

New England Peach Pest Management Strategic Plan

New England Pest Management Network
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Executive Summary

Peach production contributes \$4,000,000 annually to the New England economy. Peaches are a fragile crop, subject to damage by a variety of insect and disease pests as well as vertebrates.

A panel of New England peach growers, industry representatives, and Extension tree fruit staff met for two days in November 2003 to discuss strategic issues in peach pest management. The group identified and ranked priorities to address research, education, and regulatory needs. The over-riding priority identified by growers at the Peach PMSP meeting was the need to fill critical extension specialist positions in the six states. Key vacancies include plant pathologists in all states and fruit specialists in Connecticut, Rhode Island, and New Hampshire.

Highest Research Priorities

- **Monitoring for plant bug complex**
Tarnished plant bug, oak-hickory bug, and stink bugs are major pest problems for New England growers. Monitoring systems including threshold levels for treatment are needed as this complex of plant bugs currently requires treatment from petal fall up to harvest to prevent losses.
- **Borer mating disruption**
Peach tree borer and lesser peach tree borer are major pest problems in New England. Mating disruption technology could reduce or eliminate the need for insecticide applications during the growing season.
- **Brown rot decisions**
Brown rot management includes orchard sanitation and the application of fungicides starting at bloom and continuing up to harvest. Research that identifies the relationship of weather including temperature (and degree days) and rainfall to infection risk is needed to insure accurate timing of fungicide applications.

Highest Education Priorities

- Maintain specialist staffing and programs in Cooperative Extension
- Develop a peach pest management guide for New England growers
- Develop a grower tool for use in making decisions on treatment for Brown Rot
- Extension programming on disease biology, relationship between weather and infection, impact of sanitation practices, pesticide strategies
- Peach tree short life issues related to borers and canker diseases

- Pest management program for non-bearing peach trees
- Organic peach production recommendations

Highest Regulatory Priorities

- Preserve & maintain currently effective materials, especially organo-phosphates, until effective and safe alternatives are available
- Establish an avenue for effective communication from growers to regulators
- Establishing an effective vehicle for influencing Fish & Game on deer management

I. Introduction

Peaches in New England

The 6 New England States combine to rank 23rd in national production of peaches when these states are viewed as a state-like region. A total of 4,600,000 pounds are harvested in a “normal” year, contributing \$4,000,000 to the New England economy. More importantly, this income represents important cash flow to struggling apple orchards that have incorporated peach production to reduce financial risk. All fruit is intended for the fresh market with most of it sold at retail either directly at the farm stand or to other farm stands.

Peaches are very susceptible to low temperature winter injury to flower buds in particular, but to a lesser extent, to woody tissue. In addition, a variety of insect and disease pests as well as vertebrates are problems for New England growers, who use an Integrated Pest Management approach to managing these pests. Among the practices employed are orchard sanitation, proper pruning, orchard floor management, elimination of outside sources of pests such as “wild” trees and alternative species of plants that support these pests. While these methods support the efficient use of pesticides, they do not eliminate the need for these important orchard management tools. The loss of important pesticide options due to pest resistance, regulatory action, and consumer pressure is a concern for the entire peach industry.

Benefits to the New England Peach Industry

The New England Peach Pest Management Strategic Plan identifies at-risk pesticides and proposes future research, regulatory, and education priorities necessary to establish alternative pest management methods in event of the loss of an important pest management tool. These priorities will be used to inform EPA and state agency decision-makers and help outline a development path for pest management researchers and educators. This information will also be used to document New England peach industry needs in the pursuit of research and education funding. The diversity of pests and the variety of habitats in peach orchards makes New England-specific research and education to establish effective alternative pest management methods necessary. Current pest management programs will be made more effective through implementation of actions proposed in this plan.

The Peach Pest Management Strategic Plan Process

A review group of peach growers, researchers, and industry stakeholders throughout New England met for two days in November of 2003 to develop this strategic plan based on the 2003 New England Peach Profile. Key pests driving pesticide use were identified by the New England Peach Pest Management Tactic survey of growers conducted in 2002 and confirmed by discussion among the PMSP review group.

The group discussed the efficacy and practicality of current pesticides and pest management methods, identified acceptable alternative pest management methods, and listed the necessary research, regulatory action, and education needed to transition toward use of these new methods. The pros and cons of each available option, along with opportunities for new technologies were considered and contingency plans were discussed to prepare for possible future regulatory changes.

II. Summary

A pest-specific profile for each of the major pests identified as key pest problems by New England growers follows. Pest status, pest damage and biology, and current control options are outlined for each of these pests.

Key Peach Pest Strategic Issues

Insects and Mites

Plant Bugs. The plant bugs (tarnished plant bug, oak-hickory bug, and stink bugs) are key insect pests affecting peaches in New England. This population insures an active risk window that spans the entire season from pre-bloom through harvest. Growers have managed these insects primarily through the use of protective sprays. Insect traps are used to time applications.

Plum Curculio. Plum curculio is one of the most significant insects attacking peaches. Plum curculio is considered a difficult pest to monitor and control. Most commercial orchards are free of resident populations and are infested by adults moving in from hedgerows and woodlands.

Oriental Fruit Moth. Oriental fruit moth is a more serious pest problem in southern New England than at the northern production limits of peach. Uncontrolled, this pest can damage up to 100% of fruits but with protective sprays, damage is usually insignificant.

Peach Tree Borer and Lesser Peach Tree Borer. The borers are significant pest problems in New England, leading to reduced peach tree life. Damage is often most troublesome for trees suffering from winter injury or other damage.

European Red Mite (ERM). ERM pressure is highly variable from year to year. Populations are affected by toxicity of several key insecticides to predatory mites.

Diseases

Brown Rot. Brown rot is the most significant fungal pest attacking peach fruits. All New England peach orchards are treated with protective sprays beginning at bloom and continuing up to harvest. This disease can be epidemic in years with favorable environmental conditions.

Peach Scab. Peach scab currently affects about 20% of peach acres in New England because fungicides applied to manage brown rot control this disease as well.

Peach Leaf Curl. Peach leaf curl is an erratic pest problem in New England peach orchards. Since information on this pest is limited, most growers manage this pest with a single protective fungicide dose applied in late autumn or early spring.

X-Disease. X-disease is a cyclic, but often extremely destructive disease problem in New England peach orchards. Growers manage this pest by eradicating both infected peach trees and nearby wild choke cherry which serves as the alternate host. Antibiotic injection has been effective in controlling symptoms in infected trees, but its use is not generally available to grower.

Weeds

Annual Grasses and Broadleaf Weeds. Control of annual grasses and broadleaf weeds has shifted from a primary focus on soil-applied, pre-emergence herbicides to an increasing reliance on the use of post-emergence application of both selective and non-selective herbicides.

Perennial Grasses. The perennial grass Quackgrass is perhaps the most important weed species affecting peach and other tree fruits in New England. Control is achieved with post-emergence application of systemic herbicides.

Perennial Woody Weeds. Poison Ivy, wild raspberry, and other woody species will populate under-tree areas when annual grasses and broadleaf weeds and perennial grasses are managed. These can serve as hosts for pests that attack peach trees and interfere with harvest and other orchard management tasks.

Vertebrate and other pests

Voles. Rodenticides as a supplement to mowing and other ground cover management are important components of most vole management programs. Cultural controls including mowing, use of herbicides under-tree, and vole guards greatly reduce the need for rodenticide application.

Deer. New England peach growers manage deer primarily through the use of exclusionary fencing. In light deer pressure situations, taste and odor repellents are employed.

Strategic Issues of Specific Pest Management Tactics

Insecticides, Miticides

abamectin, bifenazate, clofentazine, fenbutatin-oxide, hexythiazox, pyridaben (mites)

- Valuable in a rotation program for resistance management.

azadirachtin (plant bugs, plum curculio, Oriental fruit moth, borers)

- Very limited experience in New England
- OMRI certified

azinphos methyl (plum curculio, oriental fruit moth)

- Widely used for management of plum curculio, applications which also give fair to good control of oriental fruit moth and limited control of plant bugs

carbaryl (plum curculio, Oriental fruit moth)

- Only fair control
- High toxicity to bees
- Tougher on mite predators than organo-phosphates

chlorpyrifos (borers)

- Single application per season gives good control
- Penetrates bark

difocol (mites)

- Mite resistance to this material is not stable but declines over time.

esfenvalerate (effective for plum curculio, plant bugs, oriental fruit moth, and borers)

- Very rough on mite predators
- Little use in New England peach orchards

endosulfan (plant bugs, borers)

- Limited pest control spectrum
- Effective for borers but only fair for plant bugs

imidacloprid

- Effective for plant bugs close to harvest
- Generally soft on predators
- Manages Japanese Beetle

kaolin clay (plum curculio, plant bugs)

- Concern about possible aluminum content
- Difficult to maintain uniform coverage during rainy periods
- Efficacy not documented in New England peach orchards
- OMRI certified

methomyl (plant bugs)

- Tough on predators, but effective, even at low rates

oil (mites)

- Very important to IPM programs.
- The first defense against European Red Mite

permethrin (effective for plum curculio, plant bugs, oriental fruit moth, and borers)

- Risk to mite predator population can lead to increased risk of European Red Mite pressure when used

pheromone ties (borers, Oriental fruit moth)

- May give season long control
- Limited experience in New England

phosmet (plum curculio, oriental fruit moth)

- Critical material in IPM programs, especially in event of azinphos methyl loss
- Widely used for management of plum curculio which results in management of oriental fruit moth

pyrethrin + rotenone (Oriental fruit moth, plum curculio, borers)

- Very limited experience in New England.

Fungicides, Bactericides

azoxystrobin (brown rot, peach scab)

- Apple phytotoxicity risk if same sprayer used for that crop or if drift occurs
- Limited New England experience

captan (brown rot, peach scab)

- Important in disease resistance management
- Generally used in combination or rotation with other materials
- Phytotoxicity risk for peach leaves
- Not used close to oil application due to phytotoxicity risk

chlorothalonil (brown rot, peach leaf curl)

- For brown rot, limited to blossom phase only
- Effective for peach leaf curl

copper hydroxide (peach leaf curl)

- Fair to good control of peach leaf curl
- Reduced phytotoxicity compared to copper sulfate

copper sulfate (peach leaf curl, bacterial spot)

- Fair to good control of peach leaf curl; fair control of bacterial spot
- OMRI certified

cyprodinil (brown rot)

- Limited New England experience

fenbuconazole (brown rot, peach scab)

- Good fungicide if no resistance present.
- Should be used in a rotation with other fungicides

fenhexamid (brown rot)

- Fair to good control
- Must practice resistance management strategy

ferbam (peach leaf curl)

- Good control of peach leaf curl
- Leaves unsightly residue

myclobutanil (brown rot, peach scab)

- Rated as effective but limited New England use

oxytetracycline (X-disease, bacterial spot)

- Special training needed to purchase and use for trunk injection (X-disease)
- Annual treatment may be necessary for control of X-disease
- Non effective for X-disease when symptoms throughout canopy
- Good control of bacterial spot
- Must be applied based on weather model prediction of infection risk for bacterial spot

propiconazole (brown rot)

- Effective but must be managed to prevent pest tolerance

sulfur (brown rot, peach scab)

- Provides only fair control
- Toxic to beneficial insects and mites and earthworms

tebuconazole (brown rot)

- Rated as effective but limited New England experience
- Must practice resistance management strategy

triflozystrobin (brown rot, peach scab)

- Limited New England experience
- Must practice resistance management strategy

thiophanate methyl (brown rot, peach scab)

- Pest tolerance is a major problem in some orchards
- Used in tank mixes with other fungicides

ziram (peach leaf curl)

- Good control of peach leaf curl
- Heavy residue

Herbicides

Pre-emergent Group

dichlobenil (annual grasses, broadleaf weeds)

- Application in dormant season only
- High leach risk on soils with very low organic matter
- Quickly lost if applied to warm soils

diuron (annual grasses, broadleaf weeds)

- High leaching risk on low organic matter or sandy soils
- Can cause injury to peach trees if organic matter in soil less than 1%

napropamide (annual grasses)

- High leaching risk on low organic matter soils
- Must be incorporated into soil by shallow cultivation or water within 24 hours of application to reduce photo-degradation

norflurazon (annual grasses)

- High leaching risk on low organic matter soils
- High organic matter can reduce activity

oryzalin (annual grasses)

- Often tank mixed with simazine to improve weed control spectrum

oxyflurazon (broadleaf weeds)

- Use limited to dormant season only

pendimethalin (annual grasses)

- Can be used on non-bearing trees only

pronamide (annual grasses)

- Use limited to dormant season only
- High organic matter and leaf litter limit effectiveness

simazine (annual grasses, broadleaf weeds)

- Not recommended on sandy or sandy loam soils low in organic matter

terbacil (annual grasses, broadleaf weeds)

- High leaching potential
- Can cause injury to peach trees if used on trees established less than 3 years

Post-emergent Group

clethodim (annual grasses, perennial grasses)

For use on non-bearing peach trees only

fluazifop-butyl (annual grasses, perennial grasses)

- Applied to actively growing grasses
- A single application will generally not kill perennial grasses

glyphosate (annual grasses and broadleaf weeds, perennial grasses and broadleaf weeds, woody weeds)

For use with wiper equipment only

Very effective against hard to control woody weeds

paraquat (annual grasses and broadleaf weeds, perennial grasses and broadleaf weeds)

Tree must be shielded from spray

Apply during active weed growth

sethoxydim (annual grasses)

- Non-bearing trees only

Vertebrate and other pests

ammonium salts of C8-18 and C18' fatty acids (deer)

- Very limited effectiveness

putrescent whole egg solids (deer)

- Very limited effectiveness

thiram (deer, rabbits, voles)

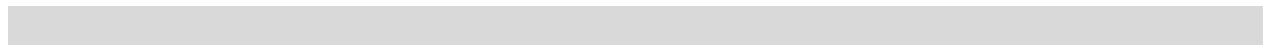
- Some limited control
- Skin irritant for some people

zinc phosphide bait (voles)

Effective

Water inactivates, limiting off-target species risk

Broadcast works only for meadow vole



Research, Education, and Regulatory Priorities

Highest Research Priorities

- Monitoring for plant bug complex
Tarnished plant bug, oak-hickory bug, and stink bugs are major pest problems for New England growers. Monitoring systems including threshold levels for treatment are needed as this complex of plant bugs currently requires treatment from petal fall up to harvest to prevent losses.
- Borer mating disruption
Peach tree borer and lesser peach tree borer are major pest problems in New England. Mating disruption technology could reduce or eliminate the need for insecticide applications during the growing season.
- Brown rot decisions
Brown rot management includes orchard sanitation and the application of fungicides starting at bloom and continuing up to harvest. Research that identifies the relationship of weather including temperature (and degree days) and rainfall to infection risk is needed to insure accurate timing of fungicide applications.

Other research priorities

- Efficacy trials for new pest control materials
- Development of thresholds for management of European Red Mite
- Organic peach production research
- The impact of orchard floor composition and management on plant bugs, borers, mites, and voles
- The oriental fruit moth – distribution and importance in New England, treatments, appropriate timing, mating disruption
- New treatments for X-disease
- Development of a treatment threshold for Peach Leaf Curl
- Bio-control for stink bugs
- Evaluate cultivars for Bacterial Spot variety resistance (early, mid-season, and late varieties with good horticultural characteristics as well)
- Vole bait-station density research
- Site attributes relative to brushy borders and nearby pest sinks on insect and disease management
- Spray program for non-bearing peaches
- Other effects of materials applied for pest management including positive effects (e.g. nutrients) and negative effects (impacts on beneficial insects and mites in the orchard)
- Plum curculio – treatment guidelines for making the second application (including if needed)


Highest Education Priorities

- Maintain specialist staffing and programs in Cooperative Extension
- Develop a peach pest management guide for New England growers
- Develop a grower tool for use in making decisions on treatment for Brown Rot
- Extension programming on disease biology, relationship between weather and infection, impact of sanitation practices, pesticide strategies
- Peach tree short life issues related to borers and canker diseases
- Pest management program for non-bearing peach trees
- Organic peach production recommendations

Highest Regulatory Priorities

- Preserve & maintain currently effective materials, especially organo-phosphates, until effective and safe alternatives are available
- Establish an avenue for effective communication from growers to regulators
- Establishing an effective vehicle for influencing Fish & Game on deer management

Other regulatory priorities

- Development of a cost-sharing program to increase use of desirable (low risk) but costly new materials
 - Reducing problem REI's such as those for captan and the organo-phosphates that make timely harvest and field work such as hand thinning difficult
 - Determination and certification that we are plum pox free
 - Maintenance of EBDC fungicides for peach tree manganese & zinc nutrition needs
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Strategic Issues for Key Pests

Insects and Mites

1. Tarnished Plant Bug-Oak Hickory Bug-Stink Bug Complex

- **Acres Affected:** All (Total crop loss possible if not managed – due to cat-facing injury primarily); every season and every orchard; come sequentially, causing season-long risk
- **Yield Losses:** 10% when a full-season control program is employed (most damaged fruits are removed during thinning operation, increasing hand thinning costs); 100% if not controlled
- **Pest Migration:** Plant bugs move into orchard throughout the season, requiring repeat applications to control new orchard populations
- **Honey Bee Risk:** A critical control time for tarnished plant bug is about bloom so there is some risk to bees. Tarnished plant bug activity during bloom will thin bloom rather than result in cat-facing damage to fruits.

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
permethrin (Ambush, Pounce)	Very effective	<ul style="list-style-type: none"> • Can be used at reduced rate with organo-phosphate • Less expensive • Manages plum curculio 	<ul style="list-style-type: none"> • Mite outbreaks are a risk due to bio-control disruption • Subject to FQPA review 	<ul style="list-style-type: none"> • Sometimes used in combination with Guthion
esfenvalerate (Asana)	Very effective	<ul style="list-style-type: none"> • Long residual • Less expensive • Manages plum curculio 	<ul style="list-style-type: none"> • Mite predator toxicity is a real problem 	<ul style="list-style-type: none"> • Mite predator toxicity may not be an issue if used pre- petal fall
formetanate HCl (Carzol)	NA	<ul style="list-style-type: none"> • Quick knockdown 	<ul style="list-style-type: none"> • Very rough on mite predators • Very expensive • Human risk • Up through petal fall only 	
azinphos-methyl (Guthion)	Fair to good	<ul style="list-style-type: none"> • Soft on predators • Less expensive • Manages plum curculio 	<ul style="list-style-type: none"> • Plant bug resistance to organo-phosphates can be an issue • Label restrictions (14 day REI) EPA SARA Title 3 list 	

imidacloprid (Provado)	Effective	<ul style="list-style-type: none"> • Effective on late season stink bug • 0 PHI • Manages Japanese beetles • Lower human toxicity • Generally soft on predators 	<ul style="list-style-type: none"> • Extremely expensive but effective • Bee toxicity 	<ul style="list-style-type: none"> • Lack of knowledge
phosmet (Imidan)	Fair	<ul style="list-style-type: none"> • Soft on predators • Used for curculio • Less expensive • 48 hour re-entry (current) • Lower applicator risk than azinphos-methyl • Manages plum curculio 	<ul style="list-style-type: none"> • EPA SARA Title 3 list 	
permethrin + azinphos-methyl (Ambush plus Guthion)	Very effective	<ul style="list-style-type: none"> • Reduced rates of each (0.33 Ambush, full rate Guthion or Imidan) 	<ul style="list-style-type: none"> • Rough on mite predators • Human toxicity 	
permethrin + phosmet (Ambush plus Imidan)	Very effective	<ul style="list-style-type: none"> • Reduced rates of each (0.33 Ambush, full rate Guthion or Imidan) 	<ul style="list-style-type: none"> • Rough on mite predators • Human toxicity 	
methomyl (Lannate)	Very effective	<ul style="list-style-type: none"> • May be effective at low rates 	<ul style="list-style-type: none"> • High human toxicity • Tough on predators • EPA FQPA issues • Short residual • Expensive at full rate 	
endosulfan (Thiodan, Phaser)	Fair		<ul style="list-style-type: none"> • Short residual • High human toxicity • Stinks • Limited pest control spectrum 	
kaolin clay (Surround)	NA	<ul style="list-style-type: none"> • Improved fruit color • OMRI approved 	<ul style="list-style-type: none"> • Difficult to maintain good coverage • Visible residue on fruit at harvest • Improves environment for San Jose scale buildup 	<ul style="list-style-type: none"> • Unproven in NE

azadirachtin (Aza-Direct, Neemix, Align)	NA	• OMRI approved	• Short residual	• Unproven in NE
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Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Management of alternative hosts	Reduces local population	Labor intensive Often located off property Does not preclude need to treat with insecticide	Alfalfa, lambs quarters & redroot pigweed are alternate hosts for tarnished plant bug Red oaks support oak-hickory bug population Ground cover research needed Incorporate cover crops pre-bloom
Trap Cropping	Offers potential to treat with registered pesticides off-site	Unproven	Work with strawberry using lamb quarters as trap crop for tarnished plant bug in Quebec promising
Intensive hand thinning	Insures high quality	Labor costs are high REI's for organo-phosphates delays hand thinning past optimum time	Growers remove insect damaged fruits when hand thinning
Monitoring	White and Pink traps will give idea of population trends but trap catches are not correlated to damage (tarnished plant bug, oak-hickory bug)	Time requirement Cost Need valid data for time spent No monitoring for stink bug	There is currently no monitoring strategy and/or threshold established
Clean cultivation	TPB control Water and weed management	Soil compaction Soil erosion Cold temperature injury to roots Calcium nutrition long term Root injury Early bloom – frost risk	

Research Needs:

- Define the impact of cover crop species and management on plant bug populations
- Develop monitoring systems for tarnished plant bug, oak-hickory bug, and sting bugs and develop action thresholds based on trap catch numbers
- Conduct efficacy trials for new materials as potential replacements for organo-phosphates and pyrethroids
- Determine the effect of orchard border composition on population and immigration of plant bugs
- Develop a best management plan for the plant bug complex that has the least impact on predaceous mites

Regulatory Needs:

- Expanded labeling for materials determined to be effective against plant bugs on peach
- Pursue Section 18, emergency registration requests (for New England as a state like region) for materials like Actara

Education Needs:

- Best management plan for management of pests with least impact on beneficial insects and mites and the environment
- Weed control (broadleaf) as part of an overall orchard floor management program

2. Plum Curculio

- **Acres Affected:** All
- **Yield Losses:** If not treated, yield loss of 100% is possible; with normal pesticide treatments, damage ranges from 0-5% - most damaged fruit is removed by labor intensive, hand thinning

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
azadirachtin (Aza-direct, Neemix, Azatin)	Not effective	<ul style="list-style-type: none"> • OMRI approved 	<ul style="list-style-type: none"> • Short residual 	Limited peach experience in NE
azinphos-methyl (Guthion)	Very Effective	Effective <ul style="list-style-type: none"> • Soft on predators • Less expensive 	Difficulty with hand thinning timing due to 14 day REI <ul style="list-style-type: none"> • FQPA review • EPA SARA Title 3 list 	
carbaryl (Sevin)	Fair	<ul style="list-style-type: none"> • Short residual 	<ul style="list-style-type: none"> • Harder on mite predators than organo-phosphates • High bee toxicity • Short residual 	<ul style="list-style-type: none"> • Little used
esfenvalerate (Asana)	Good	<ul style="list-style-type: none"> • Long residual • Less expensive • Manages plum curculio 	<ul style="list-style-type: none"> • Mite predator toxicity is a real problem 	Limited experience in NE
kaolin clay (Surround)	Fair	<ul style="list-style-type: none"> • Improved fruit color • OMRI approved 	<ul style="list-style-type: none"> • Difficult to achieve uniform coverage above • Expensive for full label rate 	Limited peach experience in NE
permethrin (Ambush, Pounce)	Good	<ul style="list-style-type: none"> • Can be used at reduced rate with organo-phosphate • Less expensive • Manages plum curculio 	<ul style="list-style-type: none"> • Mite outbreaks due to biocontrols disruption • Subject to FQPA review 	Limited experience in NE
phosmet (Imidan)	Good	<ul style="list-style-type: none"> • Soft on predators • Used for TPB • Less expensive • 48 hour re-entry (current) • Lower human toxicity than 	<ul style="list-style-type: none"> • FQPA review • EPA SARA Title 3 list • Less residual than azinphos-methyl 	

		azinphos-methyl		
pyrethrin + rotenone (Pyrellin)	Poor	<ul style="list-style-type: none"> • OMRI certified 	<ul style="list-style-type: none"> • Short residual • Environmental and human toxicity concerns • Expensive 	Limited experience in NE

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Monitoring	Helps with timing of re-spray Defines how long to maintain protection	Limb beating does not give sufficient lead time to predict damage Time consuming	Peach protected until shuck split (about 1-2 weeks after peach petal fall) No practical monitoring method
Hand thinning		Ineffective as a control measure	

Research Needs:

- Apple plum curculio trap tree and border spray research needs to be tested on peaches
- Efficacy trials for Avaunt and other alternatives to organo-phosphates and pyrethroids are needed

Regulatory Needs:

- Need to preserve organo-phosphates or other effective, non-disruptive, compatible substitute
- Pursue registration for organo-phosphate alternatives

Education Needs:

Grower education on use of plum curculio trapping and border spray system for plum curculio management

3. Oriental Fruit Moth

- **Acres Affected:** 0-50% depending on location. Higher in more southern locations.
- **Yield Losses:** Without control: 0-100% depending on location. With aggressive control, <1%
- Current sprays for other pests (TPB and PC) provide control, but switch to more specific controls for those other pests could expose peaches to OFM damage
- Damage in apples has increased in recent years which might indicate an increasing threat to peaches
- Requires repeated applications, especially with short residual insecticides

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
azadirachtin (Aza-direct, Neemix, Azatin)	Fair	<ul style="list-style-type: none"> • OMRI approved 	<ul style="list-style-type: none"> • Short residual 	<ul style="list-style-type: none"> • Limited experience in New England
azinphos-methyl (Guthion)	Fair to good	Effective <ul style="list-style-type: none"> • Soft on predators • Less expensive 	Difficulty with timing of hand thinning due to 14 day REI <ul style="list-style-type: none"> • EPA SARA Title 3 list 	
carbaryl (Sevin)	fair	<ul style="list-style-type: none"> • Might get Japanese beetle in 2nd and 3rd generation oriental fruit moth sprays 	<ul style="list-style-type: none"> • Short residual would require additional applications • Toxicity to bees is high 	
esfenvalerate (Asana)	Good	<ul style="list-style-type: none"> • Long residual • Less expensive • Manages plum curculio 	<ul style="list-style-type: none"> • Mite outbreaks due to biocontrols disruption, especially with summer timing against 2nd and 3rd generations 	
kaolin clay (Surround)	Fair	<ul style="list-style-type: none"> • Improved fruit color • OMRI approved 	<ul style="list-style-type: none"> • Difficult to achieve uniform coverage above • Expensive for full label rate 	<ul style="list-style-type: none"> • Limited experience in New England
permethrin (Ambush, Pounce)	Good	<ul style="list-style-type: none"> • Can be used at reduced rate with organo-phosphate • Less expensive 	<ul style="list-style-type: none"> • Mite outbreaks can occur due to biocontrols disruption 	<ul style="list-style-type: none"> • Limited experience in NE

		Manages plum curculio	subject to FQPA review	
pheromones (Isomate)	Fair to good	<ul style="list-style-type: none"> • Not disruptive • May give long-term control (90 day) 	<ul style="list-style-type: none"> • Requires minimum orchard size (3-5 acres), small orchard size in New England works against this labor intensive, material costing much more than insecticide • Narrow spectrum still leaves need for insecticide sprays for other pests at same time 	<ul style="list-style-type: none"> • Limited experience in New England • Requires low initial population to be effective
phosmet (Imidan)	Fair to good	<ul style="list-style-type: none"> • Soft on predators • Used for TPB • Less expensive • 48 hour re-entry (current) • Lower human toxicity than azinphos-methyl 	<ul style="list-style-type: none"> • FQPA review • EPA SARA Title 3 list • Less residual than azinphos-methyl 	
pyrethrin + rotenone (Pyrellin)	Fair	<ul style="list-style-type: none"> • OMRI certified 	<ul style="list-style-type: none"> • Short residual • Environmental and human toxicity concerns • Expensive 	<ul style="list-style-type: none"> • Limited experience in New England

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Monitoring for timing (pheromone or crop stage biofix followed by degree day accumulation)	Gives early notice of optimum timing		
Monitoring for presence (abundance) - shoot			Not typically done because of status as relatively minor pest

inspection around shuck split			
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Research Needs:

- Need to determine current geographic distribution and population density in New England using a regional trap
- Determine if mating disruption strategies are effective on the smaller orchards common in New England
- Determine status of resistance of pest to common insecticides in use in New England peach orchards

Regulatory Needs:

- Need to preserve effective controls

Education Needs:

- Growers need education about this pest as possible increasing risk, specifically of how to evaluate shoot flagging at shuck split as an indicator of Oriental Fruit Moth damage.

4. Peach Tree Borer, Lesser Peach Tree Borer

- **Acres Affected:** All acres are at risk. Risk is higher in southern New England.
- **Yield Losses:** Loss is tree death, not just a one year crop loss. Without control, up to 100% tree loss will occur over several years at a given location
- **Lesser Peach Tree Borer Interaction with cytospora canker:** adults are attracted to and lay eggs in damaged tissue

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
azadirachtin (Aza-direct, Neemix, Azatin)	Fair	<ul style="list-style-type: none"> • OMRI approved 	<ul style="list-style-type: none"> • Short residual 	<ul style="list-style-type: none"> • No experience in NE
azinphos-methyl (Guthion)	Not effective (Fair on adults only)	No incentive to use pyrethroids due to efficacy against plum curculio <ul style="list-style-type: none"> • Soft on predators Less expensive than other choices Controls other pests	Difficulty with hand thinning timing due to 14 day REI Resistance reported in NJ EPA SARA Title 3 list Repeat applications are required	Not used in New England because not as long lasting or as effective as chlorpyrifos. Requires multiple applications vs. single spray of chlorpyrifos.
carbaryl (Sevin)	Poor	<ul style="list-style-type: none"> • Might get Japanese beetle in 2nd and 3rd generation Oriental Fruit Moth sprays 	<ul style="list-style-type: none"> • Short residual would require additional applications needed • Highly toxic to bees 	<ul style="list-style-type: none"> • Not used in NE
chlorpyrifos (Lorsban)	Effective	<ul style="list-style-type: none"> • Best control available • Single spray gives year long control • Penetrates into bark • Flexible timing for application 	<ul style="list-style-type: none"> • As an organo-phosphate, continued registration status is questionable • Hand gun application required is more labor intensive • Applicator safety 	<ul style="list-style-type: none"> • Trunk spray not allowed to contact fruit
esfenvalerate (Asana)	Good	<ul style="list-style-type: none"> • Long residual • Less expensive 	<ul style="list-style-type: none"> • Mite predator toxicity is a real problem, especially with summer timing against 2nd and 3rd generation 	<ul style="list-style-type: none"> • Not used in New England because not as long lasting or as effective as chlorpyrifos. • Requires multiple applications vs.

				single spray of chlorpyrifos.
kaolin clay (Surround)	NA	<ul style="list-style-type: none"> • May improve fruit color • OMRI approved 	<ul style="list-style-type: none"> • Difficult to maintain uniform coverage • Expensive • Requires many applications 	<ul style="list-style-type: none"> • Very limited use in New England
permethrin (Ambush, Pounce)	Good	<ul style="list-style-type: none"> • Long residual • Less expensive 	<ul style="list-style-type: none"> • Mite outbreaks due to disruption of bio-controls, especially with summer timing against 2nd and 3rd generation 	<p>Not used in New England because not as long lasting or as effective as chlorpyrifos</p> <p>Requires multiple applications vs. single spray of chlorpyrifos</p>
pheromone ties (Isomate)	Good	<ul style="list-style-type: none"> • Comparable cost to insecticide spray • Applicator safety • No fruit residue concerns as with insecticide 	<ul style="list-style-type: none"> • Labor requirement somewhat higher than handgun spray 	<ul style="list-style-type: none"> • Little experience in New England • Concerns about efficacy under high pressure and variability
phosmet (Imidan)	Not effective	<ul style="list-style-type: none"> • Soft on predators • Used for tarnished plant bug • Less expensive • 48 hour re-entry (current) • Lower human risk than azinphos-methyl 	<p>Requires specific timing and repeat applications</p> <p>High rate required</p> <ul style="list-style-type: none"> • EPA SARA Title 3 list <p>Less residual than azinphos-methyl</p>	<p>Not used in New England because not as long lasting or as effective as chlorpyrifos</p> <p>Requires multiple applications vs. single spray of chlorpyrifos.</p>
pyrethrin + rotenone (Pyrellin)	Un-known	<ul style="list-style-type: none"> • OMRI approved 		<ul style="list-style-type: none"> • Not used in NE
endosulfan (Thiodan)	Good		<ul style="list-style-type: none"> • Short residual • High human toxicity • Stinks • Limited pest control spectrum 	<ul style="list-style-type: none"> • Can be used as root dip • Not used in New England because not as long lasting or as effective as chlorpyrifos • Requires multiple applications vs.

				single spray of chlorpyrifos
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Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Latex paint	Winter damage protection for trunk	Offers only partial control	Contributes to control but is not a stand alone practice
Weed control	Being done for horticultural reasons	Would require more intensive weed control than horticultural needs alone would dictate Requires increased herbicide use	Contributes to control but is not a stand alone practice
Monitoring (trunk inspection)	Effective	Time consuming	
Monitoring – pheromone trap	Presence/absence Helps with timing of insecticide application against adults		

Research Needs:

- Mating disruption validation needed, especially for small sized peach block

Regulatory Needs:

- Keep Lorsban available for trunk application

Education Needs:

- Education on the value of root dips with Lorsban for new plantings
- Opportunity for mating disruption using pheromone ties
- General education - Extension needs to distinguish between these two species (and also peach tree bark borers) in education and control recommendations.

5. European Red Mite

- **Acres Affected:** Highly variable between locations and between years at a given location. Best estimate is 5-25% of acreage affected in a given year.
- **Yield Losses:** Damage hard to quantify
- **Affected by use of predator damaging pesticides**

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
bifenazate (Acramite)		<ul style="list-style-type: none"> • Not disruptive to beneficial arthropods • Long residual • Provides alternative for miticide resistance management 	<ul style="list-style-type: none"> • Expensive • Moderate bee toxicity 	<ul style="list-style-type: none"> • Little experience on peach in NE • Presumed effective because of efficacy against ERM on apples
clofentezine (Apollo)	Good	<ul style="list-style-type: none"> • Not disruptive to beneficial arthropods • Long residual • Provides alternative for miticide resistance management 	<ul style="list-style-type: none"> • Expensive • Not effective against adults, so is not a rescue treatment • Resistance concern. Cross resistant with Savey. 	
fenbutatin-oxide (Vendex)	Good	<ul style="list-style-type: none"> • Less expensive • Provides alternative for miticide resistance management 	<ul style="list-style-type: none"> • Slow acting, esp. with cool temperatures • Resistance concern 	
hexythiazox (Savey)	Good	<ul style="list-style-type: none"> • Not disruptive to beneficial arthropods • Long residual • Provides alternative for miticide resistance management 	<ul style="list-style-type: none"> • Expensive • Not effective against adults, so is not a rescue treatment • Resistance concern. Cross resistant with Apollo. 	
oil	Effective	<ul style="list-style-type: none"> • Not disruptive to beneficial species • Less expensive • Effective on scale insects 	<ul style="list-style-type: none"> • Proper timing required to avoid phytotoxicity • Time consuming compared to other sprays • Early season timing can damage orchard floor in wet 	

			year	
pyridaben (Pyramite)	Good	<ul style="list-style-type: none"> • Effective as rescue treatment against adults 	<ul style="list-style-type: none"> • Bee toxicity • Moderately disruptive 	

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Bio control (natural predation)			Adversely affected by pesticide sprays – pyrethroids and perhaps also sulfur.

Research Needs:

- The relationship between pest density and damage needs to be clarified
- Need threshold definitions for peach
- Variety differences need to be addressed

Regulatory Needs:

- Need to maintain pesticide choices

Education Needs:

- None identified

Key Diseases

1. Brown Rot

- **Acres Affected:** 100% of acres
- **Yield Losses:** 100% non controlled, 1% if managed (10% in a bad year)

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
azoxystrobin (Abound)	Un-known		<ul style="list-style-type: none"> • Apple phytotoxicity risk from sprayer contamination or drift 	<ul style="list-style-type: none"> • Limited New England experience
captan (Captan, Captec)	Good	Tank mix with sterol inhibitors Inexpensive	4 day REI Oil risk (phytotoxicity) Phytotoxicity risk for leaves Skin sensitivity	Under high pressure not the best; also gets scab
chlorothalonil (Bravo, Echo)	Good	Good retention Fits rotation strategies	Label limits use Expensive Only blossom phase	
fenbuconazole (Indar)	Effective		<ul style="list-style-type: none"> • Resistance issues • Expensive 	<ul style="list-style-type: none"> • Activity against scab
fenhexamid (Elevate)	Fair-good	New chemistry – fits in resistance strategy	<ul style="list-style-type: none"> • Must employ resistance management strategy 	
propiconazole (Orbit)	Effective		<ul style="list-style-type: none"> • Expensive • Resistance issues • 	
tebuconazole (Elite)	Effective		<ul style="list-style-type: none"> • Resistance mgt • NE experience lacking • Expensive 	
thiophanate-methyl (Topsin)	Variable	<ul style="list-style-type: none"> • Moderately expensive • Effective if pest population not resistant 	<ul style="list-style-type: none"> • Tank mix with captan to reduce resistance development 	<ul style="list-style-type: none"> • Activity against scab
sulfur (various products)	Fair	<ul style="list-style-type: none"> • OMRI • Good for low pest pressure • Suppresses mites • Inexpensive 	<ul style="list-style-type: none"> • Need to use low water volumes or phytotoxicity • Toxic to beneficial insects and mites (including mite predators) 	<ul style="list-style-type: none"> • May reduce earthworm populations • Tank mix with other fungicides to reduce resistance

				buildup
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Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Pruning	Is done annually already	Contributes, but will not control	
Sanitation	Removal of pruning brush and mummies	Contributes, but will not control	
Elimination of wild sources		Contributes, but will not control	

Research Needs:

- Need to establish the relationship of weather to risk of infection

Regulatory Needs:

- None identified

Education Needs:

- Need plant pathologists in New England
- Appropriate timing of sprays
- A New England Peach Pest Management guide is needed for grower use

2. Peach Scab

- **Acres at risk:** 20% (could be 100 except brown rot materials keep in check)
- **Yield Losses:** currently 0-2%
- Limited New England experience with respect to scab – it over-winters in the tree but we do not know if winter temperatures kill it in New England
- Brown rot controls generally control peach scab

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
captan (Captan, Captec)	Effective	Tank mix with sterol inhibitor fungicides Relatively inexpensive	4 day reentry Phytotoxicity risk if used close to oil Phytotoxicity risk for leaves Skin sensitivity	
fenbuconazole (Indar)	Good		<ul style="list-style-type: none"> • Resistance issues • Expensive 	
sulfur	Fair	<ul style="list-style-type: none"> • OMRI • Good for low pest pressure • Suppresses mites • cheap 	<ul style="list-style-type: none"> • Need to use low water volumes to limit phytotoxicity risk • Toxic to beneficial insects and mites (including mite predators) 	<ul style="list-style-type: none"> • May reduce earthworm populations
thiophanate-methyl (Topsin)	Effective	<ul style="list-style-type: none"> • Moderately expensive 	<ul style="list-style-type: none"> • Tank mix with captan to reduce resistance development 	

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
None			

Research Needs:

- Need to accurately define the biology of this pest in New England

Regulatory Needs:

- Preserve critical brown rot materials (captan which is essential in resistance management programs)

Education Needs:

- Growers need to know the biology of this pest in New England

3. Peach Leaf Curl

- **Acres Affected:** 100%
- **Yield Losses:** If controlled – slight to none; if uncontrolled up to 60%
- Loss affects current and next year's growth and crop due to reduced growth

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
chlorothalonil (Bravo, Echo)	Effective	Good retention Fits rotation strategies	Label limits use Expensive	Narrow window for application
copper sulfate (C-O-C-S)	Fair-Good	Cheap Supplies copper OMRI certified		Narrow window for application
copper hydroxide (Kocide)	Effective	<ul style="list-style-type: none">• Reduced phytotoxicity compared to copper sulfate• Inexpensive• Supplies copper		Narrow window for application
Ferbam	Effective	<ul style="list-style-type: none">• Inexpensive	<ul style="list-style-type: none">• Leaves unsightly residue	Narrow window for application
Ziram	Good		<ul style="list-style-type: none">• Heavy residue	Registration future

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Keep trees vigorous			

Research Needs:

- Determine efficacy of biological control materials such as Serenade

Regulatory Needs:

- None identified

Education Needs:

- Proper timing of pesticide applications

4. X-Disease

- **Acres Affected:** 100%
- **Yield Losses:** If controlled – slight to none; if uncontrolled up to 100% - kills tree

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
oxytetra-cylene (Mycoshield)	Effective		Need special training Tree must be healthy enough to take it up	

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
• Kill choke cherries in vicinity of orchard		Need Roundup or Touchdown to insure complete kill	
• Plant peaches in center of apple orchard	<ul style="list-style-type: none"> • May control vector • Isolates from chokecherries 		

Research Needs:

- Determine how far from orchard edge we must control choke cherry to effect control of X-disease

Regulatory Needs:

- Need to keep access to oxytetracycline

Education Needs:

- Special education needed to use oxytetracycline

:

5. Bacterial Spot

- **Acres Affected:** Differences among varieties affects level of damage
- **Yield Losses:** Not identified

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
copper sulfate (C-O-C-S)	Fair		MAY be effective	
mycoshield (oxytetracycline)	Good		Must be monitoring weather and risk and be ready to respond Very expensive	Plums serve as source

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Use resistant cultivars			

Research Needs:

- Efficacy trials on the use of biologicals such as Serenade

Regulatory Needs:

- None identified

Education Needs:

- Identification of resistant cultivars that meet grower market needs

6. Cankers

- **Acres Affected:** 100%
- **Yield Losses:** If controlled – slight to none; contributes to short tree life (3 year recovery minimum)

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
None				

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Proper attention to crotch angles (pruning and training)	Extends tree life May reduce borer injury		
Canker removal and burning	Removes source	labor intensive (skilled)	

Research Needs:

- Determine if there are any pesticides effective against cankers
- Determine the relationship between Cytospora canker and borers

Regulatory Needs:

- None identified

Education Needs:

- Proper pruning and training
- Plant pathologists needed in New England states

Weeds

1. Annual Grasses and Broadleaf Weeds, Pre-emergence

- **Acres Affected:** All
- **Yield Losses:** Tree growth is directly related to weed pressure under tree. If weeds under tree are not controlled, tree growth and yields will suffer up to 80%.

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
dichlobenil (Casoron)	Effective	<ul style="list-style-type: none"> • Grasses & broadleaf weeds 	Very expensive	Must apply during dormant season
diuron (Direx, Karmex)	Effective	<ul style="list-style-type: none"> • Inexpensive • Grasses & broadleaf weeds 	<ul style="list-style-type: none"> • Ground water risk • Mite predator risk 	
napropamide (Devrinol)	Effective	<ul style="list-style-type: none"> • Grasses 	<ul style="list-style-type: none"> • Photodegradable • Moderately expensive • Not as effective for small seeded grasses 	
norflurazon (Solicam)	Effective	<ul style="list-style-type: none"> • Grasses • Moderately expensive 	<ul style="list-style-type: none"> • Established trees only 	
oryzalin (Surflan)	Effective	<ul style="list-style-type: none"> • Grasses • Not photo-degradable • Good for use on young trees • Moderate cost 		
pendimethalin (Prowl)	Effective	<ul style="list-style-type: none"> • Grasses 	<ul style="list-style-type: none"> • Non bearing trees only • Moderately expensive 	
pronamide (Kerb)	Effective	<ul style="list-style-type: none"> • Grasses 	<ul style="list-style-type: none"> • Established trees only 	Dormant application only
simazine (Princep)	Effective	<ul style="list-style-type: none"> • Grasses & broadleaf weeds • Inexpensive • Great for tank mixes 	<ul style="list-style-type: none"> • Ground water risk • Established trees only • Cannot use on sandy soil (phyto-toxicity plus water risk) 	

terbacil (Sinbar)	Effective	<ul style="list-style-type: none"> Grasses & broadleaf weeds 	<ul style="list-style-type: none"> Expensive Lack of weed cover re-growth can lead to low temperature root injury Established trees only 	
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Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Mowing	Reduces vole cover	Mowing grass does not eliminate grass competition with trees Cannot get under tree without damage to tree and fruit (borers, trunk damage)	
Clean cultivation, fall cover	Limits voles	Fuel Low soil organic matter content, complicating phosphorous management Increase blossom frost risk Increased winter root low temp risk	
Mulch	Organic, does control weeds Conserves moisture	Delayed hardening off in autumn Voles Expensive and labor intensive	

Research Needs:

What is the best approach to orchard floor management under tree

Regulatory Needs:

None Identified

Education Needs:

Proper use relative to groundwater risk

2. Grasses – Post Emergence

- **Acres Affected:** All
- **Yield Losses:** Up to 80% crop loss due to reduced tree growth and fruit size.

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
clethodim (Select)	Effective		Very expensive No residual activity	May give quackgrass control
fluazifop (Fusilade)	Fair to good	• Grasses only	Grass must be at the appropriate stage for kill Very expensive	
glyphosate (Roundup)	Effective	• Wiper only on peach • Systemic • Also controls broadleaf weeds and woody weeds	Risk of damage to trees	
gramoxone (Paraquat)	Effective	• Expensive • Bark injury to young trees • Quick knockdown with no residual • Also controls broadleaf weeds	• Human toxicity • Expensive • Bark injury to young trees • No residual	
pronamide (Kerb)	Effective			Dormant season application only
sethoxydim (Poast)	Fair to Good	• Not as effective as fusillade • Grasses only	Grass must be at the appropriate stage for kill Very expensive	
sulfosate (Touchdown)	Effective	• Also controls broadleaf weeds and woody weeds	• Non-bearing trees only • Wiper or shielded application only Bark injury risk	
terbacil (Sinbar)	Effective	• Expensive	Trees must be established at least 3 years	

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Mowing	Provide vole control	Mowing grass does not eliminate competition of grass with trees Cannot get under tree without damage to tree and fruit (borers, trunk damage)	
Clean cultivation, fall cover	Reduced vole population	Fuel costs Low soil organic matter content, complicating phosphorous management Increase blossom frost risk Increased winter root low temp risk	
Mulch	Organic, does control weeds Conserves moisture	Delayed hardening off in fall Voles Expensive and labor intensive	

Research Needs:

- Use of steam, hot foam, or flaming
- Use of mechanical cultivation under tree

Regulatory Needs:

- None identified

Education Needs:

- None identified

3. Broadleaf and Woody Weeds, Post Emergence

- **Acres Affected:** All
- **Yield Losses:** Difficult to determine, but can be 50% or more. In addition, serves as a plant bug reservoir and increases nematode risk

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
glyphosate (Roundup)	Effective	<ul style="list-style-type: none"> • Gets brambles and other tough ones like poison ivy • Systemic 	<ul style="list-style-type: none"> • Timing is important • Slow knockdown • Risk of injury 	
oxyfluorfen (Goal)	Effective		<ul style="list-style-type: none"> • Timing • Expensive 	
paraquat (Gramoxone)	Effective	<ul style="list-style-type: none"> • Also controls grasses • Quick knockdown • No residual 	<ul style="list-style-type: none"> • Weak on woody weeds • Human toxicity • Expensive • No residual • Bark injury to young trees 	
sulfosate (Touchdown)	Effective	<ul style="list-style-type: none"> • Also controls grasses 	<ul style="list-style-type: none"> • Non Bearing trees only • Very Expensive • Wiper or shielded sprayer application only • Bark injury risk 	
terbacil (Sinbar)	Effective	<ul style="list-style-type: none"> • Also gets grasses and broadleaf weeds pre-emergence 	<ul style="list-style-type: none"> • Weak on woody weeds • Expensive 	

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Mowing or brush cutting	Does weaken woody weeds over time	Labor and energy intensive	

Research Needs:

- Broadleaf weed complex and its interaction with insect and nematode complex

Regulatory Needs:

- Continued availability of key pre-emergence tools including sinbar and simazine

Education Needs:

- Proper timing of application for optimal control of target weed species

Key Vertebrates and other pests

1. Deer

- **Acres affected:** varies based on local deer population and impact of snow cover on access to orchard and alternative food sources
- **Yield losses:** can be devastating to young trees – at least 2 year setback

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
ammonium salts of C8-18 and C18' fatty acids (Hinder)	Poor		Does not work well Very expensive	
putrescent whole egg solids (Deer Away)	Poor		Does not work well Very expensive	
thiram	Poor		limited control but may repel rabbits and voles somewhat as well Skin irritant	

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Fencing, Electric	Cost effective	Does not work when pressure is high Liability Maintenance	
Fencing, Woven Wire	Very effective Exclusionary	Very expensive Exclusionary to customers also Maintenance	
Soap bars, coyote urine, bags of hair	Relatively inexpensive	Effective with low pressure only Crows and ravens eat soap and break leaders while doing so Soap dripping onto trunk causes voles to chew	
Lethal control	Does get rid of problem deer, especially if you get the first ones that breach electric fence	Labor intensive Neighbor relations Cold, night, work Proximity to housing	
Dogs plus invisible fence	Eliminates visible fence that may alienate customers	Company liability	

Research Needs:

- None identified

Regulatory Needs:

- Management of deer herd by Fish & Game management agencies (aimed at increasing herd size) is creating a pest problem

Education Needs:

- Pruning to repair deer damage to tree structure

2. Voles

- **Acres affected:** 100%
- **Yield losses:** Meadow and Pine voles are both problems (pine vole is not present in some soils) – losses can be up to 60% or more tree death if not managed

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
active ingredient: Brand name				
zinc phosphide (Hopkins Zinc Phosphide Bait, Phosvin, KP)	Effective	Relatively cheap Water breaks down	Timing application to appropriate weather is difficult For pine vole, must use trailbuilder or bait individual holes Potential non-target risk Toxic, but Water breaks down Bait shyness can develop	Bait stations most effective, but more work and some regulatory issues Broadcast works only for meadow voles

Cultural and Biological Alternatives

Method	Pros	Cons	Comments
Vole guards	Effective against meadow vole	Cost Deep snow Injury from wire guards, borer risk, etc. Plastic guards increase borer risk	
Mowing	Reduces pressure	Does not eliminate	
Encourage coyotes, skunks, foxes, raptors and shrews (fishers, weasels, etc)	Great community relations	Predator population will not give complete control of voles	

Research Needs:

- How to establish and maintain shrew populations for vole population management
- Determine how many bait stations needed per acre to provide economic control of voles

Regulatory Needs:

- Expanding availability of toxicants

Education Needs:

- None identified

IV. Appendices

Pesticide Efficacy for Insect and Mite Pests

active ingredient	Brand name(s)	ERM	JB	OFM	PC	PTB	SI	TPB
azadiractin	Aza-Direct, Neemix, Align			2	0	2	-	-
azinphos-methyl	Guthion			2-3	3	0	2	2
bacillus thuringiensis	Agree, Dipel, Javelin, MVP, Xentari, BioBit			-	-	-	-	-
carbaryl	Sevin		3	2	2	0	2	-
chlorpyrifos	Lorsban			-	3	3	3	-
diazinon	Diazinon		2	1	2	0	2	2
endosulfan	Thiodan, Phaser		2	0	0	3	1	2
esfenvalerate	Asana		2-3	3	3	3	1	
fenproparthrin	Danitol				3		1	3
imidacloprid	Provado		3	0	1	0	2	-
kaolin clay	Surround			2	2	-	-	-
lambda-cyhalothrin	Warrior		3	3	3	3		3
malathion	Malathion			1	2	0		1
methidathion	Supracide					-	3	-
methomyl	Lannate			2	2	1	2	2
oil	Damoil, Sunspray, UltraFine, Volck Supreme	3		-		-	3	-
permethrin	Ambush, Pounce		3	3		2	1	3
phosmet	Imidan			2-3	3	0	2	2
pyrethrin + rotenone	Pyrellin			2	1	2	1-2	1
pyriproxyfen	Esteem					-	3	-
spinosad	Spintor			-	-	-		-
tebufenozide	Confirm				0	-	0	-
clofentezine	Apollo	3						
dicofol	Kelthane	1-2						
fenbutatin-oxide	Vendex	1-2						
formetanate HCl	Carzol	2				-		1
hexythiazox	Savey	3						

Key to pest name abbreviations:

- ERM – European Red Mite
- JB – Japanese Beetle
- OFM – Oriental Fruit Moth
- PC – Plum Curculio

PTB – Peach Tree Borer, Lesser Peach Tree Borer

SI – Scale Insects

TPB – Tarnished Plant Bug, Oak-Hickory Bug, Sting Bug Complex

Key to efficacy abbreviations:

0 – Not Effective

1 - Poor

2 - Fair

3 - Good

New Pest Management Technologies for Insect and Mite Pests

Method	Source	Status	Pests Affected
indoxacarb (Avant)		Not registered	Oriental Fruit Moth, Plum Curculio
methoxyfenozide (Intrepid)		Registered	Oriental Fruit Moth
thiacloprid (Calypso)		Not registered	Plum Curculio, Plant Bugs, Scale Insects
thiamethoxam (Actara)		Registered	Plum Curculio, Oriental Fruit Moth, Plant Bugs, Scale Insects
pyriproxyfen (Esteem)		Registered	Scale Insects

Pesticide Efficacy for Diseases

active ingredient	Brand name(s)	BR	BS	PLC	PS	X
captan	Captan, Captec	2-3			2	
chlorothalonil	Bravo, Echo	2		3		
copper hydroxide	Kocide		2			
copper sulfate	COCS		2			
fenbuconazole	Indar	3	2			
fenhexamid	Elevate	2				
ferbam	Ferbam	1-2		3		
oxytetracycline	Mcyoshield					2
propiconazole	Orbit	3	2			
sulfur	Sulfur	1			1	
tebuconazole	Elite	3	3			
thiophanate-methyl	Topsin	2	2		2	

Key to pest name abbreviations

- BR – Brown Rot
- BS – Bacterial Spot
- PLC – Peach Leaf Curl
- PS – Peach Scab
- X – X-disease

Key to efficacy abbreviations:

- 0 – Not Effective
- 1 - Poor
- 2 - Fair
- 3 - Good

New Pest Management Technologies for Diseases

Method	Source	Status	Pests Affected
BAS 500 F (Cabrio)		Trial	Brown Rot
tifloxystrobin (Flint)		Trial	Brown Rot
zinc sulfate		Trial, unregistered	Bacterial Spot
<i>Bacillus subtilis</i> (Serenade)		Trial	Bacterial Spot

Pesticide Efficacy for Weeds

active ingredient	Brand name(s)	AG	AB	PG	PBW
clethodim	Select	3	-	2	-
dichlobenil	Casoron	2-3	2-3	-	-
diuron	Direx, Karmex	2-3	2-3	-	-
fluazifop	Fusilade	2-3	-	2	-
glyphosate	Roundup	3	3	3	3
gramoxone	Paraquat	3	3	2-3	1-2
napropamide	Devrinol	2-3	-	-	-
norflurazon	Solicam	2-3	-	-	-
oryzalin	Surflan	2-3	-	-	-
oxyfluorfen	Goal	-	-	-	2-3
pendimethalin	Prowl	2-3	-	-	-
pronamide	Kerb	2-3	-	2-3	-
sethoxydim	Poast	2-3	-	2	-
simazine	Princep	2-3	2-3	-	-
sulfosate	Touchdown	3	3	3	3
terbacil	Sinbar	3	3	2-3	1

Key to pest name abbreviations

AG – Annual Grasses

AB – Annual Broadleaf Weeds

PG – Perennial Grasses

PBW – Perennial Broadleaf Weeds and Woody Weeds

Key to efficacy abbreviations:

0 – Not Effective

1 - Poor

2 - Fair

3 - Good

New Pest Management Technologies for Weeds

Method	Source	Status	Pests Affected
clopyralid (Stinger)		Registered, trial	Broadleaf Weeds
halosulfuron (Sempra)		Not registered	Broadleaf Weeds

Pesticide Efficacy for Vertebrate and other pests

active ingredient	Brand name(s)	WTD	V
ammonium salts of C8-18 and C18' fatty acids	Hinder	0-1	
putrescent whole egg solids	Deer Away	0-1	
thiram	Thiram	1	
zinc phosphide	Hopkins Zinc Phosphide Bait, Phosvin, KP		3

Key to pest name abbreviations
 WTD – White Tailed Deer
 V – Voles

Key to efficacy abbreviations:
 0 – Not Effective
 1 - Poor
 2 - Fair
 3 - Good

New Pest Management Technologies for Vertebrates

Method	Source	Status	Pests Affected
None identified			

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