviruses. This nematode is important in northern Europe and Canada, causing direct damage and decline of strawberry plantings. Crop rotation with non-host crops is recommended to reduce population densities of NN. One year without a host plant may be sufficient to adequately reduce NN numbers as they are often present in fairly low numbers, and produce few eggs.

BLUEBERRIES

Nematodes, while often found associated with blueberries at relatively high population numbers, rarely if ever cause damage to blueberries by direct feeding. They pose a more serious threat to blueberries as vectors of virus diseases.

Dagger Nematode (DN), *Xiphinema americanum*

As vectors of *Tobacco Ringspot Virus* (TRSV) and *Tomato Ringspot Virus* (ToRSV), DN can be damaging at very low population levels. Virus symptoms on leaves may include yellowing of veins, mosaic, and malformation of the plant. Yields may be reduced when nematode populations reach high levels. TRSV causes necrotic ringspot disease of blueberries. The virus causes a slow, steady decline in productivity. Affected leaves are misshapen and crinkled and have very small necrotic spots (0.1 inches in diameter), which may fall out. Some cultivars may have very short internodes, but no dead spots on leaves. Small twigs are often necrotic.

December through March is the best time to sample for DN in established blueberry fields. If planting new fields, take samples during this period to increase the probability of detecting any DN present.

Root Lesion Nematode (RLN), *Pratylenchus penetrans*

RLN causes a nonspecific decline with poor growth and yellowish foliage in blueberries. Diagnosis generally is possible only by comparing nematode densities in root and soil samples of sick and healthy plants. Always include both soil and

roots in samples sent for nematode analysis. July and August are good times to sample for these nematodes in blueberries and in fields that will be planted to blueberries.

RASPBERRIES AND BLACKBERRIES

Viruses transmitted by DN is the most limiting factor to growing brambles in many areas of the U.S. Nematode direct feeding also causes raspberry and blackberry plants to decline over time. Canes get shorter and weaker; primocane growth becomes sparse. Plants are poorly rooted and can be easily pulled from the soil.

Northern Root-Knot Nematode (NRKN), *Meloidogyne hapla*. **N**RKN poses an occasional problem on blackberries, especially in sandy soils.

Root Lesion Nematode (RLN), *Pratylenchus penetrans*. RLN is the most common nematode pest on raspberries and blackberries. During the growing season, RLN live and feed inside plant roots. When the plants and roots die in the autumn, they move out of the root into the soil. RLN feeding causes death of root tissues which weakens roots and can lead to a general decline. Root symptoms may be difficult to distinguish initially when populations are relatively low or during early stages of infestation. Look for small, elongated discolorations or lesions on new roots. Symptoms become more obvious as populations increase. Look for witches-boom type symptoms (proliferation of fine roots resulting from death of feeder roots). In the final stages of infestation, all feeder roots die, leaving only large diameter roots. Above ground symptoms start with a slight stunting, which may not be distinguishable unless compared side by side with healthy canes. Reduction in cane number, diameter and general lack of plant figure follow. A slow decline results over a 3-4 year period with die out occurring 2-3 years after decline symptoms begin. The rate of decline may increase in the presence of other stresses such as drought, diseases, insect, and infertility.

Dagger Nematode (DN), *Xiphinema spp.*. Three species of dagger nematodes affect brambles. *X. diversicaudatum*, causes gall formation and stops root elongation. *X. bakeri* also causes significant direct feeding damage to raspberries. Symptoms of *X. bakeri* include swelling and 'fishhook curling' of the root tips. *X. americanum* causes little direct feeding damage to raspberries however it serves as the vector of ToRSV in brambles. This virus causes a general stunting of the bush, yellowing of leaves, and production of small, crumbly fruit, reduction in yield, and/or overall plant health in raspberries. Transmission of ToRSV is slow and generally confined to adjacent plants. However, the disease may spread more rapidly if soil containing nematodes is moved within a field. To help reduce spread in infested fields, establish a perennial grass in the alleyways between rows and eliminate all cultivation that might move soil to other areas of the field.

Needle Nematode (NN), *Longidorus elongatus*. NN appears to cause little direct feeding damage to raspberries, but substantial plant damage may be caused by the Raspberry ringspot (RRV) and Tomato black ring spot (TBRV) neopoviruses it vectors.

NEMATODE MANAGEMENT STRATEGIES FOR SMALL FRUIT PLANTINGS

Start with a nematode-free planting site whenever possible. Nematode sampling prior to planting is the first and most important component of nematode management in small fruit production. See the factsheets that follow this article for more in-depth information on nematode sampling and testing. Whenever possible, avoid replanting on sites with a previous history of nematode problems.

Keep nematodes from being introduced into clean plantings. Pest exclusion is the most important strategy to prevent nematode problems. Purchase and plant only certified nematode-free planting materials. Distance new plantings from older plantings with a history of infestation. Avoid movement of soil and equipment between infested and nematode-free plantings.

If nematodes are present. Steps should be taken to reduce populations prior to planting if test results indicate nematodes are present at economically damaging levels. Options may include fumigation, crop rotation, and/or use of cover crops as biofumigants. Following population reduction, nematode-free resistant or tolerant small fruit varieties should be planted whenever possible.

- *Fumigants* - Growing a shallow-rooted grass crop for 1 to 2 years will bring nematodes to upper soil levels where fumigation more easily controls them. Fumigants currently labeled for use in small fruit crops in NY include 1,3 dichloropropene (various Telone products), and sodium methyl dithiocarbamate (Vapam). Some of these products may be growers applied; others require custom application. Soil should be moist and friable before fumigation application, soil temperatures should be between 50 and 90 ^{o}F. All plant material should be decomposed prior to fumigation. Always read the label before making any pesticide applications; follow label instructions carefully.

- *Crop rotation*. One to two year crop rotations with non-host crops may be used as a management tactic to reduce nematode population buildup.

- *Cover crops as biofumigants.* This tactic involves timely incorporation of a green manure cover crop with the ability to release toxic products that are lethal to the nematodes upon decomposition. Crucifer crops, such as mustards, rapeseed, oilseed, radish, etc. have been used with some success as nematode biofumigants. Other nematode biofumigant cover crops include sudangrass and sorghum-sudangrass hybrids, forage pearl millet, marigolds, and flax. Planting and incorporation of these cover crops appears to suppress nematodes nearly as well as chemical fumigation.

Reduce nematode spread within plantings. Monitor, monitor, monitor! Watch for signs and symptoms of nematode infestation. Rogue out infested plants as soon as they are detected. Spot treat areas to reduce nematode population spread where possible.

Keep plants healthy. – Healthy plants have resources needed to potentially offset nematode damage; stressed plants become more susceptible to nematode damage. Minimize crop stress by maintaining adequate soil moisture and nutrition. In respect to fertility 'adequate' does not necessarily mean 'maximum'. Succulent plant tissue tends to act as a nematode magnet.

Concluding Remarks

Watch for part 2 of this nematode mini-series in the January issue which is a very well-written and informative article on strawberry black root rot, by Jim LaMondia. Part 3 will be featured in the February issue and is comprised of 3 resources provided through the workshop that include a factsheet on soil sampling for PPN assessment by George Abawi and Beth Gugino, and informational brochures on setting up and evaluating results of simple on farm bioassays for Root-Knot and Lesion Nematodes, also by George Abawi.

I hope you find this miniseries as interesting and helpful as I did. Happy Nematode Hunting!

Other Selected Nematode Resources:

1. Neher, D.A., Powers, T.O. 2004. Nematodes. In: Hillel, D., Rosenwig, C., Powelson, D., Scow, K., and Sparks, D. (editors) Encyclopedia of Soils in the Environment, Vol. 3, pp 1-5, Academic Press, NY.
2. Abawi, G.S., and Gugino, B.K. 2007. The Root-Lesion Nematode on Major Vegetable Crops Grown in NY.
3. Widmer, T.L., Ludwig, J.L, and Abawi, G.S. 1999. The Northern Root-Knot Nematode on Carrot, Lettuce, and Onion in New York. New York's Food and Life Sciences Bulletin Number 156. Cornell University, Geneva, NY.

Selected Nematode Web Resources:

1. Cornell University: http://plantclinic.cornell.edu/FActSheets/nematodes/nematodes.htm.
2. University of California Davis, Dept of Nematology: http://nematology.ucdavis.edu.
3. University of Florida: http://www.entnemdept.ufl.edu/publicat.html.
4. University of Nebraska, Lincoln: http://nematode.unl.edu/.

Questions or Comments about the New York Berry News?

Ms. Cathy Heidenreich
NYSAES Cornell, 630 W. North Street, Geneva, NY 14456
Phone: 315-787-2367 *Email*: mcm4@cornell.edu

Check out the NYSAES Tree Fruit and Berry Pathology web site at: **www.nysaes.cornell.edu/pp/extension/tfabp**

NEW YORK BERRY NEWS READER SURVEY

As New York Berry News enters it's ninth consecutive year, we are wondering how we might better serve you better. Please take a few moments to fill out the survey that follows and return it to us via e-mail, fax, or US mail.

1. Please tell us your affiliation with the berry industry: (check all that apply)
__owner/grower
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__farm staff member
__private consultant
__extension staff member
__faculty member
__processor
__grower organization
__media
__granting agency
__Other (please specify)_____

2. In what format do you receive/read NYBN? (check all that apply)
__Online version (pdf)
__E-mail text only version
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3. How often do you read NYBN?
__0-1 times/year
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__4-6 times a year
__Every month
__Other (please specify)_____

4. How much of each issue do you read?
__None
__Skim and read items of interest
__Cover to cover
__Other (please specify):_____

5. What benefits, if any, do you find from reading NYBN? (check all that apply)
__Provides current pest information and management strategies
__In-depth information on berry topics of interest
__Information on berry educational events
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__Other (please specify)_____

6. What barriers, if any, prevent you from reading NYBN? (check all that apply)
__Lack of time
__Issues too long
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__Other (please specify)_____

7. Which types of newsletter format do you prefer? (check one in each row)

__ full page format __ two column format __ three column format __ other (specify):_____

__text only __text with black and white photos __text with color photos __ other (specify):_____

(more)

8. How useful are the following NYBN items to you?

	Not at all useful		Somewhat useful		Very Useful
	1	2	3	4	5
Events calendar	O	O	O	O	O
News briefs	O	O	O	O	O
Feature articles	O	O	O	O	O
Pesticide updates	O	O	O	O	O
Research reports	O	O	O	O	O
Berry Barometer	O	O	O	O	O
Smart Marketing articles	O	O	O	O	O
Weather reports	O	O	O	O	O
Other: (please specify)	O	O	O	O	O
Other: (please specify)	O	O	O	O	O

9. How well are the following topics covered in NYBN?

	Too much coverage		Just the right amount		Too little coverage
	1	2	3	4	5
Production systems	O	O	O	O	O
Real time pest issues/management	O	O	O	O	O
Disease management	O	O	O	O	O
Insect and mite management	O	O	O	O	O
Weed management	O	O	O	O	O
Wildlife management	O	O	O	O	O
Post harvest issues	O	O	O	O	O
Food Safety/GAPS	O	O	O	O	O
Marketing	O	O	O	O	O
Varieties	O	O	O	O	O
Economics of berry crop production	O	O	O	O	O
Other: (please specify)	O	O	O	O	O
Other: (please specify)	O	O	O	O	O

10. Other Comments/Suggestions:

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Our sincere thanks for taking the time to fill out and return this survey.

Survey returns by 12/30/09 please:

- E-mail: mcm4@cornell.edu
- Fax: 315-787-2389 (attn. C. Heidenreich)
- US mail: M.C. Heidenreich, NYSAES Cornell University, 630 West North Street, Geneva, NY 14456