Wisconsin Cranberry School proceedings. Volume 1 1990

Madison, Wisconsin: Wisconsin State Cranberry Growers Association, 1990

ENTOMOGENOUS NEMATODES FOR GRUB CONTROL IN CRANBERRIES

Kirk A. Smith

BIOSYS
1057 East Meadow Circle, Palo Alto, CA

Interest in entomogenous nematodes (insect parasitic nematodes) for controlling many different insect pests has increased dramatically in recent years. Much of this is attributed to the progress in mass production and formulation methodologies for these nematodes as well as concerns for environmental contamination caused by the use of conventional insecticides.

For the past several years two species of white grub beetles (beetles belonging to the insect family Scarabaeidae) have become an increasing problem in cranberry fields located throughout the states of Massachusetts and Wisconsin. The cranberry root grub (*Lichnanthe vulpina*) is found in Massachusetts and the cranberry white grub (*Phyllophaga anxia*) is found in both states. Effective control strategies are not available for growers at this time.

Biosys (a company devoted to the development and production of entomogenous nematodes) has spent a considerable amount of time and effort investigating the potential use of entomogenous nematodes for controlling white grubs in turf. A complex of beetles (over ten different grub species) has caused annual losses in the turf industry totaling millions of dollars. Data from over four years of research has indicated that certain species of entomogenous nematodes when applied under appropriate conditions have consistently demonstrated reductions of white grub populations comparable to those achieved from the application of conventional insecticides.

For the 1990 growing season Biosys in cooperation with Ocean Spray, the University of Wisconsin-Madison and the University of Massachusetts will be conducting numerous cranberry field trials designed to test the effectiveness of entomogenous nematodes against white grubs. These studies will investigate the following parameters; 1) proper timing of application, 2) method of application, 3) optimal nematode dosage, and 4) best nematode species or strains.

If the data from these trials indicates that entomogenous nematodes could provide an effective means for controlling white grubs in cranberry fields, Biosys will still require positive data from at least one more year of study before recommending commercial sales to cranberry growers.

HOW WILL THE REVISIONS TO Ch Ag 29 AFFECT CRANBERRY GROWERS?

Dave Fredrickson
Fertilizer and Pesticide Specialist
Wisconsin Department of Agriculture, Trade and Consumer Protection
Agricultural Resource Management Division

The first major revision to Wisconsin's rules on pesticide use and control will take effect on May 1, 1990. These changes were the subject of over two years of work. The revision process was highlighted by cooperation from and between many groups that previously had been at odds over pesticide issues. The result of this new sense of cooperation is a rule that addresses real world problems, with real world solutions and common sense.

So, how will these rules affect cranberry growers in their day to day operations? Probably the largest change will be in the area of chemigation. The rule includes a new section that describes what a grower needs to do to be able to use chemigation, which for this rule means the application of pesticides through irrigation systems. The rule provisions do not apply to the application of fertilizers, though it would be wise to use the same system designs to avoid contaminating water supplies with fertilizers too. The chemigation standards in the rule offer alternatives for backflow protection, and the other system safeguards that must be in place.

In general, if you choose to use chemigation and your source of water is a well you will need to protect the well with a reduced pressure principle type backflow preventor. This has actually been required by the state well code for a number of years. Systems that rely on surface water as their source of irrigation water will not need a reduced pressure principle type backflow preventor, a lower level of protection can be provided. This lower level of protection is based on installing two check valve assemblies in series or one loop with a gooseneck loop. The loop serves as equivalent to one of the check valves. Before using any chemigation system, this year or in the future, including existing systems, you will need to register the system with the Department of Agriculture, Trade and Consumer Protection. To register the system you need to include the following information:

1) the name and address of the operator/owner of the system;
2) the location of the field being chemigated;
3) the type of water supply for the system;
4) the type of backflow protection used, including the manufacturers name, model number, serial number, size and location of the backflow preventor. If you are using a portable unit indicate that it is portable.

You will not have to renotify the department on an annual basis. Once a field is registered it will be presumed that chemigation will be used in the future. Also there is not a fee for registration. You do not need to register with other state agencies either, we will share the information that they want. The only time another department would be involved is if a system used water from a potable water system, such as a municipal supply, a situation that is unlikely to occur in agricultural operations. Other protective devices are needed to shut down the system in the event that a component of the system fails. These devices must: close the supply line if the injection unit fails; shut off the injection unit if the injection line or supply line fails; and shuts the entire system down if the flow pressure is so low that application rates are effected. The system designer can

select the specific devices that will be used, the code does not list or require specific devices.

The code also contains a requirement for chemigation system operators to prepare operation/observation plans. The plans must be at the site when chemigation is taking place, and must be available at the grower's office or residence at all other times. The plan must include an accounting of sensitive areas that need special attention when operating the system. Sensitive areas include public right of ways or roads within 100 feet of the target area, and residences, camps, schools, parks, public areas, etc. within 300 feet of the target area. The plan must describe what actions will be taken to prevent drift or overspray onto sensitive areas. The plan must list the flush time for the system, describe how to calibrate the system and check the calibration of the system when it is operating, how the operator will monitor wind speed and direction and what clothing or safety equipment must be worn by the operator when visiting the site. The site must be visited at least once every hour it is operating and the operator must be present when the system is in a sensitive area identified in the plan, or at other times identified in the plan.

Chemigation sites must be posted during chemigation. The site can be permanently posted if the grower desires. The signs for chemigation posting must be white with clearly legible, contrasting letters and symbols. The signs must have letters at least 2.5" in height and say: **KEEP OUT** at the top and immediately below show a stop sign symbol at least 8" across with the word STOP in the sign. Below the stop sign the words; **PESTICIDES BEING APPLIED IN IRRIGATION WATER**, must be shown. The signs must be up during chemigation and remain up until treated areas are dry. Areas need to be posted if they are within 100' of a road or public right of way or within 300' of a sensitive area. Signs must be placed at ordinary points of access, with at least one sign for every 1/4 mile of border.

Provisions for general posting have been clarified, and to the extent possible we have tried to create provisions that will also comply with new federal requirements for worker protection. A field must be posted if the pesticide applied has a specified re-entry TIME interval. The signs must white with red letters. The letters must be 2.5" in height. The signs must state, **DANGER - AREA TREATED WITH PESTICIDES - DO NOT ENTER**, or contain similar words or symbols. As with the chemigation signs the general signs may be permanently posted. If a compound is applied using chemigation that has a re-entry interval, then two signs would be needed. One sign for chemigation and the other for the re-entry interval. The areas that need posting are fields within 100' of a road or public right of way or within 300' of a sensitive area. The signs must stay up until the re-entry interval is over. Make sure that you check the product label carefully since any more stringent provision of the label must also be followed. For instance if the label says the exact time for re-entry must be on the sign, then you will have to add that information.

Mixing and loading of pesticides has become a very important area of pesticide use. Studies in Wisconsin and other states have found significant environmental and health problems surrounding these activities. The revised rules require that commercial application operations to employ only certified and licensed persons to mix and load pesticides. For private applicators, only certified persons will be allowed to mix or load restricted use compounds. It is possible to be certified only as commercial mixer/loader of pesticides but we recommend that persons seriously consider obtaining certification in an appropriate applicator category.

The new rules also will require installation of improved mixing loading sites (spill containment pads) at some locations. Effective on May 1, 1990 anyone

who mixes of loads pesticides (including impregnated fertilizers) within 100' of a well or surface water must do that mixing or loading over an improved site. If you are farther away than 100' then you may need an improved site depending on how much pesticide active ingredient you mix or load in a year. The rule defines a pesticide mixing/loading site as any single site or sites within 1/2 mile of each other that are owned or controlled by the person using the pesticides, at which more than 1500 pounds of active ingredients are mixed or loaded. Not included in this 1500 pound total are any products mixed or loaded in the field of application. If you are a farm operation mixing or loading for on farm use, and you exceed the 1500 pound threshold, then you will need to have an improved site by 1/1/93. The delayed date is to allow time for the development of portable mixing/loading pads, some of which are appearing on the market now. Other sites over the 1500 pound level will need improved sites by 1/1/91.

So, what is an improved site? If liquid pesticides are mixed or loaded then the site must be a paved, curbed site of concrete or asphalt, or be a synthetic material approved in writing by the department. The area that is paved or lined must be large enough to contain at least 125% of the volume of the largest tank that will be mixed or loaded into and must be at least 1500 gallons if any equipment over 1000 gallons are used. The area can drain into a below grade sump, but the sump must contain automatic pumping equipment to pump any spills to an above ground container. It is not legal to store any spills or rinsate from pesticide mixing loading pads below grade. If non-liquid pesticides are used, including impregnated fertilizers, then the improved site can be a tarp or non curbed paved areas. The tarp must be made of compatible material for the compounds being mixed or loaded. Please remember that effective immediately with the May 1, 1990 effective date that any mixing or loading within 100' of a well or surface water must be performed over an improved site.

The revised rule also contains a cross reference to the backflow prevention requirements of the state plumbing code. It is a violation of the pesticide law to use an unprotected water source to mix or load pesticides. Backflow protection is extremely important to protecting you and your families water supply. Probably the easiest way to comply is to always fill containers only by using an effective air gap. An effective air gap is one where the outlet used to fill a container is above the flood level rim of the container a distance equal to at least twice the inside diameter of the outlet. For filling a tank with a 1" hose this means keeping the hose end out of the tank, and at least 2" above the top of the tank.

The rule clearly sets out that any spill must immediately be contained and cleaned up. Taking prompt action to clean up spills is required everywhere, not just at improved sites. The rule also contains a clarification concerning pesticide overspray or significant drift. The final rule contains a note which describes what significant drift is. Drift is significant if the drift is readily visible, or results in harm to non target plants, animals or persons, or could conceivable cause harm to non target plants, animals or persons. The hearing record clearly indicated that overspray, anywhere should be a top priority of the department for enforcement action, and should not be tolerated in any circumstance.

As we noted at the start of this article this is a major revision to the rules we all must follow when using pesticides. We realize that a number of questions will arise with the implementation of these rules. We are very appreciative of the help and advice that has been provided by members of the Cranberry Growers Association. Finally, if you have questions on the revisions to Ch Ag 29 or other issues, please contact us at (608) 266-2295, or contact your local field inspector. We'll try to help.

CRANBERRY FRUIT SET: PROBLEMS AND POTENTIALS

Elden J. Stang
Department of Horticulture
University of Wisconsin-Madison

Fruit set is a term used to describe the persistence and development of an ovary or associated tissues following blossoming. It is calculated as a percent of the number of flowers successfully developing into fruit. Failure of fruit to set and develop is a common occurrence in fruit crops. The cranberry is no exception. Normal cranberry fruit set in Wisconsin ranges between 25% to 40%, occasionally up to 50% on newer cultivars in test plots. Over the past 5 decades, similar low levels of fruit set in other cranberry producing areas have stimulated studies on pollination and bee behavior, plant nutrient relationships, plant growth regulators, bee attractants, flower anatomy, contributions of various components of flower initiation and flowering behavior to yield in an attempt to understand and increase fruit set, with the prospect for enhancing yield.

Since 1982, our research program has examined a host of factors as possibilities to alter or increase fruit set in cranberry. In early field trials I tested a series of plant nutrients including zinc, foliar phosphorus, slow release nitrogen, boron and calcium-boron combinations as potential limiting factors to fruit set. No significant effect on altering flowering or fruit set was observed or measured. Concurrently, a series of tests with new plant growth regulators demonstrated the potential to increase fruit set. Fruit however were seedless (parthenocarpic) and typically did not develop to normal size. Undesirable side effects, usually excessive upright growth, further limited the potential for positive results. Despite this, our plant growth regulator research continues in the attempt to influence fruit set. A mechanical pruning trial in conjunction with plant growth regulator suppression of regrowth resulted in increased flowering in 'Searles' with little or no subsequent effect on increased fruit set or yield.

The failure of these and other field tests to increase fruit set stressed the great need for more basic studies on factors controlling flowering and fruit set in cranberry. To that end and with financial support from the Wisconsin Cranberry Board, Inc. in 1987 we initiated a project to evaluate factors affecting fruit set in cranberry. Objectives were to evaluate pollination, pollen tube growth, competition within the plant for carbohydrates and effects of night temperature on cranberry fruit set.

In a detailed examination of pollination, supplementing natural insect pollination with hand pollination increased fruit set in 'Searles' from 30% to 38% in two successive years. Inadequate pollination thus partially limits fruit set in the field. The earliest opening flowers had a greater probability of fruit development compared to flowers opening later. With one or both of the two earliest flowers developing into fruit, 18% of the flowers opening later matured into fruit. Removal of the earliest two flowers at early blossom allowed 45% to 58% fruit set for the remaining flowers, strong evidence that within plant competition for resources, possibly carbohydrates, may determine fruit set.

Examination under fluorescence microscopy verified that cranberry fruit which fail to set contain pollen tubes which may grow only partially into the style. Pollen tubes in this case are thicker, contain numerous callose plugs and fail to complete growth to the ovary and ovules (seed).

Analysis of cranberry upright tissue at various stages of flower development showed dramatic changes in carbohydrate content through the season. Sucrose,

glucose, fructose, raffinose and stachyose were predominant carbohydrates in cranberry vegetative tissue.

Except during dormancy, cranberry uprights had the highest concentration of carbohydrates at early blossom, when the lower flowers were at full bloom. As early flowers developed into fruit and later opening flowers were at or just beyond full bloom, uprights had lower carbohydrate concentrations. Starch was primarily stored and later depleted in the previous season's growth and trailing, woody stems. Fruit developed from 53% of the flowers under greenhouse conditions, compared to 38% in the field. Tissue from the greenhouse was generally higher in carbohydrates than was field grown tissue and may explain increased fruit set under controlled environments. Insufficient carbohydrate levels at the time of late blossoming, after first fruits have set, may be responsible for the low fruit set observed in the field.

In controlled temperature tests where warm night temperatures (60 °F) were compared to cool nights (45 °F), increased fruit set in controlled conditions could not be attributed to night temperature differences.

Inadequate pollination and failure of pollen tube growth only partially accounts for reduced fruit set in cranberry in the field. Competition with-in the plant during blossoming for available carbohydrates appears to be an important factor in controlling fruit set and development.

Whether carbohydrate levels influence fruit set directly through controlling seed set, alternatively through effects on pollen tube growth or both is unknown. Possible influences of natural hormones or plant nutrient deficiencies in stylar tissue on pollen tube growth cannot be discounted. These factors remain to be investigated.

Carbohydrate levels in the plant in the prebloom and early bloom stages appear to be critical to fruit set. Possibilities for altering carbohydrate levels under conventional cranberry management practices may be limited.

An unrelated test in 1989 on the use of spunbonded fabric covers to alter the early season plant environment in cranberry suggests a prospective method for altering early season plant development. Under fabric covers earlier leaf greening, if it results in earlier photosynthetic activity and higher carbohydrate levels, may influence fruit set. Initial observations of a trend to increased fruit set with fabric covers offers exciting potential to positively alter fruit set in the field. More detailed field tests in 1990 are planned to verify this intriguing possibility.

The potential for enhancing fruit set in cranberry exists. Crucial to these attempts is a better understanding of the ultimate cause(s) for flower abortion and failure to develop. This remains our objective in further research on fruit set in cranberry.

RESEARCH REPORT: SEASONAL OCCURRENCE OF SPORES OF THE COTTONBALL FUNGUS, MONILINIA OXYCOCCI.

P. G. Sanderson and S. N. Jeffers
Department of Plant Pathology
University Wisconsin-Madison

Abstract

A Burkard 7-day recording volumetric spore trap was used to collect ascospores and conidia of Monilinia oxycocci from a commercial cranberry bog in Wood Co., WI in 1987 and 1988, and 1986-1988, respectively. Ascospores were detected over a period of approximately 4 weeks starting 5 May in both years. Conidia were collected for 34, 30, and 26 days beginning 7 June, 6 June, and 17 June in 1986, 1987, and 1988, respectively. Both ascospores and conidia were collected continuously during these periods and showed a diurnal periodicity. No overlap of spore types was observed in any year. Ascospores were collected beginning approximately 1 week prior to bud break until about 1 week prior to the onset of bloom. Each year conidia first were collected at different times in relation to cranberry bloom; about 10 days before bloom in 1986, at the start of bloom in 1987, and at 50% bloom in 1988.

Introduction

Cranberry cottonball, caused by *Monilinia oxycocci*, is the most important field disease of cranberry in Wisconsin. We have been studying the disease for the last several years to determine the specific periods when infection occurs in the field. First, an overview of the disease cycle will be presented, and then results from research to determine the environmental parameters that are associated with the presence of airborne inoculum in a naturally infested commercial cranberry bog will be discussed.

Cottonball Disease Cycle

In the spring, apothecia develop from overwintered sclerotia. Ascospores (spores produced by sexual processes in the apothecia) infect developing shoots. Conidia (asexual spores) then form on stems, pedicels and petioles of blighted shoots. The conidia are reported to only infect blossoms, through which the fungus enters the developing fruit. Infected fruit develop apparently normally, without any external symptoms, until late summer or early fall whent he fungus ramifies through the fruit walls and forms a sclerotium beneath the intact epidermis. These stromatized fruit then mummify. The mummies overwinter in the soil and duff or litter layer at the base of the vines and in the spring the cycle repeats.

Results

Airborne spores were collected using a Burkard 7-day recording volumetric spore trap. A Campbell Scientific 21X Datalogger was used to monitor the following environmental parameters:

duration and amount of rainfall or irrigation,
relative humidity in the canopy,
wind speed,
periods of leaf wetness,
ambient air temperature,
air temperature in the canopy,
duff temperature, and
soil temperature at a depth of 4 cm.

Spore trap tapes were mounted on microscope slides and stained. Ascospores and conidia were counted at deposition intervals of 1 hr. In 1987, ascospores were detected in low numbers beginning day 125 (5 May) and were last detected on day 155 (4 June). The peak period of ascospore collection lasted for 16 days. During this period, buds began to break around day 133 (13 May) and by day 140 (20 May) most buds had broken. Conidia were collected beginning day 157 (6 June) and were last collected on day 186 (5 July). The conidium peak lasted 15 days. The onset of bloom coincided with the onset of conidium collection at about day 157. Full bloom was around day 175 (24 June). There was a two day lag between the last day that ascospores were detected and when conidia were first detected. In each case, once the major spore peak began, spores were collected in a single continuous shower.

The same patterns of spore collection were seen in 1988 except that the spore peaks occurred 10 days later. The peak period of ascospore collection lasted only 11 days as opposed to 16 days in 1987. There was a considerably longer lag time between the last day that ascospores were detected and the first day that conidia were detected in 1988 than in 1987; 15 days vs 2 days, respectively. Bud break and blossoming occurred during approximately the same time periods as in 1987. Bud break occurred during the week beginning day 133 (13 May), and blossoming began about day 154 (3 June) with full bloom at about day 176 (25 June). While in 1987 the spore showers coincided closely with bud break and blossoming, in 1988 they occurred quite a bit later. Bud break was just prior to the ascospore shower and the conidium shower did not occur until 50% bloom.

When the spore peaks from both years are aligned, it is striking that the amount of time from the beginning of the ascospore peaks to the beginning of the conidium peaks is the same for both years, 32 days. It follows that shoots that are infected at the beginning of the ascospore shower will be shedding conidia 32 days later. Regardless of the fact that the ascospore peaks vary in duration in each year, 16 days in 1987 and only 11 days in 1988, in both years the amount of time from the beginning of the ascospore peak to the beginning of the conidium peak was the same. This suggests that the onset of conidium production is a function of the latent period rather than external environmental factors or host development.

Daily spore count totals were compared with daily rainfall and irrigation totals, and with maximum, mean, and minimum soil and duff temperatures. Dips in the ascospore peaks appear to correspond to rain/irrigation events. Based on temperature data, these are probably irrigation events for frost protection. Dips in the peaks of conidia also correspond to wetness events and may be due to the scrubbing effect of rain on the airsporae.

In 1988, most sclerotia bearing apothecia were found in the duff. In 1987, however, a large number of the sclerotia bearing apothecia were buried in the soil up to several centimeters. Of particular interest were the relatively steady duff and soil temperatures that were found up to the beginning of the ascospore peak. In both years, a marked rise in temperature occurred at about the same time as the ascospore peak began. This pattern suggests that it may be possible to develop a temperature model to predict the onset of the ascospore shower.

A clear diurnal periodicity was observed in the numbers of ascospores caught per hour. Almost all spores in both years were collected between 10 AM to 9 PM. In 1987, most spores were collected from 4-5 PM, and in 1988, one hour later; from 5-6 PM. The number of conidia caught per hour in 1986, 1987, and 1988, also shows a diurnal periodicity, although not as pronounced as for ascospores. Peak conidium abundance was around midday. This maybe due to the drying of the morning dew off the canopy so that the wind was able to pick up and disperse the spores. However, statistical correlations of hourly spore counts with environmental data have not yet been attempted.

Conclusions

1. It appears that the latent period is the major factor in determining the onset of the conidium shower following ascospore infection.

2. In 1987, spore catches coincided closely with bud break and blossoming. Whereas in 1988, spore catches occurred at the end of bud break and relatively late in bloom.

3. Based on soil and duff temperature data, the development of a temperature model for predicting ascospore showers looks promising.

4. Ascospores and conidia, particularly ascospores, show definite diurnal patterns of spore release. It will be interesting to determine if environmental parameters are correlated with these data.

RESEARCH REPORT: EFFECTS OF ROUTINE FUNGICIDE APPLICATIONS ON CRANBERRY VINE PRODUCTIVITY AND BERRY ROTS IN STORAGE, 1986-1988

Steven N. Jeffers
Department of Plant Pathology
University of Wisconsin-Madison

INTRODUCTION

The only fungicides labelled for use on cranberry in Wisconsin are for storage rot or cottonball disease management. Storage rots of economic importance in Wisconsin are end rot and black rot primarily, but other storage rot diseases also may occur. Current recommendations for storage rot management call for three fungicide applications beginning during bloom and at 14-day intervals. Research over the years has demonstrated that numerous fungi invade cranberry stems, leaves, and fruit in addition to rotting berries in storage. Some of these fungi are known to cause minor disease problems that rarely are of economic importance in Wisconsin (e.g., upright dieback, red leaf spot, Cladosporium leaf spot, Gibbera leaf spot and berry speckle, etc.). Other fungi that are associated with cranberry but not known to cause a specific disease may be causing infections that go undetected and have a sublethal, deleterious effect on yield or productivity. Consequently, research was designed to determine: 1) if fungicides applied for storage rot management over several years have a beneficial effect on cranberry vine productivity; 2) if these fungicides effectively control storage rots; and 3) if so, do they differ in efficacy.

EXPERIMENTAL PROCEDURES

Research was conducted in two Wood County locations over a three-year period, during the growing seasons of 1986, 1987, and 1988. Climatic conditions were quite different among years. At each location, plots were permanently marked in a mature (30+ years-old) cranberry bed (cv. Searles) with wooden stakes so that the same identical plots could be treated each year. These beds had not received any fungicide applications for at least eight years previously. Four treatments were compared, the three fungicides most frequently used for storage rot management in Wisconsin -- Difolatan 80DG at 4.0 lb/acre, Bravo 720 at 4.2 pt/acre, and Dithane M-45 80WP at 4.0 lb/acre -- and an untreated control. Amounts at the lower end of the range of the labelled rates were used for each product. All treatments at both locations were applied on a 14-day schedule with each application being made on the same day in a given year. Applications were begun at different times relative to bloom in different years. Applications were made on 2 July (late bloom), 16 July, and 30 July in 1986; on 17 June (70% bloom), 1 July, and 15 July in 1987; and on 17 June (10% bloom), 29 June, and 13 July in 1988. Other than fungicide applications, plots were subjected to routine cultural practices.

All samples were collected within seven days of harvest each year. For determining yield and vine productivity, all of the upright shoots and berries from two small areas in the center of each plot were removed and combined together. From each of these samples, the numbers of vegetative uprights, flowering uprights, flowers, marketable berries, and defective berries were counted and the weight of all uprights and marketable berries were measured. From these data, the

following parameters were calculated: the total number of uprights, weight of an individual upright, total number of berries, weight of an individual berry, estimated yield, % marketable berries, % uprights flowering, number of flowers per flowering upright, % fruit set, and number of marketable berries per flowering upright. The five basic components of yield are: no. uprights, % uprights flowering, no. flowers/flowering upright, % fruit set, and weight/berry.

To determine treatment effects on storage rots, a two-liter sample was hand-raked from each plot and soaked in a beaten bed for 1-4 hours. Berries were then air-dried, sorted for defects, and stored at 38 F. After three months, berries in each sample were divided into three categories: soft and rotten, black rotted, and marketable. All yield component and storage rot data were analyzed statistically by analysis of variance.

RESULTS

Cranberry Vine Productivity and Yield

At Location 1, estimated yield was decreased by Difolatan in 1986 and by all three fungicides in 1987 and 1988. In all three years, various yield parameters were affected significantly (e.g., no. berries, % uprights flowering, no. flowers/flowering upright, and % fruit set), which accounted for the decreased yields. Fruit size was not affected by any treatment in any year. At Location 2, none of the fungicide treatments significantly affected yield compared to the untreated control treatment. However, in 1987, Bravo reduced yield compared to Difolatan and reduced % fruit set compared to all other treatments. No significant differences among treatments occurred for any of the other yield parameters measured in all three years at this location. At both locations, no beneficial effects were evident after three years in the plots treated with fungicides compared to those left untreated.

Storage Rots

The effects of treatments on storage rots were similar at both locations. Treatments generally did not affect the proportion of berries with black rot in a given year. Although, when Bravo applications were initiated early in 1988 (at 10% bloom), black rot incidence was increased at both locations. The percentage of berries with black rot remained fairly constant at each location among years (3-5% at Location 1 and 1-3 % at Location 2). Difolatan consistently increased the percentage of marketable berries in all years at both locations. Bravo increased the percentage of marketable berries at both locations in 1986, increased or had no effect on this percentage in 1987, and reduced or had no effect on the percentage of marketable berries in 1988 at Locations 1 and 2, respectively. Based on these data, the time of beginning Bravo applications appears to have affected the efficacy of this product. Dithane M-45 had no significant effect on the percentage of marketable berries in any year or at either location, except at Location 2 in 1987 when it decreased the percentage compared to the untreated control treatment.

CONCLUSIONS

1. Fungicide applications had either no or a negative effect on yield and yield components in a given year.
2. There was no beneficial effect in plots treated with fungicides after three years compared to those left untreated.
3. Berries that are NOT to be put into storage, should NOT be treated with fungicides.
4. Difolatan was the most effective fungicide for managing storage rots. Unfortunately, however, this product is no longer available.
5. Bravo was less effective for storage rot management when applications were initiated early during bloom. Therefore, Bravo applications should be initiated at late bloom for best storage rot control.
6. Dithane M-45 was ineffective at managing storage rots.

This research was funded by the Wisconsin Cranberry Board, Inc. The cooperation of the growers at Location 1 and 2 and Ocean Spray Cranberries, Inc. during the course of this research is gratefully acknowledged.

BENEFICIAL USES OF ENTOMOGENOUS NEMATODES IN AGRICULTURE

Kirk A. Smith

BIOSYS
1057 East Meadow Circle, Palo Alto, CA

Due to the recent progress in mass production, the entomogenous nematodes, Steinernema and Heterorhabditis based products are commercially available for insect control. Wide interest in these nematodes reflects their impressive attributes for biological control, particularly the broad spectrum of activity against many species of insect pests in many different orders and the ability to kill the insect host within 24-48 hours.

What makes these nematodes so attractive as alternative control agents is that they do not harm the environment and are safe to non target organisms. Numerous publications have described these attributes in detail. Presently the Environmental Protection Agency does not require the registration of entomogenous nematode based products under the Federal Insecticide Fungicide and Rodenticide Act.

Many factors affect our ability to place quantities of nematodes on or in close proximity to the target host to produce optimal results at the lowest possible cost. Application methods and timing are crucial for success; however, without proper consideration to a reliable and stable formulation, successful application of entomogenous nematodes is not very probable. Substantial improvement in formulation stability has been obtained by immobilizing or partially desiccating the nematodes on specific carriers. Apparently, these carriers reduce nematode metabolism, improving their tolerance to temperature. The storage period for such formulations is related to the oxygen and/or moisture requirements for the nematodes.

As with chemical pesticides, selection and use of application equipment are of utmost importance and deserve major emphasis when considering nematode application. Fortunately nematodes can normally be applied through conventional application or irrigation systems if nozzle diameters are at least one micron in size or larger and system pressures do not exceed 300 pounds per square inch. In spite of these limitations, nematode products have been introduced successfully in markets where safety and/or the use of restricted insecticides is an issue.

In recent years, efforts made to narrow the efficacy gap between chemical pesticides and nematodes have been successful in various market segments. Research efforts towards adopting a quality control procedure, selection of suitable target environments and target insects for nematodes, selecting effective nematode strains and dosages, proper timing of application, and selecting appropriate methods of application or delivery to increase the probability of successful insect-nematode interaction have been instrumental in commercializing these entomogenous nematodes.

BIOTECHNOLOGY CROP RESEARCH UPDATE

Allen J. Dines
Director of Business Development
Agracetus, Inc., Middleton, Wisconsin

Thank you for this opportunity to speak today. I want to tell you about the status of crop research in biotechnology. First, I will talk briefly about the applications of biotechnology to agriculture, then I will turn to a brief description of two projects at Agracetus which illustrate the kinds of improvements biotechnology will bring to agriculture. The first of these is our work in insect resistance; the second is fiber quality. For you in the cranberry business, I am afraid I will have to ask your indulgence as most of our work is directed at major feed crops. We do see applications of this work that will eventually benefit cranberry production, but you will have to be patient.

Agracetus is a small plant research company located in Middleton, Wisconsin with a staff of about 70. Founded in 1981, we have recently become a wholly-owned subsidiary of W.R. Grace & Co. Our research focuses on plant genetic engineering using techniques of recombinant DNA. Corn, soybean and cotton are our major target crops. Our projects also include a research effort to develop new microbial biopesticides that will reduce the need for chemical fungicides now relied upon for plant disease control.

Applications of biotechnology to agriculture fall into two broad categories--products that will be of direct interest to the grower and products that will be of interest to the processing industry that purchases the agricultural commodity. Grower applications include seed for improved crop traits such as insect resistance, disease resistance, herbicide resistance and improved tolerance to stress. Processor traits include improved oil or protein quality, and improved processing efficiency. Biotechnology will also make possible new products derived from plant sources that were not possible before.

Insect resistance

As an example of an improved agronomic trait of interest to growers, let us consider current research toward development of plants that carry their own built-in resistance to insect attack. Some plants have a natural resistance to certain insect predators. However, for most crops of economic importance, nature was not so generous with similar resistance. Corn and cotton account for the major use of insecticides in the U.S. today; thus they are attractive initial targets. Cotton along accounts for about $200 million per year in chemical insecticide sales. About half of this use is to control the pests known as the tobacco budworm and the cotton bollworm. These pests are from the insect order called Lepidoptera. These are commonly referred to as caterpillars and they are the larval form of moths and butterflies. In the larval form, these insects are responsible for extensive damage to agricultural and forestry production. Gypsy moth, corn borer, armyworm and tent caterpillar are a few of the common names associated with this class of pest. The fruitworm of cranberry is a lepidopteran pest.

Scientists have identified and isolated a gene for a toxin protein active only against this order of insects and inserted that gene into plants such as cotton, tobacco and tomato. Genes are the fundamental building blocks of cell function. Each gene carries instructions for production of a particular protein within the cell. In total, the genes prescribe the master plan for the creation of necessary

cellular metabolism. This particular insect protein gene was taken from a common soil bacterium called *Bacillus thuringiensis* or B. t. for short. B. t. is a bacterial predator of caterpillars. This toxin gene has been found to be the active protein that enables the B. t., once ingested by the caterpillar, to poison the gut of the insect. This bacterium has been used for more than two decades as a bacterial pesticide to control a variety of caterpillar pests. Its safety is well studied. Indeed, it has a reputation as among the safest insecticidal materials available because of its natural origins and its high selectivity to target pests. As a biological product, it rapidly breaks down in sunlight and leaves no residues. The problem with B. t. for growers is that the very factors that make it safe also limit its effectiveness as an insecticide - it's difficult to get it to the right place at the right time. As a result, B. t. has never taken more than a 1% share of the U.S. insecticide market.

With biotechnology, we expect that to change. By taking the gene responsible for the insecticidal activity of B. t. and transferring it to the plant, scientists have put the active ingredient precisely where it is most needed when the plant needs it. Seed products are still in development, but preliminary field results are promising. Most companies expect the first such insect resistant seed products to reach the market by about 1995.

At Agracetus we have been working with Dr. Brent McCown, a tissue culture expert at the University of Wisconsin, and we have successfully inserted a highly active form of the B. t. gene into cranberry. During 1990, we will be evaluating the degree to which the gene produces this protein toxin in the cranberry plants regenerated from these experiments. If insecticidal activity can be measured in the laboratory, we will proceed with field testing. Details of exactly how effective this new cranberry variety could be in eliminating use of some chemical insecticides in the field are not yet known. I hope to have a favorable follow-up report for you in another year or two.

Fiber Quality

Admittedly, cotton is not very relevant to cranberry production. However, we all wear cotton fabrics and we have in common an interest in strong lightweight breathable cottons that, depending on the time of year, will keep us cool or keep us warm. I want to tell you about our work in cotton fiber quality because it illustrates an approach to how we might use biotechnology to solve more complex crop improvement problems. Fiber quality is a complex multigenic trait. Unlike the insect resistance research described above, improving fiber will not be so simple as adding a single gene and getting stronger, longer or finer fiber. A major problem has been even finding a place to start since no one has previously identified genes known to be related to fiber production.

At Agracetus, we are working to improve the quality of the fiber produced by the cotton plant so as to optimize the efficiency and quality of the yarn spinning process. This means basically finding genes that make the fiber longer, stronger and finer. Modern textile spinning is dependent on a complex set of requirements that must all be in balance in order to spin strong high quality yarns at an economical cost. Thus, this is a trait of primary interest to the textile industry rather than the grower (although the grower certainly aims to produce a fiber product that meets his customer's needs). Foreign competition and improved machinery are forcing textile mills to optimize the highest quality yarns from the raw cotton fiber and do this at the lowest cost.

We have identified several genes from different types of cotton that we believe to be associated with the fiber development process. In all, we have nearly

20 such genes. To do this, we have pioneered a method of analysis based on isolation of the cotton messenger RNA. This is the intermediate carrier material that takes the information from a gene and directs the machinery of the plant cell to produce a specific protein product. We have exhaustively analyzed this messenger RNA from cotton at different times in the cotton's life cycle and in different varieties of cotton that have widely different fiber traits. Based on an analysis of the differences, we have narrowed the search considerably for genes associated with this complex trait. The 20 such genes we have obtained are ready to be inserted into cotton to evaluate the changes in fiber. We can not be certain we will have a useful result, but we are very encouraged with the prospects for this work.

We believe this method is important because it is likely to be transferrable to finding genes associated with other multigene traits such as oil quality, protein quality or processing traits that improve food shelf-life or control costs.

Conclusion

Biotechnology is an almost overworked word in some circles. No doubt you have been hearing for years that it has been coming and that it will change everything in mysterious ways. Well, the fact is it is coming and it will have a major impact. But it is not happening so fast that you won't be able to keep up with it. The research I have described in insect resistance and fiber quality are but two examples of how scientists are taking our expanded understanding of cellular biology and genetics and applying it to new opportunities in agricultural production. I encourage you to keep your ears open to learn as much as you can about this technology in the coming years. As you learn more, your understanding will greatly increase and the mystery will be replaced by confidence and optimistic curiosity.

CRANBERRY TIPWORM

Daniel L. Mahr and Roseann Kachadoorian
Department of Entomology
University of Wisconsin - Madison

Cranberry tipworm is a tiny insect which damages the growing tips of cranberry uprights. Damage late in the season kills the fruiting bud for the following year, thereby reducing yield. This paper summarizes our knowledge of the life cycle and biology of this insect, including recent research results from the University of Wisconsin.

Identification of Tipworm

Cranberry tipworm is a member of the gall midge family Cecidomyiidae. This family is in the larger group of insects, order Diptera, that includes flies, gnats, and mosquitoes. Gall midges are small insects, often less than half the size of a mosquito. The adults have two wings, long slender legs, and bristly, beaded antennae.

The scientific name of cranberry tipworm has been Dasineura vaccinii, but a recent re-examination of the insects in this group has lead to the renaming of the insect to Dasineura oxycoccana. These two names are synonymous and refer to the same species of insect.

A closely related species of gall midge occurs on loosestrife in and around cranberry marshes. Each of the two species is fairly restricted to feeding on its preferred type of host plant. Because of their small size and close relationship, it takes a specialist to be able to distinguish the adults of the two species. This situation could confuse monitoring programs which are based on adult sampling.

Summary of Life Cycle

The insect starts life as an egg laid by the adult female midge. The eggs are laid on the leaves in the vicinity of the growing tip. The egg hatches into a tiny clear, headless, legless maggot-like larva, which is the damaging stage. As the insect grows during the larval stage, its color changes, first to white, then to a peach color. When fully grown and done feeding, the larva spins a silken cocoon in the damaged stem tip, and transforms to the pupal stage within this cocoon. An adult midge eventually emerges from each cocoon. After mating, the females begin laying eggs, thereby completing the life cycle.

The literature is somewhat confusing as to the length of the life cycle and the number of generations per year, with two to five being reported, depending upon the source of information. As part of our research on this insect, we assessed the number of generations per year in both 1988 and 1989 on a tipworm-infested marsh in the Warrens area. One hundred uprights were sampled weekly from each of two plots on each of four beds (eight plots, 800 terminals total per week). The terminals were cut and taken to our lab in Madison where they were microscopically examined for presence of tipworm stages and damage. The results of these studies are presented in the accompanying figures. To summarize, during the hot 1988 growing season, there were apparently five generations, but only four during the more typical conditions of 1989 (most easily seen in the graphs of the egg stage, Figure 1). Depending upon the time of year, the duration of each generation was from slightly over two weeks to about 3.5 weeks. Because of the

relatively short life cycle, generations tend to overlap, somewhat obscuring the start and end of each generation. This is part of the explanation for the apparently lengthy periods of larval duration in Figure 2; the "peaks" which appear to last 4-6 weeks actually consist of two generations.

Distribution of Larvae Within and Between Beds

When developing monitoring and management strategies for tipworm, it is important to consider the pattern of distribution of the insects within a bed and to compare population densities occurring in adjacent beds. Although the research reported here is somewhat preliminary, there is good evidence for considerable differences in population density both within a bed and comparing adjacent beds (Figures 3 and 4). We also found that population density can vary from generation to generation within a given plot. These differences can be seen by comparing the accompanying illustrations.

Damage Caused By Tipworm

The tipworm larva causes damage by killing the apical tip of the upright. Previously published reports (especially by Prof. Marucci of Rutgers University and the New Jersey cranberry experiment station) indicated that early season damage resulted in the development of secondary lateral shoots which eventually became bearing, thereby increasing the number of fruit buds, and, theoretically, increasing the yield. However, damage later in the season killed fruiting buds, which would cause a reduced yield. Because these reports did not correlate "early" and "late" damage with specific tipworm generations, the studies are very difficult to interpret for development of pest management strategies. Further, our research shows that population density is very low in later generations (Fig. 2), and therefore we expect that late season larvae do not cause significant economic injury. Our intent is to do further research to relate the time of damage with the ultimate fate of the damaged terminals.

Control of Cranberry Tipworm

Cranberry tipworm is important as a pest in Wisconsin, Massachusetts, and New Jersey. It occurs in the cranberry growing regions of the Pacific Northwest, but is not considered to be a significant pest there.

Research by Prof. Marucci showed that holding late water for control of other types of insects actually increased tipworm damage. This should not be a concern because holding late water is not a common practice in Wisconsin.

Several reports in the literature, including Extension recommendations, indicate that sanding is helpful in controlling tipworms. We expect to further evaluate this practice during 1990.

Tipworm larvae are attacked by tiny parasitic wasps that could provide some degree of natural or biological control. However, there has been virtually no research on this beneficial insect and we have not encountered it in our samples. We have, however, seen certain predatory insects (such as hover fly larvae) feeding on the tipworms, although this activity is usually of limited scope. Generally, beneficial insects such as these are highly susceptible to broad spectrum insecticides. As IPM practices become more fully adopted, and the routine use of traditional insecticides is decreased, we anticipate seeing an increase in the benefit provided by such types of natural enemies.

Insecticidal approaches to tipworm have been unreliable in all growing regions. Therefore, in 1989 we collaborated with entomologists in Massachusetts

and New Jersey to evaluate eight different insecticidal products, most of which have current registration on cranberry. The products originally included in the study were Orthene, Guthion, Imidan (not currently registered), Insecticidal Soap (not currently registered), Lorsban, Malathion, Diazinon, and Sevin. All products except Lorsban and Malathion were evaluated. Sprays were applied two to four times per generation (as separate treatments in separate plots) in the hopes of finding the most susceptible stage in the life cycle. All treatments were unsuccessful at controlling tipworm and further research is necessary to develop control methods for this insect.

Acknowledgments

We thank Charles Strozewski for allowing us to conduct research on his marsh. Tim Dittl applied the insecticide sprays reported herein. We thank David Ware for field and laboratory assistance. This research was supported in part by a grant from The Wisconsin Cranberry Board, Inc., and by the University of Wisconsin Integrated Pest Management Program. Mention of specific insecticide brand names is for convenience only and is not intended as a recommendation over similar products.

Figure 1. Seasonal occurrence of tipworm eggs, Warrens, 1988 and 1989.

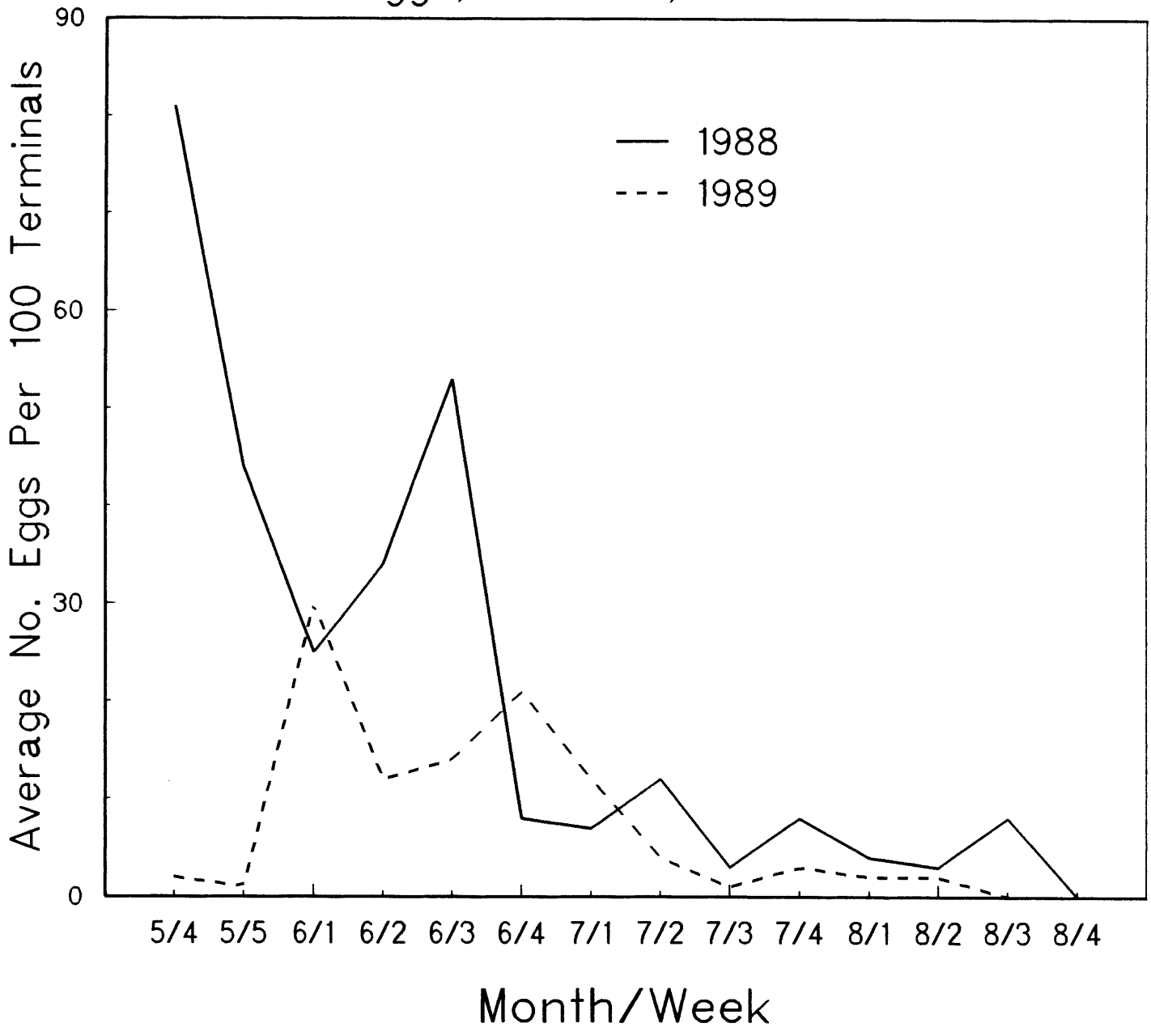


Figure 2. Seasonal occurrence of tipworm larvae, Warrens, 1988 and 1989.

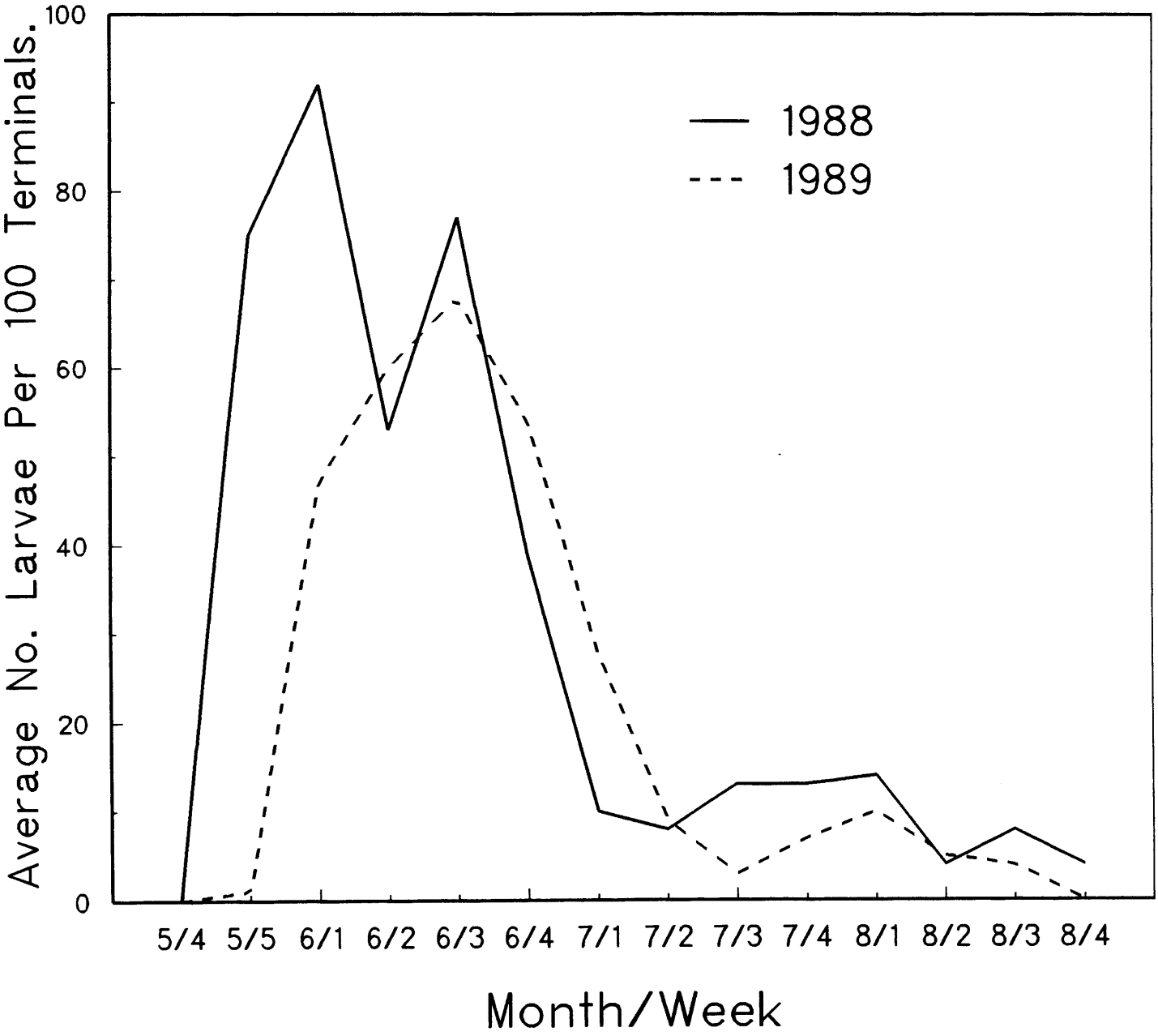


Figure 3. Number tipworm larvae per plot, June 15, 1989.

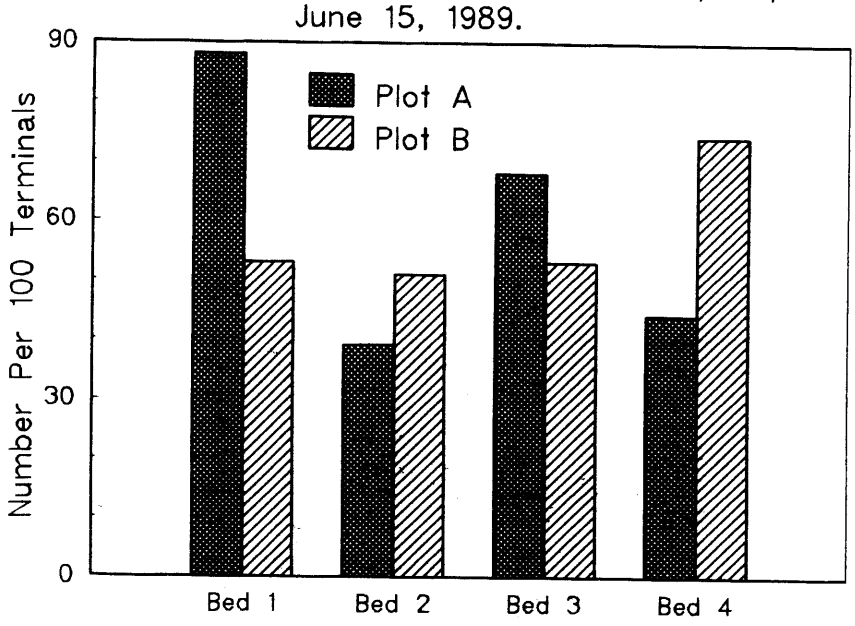
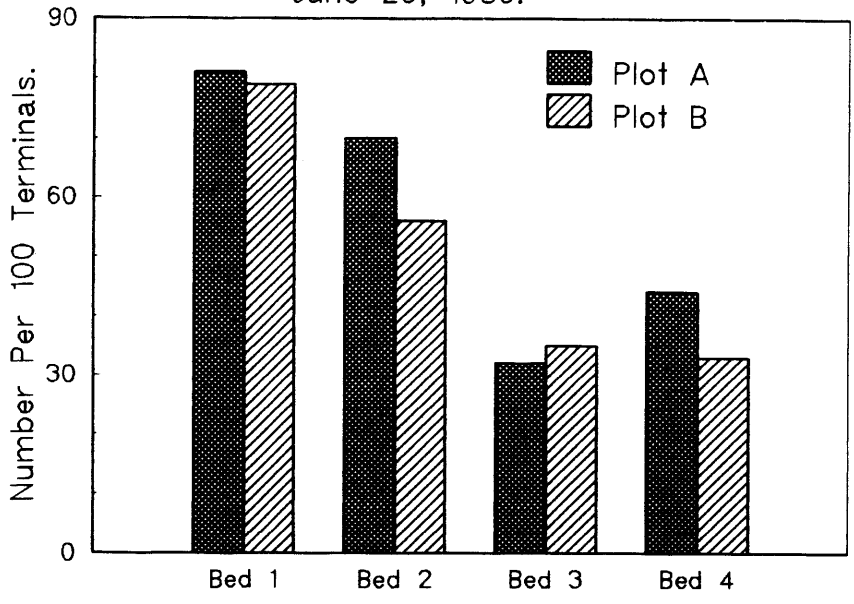


Figure 4. Number tipworm larvae per plot, June 29, 1989.



THE UNIVERSITY OF WISCONSIN-EXTENSION CRANBERRY INTEGRATED PEST MANAGEMENT PROGRAM, WITH COMMENTS ON MONITORING METHODS IN RELATION TO PHEROMONE TRAP COUNTS FOR BLACKHEADED FIREWORM

Roseann Kachadoorian - IPM Program Coordinator
Daniel L. Mahr - Extension Entomologist

Introduction

The University of Wisconsin - Extension (UWEX) initiated a four year pilot Cranberry Integrated Pest Management (IPM) Program in 1986. Trained scouts monitored and reported insect, disease and weed levels on a weekly basis and the program coordinator made control recommendations as needed. Participating growers also received a newsletter every two weeks detailing pest activity in the state. Growers were charged a fee based on the number of acres scouted.

Program Objectives

The major objectives of the UWEX Cranberry IPM Program are:

1. *To improve pest detection through regular scouting.*
   Scouting allowed growers to be aware of pests before they reached damaging levels and learn what types of pests were the most problematic.

2. *Reduce pesticide usage.*
   Results of the UWEX questionnaire and a review of grower pesticide records indicate seventy-five percent of the IPM growers reduced their pesticide use by at least one application. Growers who did not reduce the number of applications stated that they "received better control" because of more timely pesticide applications.

3. *Collect additional information necessary to incorporate biological control into current IPM programs.*
   Critical biological information on the relationship between pests and their natural enemies is necessary in order to reduce pesticide usage even further. Regular scouting provides baseline information on the most common predators and parasites occurring in commercial marshes. Scout reports indicate hover fly and lacewing larvae feeding on tipworm and blackheaded fireworm larvae. In addition, an egg parasitoid (Trichogramma pretiosum) of blackheaded fireworm was collected in 1989. This tiny wasp is a parasitoid of cranberry fruitworm eggs, and had not previously been recorded on blackheaded fireworm.

4. *Assist in the development of commercial IPM scouting programs.*
   In 1986, UWEX offered the only cranberry IPM program in Wisconsin. Almost 160 acres were scouted in three counties. By 1989, two private companies and one grower cooperative (Ocean Spray) offered programs modeled after the UWEX program. In 1989, 1,800 acres were scouted in twelve counties; UWEX scouted less than ten percent of the acreage. Growers were strongly encouraged to participate in programs offered by the companies and grower cooperative.

Number of Participants

The number of growers participating in the UWEX IPM program varied yearly (Table 1). A limited number of growers were offered the program in 1989, and former program participants were encouraged to join the privately offered programs.

Table 1. Number of UWEX Cranberry IPM Participants (1986-1989).

Year	Marshes	Acres	Counties
1986	7	158	3
1987	20	366	6
1988	25	525	6
1989	5	150	3

IPM OF THE FUTURE

In pilot IPM programs the number of pesticide applications are often reduced because of weekly pest status information provided by the IPM scouts. This information enables growers to treat only if necessary and time applications more precisely. In addition, the scout supervisor can recommend or suggest the most efficient and least environmentally harmful pesticide, or pesticide alternative. However, this is only the first phase of an IPM program.

IPM programs are dynamic. Research conducted by the University of Wisconsin and other universities will provide additional cost-effective methods for improved management of pests. Many of the following methods listed below will be part of future IPM programs.

(1) Improved sampling programs for insects and diseases.

(2) Increased reliance on predictive models. Three degree day models have been developed and are being field tested: blackheaded fireworm, cranberry girdler, and dodder. Cranberry tipworm will be the next model to be developed.

(3) Use of infrared photography to detect germinating weed seeds and areas damaged by diseases and insects.

(4) Increased reliance on biological control of weeds, diseases, and insects.

(5) Use of pesticide-resistant beneficial insects.

(6) Use of selective insecticides that will not harm beneficials. Such insecticides may include insect growth regulators and microbial pesticides.

(7) Development of a method for quickly analyzing pest insects to determine percent diseased or parasitized.

(8) Planting genetically engineered plants that are resistant or tolerant to pests.

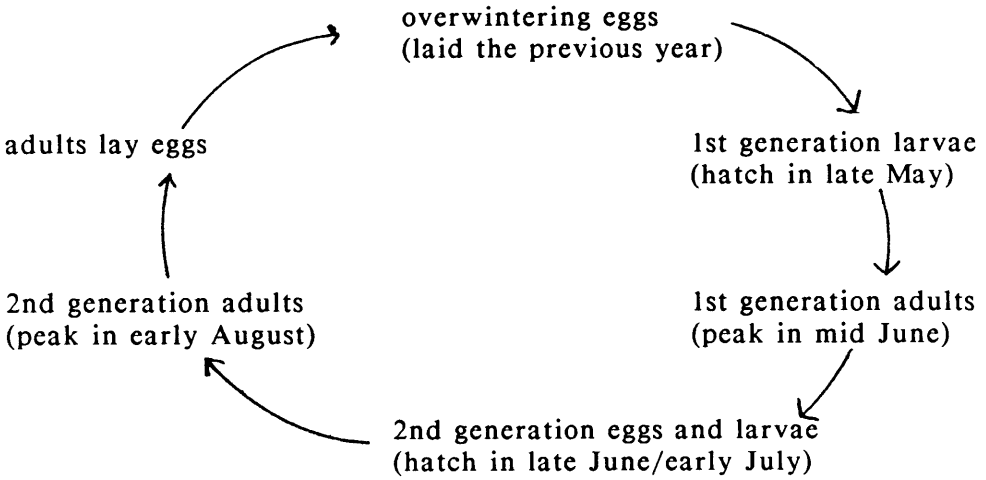
MONITORING METHODS FOR BLACKHEADED FIREWORM IN RELATIONSHIP TO PHEROMONE TRAP COUNTS: RESEARCH RESULTS AND THEIR APPLICATIONS TO SAMPLING

Pheromone baited traps were used to monitor blackheaded fireworm adults. One trap was placed every ten scouted acres, with most marshes containing two traps. Pheromone baits (which attract male moths only) were replaced every three weeks. Trap catches were counted weekly. Each week, beds were swept with an insect sweep net and observations for larval presence and damage were made. Beds were swept seventy-five to one hundred times, depending on bed size.

Adult Trap Counts

There are two main peak flight periods for blackheaded fireworm in central Wisconsin; mid June and early August (Figure 1). Ninety-five percent of the time the first generation trap counts are larger than the second. Eighty percent of the time there is a correlation between the size of the first and the second generation trap counts. In an untreated situation the correlation is most likely higher.

Figure 1. Blackheaded Fireworm Life Cycle.



Adult Trap Counts and Larval Frequency

The relationship between adult trap counts and the frequency of larval detection is influenced by the time of year, pesticide applications, scouting techniques and the environmental conditions. Because of these factors it is difficult to predict the exact number of larvae that will be collected based on trap counts. The larval data used in this study were collected by relative methods (sweep net and observation), rather than using an absolute method. Marshes were treated with insecticides.

Observations play an important role in cranberry IPM. Many cranberry insects such as blackheaded fireworm have highly aggregated populations, and it is not uncommon for growers to have "hot spots". Because the distribution pattern and larval size affects how precise sweeping is, larvae are observed more frequently than swept during certain time periods.

Between-Year Larval and Adult Relationships

There is a seventy percent correlation between second generation trap counts and the following year's first generation larval levels. If second generation trap counts exceed five adults, larvae are fifteen times (77 vs. 5 percent of the marshes) more likely to be collected in the sweepnet and are three times (100 vs. 29 percent) more likely to be observed by IPM scouts the following spring, than if the adult level is five or below. This is critical information for growers who have high second generation adult trap counts because it may indicate the potential for a high first generation larval level the following year. Sixty percent of the growers have second generation trap counts of five or below.

Within-Year Larval and Adult Relationships

First generation adults and second generation larvae. First generation trap counts can be used to predict the probability of collecting second generation larvae. When the first generation peak adult trap count is five or less (twenty-eight percent of the total marshes), scouts are unlikely to collect larvae through sweeping or observation (Table 2). Larvae will not be collected through sweeping unless the adult peak is over twenty-five. Larvae at low populations will be detected more readily through observations than through sweeping.

Table 2. Percentages of marshes in which second generation larvae were collected in late June/early July in relation to the previous first generation adult levels.

Peak No. of Adults	Sampling Method: Sweepnet				Observed			
	Not Found		Found		Not	Found	Found	
	No.	%	No.	%	No.	%	No.	%
0-5	19	100	0	0	19	100	0	0
6-25	18	100	0	0	13	72	5	28
26-55	5	62	3	38	4	50	4	50
over 55	13	56	10	44	6	26	17	74

First generation larvae and adults. First generation eggs hatch into larvae in late May. The larvae pupate and give rise to first generation adults. If no first generation larvae are collected in the sweepnet, the following first generation peak trap counts are unlikely to exceed twenty-five adults. (Table 3). Larvae were observed at fifty percent of the marshes when the resulting adult trap counts are between six and twenty five adults. Larvae were readily collected in the sweepnet or through observation, when the following trap counts exceed fifty-five.

Table 3. Percentage of marshes in which first generation larvae were collected and the resulting peak adult levels.

Peak No. of Adults	Sampling Method: Sweepnet Not Found No.	%	Sweepnet Found No.	%	Observed Not Found No.	%	Observed Found No.	%
0-5	18	95	1	5	17	89	2	11
6-25	18	100	0	0	9	50	9	50
26-55	6	75	2	25	3	38	5	62
over 55	7	0	16	70	1	4	22	96

Second generation larvae and adults. Second generation larvae peak in late June/early July, pupate, and develop into second generation adults. Second generation larvae were rarely collected from marshes whose ensuing second generation trap counts were below five adults (Table 4). There was a fifty percent chance of finding larvae by sweeping, when the following adult trap counts was between six and twenty-five. This is substantially different than the first generation (no larvae collected)(Tables 3 and 4). Larvae were swept at all marshes when the following adult peak was over fifty-five adults, compared to seventy percent in the first generation.

Table 4. Percentages of marshes in which second generation larvae were collected and the resulting peak adult levels.

Peak No. of Adults	Collection Method: Sweepnet Not Found No.	%	Sweepnet Found No.	%	Observed Not Found No.	%	Observed Found No.	%
0-5	43	98	1	2	34	77	10	23
6-25	9	50	9	50	5	28	13	72
25-55	4	57	2	43	1	17	5	83
over 55	0	0	4	100	0	0	4	100

Conclusion

First generation trap counts can be used to predict the probability of collecting second generation larvae. Second generation trap counts can be used to estimate the following year's first generation larval level and frequency. Also, the probability of collecting larvae is reflected in the subsequent trap counts. Additional research needs to be conducted to determine if trap counts can accurately predict larval levels.

ACKNOWLEDGMENTS

This program was approved by the Integrated Pest Management Steering Committee and funded by the Federal Extension Integrated Pest Management Program and by grower subscription fees. We thank the Wisconsin cranberry growers who were involved in this program, and acknowledge the assistance of the following UWEX cranberry IPM scouts : Sara Ott, Laurel Riedel, Susan Lyford. Nichole Franklin and John Jacobson.

LEGAL LIABILITIES

Richard D. Weymouth
Nash, Podvin, Tuchscherer, Huttenburg, Weymouth & Kryshak, S.C.
Attorneys at Law

In today's litigious society it is important for all of us to do what we can to protect ourselves. The liability of cranberry operations can be divided into four main areas. Each of those will be described briefly below.

Tort Liability (negligence)

Under the law negligence is equal to fault. This means that if some accident is determined to be your fault you will be deemed negligent. Negligence may be shown to people outside our operations (others) or to our employees. We owe others the "duty of due care". This is required from the owners or operators and from their employees **in the course of their employment**. Their negligence is imputed to principal.

In the case of an accident where both parties may have been at fault a court may use a comparative fault system. In this case the negligence of those involved in the accident is compared. Any damages awarded may then be reduced by the amount of negligence determined.

Growers are not, however, required to keep their operations safe for recreational use or to give warning of unsafe condition, use or activity on the their property. For this to apply, growers cannot ask or expect compensation for access to their land.

Tort liability is limited by statues of limitations. After a certain amount of time has passed following an accident no suit may be brought.

There are several ways to avoid or to pay for liability. The first way is through insurance. All businesses should have adequate liability insurance. Make sure that yours is current and is large enough to protect your assets. Your liability policy should cover employees who are operating your vehicles or equipment.

Another type of insurance policy is an umbrella policy. Such policies offer protection "on top of" or in addition to other liability policies.

Businesses may also protect themselves through their corporate structure. While this solution may offer some liability protection it may also have other unwanted attributes.

Employees are covered under worker's compensation. This program covers employees for injuries caused by other employees, or even from their own negligence. More will be said about this later.

Contract Liability

Most contracts take the form of offering consideration (money or goods) for a promise of performance (work). We have the duty or perform whatever was promised in the contract.

Parties can be awarded damages for breach of contract. These damages may take the form of actual damages or consequential damages. Consequential damages are those that flow from the breach. That is expected payments. One example of this is the case of Hadley v. Baxendale from Old English Law that is still cited today.

We must distinguish between oral and written contracts. Oral contracts are enforceable they are just more difficult to prove. Written contracts are almost always better.

Employment Liability

Employment practices are another source of liability. The general rule used in employment practices is the "at will doctrine". That is that hiring, firing, promotion, demotion are at the will of the employer. There are, however, some exceptions to this rule. These are contained in the Wisconsin Fair Employment act. This act disallows job discrimination based on:

Age
Arrest or conviction record
Creed (system of religious beliefs)*
Handicap*
Marital status
National Guard/Military Reserve membership
National origin/ancestry
Race
Sex (including harassment)*
Sexual orientation
Unfair honesty testing

* In these cases the employer must accommodate the job to the employee unless it causes hardship.

In addition, employees may not be demoted or fired for refusal to perform an illegal act.

There is a trend to grant relief to employees who were "wrongfully" discharged. The employers liability if found to have discriminated may include back wages, reinstatement, and/or promotion. The employer may also be liable for discrimination on the part of a supervisor or manager.

Employers also have statutory responsibilities towards employees. Agricultural requirements for coverage are somewhat different from general employees.

Worker's compensation coverage is required if you employ 6 or more employees on any 20 days of a calendar year. Worker's compensation is not a fault system. Employees are covered in the system if they are injured on the job **in the course of employment** *regardless of fault.* This also includes occupational diseases. The system does allow for third party claims against defective equipment or negligent co-employees.

Unemployment compensation is required if eligibility requirements are met and an employee does not quit or if not fired for job related misconduct. Unemployment compensation is required if an employer paid $20,000 in wages during any quarter of the current or prior year, or had 10 employees on 20 days, each day being in a different calendar week.

Employers are required by statute to provide a safe place of employment. This includes have guards in place on equipment if available. Violations of this statute will lead to increased worker's compensation awards. Third party actions in such cases may not be covered by worker's compensation law or insurance. It behooves employers to take all precautions to make their workplace as safe as possible.

Employers are required to withhold Social Security and Federal Income Taxes from employees paychecks. The Federal Income Tax Withholding Requirement is new and began effective January 1, 1990.

Workers have claim on their earned wages. Fired employees must be paid within 3 days. An employee who quits must be paid within 15 days. Failure to pay on time results in a criminal penalty of up to $500 fine and/or 90 days in jail. Employers can't withhold paychecks or portions thereof for damage caused by an employee without permission.

Cranberry Laws

The "Cranberry Laws" were passed by the Wisconsin State legislature in 1867. They grant cranberry growers the statutory right to construct dams and ditches on lands adapted for cranberry culture. Recent State Supreme Court cases have construed this law to include the right to divert water for use in cranberry culture without permission or regulation.

Caution should be exercised in application of the "Cranberry Laws". By Statute construction of new dams or ditches cannot damage other dams and ditches previously established and maintained. An arbitration system was also established to determine and enforce damages subject to the right to appeal.

The "Cranberry Laws" are not an unlimited right. The "reasonable use doctrine" limits the right to withdraw water. Growers are liable for damages from unreasonable use.

The Wisconsin DNR and the Army Corps of Engineers are interested in controlling construction of dams and water use. The law is changing and is likely to be seriously challenged by Wisconsin DNR and others.

Editor's note. This section is intended only to remind you of what you heard at the 1990 Wisconsin Cranberry School. This is not intended to be a legal opinion. If you have questions concerning any of the matters presented above contact a competent attorney.

WETLAND WILDLIFE ENHANCEMENT

Joseph C. Haug
Area Wildlife Manager
Wisconsin Department of Natural Resources

Following the agricultural drainage era of the early 1900's, vast acreages of previously farmed wetlands in Central Wisconsin reverted to public ownership through tax delinquency or resettlement. Federal, state and county authorities were entrusted with these public ownerships, and by the late 1930's properties such as the Necedah National Wildlife Refuge, Central Wisconsin Conservation Area (now Meadow Valley) and the Wood County Public Hunting and Fishing Grounds had received their identities. Along with "identities" came property managers and management programs.

Historically, wildlife management practices implemented on these publicly-owned lands in the "cranberry region" of Central Wisconsin have emphasized wetlands and wetland species. Managers set about "restoring" literally thousands of acres of drained and formed lowlands to their former wetland status by constructing dams, dikes and impoundments. Where possible, water was held at high enough levels to provide surface water throughout the year. Management consisted of periodic drawdowns and controlled burning to enhance or control wetland vegetation. Development dollars were obtained from an excise tax on sporting arms and ammunition (Pittman-Robertson Fund) and waterfowl stamp revenues. Waterfowl production and staging was emphasized to accommodate an increasing recreational demand.

With the notable exception of ducks, the wildlife response to agency wetland restoration efforts in Central Wisconsin has been a success story. This was made possible by the resilience and adaptability of Mother Nature's critters as well as having the good fortune of having projects located in the midst of extensive existing surface water cranberry developments that provided a source of "seed" as well as many other wetland benefits. Numerous wetland wildlife species such as aquatic furbearers (beaver, muskrat, etc.), waterfowl (Canada geese, some ducks, etc.) and many non-game species (herons, sandhill cranes, etc.) responded positively to these wetland enhancements. Had it not been for these early wetland restoration efforts, populations of these species would not be as abundant or as diverse as they presently are.

It we were to point out the single greatest failure and/or frustration that agency people have had to face in their wetland restoration-enhancement efforts in Central Wisconsin it would have to be our inability to increase local populations of breeding puddle ducks (mallards and teal). The continuous decline in our continental and Mississippi Flyway populations of ducks since the 1940's, coupled with an increased recreational demand have only served to heighten public and managerial disappointment. Although we've had some success in staging or attracting ducks to wetlands during spring and fall migrations, we've had to face failure in our ability to hold large numbers of puddle ducks locally for breeding purposes.

Since wildlife management is a relatively new science (only dating back to the 1930's) when compared with many others such as cranberry culture, we've had to "learn as we go" using traditional methods of trial and error. However, as with any science, we've also recognized the need for research and the delving into the intricacies of nature in our attempts to find solutions to problems. Perhaps if all the habitat requirements of a species were known, we'd then have sufficient insight as managers to address and correct problems.

In our efforts to conserve and enhance continental waterfowl populations in North America, research biologists have been studying the breeding biology of various species for almost 50 years. These efforts have been concentrated in "traditional" duck breeding areas such as the prairie pothole regions of the United States and Canada where 96% of all production occurs.

Research findings on breeding puddle ducks indicate that essential habitat requirements include 1) shallow seasonal and temporary wetlands, 2) 3-4 acres of upland nesting cover for each acre of surface water wetland, 3) fertile, clear water which is neutral to slightly basic - pH 8.0 - 9.0 and, 4) a protein lode or source within the water consisting of invertebrate larvae, snails, etc. that is available to hens during nesting and broods during the summer rearing period.

In attempting to compare our Central Wisconsin breeding duck habitat then with "the duck factory" situation in the prairie pothole region, one can see that the greatest habitat disparity occurs in water quality. Where "duck factory" water is clear, fertile and basic, our "Great Swamp" region of Central Wisconsin is characterized by having bog waters that are strained or dark in color, infertile, acidic (pH 4.0 - 6.0) and generally lacking in the aquatic invertebrates required for major duck production. We could go so far as to say that the very waters that make our region a top cranberry producer also appear to be the major limiting factor for puddle duck rearing. So what can we as wetland owners do to enhance our wetlands and wetland wildlife?

We as agency people have come to accept our wetland limitations as it pertains to breeding ducks at least until technology becomes available to provide realistic tools and procedures for change. However, our existing wetlands can continue to benefit many other wildlife species that have adapted to our Central Wisconsin area. Perhaps our best example of a recent adaptation is the Canada goose and its increase in breeding numbers over the past 20 years. Since it obtains its "protein lode" for reproduction by grazing on green vegetation similar to a cow, it has found your cranberry developments to be very suitable habitat. While this may not be desirable depending on individual growers tolerances, it does indicate a very positive response by a species to excellent wetland habitat.

We have attempted to enhance wetland habitat conditions on public lands using periodic drawdowns to provide plant foods for migrating waterfowl, controlled burning to control brush and release nutrients, water level manipulations and nesting island construction. While we feel these all have been of some benefit they have not been down without great expenditures of time and money.

We would like to pose the following suggestions to you that we feel could guarantee the continued existence of our wetland wildlife species in Central Wisconsin with a minimum of expenditures on your part.

1) Maintain every acre of surface water wetlands possible because of their benefits to all living things - including mankind.
2) Mitigate wetland losses brought about by developments such as bed expansions, etc.
3) Support legislation that restores wetlands such as Waterfowl Production Areas, Habitat Restorations areas, etc.
4) Provide financial and moral support to private organizations attempting to conserve wetlands such as Ducks Unlimited, Wisconsin Waterfowlers Association, etc.
5) Remain concerned about how important your wetlands are for wildlife.
6) Continue to prove to the world that cranberry culture and wildlife can co-exist!

SKIN CANCER

Cancer of the skin is the most common of all cancers, accounting for more than 500,000 cases each year. Fortunately, this is the easiest of all cancers to detect and most can be treated successfully. Skin cancer is linked to repeated exposure to the sun, and can be largely prevented with simple precautions. As with other cancers, skin cancer is more easily prevented than cured.

The skin is the largest organ of the body. It performs several important functions. It protects the structures underneath from injury. It regulates body temperature, excretes wastes, and prevents the loss of too much water and other compounds. The skin also serves as a sense organ for touch, pressure, cold, heat, and pain.

The skin has two main layers and several sublayers. The lower layer of connective tissue is the dermis. The thinner, uppermost layer is the epidermis.

Types of Skin Cancer

There are three types of skin cancer. Each has unique characteristics.

Basal Cell. Basal cell cancers resemble the layer of cells that form the base between the epidermis and the dermis. They are slow-growing and do not spread to other parts of the body, although they can invade deeply and widely if left untreated.

Basal cell cancers can have a high rate of recurrence; a person who develops one basal cell cancer has a 40 percent chance of developing another. Although basal cell cancer used to be considered a disease of middle age or older, it is being seen more and more among young people as a direct result of exposure to the sun's rays. Presently basal cell cancers account for 75% of all skin cancers.

Squamous Cell. Squamous cell cancers resemble the middle and uppermost layers of the skin. Squamous cell cancers grow more quickly than basal cell cancers and are more likely to invade underlying structures. They are also more likely to spread to other parts of the body. Still, only about 2% of squamous cell cancers spread, although this figure rises to 20% for such cancers forming in burn or x-ray scars and those that occur on the lips. Approximately 20% of skin cancers are squamous cell.

Malignant Melanoma. The less common most dangerous type of skin cancer, malignant melanoma begins in cells known as melanocytes. These cells produce the pigment, melanin, that results in a tan to help protect the skin from burning. Because malignant melanomas still produce this dark pigment, their coloring often includes shades of brown and black.

Melanoma is much more likely to spread than the other forms of skin cancer. Melanomas that spread to organs neat the original site can still be cured in many cases, but those that migrate to distant sites often cannot. That is why melanoma accounts for only 5% of skin cancer cases, but 75% of the deaths.

Precancerous Conditions

Middle-aged individuals, particularly those with lighter skin, may develop flat, scaly patches known as solar keratoses. They, too, are caused by overexposure to the sun. They may be pink, yellow, or brown and usually appear on the head, shoulders, and shins.

Solar keratoses are slow-growing and do not usually produce any symptoms other than the visible skin patch and itch and tenderness. Although they may not be very noticeable or troubling, they can turn into squamous cell cancers if not removed.

There are other skin conditions which could become cancers. Regular examination of the skin by a physician is essential.

Early Detection of Skin Cancer

Any unusual skin condition or any change in an existing skin condition should be checked by a physician. Only a physician can determine for sure whether an abnormal growth is benign, precancerous, or cancerous.

You can notice a change only if you are already familiar with your skin and its pattern of moles, freckles and other marks. The best way to do this is to give yourself a skin examination, particularly noting the pigmented areas.

Basal cell cancers often first appear as small round or oval patches, usually white or gray, shiny, and hard, but sometimes pink or red and scaly. The appearance of squamous cell cancers is more variable, but they are usually small, round, slightly elevated, and red and crusty, often with a sore in the center that does not heal.

Although melanomas can appear suddenly on the skin, they are often associated with a mole. That's why it is important for people to become familiar with their moles and note any changes. The **ABCDE** rule can be used to help distinguish a normal mole or other skin mark from a melanoma.

Melanomas display one or more of the **ABCDE** characteristics:

Asymmetry. One half does not match the other.

Border irregularity. The edges are ragged, notched, or blurred.

Color. The color is not uniform, but may be differing shades of tan, brown, or black, sometimes with patches of red, white or blue.

Diameter. A diameter greater than 1/4 inch and any that is increasing in size may indicate a melanoma.

Elevation. A mole raised above the skin surface.

Prevention

Overexposure to the ultraviolet rays of the sun is the principal cause of skin cancer. Fair skinned people, notably redheads and blonds, are the most likely to get skin cancer, because they lack sufficient quantities of melanin, the pigment that helps prevent burning.

Skin cancer rarely occurs in childhood and the average age for discovery of a first skin cancer is 50. That age is decreasing as skin cancer becomes more common among younger people.

People who work outdoors, such as farmers and sailors, and those who play a lot of outdoors sports or lie on the beach are at high risk of developing skin cancer.

Sunlight is most intense and most damaging between 10 am and 3 pm. The risk of exposure drops considerably before and after those times. If you must be out in the sun during midday protect your skin from direct exposure to the sun.

There are two basic ways of protecting your skin from the damaging effects of ultraviolet (UV) rays:

- Blocking out all light with opaque materials such as clothing
- Using a chemical sunscreen that selectively absorbs ultraviolet rays.

Blocking out all the light is the most effective method but may not be practical. A loose-weave cotton such as a white T-shirt passes large amounts of UV light. Shade from trees or umbrellas only provides partial protection since UV light may be reflected from water, snow, equipment or soil. If you must be in bright sunlight it is best to protect yourself by wearing long sleeved shirts and wide brimmed hats.

There are many clear sunscreens available that absorb UV light. The better ones are labelled with a number called the sun protection factor (SPF). The higher the SPF the better the protection. The best sunscreens have an SPF of at least 15. Most sunscreens wash of in water so it will need to be re-applied after swimming or washing. Suncreens will need to be reapplied if you are perspiring heavily.

You should also protect your lips from sun damage. Lip balms with sunscreen protection are available.

If you must be out in the sun a lot, or if you have extreme sensitivity, use an opaque sunscreen such as zinc oxide, a thick white ointment, to completely cover vulnerable areas such as lips and noses.

While we can never be completely free from cancer risk it is prudent to take whatever steps we can to reduce our chances of contracting a cancer. Skin cancer is one cancer that is clearly preventable.

PETROLEUM PRODUCT STORAGE TANK REGULATION

SAFETY AND BUILDINGS DIVISION
BUREAU OF PETROLEUM INSPECTION AND FIRE PROTECTION

NOTE: THIS OUTLINE SHOULD NOT BE USED AS A DOCUMENT FOR DETERMINING AN OWNER'S SPECIFIC REQUIREMENTS FOR COMPLIANCE. THE FEDERAL RULES PHASE IN OVER DIFFERENT TIME FRAMES AND THERE ARE DIFFERENT REQUIREMENTS FOR NEW AND EXISTING PETROLEUM PRODUCT STORAGE TANK SYSTEMS. DETAILED INFORMATION ON THE SPECIFIC TIME FRAMES FOR COMPLIANCE CAN BE OBTAINED BY CONTACTING THE FOLLOWING ORGANIZATION:

BUREAU OF PETROLEUM INSPECTION AND FIRE PROTECTION
P.O. BOX 7969
MADISON, WISCONSIN 53707

I. The Bureau regulates underground and aboveground petroleum product storage tanks. The regulation is based upon:

A. Ind. 8, the Flammable and Combustible Liquids Code, which originated in 1931 and has been updated periodically. The current version was created in 1982.

B. The delegation of the responsibility for implementing the federal EPA tank rules. This delegation was by the Governor and it made the Bureau responsible for:

1. The technical tank standards (design, construction, installation, inspection, removal, testing, and leak detection).

2. The financial responsibility requirements of the federal rules.

NOTE: The DNR based upon state statute is responsible for the part of the Tank program concerning corrective action and cleanup.

C. The issuance of the federal rules preempted a number of the provisions of the state code. Tanks which are federally regulated are now covered by both the state code (Ind. 8) and the federal rules. The tanks covered under the federal regulations are:

1. Underground tanks that store petroleum products or certain hazardous chemicals.

2. The federal rule does exclude some tanks, however, and these are:

a. Farm and residential tanks holding 1,100 gallons or less motor fuel used for noncommercial purposes.
b. Tanks storing heating oil used on the premises where it is stored.
c. Tanks on or above the floor of underground areas, such as basements.
d. Septic tanks, storm and waste water tanks, flow-through process tanks, tanks holding 110 gallons or less and emergency spill and overfill tanks.

D. The federal rules establish a new tank standard which new tanks being installed must meet at time of installation and which existing tanks must meet by 1998. The EPA standard is:

1. Corrosion protection of the tank through the use of a cathodically protected and coated steel tank, a fiberglass tank or a clad tank.

2. Corrosion protection of the lines through the use of cathodically protected and coated steel lines or fiberglass lines.

3. Leak detection for tanks which can include the use of a tank monitor, groundwater monitoring wells, vapor monitoring wells, or for a ten year period inventory control combined with tightness testing.

4. Leak detection for piping. Depending on whether the piping system is pressurized or a suction system, the requirements vary.
   a. Pressurized piping must have a flow restrictor or automatic shutoff device or an alarm system and a monitoring system or annual line testing.
   b. Suction systems that have the check valve at the tank must have a monitoring system or be tested every three years.
   c. Suction systems that have the check valve at the dispenser and inspectable, have no special requirements.

5. Spill and overfill devices.

E. The financial responsibility requirements of the federal rules require that:

1. Non-marketers, with less than 10,000 gallons per month average throughput, have coverage of $500,000 per occurrence and $1,000,000 annual aggregate.

2. Marketers with 1 to 99 tanks and non-marketers not included in #1 have to have coverage of $1,000,000 per occurrence and $1,000,000 annual aggregate.

3. Marketers with more than 100 tanks will have to have $1,000,000 per occurrence and a $2,000,000 annual aggregate.

4. Financial responsibility requirements phase in but by October 26, 1990, all federally regulated tanks are to be covered.

II. To resolve the overlap between the two sets of rules, the Department is in the process of carrying out a rewrite of the state code. The rewrite of the code is accomplished through the use of a code committee made up of members of the regulated community, the public, government and other interested groups.

A. The code committee is responsible for:

1. Reviewing and making changes to a draft which was prepared by the staff of the Division.

2. Reviewing and approving for hearings the final code draft.

3. Considering comments from the public hearings and making decisions on the changes that need to be made in order to respond to the comments.

B. The code committee has completed its initial work and suggested that the draft code be taken to hearing. The Secretary's Office is now reviewing the document and will likely provide their approval for hearings in the near future. If individuals would like to be on the mailing list for a draft of the code, this can be accomplished by sending a post card to:

BUREAU OF PETROLEUM INSPECTION AND FIRE PROTECTION
P.O. BOX 7969
MADISON, WI 53707

III. The new code will be known as ILHR 10 and will accomplish both an updating of the current state regulations and the incorporation of the federal rules. Significant features of the new code are:

A. In Wisconsin we have a statutory mandate to regulate all underground storage tank and those aboveground tanks that are 5,000 gallons in size or larger. We do not have to regulate the tanks to the same degree but we must provide for both fire prevention and groundwater protection.

B. The federally regulated tanks and their requirements will be one subchapter in the code. If you have a federally regulated tank, the requirements will be in that segment. The rules have been maintained substantially as the EPA developed them, however, we have had had to take some steps to make them operational. For example:

1. Although the EPA required site assessments at the closure of federally regulated tanks, they never specified what a site assessment would consist of. We have specified a site assessment process and this will be a part of the code.

2. The EPA exempts smaller farm and residential tanks (1,100 gallons or less) but they never define what is a farm or a residence. We have developed these definitions based upon our existing codes and statutes.

3. Additional information on leak detection methods and requirements are provided to help individuals implement systems.

C. The remaining segments of ILHR 10 will deal with the other tanks and issues that we are required to regulate in Wisconsin. Although it isn't possible to fully describe the new code, it may be helpful to talk about some of the issues and ideas in the document.

1. The enforcement of the new code will be through the Bureau of Petroleum Inspection and Fire Protection and by a system of local program operators.

2. Local program operators will be signed up to provide services for a specified period of time and will be required to maintain a certified inspector. The first offer to operate the program will go to the local fire departments, if they decline the program we will look to other governmental agencies.

3. Local program operators will be responsible for installation inspections, on-going inspections, control of removals and general enforcement. For performing these duties, they will receive 80% of the tank installation inspection fee and 80% of the tank permit fee.

4. The enforcement of the rule will follow the traditional methods of the Department, however, there will be an expanded use of "red tag" authority. Red tag authority allows the Department to close tank systems which present a hazard to life safety or the environment. Red tagging of a system can occur in a number of different ways.

a. Immediate shut down when there is an imminent threat to life safety (uncontrolled release of product).
b. Closure after investigation. This approach allows closure when an investigative effort has concluded that there is reason to believe that a system is leaking. The system would be closed until it is repaired or replaced.
c. Delayed shut down. This action would be taken where there is a long history of code violations. Based upon the failure to correct the violations, the system would be closed. The issue here is that the system is likely to result in a hazard to life safety or the environment.

5. The new code will institute a permit system for federally regulated tanks. A permit must be obtained to maintain a tank in service. The permit would be for 5 years and be priced at $100.

6. Although the EPA has exempted heating oil tanks which have product for use on the premises, the state code has always covered these tanks. The EPA believes that a mistake was made in this exemption and that the larger heating oil tanks should have been covered. The code committee also recognized a risk and additional regulations have been included for heating oil tanks. The regulations will require:

a. Tanks of 4,000 gallons or larger to, over a phase in period, meet the EPA's new tank standard. They would, however, not have to demonstrate financial responsibility or conduct a site assessment at closure.
b. Tanks less 4,000 gallons would have to conduct static testing for leaks on a regularly scheduled basis.

7. The use of aboveground tanks for fueling vehicles has generally not been allowed in Wisconsin. The exceptions to this have been farm, marina and temporary use at construction projects. In the draft of ILHR 10, an expanded use of aboveground fueling is proposed. The code suggests:

a. Fleet use of aboveground tanks would be generally allowed but there would be specific requirements. Many of the requirements are based upon NFPA 30. Some of them are:
(1). Set backs from buildings and property lines.
(2). A liquid tight diking system able to contain 125% of the largest tank's contents.
(3). Piping to be underground, protected against corrosion and treated as pressurized.
(4). Maximum tank size of 10,000 gallons and maximum gallonage on site of 30,000.

b. Retail use of aboveground tanks is also being proposed. The majority of the requirements will be the same as for fleet facilities, however, retail facilities will need to:
(1). Provide for a minimum separation between the tanks and the dispenser.
(2.) Provide for leak detection for the "pressurized" piping.

IV. The Bureau also operates the Petroleum Environmental Cleanup Fund. This fund is designed to assist individuals, with federally regulated underground petroleum product storage tanks and home heating oil tanks, deal with contamination cleanups. The PECFA fund:

1. Provides coverage for federally regulated tanks containing gasoline, kerosene, diesel fuel, aviation fuels, waste oil and other products that the Bureau charges a petroleum inspection fee on. The fund also covers home heating oil tanks but at a reduced dollar level.

2. The fund provides, for covered federally regulated tanks, 100% reimbursement of cleanup costs, after a $5,000 deductible, up to a maximum payout of $195,000. The expenses must be paid and then a claim for reimbursement can be filed with the Bureau. Approval of the cleanup, by the DNR, is also required for a claim to be eligible for reimbursement.

3. The fund also provides limited coverage for home heating oil tanks. For home heating oil tanks there is no deductible but the maximum reimbursement is $7,500.

4. PECFA also makes awards for investigation activities (when no release is found) if the owner/operator is under orders from DILHR or DNR to conduct an investigation. Reimbursement is for 100% of eligible costs incurred.

5. During the life of the program, PECFA has paid 105 claims totalling in excess of 4.2 million.

6. There are a series of legislative proposal now under consideration. These proposals would change the operation and coverage of the program; among the suggested changes are:
a. Expanding coverage to include aboveground tanks. In this proposal, PECFA would cover aboveground tanks for wholesale/retail use, farm and residential tanks over 1,100 gallons and fleet tanks. The law would not cover heating oil tanks where the product was for use on the premises.
b. Expanding coverage to make PECFA a true instrument for meeting the financial responsibility requirements of the EPA rules.