

New England Winter Squash Pest Management Strategic Plan

New England Pest Management Network
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Executive Summary

The Food Quality Protection Act (FQPA) has required the Environmental Protection Agency (EPA) to register and re-register pesticides in regards to health risk to consumers. The EPA is looking closely at organophosphate, carbamate and suspected B2 carcinogenic pesticides. Some of the older pesticides that have been effective in controlling pest problems may lose registration status. Although pesticides with newer chemistries are becoming available, their efficacy is unknown. University extension research is needed to determine the efficacy and economic feasibility of these products to control current pest pressures.

Representatives from the New England winter squash industry met for 2 days in November 2003 to discuss strategic issues concerning winter squash production in New England. The input from this meeting, along with the New England Vegetable Management Guide and a New England Winter Squash Pest Management survey conducted in Fall 2003 have been used to develop this report.

I. Introduction

Background of Winter squash in New England

New England (when treated as a state) is ranked 6th in the nation for squash production. Winter squash is grown throughout New England with Massachusetts being the state with the largest amount of acres. Growers planted approximately 54% of the winter squash acreage with Butternut varieties, followed by 19% Buttercup, 11% Acorn, 5% Hubbard, and 9% mixed varieties. The average yield per acre is approximately 10,000 pounds.

The wholesale market accounted for 46% of the winter squash harvest, followed by the retail market at 37%, processing at 14%, and remaining harvest split between U Pick and Community Supported Agriculture (CSA).

Benefits to the New England Winter Squash Industry

The New England Winter Squash Pest Management Strategic Plan will identify at-risk pesticides and propose future research, regulatory, and education priorities necessary to establish alternative pest management methods in the event of loss. These priorities will be used to inform EPA and state agency decisions and outline a development path for pest management researchers and educators. This information will be of great value in the pursuit of funding to address research and education needs identified through the Strategic Plan.

The Winter Squash Pest Management Strategic Plan Process

A review group of vegetable growers, researchers and industry stakeholders throughout New England met for two days in November 2003 in Concord, New Hampshire to develop this strategic plan based on the 2003 New England Winter Squash Survey. The group tasks were to assess the state of current pesticides and pest management recommendations as well as identify the regulatory, educational, and research issues impacting production of these crops.

The review group consisted of the following individuals:

Hank	Bissell	Lewis Creek Farm / VT producer
V Mario	Marini	Marini Farms / MA producer
Frank	Whittemore	Brookdale Fruit Farm / NH producer
Bill	Jordan, Jr	Jordan Farm / ME producer
Tom	Baggott	Baggott Farms / CT producer
Richard	Cole	Helena Chemical
John	Ayers	Pennsylvania State, facilitator
Margaret	Siligato	University of Rhode Island / mtg coordinator
Dave	Wallace	University of Rhode Island / Extension
George	Hamilton	University of New Hampshire / Extension
Ann	Hazelrigg	University of Vermont / Extension
Edith	Lurvey	Cornell University
Mark	Hutton	University of Maine/ Extension
James	Dill	University of Maine / Extension
Richard	Bonanno	University of Massachusetts / MA producer
Ruth	Hazzard	University of Massachusetts / Extension
Amanda	Duphily	University of Massachusetts / Extension
Natalia	Clifton	University of Massachusetts / mtg coordinator

II. Summary of the Winter Squash Pest Management Strategic Plan

Key Winter Squash Pest Strategic Issues

Insects and Mites

The most common insect pest on winter squash crops is the striped cucumber beetle which is an annual problem pest for 70% of the growers. Squash bug affects 40% of the growers on annual basis. Minor insect pests include squash vine borer, aphids, and seedcorn maggot.

Diseases

Powdery mildew, black rot and downy mildew are the most common diseases in winter squash. However, once phytophthora infects a field there is currently effective treatment.

Weeds

Lambsquarter, pigweed, velvetleaf, ragweed and purslane are major weeds in winter squash.

Vertebrate and other pests

The most important vertebrate pests are deer, woodchuck, and birds.

Strategic Issues of Specific Pest Management Tactics

Research Needs:

Pest management alternatives for cucumber beetle such as, seed treatment, spinosad, PyGanic, and BioYield.

Phytophthora management including cultural controls and chemical controls (foliar phosphite and Acrobat)

Galinsoga management

Deer and crow management

Regulatory Needs:

Maintain the registration of the insecticide carbaryl (Sevin).

Maintain the registrations for chlorothalonil and EBDC fungicides.

Maintain the registration for the herbicide ethalfluralin (Curbit).

Reduce herbicide carryover restrictions.

Register seed treatment with imidacloprid or thiamethoxam.

Cost share for fencing to manage vertebrate pests.

Education Needs:

Provide pest identification education for insects, diseases and weeds.

Provide life cycle and timing information for management of insects, diseases, and weeds.

Provide education for deer fence use and construction.

Worker Activities

The majority of the winter squash acreage is direct seeded using tractor mounted seeders. Some growers (40%) use transplants that may require workers to hand place them directly into the field. Drip irrigation systems are used by 22% of the growers and are put in place during planting. Herbicide applications may be applied directly after seeded but before crop emergence. Workers may cultivate and hand weed especially around seedlings in black plastic fields. Growers (19%) place rows covers for insect management above crop rows at the 3-4 leaf stage. Hand thinning is done after seedlings are well established early in the season. Field scouting should be conducted weekly to monitor for pest outbreaks, fruit set and disease development. Insecticide applications may be made early in the growing season during heavy feeding activity. Applications for controlling diseases are made in the later part of the growing season starting in late July. Harvesting of winter squash is done by hand when the fruit has hardened.

III. Strategic Issues for Key Winter Squash Pests

Key Insects and Mite pests

1. Striped Cucumber Beetle:

Growers reported using pesticide applications on approximately 80% of the winter squash acreage. This pest can be present throughout the growing season and control is necessary. The pest can also lead to greater incidence of bacterial wilt.

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
bifenthrin Capture 2EC	UNK	Registered. Pyrethroid	“Possible” human carcinogen. Restricted use to due toxicity to fish and aquatic organisms. Highly toxic to bees.	Not used. REI 12 hrs.
carbaryl Sevin XLR Plus	E/G	Registered, broad spectrum	Carbamate. “Likely” human carcinogen. Highly toxic to bees.	Used on 49% of acreage. REI 12 hrs. 1-3 applications.
esfenvalerate Asana XL	E/G	Registered, pyrethroid	Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees.	Used on 6% of acreage. REI 12 hrs 2 applications in combination with Sevin.
fenpropathrin Danitol 2.4 EC	UNK	Registered. Pyrethroid	Restricted use to due toxicity to fish and aquatic organisms. Highly toxic to bees.	Not used. REI 24 hrs.
imidacloprid Admire 2F	E	Registered, Neonicotinoid	Highly toxic to bees and aquatic invertebrates.	Used on 7% of acreage. REI 12 hrs. 1 application in furrow, also with transplants.
kaolin Surround WP	G	Registered, Effective for organic growers (OMRI listed).	Suppression and repellence only.	Used on 2% of acreage. REI 4 hrs.
permethrin Ambush, Pounce	E/G	Pyrethroid	“Suggested evidence” of carcinogenicity. Restricted use due to	Used on 16% of acreage. REI 12 hrs.

			toxicity to fish and aquatic organisms. Highly toxic to bees. Future registration uncertain.	
pyrethrins PyGanic EC 5.0	UNK	Registered. OMRI listed.	"Suggested evidence" of carcinogenicity. Highly toxic to fish.	Used on less than 1% of acreage. REI 12 hrs.
pyrethrins & piperonyl butoxide Pyrenone	UNK	Registered.	"Suggested evidence" of carcinogenicity. Highly toxic to fish.	Used on less than 1% of acreage
spinosad Entrust, Success, Spintor	UNK	Registered. OMRI listed.		More research needed. REI 4 hrs.

Cultural and Biological Alternatives: Crop rotation provides excellent control. Row covers are used successfully to protect seedling from the pest. Use of transplants can reduce early treatments for this pest. Some preliminary research with trap cropping using other cucurbit species may control light to moderate populations and spare beneficials².

2. Squash Bug

Growers report treating approximately 28% of the acreage for this pest.

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
azadirachtin Neemix 4.5	UNK	Registered, Biological Insecticide		REI 12 hrs. Insect growth regulator and repellent
bifenthrin Capture 2EC	UNK	Registered. Pyrethroid	“Possible” human carcinogen. Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees.	Not used. REI 12 hrs.
carbaryl Sevin XLR Plus	G	Registered, broad spectrum	Carbamate. “Likely” human carcinogen. Highly toxic to bees.	Used on 17% of acreage. REI 12 hrs.
esfenvalerate Asana XL	E/G	Registered, pyrethroid	Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees.	Used on only 2% of acreage. REI 12 hrs.
permethrin Ambush, Pounce	E/G	Pyrethroid	“Suggested evidence” of carcinogenicity. Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees. Future registration uncertain.	Used on 9% of acreage. REI 12 hrs.

Cultural and Biological Alternatives: Crop rotation provides good control. Both the use of no till and the use of organic mulch such as straw or hay can lead to increased populations of this pest. Some preliminary research with trap cropping using pumpkins may control light to moderate populations.

3. Squash Vine Borer

Growers (24%) report that this pest require annual and/or occasional control

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
bifenthrin Capture 2EC	UNK	Registered. Pyrethroid	“Possible” human carcinogen. Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees.	Not used. REI 12 hrs.
carbaryl Sevin XLR Plus	E/G	Registered, broad spectrum	Carbamate. “Likely” human carcinogen. Highly toxic to bees. Not registered for squash vine borer.	Used on 14% of acreage. REI 12 hrs.
esfenvalerate Asana XL	E/G	Registered, pyrethroid	Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees.	Used on 3% of acreage. REI 12 hrs.
permethrin Ambush, Pounce	E/G	Pyrethroid	“Suggested evidence” of carcinogenicity. Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees. Future registration uncertain.	Used on 7% of acreage. REI 12 hrs.

Cultural and Biological Alternatives: Reduced tillage systems many encourage higher populations of this pest. Remove crop stems after harvest before tillage to remove overwintering sites.

4. Aphids:

Grower treated over 18% of the acreage to control this pest.

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
azadirachtin Neemix 4.5	UNK	Registered, Biological Insecticide. OMRI listed		REI 12 hrs. Insect growth regulator and repellent
bifenthrin Capture 2EC	UNK	Registered. Pyrethroid	"Possible" human carcinogen. Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees.	Not used. REI 12 hrs.
fenpropathrin Danitol 2.4 EC	UNK	Registered. Pyrethroid	Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees. REI 24 hours	Not used. REI 24 hrs.
imidacloprid Admire 2F	E	Registered, Neonicotinoid	Highly toxic to bees and aquatic invertebrates.	Not used. REI 12 hrs.
insecticidal soap M-Pede	F	Registered, Biorational insecticide	Phytotoxicity issues. Thorough coverage needed for control.	Not used. Should be mixed with other products. REI 12 hrs.
methomyl Lannate	E	Registered on some varieties of summer squash	Restricted use. High acute toxicity to humans. Carbamate	Used on 9% of acreage. REI 48 hrs. Worker exposure issues.
oxydemeton-methyl Metasystox R	E	Registered	Restricted use due to reproductive effects. Organophosphate	Not used. DH 14, REI 48 hrs.
pemethrin Ambush, Pounce	F/P	Registered. Pyrethroid	"Suggested evidence" of carcinogenicity. Restricted use due to toxicity to fish and aquatic organisms. Highly toxic to bees. Future registration uncertain.	Used on 6% of acreage. REI 12 hrs.

pyrethrins PyGanic EC 5.0	G/F	Registered. OMRI listed.	“Suggested evidence” of carcinogenicity. Highly toxic to fish.	Not used. REI 12 hrs.
pymetrozine Fulfill	UNK	Registered, Pyridine azomethines (new mode of action) Low toxicity to beneficials	“Likely” human carcinogen.	Used on 3% of acreage. REI 12 hrs.
rosemary oil Hexacide	UNK	24B Minimum Risk Pesticide	Efficacy unknown	Not used.
thiamethoxam Platinum	UNK	Registered, Neonicotinoid	“Likely” human carcinogen. SRU in MA due to groundwater concerns	Not used. REI 12 hours. Soil applied

Cultural and Biological Alternatives: Reflective mulch is good for controlling aphids but this practice is not used. Row covers provide excellent control. Conservation and enhancement of beneficials can be a good means of control.

5. Seedcorn Maggot

Not a significant problem in this area

Key Diseases

1. Powdery Mildew

Growers (66%) have to control this disease on annual and/or occasional basis. Early detection is necessary along with a well planned resistance management program.

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
azoxystrobin Quadris	E/G	Registered Strobilurin	Resistance mgmt program important	Used on 30% of acreage, REI 4 hrs.
chlorothalonil Bravo Ultrex WDG	G/F	Registered, good for resistance mgmt	“Likely” human carcinogen. SRU in MA due to groundwater concerns	Used on 23% of acreage. REI 12 hrs. 1 application
cupric hydroxide Kocide 4.5 LF	G	Registered	Toxic to fish	Used on 13% of acreage. REI 24 hrs.
myclobutanil NOVA 40W	G	Registered	Resistance issues	Not used. REI 24 hrs. 2 applications in combination with Bravo
pyraclostrobin Cabrio EG	E	Registered Strobilurin	Resistance mgmt program important	Not used. REI 12 hrs. 1 application alone
thiophanate methyl Topsin-M 70W	G	Registered	“Likely” human carcinogen	Used on 14% of acreage. REI 12 hrs. Used in tank mixes
trifloxystrobin Flint	E	Registered Strobilurin	Resistance mgmt program	Not used. REI 12 hrs.
boscalid Endura	UNK	Registration pending		
Foliar phosphyte	UNK	Biopesticide		1-2 applications, needs more research

Cultural and Biological Alternatives: There are some “excellent” and “good” resistant varieties available.

2. Downy Mildew (*Pseudoperonospora cubensis*)

Growers (39%) have to control this disease on annual and/or occasional basis. Disease appears later in the season since it does not overwinter in New England.

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
fosetyl Al Aliette WDG	UNK	Registered		Not used. REI 12 hrs.
maneb Maneb 80WP	G	Registered	"Probable" human carcinogen	Used on 2% of acreage. REI 24 hrs.
maneb & zinc Manex	E	Registered	"Probable" human carcinogen	Used on 5% of acreage. REI 24 hrs. 2 applications
mefenoxam plus chlorothalonil Ridomil Gold/Bravo	G	Registered	"Likely" human carcinogen. SRU in MA due to groundwater concerns	Used on 14% of acreage. REI 48 hrs. Use up to 3 applications
mefenoxam plus manzate Ridomil Gold MZ	E	Registered on summer squash only	"Probable" human carcinogen	Used on 8% of acreage. REI 48 hrs. Good mix that control other diseases as well.

Cultural and Biological Alternatives

None identified.

3. Anthracnose (*Colletotrichum*)

Growers (23%) have to control this disease on annual and/or occasional basis.

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
chlorothalonil Bravo Ultrex WDG	G/F	Registered, good for resistance mgmt	"Likely" human carcinogen. SRU in MA due to groundwater concerns	Used on 8% of acreage. REI 12 hrs.
maneb Maneb 80WP	G	Registered	"Probable" human carcinogen	Used on 2% of acreage. REI 24 hrs.
maneb & zinc Manex	E	Registered	"Probable" human carcinogen	Used on 10% of acreage. REI 24 hrs.
thiophanate methyl Topsin-M 70W	G	Registered	"Likely" human carcinogen. Resistance management issues	Used on 7% of acreage. REI 12 hrs.

Cultural and Biological Alternatives

Crop rotation out of cucurbits for 2 years. Larger and wider spacing for better air circulation. Weed management important for good air circulation. Use of no-till cover crops or plastic mulch in growing systems can limit fruit contact with the soil that may reduce infection.

4. Black Rot (*Didymella*)

Growers (31%) have to control this disease on annual and/or occasional basis. It is one of the most destructive diseases of winter squash.

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
chlorothalonil Bravo Ultrex WDG	E/G	Registered, good for resistance mgmt	"Likely" human carcinogen. SRU in MA due to groundwater concerns	Used on 17% of acreage. REI 12 hrs.
maneb Maneb 80WP	G	Registered	"Probable" human carcinogen	Used on 8% of acreage. REI 24 hrs. 4 applications
maneb & zinc Manex	E/G	Registered, Cost effective	"Probable" human carcinogen	Used on 9% of acreage. REI 24 hrs. 4 applications

thiophanate methyl Topsin-M 70W	E/G	Registered	"Likely" human carcinogen. Resistance mgmt issues	Used on 12% of acreage. REI 12 hrs.
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Cultural and Biological Alternatives

Crop rotation out of cucurbits for 3 years. Practice good sanitation and plow under plant debris after harvest. Weed management important for air circulation. Use of no-till cover crops or plastic mulch in growing systems can limit fruit contact with the soil that may reduce infection. Well drained soils are important. It is important to have good curing at harvest time and minimize marks. Also storage conditions should not be too cold.

5. Angular leaf spot (*Pseudomonas lachrymans*)

Growers (17%) have to control this disease on annual and/or occasional basis. This disease is usually not serious in New England.

Currently Registered Pesticides

Pesticide	Efficacy	Pros	Cons	Comments
basic copper sulfate: Basicop 53 WP	E	Registered	Toxic to fish	Not used. REI 24 hr. 2 applications or 3-4 applications
cupric hydroxide Kocide 4.5 LF	G	Registered	Toxic to fish	Used on 14% of acreage. REI 24 hr 2 applications or 3-4 applications
Maneb & zinc Manex	E/G	Registered?, Cost effective	"Probable" human carcinogen. Registered for this use on Pumpkins	Used on 10% of acreage. REI 24 hrs. 4 applications Mix with copper

Cultural and Biological Alternatives

Crop rotation out of cucurbits for 1 year. Drip irrigation is good for reducing the spread of the disease. Practice good sanitation and plow under plant debris after harvest.

6. Scab (*Cladosporium*)

Growers (25%) have to control this disease on annual and/or occasional basis.

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
chlorothalonil Bravo Ultrex WDG	E/G	Registered, good for resistance mgmt	"Likely" human carcinogen. SRU in MA due to groundwater concerns	Used on 12% of acreage. REI 12 hrs.

Cultural and Biological Alternatives

Crop rotation out of cucurbits for 2 year. Larger/wider spacing is good. No resistant varieties. Well drained soils are important. Use of no-till cover crops or plastic mulch in growing systems can limit fruit contact with the soil that may reduce infection. Practice good sanitation and plow under plant debris after harvest.

7. *Phytophthora* Blight and Fruit Rot

Growers (32%) have to control this disease on annual and/or occasional basis.

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
Fosetyl Al Aliette WDG	E	Registered		Used on 4% of acreage. REI 12 hrs.
Mefenoxam plus chlorothalonil Ridomil Gold/Bravo	P	Registered	"Likely" human carcinogen. SRU in MA due to groundwater concerns	Used on 3% of acreage. REI 48 hrs. Variable control due to resistance
Mefenoxam plus manzate Ridomil Gold MZ	P	Registered on summer squash only	"Probable" human carcinogen	REI 48 hrs. Variable control due to resistance

Cultural and Biological Alternatives

Crop rotation for 3-4 years (preferable fallow). It is important to have raised beds and well drained soil. Subsoiling using a chisel plow may help to improve drainage. Contaminated water sources (such as ponds) can carry *Phytophthora* into the field.

8. Bacterial Wilt (*Erwinia*)

Growers (39%) have this disease on annual and/or occasional basis.

Currently Registered Pesticides

There are no pesticides currently registered to control this disease. However, proper management of striped cucumber beetles can reduce incidence of the disease.

Cultural and Biological Alternatives

Trap cropping for managing cucumber beetles may reduce disease. Some powdery mildew resistant varieties seem to be more susceptible to bacterial wilt.

9. Post-Harvest Fruit Rot (Various fungi)

Growers (33%) have this problem on annual and/or occasional basis.

Currently Registered Pesticides

There are no pesticides currently registered to control this problem. However, proper management of diseases in the field can limit the amount of infection in storage.

Cultural and Biological Alternatives

Good curing at harvest time and minimizing marks. Storage conditions should not be too cold.

10. Cucurbit Viruses

Growers (33%) have this problem on annual and/or occasional basis.

Currently Registered Pesticides

There are no pesticides currently registered to control this problem. However, controlling aphids may reduce the incidence of these viruses.

Cultural and Biological Alternatives

Resistant varieties are not available. Weed management is important since some weed species are hosts for the viruses. Destroy and/or remove infected plants to prevent spreading to other plants is important.

Weeds⁴

Broadleaf and grass weeds can reduce yield, interfere with pesticide applications, reduce air circulation, and impede harvesting. Early management can limit the impact and cost of weeds. Most growers (80%) report yearly management of annual broadleaf weeds, followed by annual grasses (66%), perennial broadleaf weeds (47%), and perennial grasses (41%).

1. Stale seed bed

Approximately 20% of the growers used this technique for managing weeds.

Currently Registered Pesticides

Pesticide	Effi- cacy	Pros	Cons	Comments
paraquat Gramoxone Max 3S	E	Registered	RUP. Acutely Toxic to humans. Contact only	Used on 12% of the acreage. REI 12 hrs.
glyphosate, Roundup Ultra 4S	E/G	Registered. Translocates.	Drift issues	Used on 23% of the acreage. REI 12 hrs.
pelargonic acid Scythe 4.2	F	Registered	Contact only	Used on 1% of the acreage. REI 12 hrs.

2. Pre-plant Incorporated / Pre-emergence

Growers (40%) used this technique to manage weeds on 79% of the acreage.

Currently Registered Pesticides

Pesticide	Effi- cacy	Pros	Cons	Comments
bensulide Prefar 4E	G	Registered. Good for controlling grasses	Organophosphate	Used on 6% of the acreage. REI 12 hrs.
clomazone Command EC	E	Registered. Controls velvetleaf and galinsoga.	Drift issues. Not for use under black plastic.	Used on 26% of acreage. REI 12 hrs. Good for controlling lambsquarters.
ethalfluralin Curbit 3EC	G	Registered. Controls grasses, pigweed and lambsquarters.	"Possible" human carcinogen. Cold wet weather use can lead to crop injury.	Used on 41% of acreage. REI 24 hrs. Not for use under mulches

				and row covers
ethalfuralin & clomazone Strategy	G	Registered. Controls lambsquarters, grasses, pigweed, velvetleaf, and galinsoga.	"Possible" human carcinogen.	Used on 32% of acreage. REI 24 hrs.
halosulfuron Sandea 75 WSG	G	Registered. Controls lambsquarters, nutsedge, and ragweed.	Some carryover concerns.	Used on 11% of acreage. REI 12 hrs.

3. Post Emergence

Growers (24%) used this technique to manage weeds on 43% of the acreage

Currently Registered Pesticides

Pesticide	Effi-cacy	Pros	Cons	Comments
clethodim Select 2 EC	G	Registered. Controls warm and cool season grasses.	No soil activity.	Used on 5% of acreage. REI 24 hrs.
halosulfuron Sandea 75 WSG	G	Registered. Controls nutsedge and ragweed.	No post activities of lambsquarters.	Used on 12% of acreage. REI 12 hrs.
paraquat Gramoxone Max 3S	E	Registered	RUP. Acutely Toxic to humans. Contact only.	Used on 6% of the acreage. REI 12 hrs.
pelargonic acid Scythe 4.2	F	Registered	Contact only.	Not used. REI 12 hrs.
sethoxydim Poast 1.53 EC	G	Registered	No soil activity.	Used on 24% of acreage. REI 12 hrs.

4. Cultural and Biological Alternatives

Growers (92%) used other cultural weed management strategies including **cultivation** (83%), **hand weeding** (80%), **mulching** (26%), **mowing** (15%), and **black plastic** (10%). Most reported “excellent” or “good” weed management.

Forty-five percent of the growers reported using **cover crops** for in winter squash. On approximately 10% of the acreage of winter squash, the cover crops were killed, winter squash planted no till into the dead cover. Of those growers who used cover crops, most (87%) used winter rye and reported “good” weed suppression. Others used oats (28%), buckwheat (15%), and red clover (15%). They also reported “excellent” or “good” weed suppression.

Key Vertebrate pests

Forty-two percent of the growers reported vertebrate pest problems. Deer and woodchucks were most often reported by growers. Twenty-seven percent of growers used various management strategies for **deer** including electric fences (8%), off-season permit (6%), other fencing (4%) and repellents. Nineteen percent of the growers had problems with **wood chucks** and they used rifles (5%), smoke bombs (5%), traps (4%), and dogs (3%). Birds appear to be a problem in direct seeded sites.

Currently Registered Pesticides

None identified

Cultural and Biological Alternatives for Deer

Method	Pros	Cons	Comments
Electric fence	Effective	Expensive	
Fencing permanent wire	Effective	Expensive	
Shooting	Effective	Hunting limited in some states	

Cultural and Biological Alternatives for Woodchucks

Method	Pros	Cons	Comments
Shooting	Effective	Hunting limited in some states	
Smoke bombs	Effective		
Dogs	Effective scares away pest		
Trapping	Effective	Animals must be euthanized. Risk to handler.	

IV. References

1. This document was prepared using information gathered from the New England Winter Squash Survey Results conducted in 2003 by the University of Massachusetts Extension and the New England Pest Management Network (www.pronewengland.org)
2. New England Winter Squash Crop Profile, Clifton, N.P. and A. Duphily. University of Massachusetts Extension and the New England Pest Management Network 2006. (www.pronewengland.org)
3. New England Vegetable Management Guide, 2002-2003. John C. Howell, Editor. February 2002.
4. Weed management data used from Vegetable Crop Management Survey conducted by New England Vegetable and Berry Growers Association 2004-2005.
5. National Agricultural Statistic Service, 2002 Census (http://151.121.3.33:8080/Census/Create_Census_US.jsp)

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