Tuesday Morning
Asparagus Session ............................................................... 1
   Asparagus Disease Update .................................................. 1
Pickling Cucumber Session ..................................................... 3
   Pickle and Vine Crop Weed Control - 2001 and 2002 .................... 3
Tomato Session ................................................................. 4
   Possible Cures for Shoulder Checking .................................... 4

Tuesday Afternoon
Cover Crops Session .......................................................... 6
   Cover Crops as Management Tools for Root Diseases and Soil .......... 6
   Cover Crops in Michigan Vegetable Systems .................................. 8
   Cover Crop Experiences from California and Beyond ..................... 9
   Influence of Eight Cover Crops on Yield and Quality
      of Cucumber, Eggplant, Pepper, Squash and Tomato ..................... 12
   Wind Erosion Control for Vegetable Production on Organic Soils ......... 17
Pepper Session ................................................................. 18
   Cost of Fresh Market Green Bell Pepper Production in Southeastern Michigan ............................................................................. 18
   Pepper Studies at SWMREC .................................................. 19
Vine Crop Session ............................................................... 23
   Phytophthora Management in Vine Crops ..................................... 23
   Pickle and Vine Crop Weed Control 2001 and 2002 ....................... 26

Wednesday Afternoon
Onion Session ................................................................. 27
   Soilborne and Leaf Blight Diseases of Onions .................................. 27
   Grassy Refuge Strips and Narrow Spectrum Insecticide Use Conserve Ground Beetle
      (Coleoptera: Carabidae) Populations in Michigan Onions ................. 29
   Weed Control in Onions 2001 and 2002 ....................................... 30
   Bacterial Diseases and Black Mold of Onions ................................ 31
# 2001 VEGETABLE SESSIONS

## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Session</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Potato Session</strong></td>
<td>33</td>
</tr>
<tr>
<td>The Latest in Colorado Potato Beetle Control</td>
<td>33</td>
</tr>
<tr>
<td>Current Weed Control Issues in Potatoes</td>
<td>35</td>
</tr>
<tr>
<td>Improving Quality and Storability in Chip Potatoes</td>
<td>37</td>
</tr>
<tr>
<td><strong>Sweet Corn Session</strong></td>
<td>39</td>
</tr>
<tr>
<td>Stewart’s Bacterial Wilt Project Report: the Corn Flea Beetle in 2001</td>
<td>39</td>
</tr>
<tr>
<td>Can You Really Produce and Market Corn for $1.00 per Dozen?</td>
<td>41</td>
</tr>
<tr>
<td><strong>Wednesday Afternoon</strong></td>
<td></td>
</tr>
<tr>
<td>Carrot Session</td>
<td>42</td>
</tr>
<tr>
<td>Aster Leafhoppers Vectoring Aster Yellows on Vegetables in Michigan</td>
<td>42</td>
</tr>
<tr>
<td>Management of Leaf Blight Diseases and Root-knot Nematode on Carrots in New York</td>
<td>44</td>
</tr>
<tr>
<td>Use of Tom-Cast Disease Forecaster in Michigan Carrots</td>
<td>47</td>
</tr>
<tr>
<td>Weed Control in Carrot 2001 and 2002</td>
<td>50</td>
</tr>
<tr>
<td>Cost of Carrot Production in Northwestern Michigan</td>
<td>51</td>
</tr>
<tr>
<td>Farm Policy Session</td>
<td>52</td>
</tr>
<tr>
<td>The Increasing Role of Fruits and Vegetables in Farm Bill Policy and Agricultural Programs</td>
<td>52</td>
</tr>
<tr>
<td><strong>Plasticulture Session</strong></td>
<td>55</td>
</tr>
<tr>
<td>Weed Control in Plasticulture Systems</td>
<td>55</td>
</tr>
<tr>
<td>The Effect of Plastic Mulch Color on Tomato Growth and Development</td>
<td>57</td>
</tr>
<tr>
<td><strong>Sustainable Vegetable Production</strong></td>
<td>59</td>
</tr>
<tr>
<td>Nonchemical Weed Control</td>
<td>59</td>
</tr>
<tr>
<td>Overview of Available Cover Crops</td>
<td>62</td>
</tr>
<tr>
<td><strong>Thursday Morning</strong></td>
<td></td>
</tr>
<tr>
<td>Celery Session</td>
<td>63</td>
</tr>
<tr>
<td>The Use of Admire for Insect Control in Celery</td>
<td>63</td>
</tr>
<tr>
<td>The Impact of the Energy Crisis on California Celery Production</td>
<td>64</td>
</tr>
<tr>
<td>Cost of Celery Production in Northwestern Michigan</td>
<td>67</td>
</tr>
<tr>
<td><strong>Halloween Crops Session</strong></td>
<td>68</td>
</tr>
<tr>
<td>Cost of Jackolantern Pumpkin Production in Southeastern Michigan.</td>
<td>68</td>
</tr>
<tr>
<td>What Happened to the 2001 Pumpkin Crop?</td>
<td>69</td>
</tr>
<tr>
<td>Indian Corn: Growing a Treasure Hunt</td>
<td>70</td>
</tr>
<tr>
<td><strong>Organic Production Session</strong></td>
<td>72</td>
</tr>
<tr>
<td>Marketing Opportunities for Organic Produce: Panel</td>
<td>72</td>
</tr>
<tr>
<td>Marketing Opportunities for Organic Produce</td>
<td>74</td>
</tr>
<tr>
<td>Soil Fertility, Quality and Health</td>
<td>75</td>
</tr>
<tr>
<td>Organic Work Shops and Conference</td>
<td>78</td>
</tr>
<tr>
<td>MSU Organic Fruit and Vegetable Projects</td>
<td>80</td>
</tr>
</tbody>
</table>
**ASPARAGUS DISEASE UPDATE**

J. Tuell, M.K. Hausbeck, Department of Plant Pathology  
B. Bishop, E. Grafius, Department of Entomology  
Michigan State University

**Asparagus miner and Fusarium:** The asparagus miner (*Ophiomyia simplex*) is commonly found on asparagus throughout the commercial asparagus growing regions of the United States. During the fern stage the fly lays its eggs at the base of asparagus stems where larvae mine stems and pupate within them. It is currently thought that feeding by the asparagus miner, resulting in extensive stem mining damage, can lead to increased stem rot by *Fusarium*. Pathogenic strains of both *F. oxysporum* f. sp. *asparagi* and *F. proliferatum* have been associated with all life stages of the asparagus miner with infected pupae serving as an overwintering source of inoculum in Massachusetts.

Due to extensive mining damage in several newly established commercial asparagus fields in Michigan during 2000 and 2001, a project was established to better understand the biology of the asparagus miner, its control and impact on Fusarium crown and root rot.

A preliminary survey in August indicated that 58% (15 out of 26) of the pupae collected from asparagus stems from commercial fields had *F. proliferatum*. Four percent (1 out of 26) had *F. oxysporum* f.sp. *asparagi*. Larvae were also collected and 3 out of 10 had *F. proliferatum*.

Asparagus miner flies were trapped using sticky cards in a newlyplanted asparagus field. From May 30 to September 13 there were two peaks in numbers of asparagus miner flies (see graph right).

One of the experiments conducted during the 2001 season involved applications of the insecticide Pounce 3.2EC to the asparagus fern in an attempt to reduce the number of mines. Pounce 3.2EC (4 oz/A) was applied weekly to plots (50' by 50') beginning June 22 and continuing through September 13, and compared to plots that were not treated. The number of stems with mines were counted weekly. Large differences between the 7day treatment and no treatment were not observed (see graph next page). This may have been because Pounce does not control asparagus miner adults or because the insecticide did not reach the bottom of the stems, where females lay eggs.
Control of rust of asparagus
‘Franklin,’ ‘Mary Washington,’
and ‘Viking’ with foliar sprays,
2001: During the 2001 growing season,
Michigan asparagus growers had a
Section 18 label for Folicur 3.6F against
rust. Several rust trials were
conducted with grower cooperators to
compare Folicur 3.6F with the
standards of Bravo Ultrex 82.5WDG
and Nova 40W. In all of our studies,
regardless of variety, Folicur 3.6F
provided superior control. Four
treatments were applied at site A on
July 18; and August 2, 15 and 29. Four treatments were applied at site B on July 18; and August 1, 15
and 29. Seven treatments were applied to ‘Mary Washington’ fern on June 20 and 28; July 5 and 19; and
August 1, 15 and 29. Eight treatments were applied to ‘Viking’ fern on June 14 and 28, July 12 and 26,
August 8 and 22, and September 5.

<table>
<thead>
<tr>
<th>Treatment and rate per acre, applied at 14day intervals</th>
<th>Rust rating*</th>
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<tr>
<td></td>
<td>‘Franklin’</td>
</tr>
<tr>
<td></td>
<td>site A-8/29</td>
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<tr>
<td>Untreated</td>
<td>6.3 c**</td>
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<tr>
<td>Bravo Ultrex 82.5 WDG 1.82 lb</td>
<td>3.3 b</td>
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<tr>
<td>Folicur 3.6F 6.1 fl oz + Induce 8.33EC 3.8 fl oz . . .</td>
<td>1.0 a</td>
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<tr>
<td>Nova 40W 5.0 oz + Latron B1956 8.33EC 0.5 pt . . .</td>
<td>2.8 b</td>
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</table>

* Based on a rating of 1 to 10 where 1=0% to trace of defoliation to 10=fern defoliation and death.
** There were no significant differences among treatments (StudentNewmanKeuls; P=0.05).

This research was supported by funds from Project GREEEN (Generating Research and Extension to meet Economic and Environmental Needs) for the Research Project entitled, “A Novel Program for Managing Foliar and Soilborne Pathogens of Asparagus,” the Michigan Asparagus Research Committee and Michigan asparagus growers and processors.
PICKLE AND VINE CROP WEED CONTROL - 2001 AND 2002
Bernard Zandstra, Department of Horticulture
Michigan State University

Weed control in cucumbers and other vine crops remains difficult, but there is hope for better days. In 2001 we tested several herbicides to determine effective methods to use them in cucurbit weed control. Several new labels were issued for cucurbits in 2001. COMMAND 3ME (clomazone) is now labeled for use on all cucurbits except bright orange squashes and Jack-o-lantern pumpkins. SELECT (clethodim) is registered for grass control in all the cucurbits. SANDEA (halosulfuron) is labeled for preemergence and postemergence broadleaf weed control in cucumbers.

PCC 170, a combination of ethalfluralin (CURBIT) and clomazone (COMMAND) has been very effective for preemergence weed control in our experiments. It will be marketed as STRATEGY and may be labeled for 2002. Rates will vary from 2-5 pints per acre, depending on soil type.

All the cucurbits are sensitive to several herbicides used on corn and soybeans. Obtain a pesticide history of any land on which you plan to plant cucumbers, pumpkin, or squash before renting the land or planting the crop. If in doubt, contact your MSUE agent for more information.

Herbicide recommendations for 2002 are as follows: apply CURBIT plus COMMAND 3ME (or the premix STRATEGY, if labeled) preemergence and follow with rain or irrigation. Use rate appropriate for your soil type. Use lowest rates on light sandy soil. If needed, apply POAST or SELECT for postemergence grass control. If broadleaf weeds or yellow nutsedge become a problem, apply SANDEA 0.5 ounce per acre plus NIS.
POSSIBLE CURES FOR SHOULDER CHECKING
Sieglinde Snapp and Jinsheng Huang, Department of Horticulture
Michigan State University

Tomato shoulder check is a physiological defect involving multiple microcracks and senescent cells on the fruit epidermis (skin). This has been a serious problem in Southwest Michigan, associated with variable weather: hot, dry alternating with moist conditions. Preliminary findings suggest that high tunnel covers and spraying fruit with boron may help reduce shoulder check. High tunnels reduced the yield (fresh fruit weight) of shoulder check tomatoes by 53%, and decreased the number of fruit with the defect from 55 to 28% in a sample of 100 fruit. Spraying fruit with a combination of boron and calcium reduced yield of fruit with the defect by 22%, where 41 fruit had the defect compared to 55 in the control unsprayed fruit. By contrast, Surround WP (kaolin clay) spray made the problem worse: it increased yield (fresh fruit weight) of fruit with shoulder check by 24%. Similar results were found at every harvest (see photo below). A greenhouse study and applications on a grower’s field revealed similar results. Weekly boron sprays reduced the number of fruits with check by as high as 80% in the greenhouse, while calcium spray alone provided limited benefit.

Over the past two seasons we have found that tomato shoulder check was most likely to occur with rapid movement of water and solutes into dry tomato fruit. The defect occurred in 2001 after a long period of dry, hot weather followed by sudden rain. Around 45% of the fruit were found to have check defect by Aug. 20, in Benton Harbor, MI, just 3 days after one inch of rain. Three more days of an additional 2.5 inches of rainfall was associated with yield losses of up to 70% from shoulder check. A similar pattern occurred the summer of 2000.

High tunnel covers formed a small greenhouse preventing rain from contacting plants. The measured leaf wetness under the plastic tunnels was lower than noncover plants. These temporary tunnels improved fruit quality substantially, with as high as 80% yield without any shoulder check defect. High tunnels are expensive to install, but provide other advantages over conventional practices through providing some frost protection and extending the tomato harvest season.

Spraying fruit may provide a less expensive solution than high tunnels to improving fruit quality (photo). Boron (B) plays an important role in plant cell wall formation, calcium activity, and the transport of potassium to guard cells for control of internal water balance. Boron deficiency is common when soil pH is high or irrigation water has high alkalinity. Boron leaches easily so coarse sandy soils and high rainfall may cause temporary soil shortages. Further, B may be taken up early in the season but then become immobilized in the plant and not available for rapidly growing plant parts, such as fruit. Deficiency symptoms generally occur in the growing points or flower and fruiting parts of the plant. Boron deficient leaves are often puckered or crinkled. Our results are very preliminary and will be tested again next year. It appears that spraying B weekly when fruit is at risk for variable weather (late July early August) may provide moderate reduction in tomato shoulder check.
The most popular soluble sources of boron are Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$, 11% B) and Solubor ($\text{Na}_2\text{B}_{10}\text{O}_{16} \cdot 2\text{H}_2\text{O}$, 20% B). Broadcast and incorporation of boron is recommended for deficient soils, at rates of $\frac{1}{4}$ lb/acre up to 3 lb/acre of elemental boron. Boron should be used ONLY in very small amounts, 3 lb/acre applied to soil is the maximum for sandy sites because it can become toxic to plants if overapplied. The recommended foliar spray rate of boron element is 0.1 to 0.3 lb/acre and $\frac{1}{2}$ lb of actual B is the maximum that should be applied as a foliar spray.

**Other Recommendations:**

Research conducted by Dr. Mary Hausbeck and Brian Cortright over the last two seasons indicates that the fruit defect occurred regardless of variety grown. Use of recommended fungicides also did not significantly influence shoulder check incidence. Thus no change is recommended regarding which varieties should be grown and which disease protection strategies should be followed.

It may be helpful for growers to harvest tomato fruit at the earliest time point the market allows, during the maturegreen or breaker stage. We found that fruits were particularly susceptible when fruits turn pink or red. The measured fruit diameter expanded rapidly each day, and even hourly, as fruit color deepened, which increased shoulder check microcrack defects.

Avoiding sudden changes in growing conditions and maintaining steady, constant plant water status to the extent possible may be the most important means to reduce tomato defects. In our trials, spraying water weekly on dry fruit – water alone without any nutrients added reduced the number of fruit with shoulder check by about 10%. We are continuing our investigations of how water and boron reduce fruit defects. The water treatment may help by keeping moisture at the fruit surface constant. Other means to improve consistency in plant water status may help as well, such as careful scheduling of irrigation.
Cover crops are usually grown during the off season of an annual cash crop, but they may also be used as an inter-crop or grown during the main season. When a cover crop is incorporated into the soil in a vegetative state (fresh), it is referred to as a "green manure". The addition of fresh sources of organic matter into the soil has been shown to generally improve soil quality and health. Organic matter is one of the most important components of soil. In fact, many of the soil's biological, physical and chemical properties are a function of soil organic matter quantity and quality. Increasing organic matter in the soil has many benefits including increasing plant nutrient availability, providing a favorable physical condition for plant growth, increasing the buffering capacity of soil, stimulating root development and increasing biological diversity. Increasing the diversity and activities of the total microbial community generally result in the suppression of root pathogens and other pests as well as their damage to plants, thus improving soil health. In contrast, poor replenishment of organic matter in the soil after harvest will result in deterioration of soil quality and productivity. As soil organic matter decreases, it becomes more difficult to maintain high crop productivity without additional inputs due to problems with erosion, compaction, reduced fertility, inadequate water availability and increased disease and other pests.

Cover crops and their green manures can be effective in suppressing populations and damage of plant-parasitic nematodes, fungal soilborne pathogens or other pests. The preferred characteristics of a cover crop for suppressing damage by root pathogens are that it is a non-host or poor host to the target pathogen(s) and that it will also suppress the existing soil population of the pathogen(s) when it is incorporated as a green manure. However, it is important to allow enough time for decomposition of the green manures prior to planting. Recent results obtained from greenhouse and field tests on the efficacy of selected cover crops in suppressing root rots of beans and the lesion and root-knot nematode are briefly summarized below.

Root rot diseases are widespread and often cause significant losses to beans in New York. These diseases are most damaging when soil conditions are poor including low organic matter content, high soil compaction and others. The major pathogens causing root rots of beans are Pythium ultimum, Fusarium solani f. sp. phaseoli, Rhizoctonia solani, Thielaviopsis basicola, and the lesion nematode (Pratylenchus spp.), occurring individually or in various combinations. Results of greenhouse tests suggested that green manures of the 12 cover crops tested differed greatly in their level of suppression of root rot severity and effects on bean growth. Rapeseed, crown vetch, wheat, sudangrass and ryegrain were among the most effective in suppressing root rot severity ratings. In contrast, root rot severity was highest after hairy vetch, white clover or fallow. Results from one field test showed that a previous cover crop of ryegrain incorporated as a green manure resulted in the highest bean yield and slightly lower root rot severity, whereas that of hairy vetch resulted in the lowest yield and the highest root rot severity.
Reproduction of the lesion nematode (P. penetrans) on 16 cover crops was evaluated in the greenhouse. The final population of the nematode in soil and roots was determined after 8 weeks. Of the crops tested, only ryegrass was a poor host (reproductive factor = <1) to P. penetrans. The most efficient host was hairy vetch (reproductive factor = >5), whereas all the other crops were intermediate hosts. The same cover crops were grown and incorporated as green manures into soil infested with P. penetrans. After 30 days, the soils were planted to beans and the number of lesion nematodes in roots was determined after 8 weeks. The most suppressive green manures against this nematode were sudangrass, rapeseed, and ryegrass. However, the highest numbers of the lesion nematodes were found in roots of beans growing in soils receiving the green manures of hairy vetch and alfalfa.

The effects of cover crops and their green manures against the northern root-knot nematode (Meloidogyne hapla) and its damage to vegetables are dramatic and vary greatly. This nematode has a wide host range consisting of more than 550 crop and weed species. However, most of the grain crops tested against populations of this nematode were found to be non-hosts such as sudangrass, corn, ryegrain, annual ryegrass, wheat, barley, oats, tall fescue, Kentucky bluegrass and others. Only green manures of sudangrass (cv. Trudan 8 and others), rapeseed, (cv. Jupiter) marigolds (cvs. Poly-nema, and Nema-gone) and several accessions of white clover were effective in reducing egg production and root-galling severity as well as increasing marketable yields of lettuce, carrots and onions. The primary mechanism involved in the suppression of this nematode by green manures of sudangrass was primarily due to the production of hydrogen cyanide during decomposition in soil. There was also a positive correlation between the content of cyanogenic compounds in leaf tissues of sudangrass cultivars and the suppression level observed against the northern root-knot nematode.

The above results showed that lesion and root-knot nematodes as well as root rot diseases of beans can be managed with the use of selected cover crops. However, the suppressive activities of green manures of adapted cover crops might be site-specific, thus they should be validated in different production regions and soil environments.

**Selected References**


COVER CROPS IN MICHIGAN VEGETABLE SYSTEMS
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A GREEEN grant helped to establish a cover crop network between three Michigan counties in 2000 and 2001. These counties include Newaygo (potato/onion), Monroe (pumpkin) and Berrien (tomato). Cover crops were seeded in 2000 and plant measurements were taken in 2001.

The network consisted of an MSUE person and a farmer. The MSU/KBS Cover Crop/IPM Program coordinated this effort. Several cover crop species and combinations of species will be presented for these different cropping systems.
COVER CROP EXPERIENCES FROM CALIFORNIA AND BEYOND
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Introduction

The desert valleys of Southern California produce a large variety of vegetables. Vegetable growers in the desert valleys of Southern California have become increasingly interested in sustainable production systems (Hutchinson and McGiffen 2000, Mitchell et al. 2001, Ngouajio and McGiffen 2001). This trend has been encouraged by several factors. Few herbicides are registered for use on vegetables (Hutchinson and McGiffen 2000). There are growing concerns on the effects of conventional production systems on the environment and health (Bond et al. 1998, Buys 1993, Clark et al. 1999, Liebman and Davis 2000). Finally, growers are attracted by higher prices commanded by organic produce (Batte et al. 1993). More recently, the threat of methyl bromide loss coupled with the lack of immediate alternatives has created a wave of reactions among vegetable growers. Interest in use of cover crop has increased tremendously over the last couple of years. Crop production in Southern California is characterized by several factors:

- More than one crop is usually grown per year on the same land
- Rainfall is negligible, and all crops are irrigated
- Soil organic matter is generally very low (less than 0.5%)
- Summer temperatures are very high and limit summer crop choices.

Under such an intensive system, there is great need to improve soil fertility and organic matter for sustainable production. California is a unique environment where both summer and winter cover crops are used. However, summer cover cropping is the common practice among vegetable growers in the desert areas of Imperial, Coachella, and Central Valleys.

Effects of Summer Cover Crop on Fall Lettuce Production in California.

Experiments were conducted in 1999 and 2000 in Coachella Valley to test the effects of summer cover crops on fall lettuce yield. Three cover crop treatments were used (Cowpea, Sudangrass, and Fallow).

Results

The highest yield in both years was obtained when summer cowpea was incorporated into the soil prior to lettuce transplanting. Yield in those plots was 15.0 t ha\(^{-1}\) in 1999 and 16.4 t ha\(^{-1}\) in 2000, corresponding to 20% (1999) and 78% (2000) increase compared to the fallow plots. The second highest yield was obtained with summer dry fallow in 1999, and with sudangrass in 2000. The lowest lettuce
yields were following sudangrass in 1999 and summer dry fallow in 2000. Reduced yield in 1999 with sudangrass cover crop was probably due to allelopathic effects of sudangrass residue on lettuce. Lettuce plants were severely stunted in those plots and showed pronounced yellowing. Holmes (1998 a, b) proposed that sudangrass residue have the effect of immobilizing nutrients. Before integrating sudangrass into a vegetable cropping system, an evaluation of its negative effects on the economic crop should be investigated thoroughly.

The beneficial effects of cowpea incorporation into the soil on lettuce yield were due among other things to its ability to increase soil nitrogen content. Cowpea is a legume crop and is capable of fixing large quantities of atmospheric nitrogen (Anonymous 1996).

In 2000, yield declined in plots that were fallow in the summer. The yield reduction indicates that summer fallow may not be the best production system.

Desert soils in Coachella are very low in organic matter. Cowpea and sudangrass increased significantly the amount of organic matter. After two years, greater microbial activity measured with the fumigation incubation method was highly increased under cover crop systems.

One of the biggest challenges with use of cover crops in California is the ability to kill it at the appropriate time, without running the risk of volunteer infestation. Under the Michigan conditions, winter is an effective and environmentally safe way to kill cover crop. In California however, most growers still rely on herbicides and cultivation to kill cover crops.

References


INFLUENCE OF EIGHT COVER CROPS ON YIELD AND QUALITY
OF CUCUMBER, EGGPLANT, PEPPER, SQUASH AND TOMATO
Ron Goldy, Dale Mutch, Todd Martin, Kevin Kosola, Sieglinde Snapp,
Virginia Wendzel and Dave Francis

OBJECTIVE: To determine if cover crops have an influence on yield and quality of the five major vegetable
crops grown in southwest Michigan. Also to evaluate how effective cover crops are as part of an IPM
disease control program.

SUMMARY: Cover crops increased total yield for tomato and eggplant. No total yield differences were
observed for cucumber, pepper and squash. The best performing treatments overall were hairy vetch and
hairy vetch/rye. Oil seed radish tended to decrease squash plant mortality and tomato fruit size. Cover
cropping is a long term process and care should be used in interpreting results from only one year.

METHODS:
1. Fertilizer: Prior to planting, 0060, 2100, sulfur, and Solubor was applied at a rate of 200, 150, 25 and 5
   pounds/acre, respectively. After planting, nutrients were supplied through the drip system using 4082(Ca)
at a rate of 1 pound nitrogen/a/day. Application began 4 June and continued through 10 September.
2. Herbicide: Prior to planting, 2 pints/a Curbit 3E was applied between the plastic.
3. Cover Crops: All cover crop treatments were planted 19 August, 2000 and were as follows:
   1. Hairy vetch + rye (25# + 1 bu/A) 5. Oats (1.5 bu/A)
   2. Oats + rye (1 bu + 1 bu/A) 6. Oilseed radish (20#/A)
   3. Oilseed radish + rye (15# + 1 bu/A) 7. Rye (1 bu/A)
   4. Hairy vetch (30#/A) 8. Control (no planted cover)
4. Planting: ‘Vivaldi’ pepper and ‘Nadia’ eggplant were started in a greenhouse 5 April, 2001 and
   ‘Mountain Spring’ tomato 17 April, 2001. Transplants were set 25 May, 2001. ‘Tigress’ zucchini and
   ‘Greensleeves’ cucumber were direct seeded 29 May, 2001. All plants were placed on 6” high by 24"
   wide, plasticmulched beds spaced 5.5’ between beds. Peppers were in double rows 14” between rows
   and 18” between plants in the row (10,560 plants/acre). ‘Tigress’, ‘Nadia’ and ‘Mountain Spring’ were
   placed in single rows, 18” between plants (5280 plants/acre). ‘Greensleeves’ was placed 18” in the row,
two plants/hill (10,560 plants/acre). Each bed was irrigated as needed using drip irrigation. The trial was
planted 90° to the previous cover crop. It was analyzed as a randomized block design with three
replications, 16 plants/replication for ‘Vivaldi’ and ‘Greensleeves’ and eight for ‘Mountain Spring’,
‘Nadia’ and ‘Tigress’.
5. Harvest: ‘Tigress’ was harvested 11 times between 13 July and 13 August, 2001. ‘Greensleeves’ was
   harvested eight times between 23 July and 13 August, 2001. ‘Vivaldi’ was harvested 9 and 22 August,
   12 September and 3 October, 2001. ‘Nadia’ was harvest nine times between 30 July and 19 September,
   2001. ‘Mountain Spring’ was harvested five times between 15 August and 10 September, 2001. To
determine mortality rate, plant counts of ‘Tigress’ were taken from 11 July to 17 August, 2001.
RESULTS: Hairy vetch was among the leaders in total yield for all vegetable species (Tables 1-5). Hairy vetch/rye was among the leaders for all species except squash. Hairy vetch is the only cover crop species capable of providing additional nitrogen to the vegetable crop. The control was among the poorer performers for tomato and eggplant. Rye (a standard cover crop for most growers) gave poor performance on eggplant and cucumbers. No treatment significantly influenced pepper yield and quality. Oilseed radish had a negative influence on tomato fruit weight.

Oilseed radish tended to reduce plant mortality in squash (Figure 1). The influence, however, did not translate into significant increased yields over five other treatments. This agrees with other studies that indicate oilseed radish may be helpful in reducing plant death due to soil borne pests.

Table 1. Yield in 1-1/9 bushels/A of ‘Greensleeves’ cucumber. Plants were grown on raised, plastic mulched beds with drip irrigation. Beds were 66” on center, plants were 18” in the row with two plants/hill (10,560 plants/A).

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<td>925</td>
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<td>323</td>
<td>1.6</td>
</tr>
<tr>
<td>8</td>
<td>770</td>
<td>310</td>
<td>40</td>
<td>192</td>
<td>268</td>
<td>1.6</td>
</tr>
<tr>
<td>5</td>
<td>760</td>
<td>319</td>
<td>42</td>
<td>147</td>
<td>294</td>
<td>1.7</td>
</tr>
<tr>
<td>3</td>
<td>736</td>
<td>288</td>
<td>39</td>
<td>133</td>
<td>315</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>694</td>
<td>260</td>
<td>37</td>
<td>145</td>
<td>290</td>
<td>1.6</td>
</tr>
<tr>
<td>1</td>
<td>686</td>
<td>241</td>
<td>34</td>
<td>121</td>
<td>324</td>
<td>1.7</td>
</tr>
<tr>
<td>6</td>
<td>667</td>
<td>201</td>
<td>29</td>
<td>152</td>
<td>314</td>
<td>1.3</td>
</tr>
<tr>
<td>7</td>
<td>661</td>
<td>219</td>
<td>33</td>
<td>141</td>
<td>301</td>
<td>1.6</td>
</tr>
</tbody>
</table>

LSD(0.05) = 7  100  ns  ns

1Mean separation within columns according to Fisher’s test for least significance. P <= 0.05. TRT = cover crop treatment; Ty = total yield; No1Y = number one yield; No2Y = number two yield; CuY = cull yield; PW = above ground plant weight after last harvest.

Table 2. Yield of ‘Nadia’ eggplant in 1-1/9 bushels/A. Plants were grown on raised, plastic mulched beds with drip irrigation. Beds were 66” on center, plants were 18” in the row (5280 plants/A).

<table>
<thead>
<tr>
<th>TRT</th>
<th>TY</th>
<th>No1Y</th>
<th>No2Y</th>
<th>CuY</th>
<th>PW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1538</td>
<td>1266</td>
<td>190</td>
<td>82</td>
<td>3.4</td>
</tr>
<tr>
<td>1</td>
<td>1402</td>
<td>1048</td>
<td>266</td>
<td>88</td>
<td>3.9</td>
</tr>
<tr>
<td>3</td>
<td>1371</td>
<td>1000</td>
<td>265</td>
<td>106</td>
<td>3.5</td>
</tr>
<tr>
<td>5</td>
<td>1342</td>
<td>1056</td>
<td>191</td>
<td>96</td>
<td>3.4</td>
</tr>
<tr>
<td>4</td>
<td>1262</td>
<td>996</td>
<td>184</td>
<td>82</td>
<td>3.1</td>
</tr>
<tr>
<td>7</td>
<td>1183</td>
<td>899</td>
<td>217</td>
<td>67</td>
<td>2.8</td>
</tr>
<tr>
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<td>1118</td>
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<td>183</td>
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<tr>
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</tr>
</tbody>
</table>

LSD(0.05) = 7  100  ns  ns

1Mean separation within columns according to Fisher’s test for least significance. P <= 0.05. TRT = cover crop treatment; Ty = total yield; No1Y = number one yield; No2Y = number two yield; CuY = cull yield; PW = above ground plant weight after last harvest.
Table 3. Yield of ‘Tigress’ zucchini in 1/2 bushels/A. Plants were grown on raised, plasticmulched beds with drip irrigation. Beds were 66" on center, plants were 18" in the row (5280 plants/A).

<table>
<thead>
<tr>
<th>TRT</th>
<th>TY</th>
<th>SmY</th>
<th>MedY</th>
<th>LrgY</th>
<th>CuY</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1684</td>
<td>292</td>
<td>308</td>
<td>641</td>
<td>443</td>
</tr>
<tr>
<td>4</td>
<td>1617</td>
<td>239</td>
<td>373</td>
<td>517</td>
<td>489</td>
</tr>
<tr>
<td>6</td>
<td>1562</td>
<td>371</td>
<td>341</td>
<td>549</td>
<td>301</td>
</tr>
<tr>
<td>8</td>
<td>1332</td>
<td>255</td>
<td>245</td>
<td>577</td>
<td>256</td>
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<tr>
<td>2</td>
<td>1151</td>
<td>182</td>
<td>150</td>
<td>345</td>
<td>474</td>
</tr>
<tr>
<td>7</td>
<td>1088</td>
<td>221</td>
<td>239</td>
<td>456</td>
<td>172</td>
</tr>
<tr>
<td>5</td>
<td>1043</td>
<td>223</td>
<td>251</td>
<td>299</td>
<td>269</td>
</tr>
<tr>
<td>1</td>
<td>872</td>
<td>164</td>
<td>255</td>
<td>347</td>
<td>105</td>
</tr>
</tbody>
</table>

LSD\(_{0.05}\)^1 632 150 154 ns 168

^1Mean separation within columns according to Fisher’s test for least significance. P <= 0.05.

TRT = cover crop treatment; TY = total yield; SmY = yield small (<+ 6”); MedY = yield medium (6  8”); LrgY = yield large (8” +); CuY = cull yield.

Table 4. Yield of ‘Mt. Spring’ tomato in 25# cartons/A. Plants were grown on raised, plasticmulched beds with drip irrigation. Beds were 66" on center, plants were 18" in the row (5280 plants/A).

<table>
<thead>
<tr>
<th>TRT</th>
<th>TY</th>
<th>Yno1</th>
<th>No1FW</th>
<th>Yno2</th>
<th>YCRT</th>
<th>YCU</th>
<th>PW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3045</td>
<td>1713</td>
<td>324</td>
<td>629</td>
<td>166</td>
<td>538</td>
<td>6.2</td>
</tr>
<tr>
<td>4</td>
<td>2635</td>
<td>1516</td>
<td>302</td>
<td>470</td>
<td>299</td>
<td>350</td>
<td>7.6</td>
</tr>
<tr>
<td>7</td>
<td>2594</td>
<td>1397</td>
<td>317</td>
<td>554</td>
<td>298</td>
<td>345</td>
<td>6.7</td>
</tr>
<tr>
<td>5</td>
<td>2458</td>
<td>1352</td>
<td>331</td>
<td>467</td>
<td>192</td>
<td>446</td>
<td>7.2</td>
</tr>
<tr>
<td>6</td>
<td>2450</td>
<td>1312</td>
<td>235</td>
<td>407</td>
<td>227</td>
<td>504</td>
<td>7.1</td>
</tr>
<tr>
<td>8</td>
<td>2437</td>
<td>1347</td>
<td>322</td>
<td>514</td>
<td>191</td>
<td>384</td>
<td>7.2</td>
</tr>
<tr>
<td>2</td>
<td>2424</td>
<td>1507</td>
<td>324</td>
<td>355</td>
<td>214</td>
<td>348</td>
<td>6.2</td>
</tr>
<tr>
<td>3</td>
<td>2394</td>
<td>1463</td>
<td>323</td>
<td>385</td>
<td>189</td>
<td>357</td>
<td>6.9</td>
</tr>
</tbody>
</table>

LSD\(_{0.05}\)^1 519 400 80 179 126 189 ns 168

^1Mean separation within columns according to Fisher’s test for least significance. P <= 0.05.

TRT = cover crop treatment; TY = total yield; Yno1 = number one yield (2 5/8 " + dia.); No1FW = number one fruit weight in grams; Yno2 = yield number two; YCRT = yield number one small (2 1/8  2 5/8” dia.); YCu = yield cull; PW = above ground plant weight after last harvest.
INFLUENCE OF EIGHT COVER CROPS ON YIELD AND QUALITY
OF CUCUMBER, EGGPLANT, PEPPER, SQUASH AND TOMATO

Table 5. Yield of ‘Vivaldi’ pepper in 1-1/9 bushels/A. Plants were grown on raised, drip irrigated, plasticmulched beds. Beds were 66” on center, plants were in double rows 14” between rows and 18” in the row (10,560 plants/A).

<table>
<thead>
<tr>
<th>Trt</th>
<th>TY</th>
<th>Y</th>
<th>Fwt</th>
<th>No2</th>
<th>Cu</th>
<th>Jum</th>
<th>Xlg</th>
<th>Lrg</th>
<th>Med</th>
<th>Pw</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1188</td>
<td>251</td>
<td>162</td>
<td>123</td>
<td>592</td>
<td>218</td>
<td>63</td>
<td>28</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1147</td>
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<td>159</td>
<td>109</td>
<td>568</td>
<td>182</td>
<td>100</td>
<td>28</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1118</td>
<td>245</td>
<td>193</td>
<td>109</td>
<td>561</td>
<td>160</td>
<td>73</td>
<td>22</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1116</td>
<td>244</td>
<td>197</td>
<td>81</td>
<td>533</td>
<td>226</td>
<td>47</td>
<td>33</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1103</td>
<td>250</td>
<td>153</td>
<td>113</td>
<td>529</td>
<td>185</td>
<td>89</td>
<td>34</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1103</td>
<td>247</td>
<td>130</td>
<td>97</td>
<td>558</td>
<td>201</td>
<td>96</td>
<td>20</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1080</td>
<td>244</td>
<td>153</td>
<td>103</td>
<td>515</td>
<td>185</td>
<td>96</td>
<td>28</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1060</td>
<td>252</td>
<td>145</td>
<td>121</td>
<td>549</td>
<td>166</td>
<td>60</td>
<td>20</td>
<td>3.3</td>
<td></td>
</tr>
</tbody>
</table>

LSD<sub>0.05</sub> 1

1Mean separation within columns according to Fisher’s test for least significance. P <= 0.05.

TRT = cover crop treatment; TY = total yield; Y = number one yield; Fwt = average number one fruit weight in grams; No2 = yield number two; Cu = yield cull; Jum = yield of jumbo (240 + grams); Xlg = yield extralarge (200-240 grams); Lrg = yield large (170-200 grams); Med = yield medium (<170 grams); PW = above ground plant weight after last harvest.

Table 6. Yield of ‘Mt. Spring’ tomato in 25# cartons/A following eight cover crop treatments in a commercial production situation. Plants were grown on raised, plasticmulched beds with drip irrigation. Beds were 66” on center, plants were 21” in the row.

<table>
<thead>
<tr>
<th>TRT</th>
<th>TY</th>
<th>Yno1</th>
<th>Pno1</th>
<th>No1FW</th>
<th>Yno2</th>
<th>YCRT</th>
<th>YCu</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2200</td>
<td>709</td>
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<td>312</td>
<td>564489</td>
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<tr>
<td>8</td>
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<tr>
<td>5</td>
<td>1998</td>
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<td>312</td>
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<tr>
<td>7</td>
<td>1880</td>
<td>566</td>
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<td>471576</td>
<td>267</td>
<td></td>
</tr>
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</tr>
</tbody>
</table>

LSD<sub>0.05</sub> 1

1Mean separation within columns according to Fisher’s test for least significance. P <= 0.05.

TRT = cover crop treatment; TY = total yield; Yno1 = number one yield (2 5/8 “ + dia.); Pno1 + per cent number 1 fruit; No1FW = number one fruit weight in grams; Yno2 = yield number two; YCRT = yield number one small (2 1/8 2 5/8” dia.); YCu = yield cull.
### INFLUENCE OF EIGHT COVER CROPS ON YIELD AND QUALITY OF CUCUMBER, EGGPLANT, PEPPER, SQUASH AND TOMATO

<table>
<thead>
<tr>
<th>Date</th>
<th>Plant Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/11/01</td>
<td>Trt 1</td>
</tr>
<tr>
<td>7/13/01</td>
<td>Trt 2</td>
</tr>
<tr>
<td>7/15/01</td>
<td>Trt 3</td>
</tr>
<tr>
<td>7/17/01</td>
<td>Trt 4</td>
</tr>
<tr>
<td>7/19/01</td>
<td>Trt 5</td>
</tr>
<tr>
<td>7/21/01</td>
<td>Trt 6</td>
</tr>
</tbody>
</table>

**Trt 1** = nothing  
**Trt 2** = Methyl Bromide / Chloropicrin  
**Trt 3** = Telone C35 broadcast NO Chloropicrin at bed shaping  
**Trt 4** = Telone C35 broadcast Chloropicrin at bed shaping  
**Trt 5** = In line  
**Trt 6** = Chloropicrin
WIND EROSION CONTROL FOR VEGETABLE PRODUCTION ON ORGANIC SOILS
Jim Breinling, MSU Extension Vegetable Agent, WC Region
Michael Bouwkamp, Grower, Grant, Michigan

Wind erosion can cause immediate crop loss on muck soils, however the effect of long-term loss of soil productivity is of even greater concern for growers. Soil erosion is not only limited to muck soils as much of the vegetable production in West Michigan is on coarse textured erodible mineral soils.

Planting of barley as onions are seeded in the spring is a common practice to reduce wind erosion and protect young seedlings. However, this practice does not provide protection during the critical period immediately after planting. The objective of the work at the Bouwkamp farm was to look at alternatives to the current practice in reducing the risk of wind erosion. Two concepts were identified:

1. Fall shaped raised beds with rye cover to hold beds in place for spring planting and minimize spring tillage.

2. The planting of onions between rows of fall planted cover crops that would be established and provide protection immediately after planting.

The in-field trials:

Over 50 acres in various fields were bed shaped in the fall of 2000. Field corn and sweet corn were planted in the spring of 2001 in these fields.

A twenty acre field was planted to fall cover crops in the row spacing used for spring planted onions. Two cover crops, rye and oilseed radish were planted and replicated three times in the field. Comparisons of bio-mass and weed suppression were taken and are reported in On-Farm Research & Demonstration; Field Crops Team 2000. The onions were planted on April 13, 2001 and harvested August 18, 2001.

Observations:

The fall formed beds did not maintain their shape and were not firm enough for spring planting. Planting on the center of the beds was difficult. To have ideal seedbed conditions the beds need to be reshaped in the spring at planting.

Onion yields were approximately 20% greater when oilseed radish was used compared to rye as a fall cover crop. This observation was repeated 4 times during the harvest of the 20-acre field.

Discussion:

The results of 2001 are encouraging and currently oilseed radish is planted at three locations as a cover crop for vegetable production. In two of the fields a oilseed radish plus rye combination was used. Areas of rye only were planted for comparison.
COST OF FRESH MARKET GREEN BELL PEPPER PRODUCTION IN SOUTHEASTERN MICHIGAN

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This presentation will review both the methods used to gather the cost of production and the cost of production found. The budget presented will represent the full cost of production including fixed costs and returns to owner labor and management. The information on green pepper cost structure and yields was developed using a focus group of growers with a good knowledge of the industry and good field, enterprise, and financial records. The process was initiated by defining a green pepper production system and strategic planning context representative of Macomb County, Michigan. Subsequently, both the sequence of decisions and the information necessary to make these key decisions was collected. These key decisions covered fall activities as well as decisions within the production year. This process resulted in a list of inputs and input prices that were then translated into costs. Buildings, machinery and services were priced to the enterprise on a "custom" basis. Further, services such as land preparation were priced to the enterprise as a "bundled" service or task reflecting both the machinery and labor components of the service. Costs were verified against grower records. The results of this presentation will be available in the Michigan State University Department of Agricultural Economics Staff Paper 0146, “Cost of Green Bell Pepper Production in Southeastern Michigan.” A paper copy can be requested from Tobin Mellberg at 517.432.0848 or can be found by clicking on the “Staff Papers” link at:

http://www.aec.msu.edu/agecon/pubs.htm
PEPPER STUDIES AT SWMREC
Ron Goldy, MSU Extension District Vegetable Agent
Southwest Michigan Research & Extension Center
Michigan State University

Table 1. Yield of ‘Mitla’ jalapeno pepper in bushels/A following five foliar applications of gibberellic acid. Plants were grown on raised, drip irrigated, plasticmulched beds. Beds were 66” on center, plants were in double rows 14” between rows and 18” in the row (10,560 plants/A).

<table>
<thead>
<tr>
<th>GA (ppm)</th>
<th>Yield</th>
<th>Ftct</th>
<th>Ft wt</th>
<th>Plwt</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>662,808</td>
<td>26.4</td>
<td>.48</td>
</tr>
<tr>
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<td>743,325</td>
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<td>.53</td>
</tr>
<tr>
<td>2</td>
<td>1070</td>
<td>703,230</td>
<td>27.6</td>
<td>.54</td>
</tr>
<tr>
<td>4</td>
<td>1201</td>
<td>792,990</td>
<td>27.3</td>
<td>.60</td>
</tr>
<tr>
<td>8</td>
<td>1060</td>
<td>704,385</td>
<td>27.3</td>
<td>.58</td>
</tr>
</tbody>
</table>

LSD\(_{(0.05)}\)^1  ns  ns  ns  ns

^1 Mean separation within columns according to Fisher’s test for least significance.

\( P \leq 0.05. \)

Ftct = fruit count/A; Ftwt = weight of fruit in grams; Plwt = above ground plant weight in kilograms after last harvest.
Table 2. Yield of 19 bell pepper varieties grown at the Southwest Michigan Research and Extension Center. Plants were grown on raised, drip irrigated, plasticmulched beds. Beds were 66” on center, plants were in double rows 14” between rows and 18” in the row (10,560 plants/A).

<table>
<thead>
<tr>
<th>Variety</th>
<th>SS</th>
<th>TY</th>
<th>No1</th>
<th>%T</th>
<th>Fwt</th>
<th>No2</th>
<th>Cu</th>
<th>Jum</th>
<th>Xlg</th>
<th>Lrg</th>
<th>Med</th>
<th>Color</th>
<th>Bls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vivaldi</td>
<td>VL</td>
<td>1696</td>
<td>1219</td>
<td>72</td>
<td>240</td>
<td>369</td>
<td>108</td>
<td>676</td>
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<td>195</td>
<td>45</td>
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</tr>
<tr>
<td>HA769</td>
<td>HZ</td>
<td>1494</td>
<td>1167</td>
<td>78</td>
<td>204</td>
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<td>51</td>
<td>323</td>
<td>390</td>
<td>301</td>
<td>153</td>
<td>123</td>
<td></td>
</tr>
<tr>
<td>Orion</td>
<td>EZ</td>
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<td>1125</td>
<td>76</td>
<td>223</td>
<td>226</td>
<td>122</td>
<td>523</td>
<td>263</td>
<td>193</td>
<td>145</td>
<td>GR 123</td>
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</tr>
<tr>
<td>#830</td>
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<td>1464</td>
<td>1235</td>
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<td>HA744</td>
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<td>350</td>
<td>258</td>
<td>158</td>
<td>GR 123</td>
<td></td>
</tr>
</tbody>
</table>

LSD<sub>(0.05)</sub> = 150 | 139 | 7 | 15 | 85 | 50 | 119 | 96 | 103 | 72

<sup>1</sup>Mean separation within columns according to Fisher’s test for least significance. P <= 0.05.

SS = Seed Source (VL = Vilmorin, HZ = Hazerra, EZ = Enza Zaden, AC = Abbott & Cobb, RS = Rogers Seed, SK = Sakata Seeds, UG = United Genetics; TY = total yield; No1 = number one yield; %T = per cent of fruit as number one; Fwt = average number one fruit weight in grams; No2 = yield number two; Cu = yield cull; Jum = yield of jumbo (240 + grams); Xlg = yield extralarge (200-240 grams); Lrg = yield large (170-200 grams); Med = yield medium (<170 grams); Bls = resistant to race 1,2,3 or 5 of bacterial leaf spot.
Table 3. Fruit counts of ‘Vivaldi’ and ‘Enterprise’ after foliar application of five gibberellic acid treatments. Plants were grown on raised, drip irrigated, plasticmulched beds, 66” on center. Plants were in double rows, 14” between rows and 18” in the row (10,560 plants/A).

<table>
<thead>
<tr>
<th>Variety</th>
<th>GA</th>
<th>Tot</th>
<th>No1</th>
<th>No2</th>
<th>Cu</th>
<th>Jum</th>
<th>Xl</th>
<th>Lrg</th>
<th>Med</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Vivaldi'</td>
<td>0</td>
<td>9.5</td>
<td>7.5</td>
<td>1.6</td>
<td>0.5</td>
<td>3.0</td>
<td>1.6</td>
<td>1.9</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>10.2</td>
<td>7.2</td>
<td>1.7</td>
<td>1.3</td>
<td>2.8</td>
<td>1.8</td>
<td>1.6</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>9.0</td>
<td>6.7</td>
<td>1.8</td>
<td>0.5</td>
<td>2.8</td>
<td>1.6</td>
<td>1.3</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>8.6</td>
<td>6.6</td>
<td>1.6</td>
<td>0.7</td>
<td>2.9</td>
<td>1.7</td>
<td>1.1</td>
<td>0.9</td>
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<td></td>
<td>8</td>
<td>8.9</td>
<td>6.7</td>
<td>1.8</td>
<td>0.4</td>
<td>3.1</td>
<td>1.5</td>
<td>1.5</td>
<td>0.7</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>0.6</td>
<td>ns</td>
<td>ns</td>
<td>0.6</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

| Enterprise | 0  | 10.4| 8.2 | 1.7 | 0.5 | 0.6 | 2.1 | 2.3 | 3.1 |
|           | 1  | 9.4 | 7.2 | 1.6 | 0.6 | 0.3 | 1.7 | 2.8 | 2.4 |
|           | 2  | 10.3 | 7.9 | 1.9 | 0.5 | 1.5 | 2.3 | 2.3 | 1.8 |
|           | 4  | 7.2 | 5.7 | 0.9 | 0.6 | 0.2 | 1.4 | 2.1 | 2.0 |
|           | 8  | 8.8 | 6.2 | 2.0 | 0.6 | 0.5 | 1.7 | 2.4 | 1.7 |
| LSD (0.05) | 1.7 | 1.4 | 0.8 | ns | 1.0 | 0.7 | ns | 1.0 |

1 Mean separation within columns according to Fisher’s test for least significance. P <= 0.05.

GA = level of gibberellic acid in ppm; Tot = average fruit/plant; No1 = number one fruit/plant; No2 = number two fruit/plant; Cu = cull fruit/plant; Jum = jumbo fruit/plant (240 + grams); Xl = extralarge fruit/plant (200–240 grams); Lrg = large fruit/plant (170–200 grams); Med = medium fruit/plant (<170 grams).
Table 4. Yield in 1-1/9 bushels/A of ‘Vivaldi’ and ‘Enterprise’ after foliar application of five gibberellic acid treatments at the Southwest Michigan Research and Extension Center. Plants were grown on raised, drip irrigated, plasticmulched beds, 66” on center. Plants were in double rows, 14” between rows and 18” in the row (10,560 plants/A).

<table>
<thead>
<tr>
<th>Variety</th>
<th>GA</th>
<th>TY</th>
<th>Y</th>
<th>Fwt</th>
<th>No2</th>
<th>Cu</th>
<th>Jum</th>
<th>Lrg</th>
<th>Med</th>
<th>Pwt</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Vivaldi’</td>
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<td>1263</td>
<td>1012</td>
<td>218</td>
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<td>220</td>
<td>211</td>
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<td>196</td>
<td>127</td>
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<td>243</td>
<td>182</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1205</td>
<td>973</td>
<td>225</td>
<td>202</td>
<td>30</td>
<td>489</td>
<td>226</td>
<td>143</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1192</td>
<td>921</td>
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<td>65</td>
<td>472</td>
<td>242</td>
<td>128</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>1216</td>
<td>958</td>
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<td>211</td>
<td>47</td>
<td>524</td>
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<td>168</td>
<td>59</td>
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LSD(0.05)  

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<th>Variety</th>
<th>GA</th>
<th>TY</th>
<th>Y</th>
<th>Fwt</th>
<th>No2</th>
<th>Cu</th>
<th>Jum</th>
<th>Lrg</th>
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<tbody>
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<td>1140</td>
<td>914</td>
<td>180</td>
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<td>268</td>
<td>267</td>
<td>283</td>
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<tr>
<td></td>
<td>1</td>
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<td>202</td>
<td>44</td>
<td>248</td>
<td>300</td>
<td>268</td>
<td>170</td>
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<tr>
<td></td>
<td>4</td>
<td>791</td>
<td>655</td>
<td>184</td>
<td>87</td>
<td>49</td>
<td>31</td>
<td>192</td>
<td>243</td>
<td>188</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>985</td>
<td>732</td>
<td>187</td>
<td>200</td>
<td>53</td>
<td>79</td>
<td>225</td>
<td>269</td>
<td>159</td>
</tr>
</tbody>
</table>

LSD(0.05)  

1 Mean separation within columns according to Fisher’s test for least significance. P <= 0.05.

GA = gibberellic acid treatment in ppm; TY = total yield; Y = number one yield; Fwt = average number one fruit weight in grams; No2 = yield number two; Cu = yield cull; Jum = yield of jumbo; Xlg = yield extralarge; Lrg = yield large; Med = yield medium; PW = above ground plant weight in kilograms after last harvest.
Michigan growers producing cucumbers, squash, pumpkins, peppers, eggplants and tomatoes have reported significant losses due to Phytophthora blight in recent years. In most cases, the fungus Phytophthora capsici is responsible. Infected plants often have brown to black discolored roots and crowns. The disease is more easily seen on infected fruit, initially as dark, watersoaked lesions which may develop a distinctive white ‘powdered sugar’ layer of spores on the surface of the fruit. Infection of fruit is especially troublesome as the infection may occur days before the symptoms become visible.

**Control:** Crop rotation reduces the number of pathogen spores remaining in a field. A minimum of 3 years crop rotation to hosts other than those listed in the table below is recommended to avoid buildup of *P. capsici* spores. Good drainage is important in managing this disease. Susceptible crops should be planted on well-drained sites and in raised beds. However, even plants growing on well-drained fields on raised beds may have severe disease if rainfall is heavy. Fungicides are most effective used with appropriate fungicide rotation. Growers should avoid relying on a single fungicide, to delay development of fungicide resistance with *P. capsici*. Crop rotation may help to lower *Phytophthora* levels in a field, but planting any of the susceptible vegetable crops into a field with a history of *Phytophthora* is risky.

**Common vegetable hosts affected by *P. capsici***

<table>
<thead>
<tr>
<th>Cucumber</th>
<th>Bell pepper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumpkin</td>
<td>Hot pepper</td>
</tr>
<tr>
<td>Summer squash</td>
<td>Tomato</td>
</tr>
<tr>
<td>Winter squash and gourds</td>
<td>Eggplant</td>
</tr>
<tr>
<td>Zucchini</td>
<td>Watermelon</td>
</tr>
</tbody>
</table>

**Control Strategies Preplant:**
- Consider a preplant banded fungicide application for fields with known problems with *P. capsici*.
- Plant susceptible crops in well-drained fields.
- Utilize raised beds (6” minimum) whenever possible.
- Do not plant in low-lying areas of the field.
- Do not irrigate a field with water that contains runoff from fields with a history of *Phytophthora* disease.

**Control Strategies Production:**
- Monitor fields for disease, including damping off, plant stunting, root and crown rot.
- Irrigate conservatively and, if possible, do not irrigate prior to harvest.
• Plow under portions of the field with diseased plants, including healthy plants that border diseased areas.
• Remove diseased fruit from the field.
• Never dump culls or diseased fruit from other fields or farms into production fields. Once *P. capsici* is introduced, it may remain indefinitely.
• Apply fungicide preventively, especially for known problem fields.
• Rotate the types of fungicides used.

**Control Strategies Postharvest:**
• Harvest fruit as soon as possible from problem fields.
• Keep harvested fruit dry and cool.

**Raised Bed Study:** This study was conducted at a cooperator’s farm on a sandy clay loam soil known to have a history of *Phytophthora capsici*, and previously planted to squash. The field was cultivated, and drip irrigation installed. Some plots were formed into raised beds, compost was added and incorporated to some plots, and some plots were covered with plastic on 21 May. Zucchini ‘Spineless Beauty’ was transplanted in the field on 30 May. Some plots were covered with straw on 15 Jun. Plots consisted of one 15foot row, with 5 feet between rows and 15 inches between plants. Fruits from the center 5 plants of the treatment row were harvested 11 times from 3 to 30 July. Number and weight of infected and total fruit was recorded at harvest and after four days storage at room temperature. Stand count was recorded on 27 July.

All treatments on raised beds significantly increased stand count and number of healthy fruit harvested compared to the treatment on flat ground (see table, below).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Stand count</th>
<th>Number healthy fruit at harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat bed</td>
<td>7.5</td>
<td>b</td>
</tr>
<tr>
<td>Raised bed</td>
<td>13.5</td>
<td>a</td>
</tr>
<tr>
<td>Raised bed, black plastic</td>
<td>13.8</td>
<td>a</td>
</tr>
<tr>
<td>Raised bed, black plastic, 1” straw</td>
<td>13.5</td>
<td>a</td>
</tr>
<tr>
<td>Raised bed, black plastic, 2 ton/A compost</td>
<td>12</td>
<td>a</td>
</tr>
<tr>
<td>Raised bed, black plastic, 2 ton/A compost, 1” straw</td>
<td>13.2</td>
<td>a</td>
</tr>
</tbody>
</table>

* Column means with a letter in common are not significantly different (StudentNewmanKeuls; \(P=0.05\)).
**Fungicide Study:** The isolate of *P. capsici* that is sensitive to Ridomil Gold, did not form lesions on zucchini fruits treated with Ridomil Gold Bravo or Ridomil Gold 4EC (see graph). Other treatments that kept fruit healthy included Acrobat alone and Acrobat + Kocide. When fruits were inoculated with the isolate of *P. capsici* resistant to Ridomil Gold fungicide, fruit became diseased. Two treatments completely prevented disease on zucchini fruits: Acrobat alone and Acrobat + Kocide.

This research was supported by funds from Project GREEEN (Generating Research and Extension to meet Economic and Environmental Needs) for the Research Project entitled, “An Integrated Approach to Manage Phytophthora Blight on Michigan’s Vine Crops,” and from the Pickle Seed Research Fund and the Pickle and Pepper Research Committee.
PICKLE AND VINE CROP WEED CONTROL  2001 AND 2002
Bernard Zandstra, Department of Horticulture
Michigan State University

Weed control in cucumbers and other vine crops remains difficult, but there is hope for better days. In 2001 we tested several herbicides to determine effective methods to use them in cucurbit weed control. Several new labels were issued for cucurbits in 2001. COMMAND 3ME (clomazone) is now labeled for use on all cucurbits except bright orange squashes and Jackolantern pumpkins. SELECT (cethodim) is registered for grass control in all the cucurbits. SANDEA (halosulfuron) is labeled for preemergence and postemergence broadleaf weed control in cucumbers.

PCC 170, a combination of ethalfluralin (CURBIT) and clomazone (COMMAND) has been very effective for preemergence weed control in our experiments. It will be marketed as STRATEGY and may be labeled for 2002. Rates will vary from 25 pints per acre, depending on soil type.

All the cucurbits are sensitive to several herbicides used on corn and soybeans. Obtain a pesticide history of any land on which you plan to plant cucumbers, pumpkin, or squash before renting the land or planting the crop. If in doubt, contact your MSUE agent for more information.

Herbicide recommendations for 2002 are as follows: apply CURBIT plus COMMAND 3ME (or the premix STRATEGY, if labeled) preemergence and follow with rain or irrigation. Use rate appropriate for your soil type. Use lowest rates on light sandy soil. If needed, apply POAST or SELECT for postemergence grass control. If broadleaf weeds or yellow nutsedge become a problem, apply SANDEA 0.5 ounce per acre plus NIS.
SOILBORNE AND LEAF BLIGHT DISEASES OF ONIONS
Dr. James W. Lorbeer
Department of Plant Pathology
Cornell University
Ithaca, New York

SOILBORNE DISEASES

**Onion Smut**  For many years onion smut has been well controlled in New York by the use of either nabam, maneb, or mancozeb (along with an insecticide for onion maggot control) applied as a drench or spray to the onion seed furrow at the time of planting. An alternative method of successful control has involved the use of thiram treated granules also containing an insecticide for maggot control applied to the seed furrow. The treatment of onion seed with ProGro (thiram and carboxin) used along with the fungicide and insecticide granule generally resulted in control equal to that achieved with the drench treatment. In recent years onion smut has occurred on a number of farms in New York at levels reaching as high as 30-50%. Research results and field observations suggest the failures have occurred either because: (1) when the drench treatment was no longer used, reliance for smut control was based solely on seed treated with ProGro, (2) when the drench treatment was used and onions were seeded in soils that were somewhat dry, the volume of water carrier utilized was insufficient to distribute the fungicide throughout the soil profile region through which the seedlings were growing and emerging, or (3) when new planting equipment was utilized, the fungicide was not properly placed in the seed furrow. At present in New York the most reliable procedure for controlling the onion smut disease is to utilize maneb or mancozeb in the drench procedure. However, since a number of New York growers are anxious to control smut and maggot solely by a seed treatment procedure, studies involving my research program in cooperation with those of Dr. Alan Taylor (Geneva, New York), Dr. Mary Ruth McDonald (Guelph, Canada) and Jan van der Heide (Oswego County, New York) are focused in this area.

**Damping Off**  Damping off of onion seedlings caused by *Pythium* species occurs when soils maintain high moisture levels. Either mancozeb and/or metalaxyl (Ridomil) applied to the seed furrow as a drench or thiram applied on granules is effective in controlling the disease. Since damping off and smut need to be controlled simultaneously, it is important that any future fungicide program, particularly if it is solely based on seed treatment, needs to accomplish this task.

**Fusarium Basal Rot and Pink Root**  Both Fusarium basal rot and pink root can be controlled through the use of resistant varieties. In New York onion varieties described as pink root resistant frequently become infected by *Phoma terrestris*, the cause of the disease. Varieties resistant to pink root caused by strains of *Phoma terrestris* which occur in New York need to be developed for use in New York and elsewhere that pink root occurs in spite of the use of varieties described as pink root resistant.

**White Rot**  White rot caused by the fungus *Sclerotium cepivorum* is a serious disease in many regions of the world where onions are grown. In recent years the onion growing areas near Toronto and Montreal in Canada have had serious outbreaks of the disease. In New York the disease was limited until last year to a low level of occurrence on one onion farm in Orange County. White rot has now been detected the
past two summers on several other onion fields in Orange County. It is suspected that the disease may be naturally controlled biologically in New York by the presence of the soilborne bacterium *Burkholderia cepacia* which protects onions from infection by *Sclerotium cepivorum* and a species of the soilborne fungus *Trichoderma* which attacks and kills the sclerotia of the fungus when they are formed. White rot where it has occurred has been partially to well controlled by a number of systems involving either flooding, soil treatment with diallyl disulphide (DADS) in combination with tebuconazole (Folicur) treated Lime Super fertilizer applied with the seed, or by the use of a dicarboximide fungicide dip treatment for transplant onions.

**ONION LEAF DISEASES**

Four leaf diseases of onion are annual threats to cause significant economic losses to commercial onion growers in New York. The diseases are Botrytis leaf blight, Alternaria purple blotch, downy mildew, and Stemphylium leaf blight. During the 1950s and 1960s, maneb and then mancozeb applied weekly as foliar sprays were the fungicides of commercial choice that effectively controlled the first three diseases. Since 1972 fungicide mixtures of mancozeb and chlorothalonil (Bravo) have been used commercially to simultaneously control the first three diseases. Iprodione (Rovral) can be added as an additional component of the mixture to enhance disease control of Botrytis leaf blight. Maneb or mancozeb sprays at full dosage rates applied at the appropriate times effectively control outbreaks of downy mildew in New York as does the use of metalaxyl (Ridomil). Chlorothalonil does not control downy mildew. Stemphylium leaf blight has not been effectively controlled by maneb, chlorothalonil, or iprodione sprays applied individually or in any combination.

In recent years it has been demonstrated in field trials in New York that the commercial fungicides propiconazole (Tilt) and cyprodinil + fludioxonil (Switch) are effective in controlling *Botrytis squamosa*, the cause of Botrytis leaf blight when used alone or in combination with mancozeb or chlorothalonil. The control of Stemphylium leaf blight under field conditions with the presently registered fungicides is problematic. However, the use of Switch in laboratory tests has effectively prevented the growth of *Stemphylium vesicarium* which causes the disease. During the past two years field trials utilizing azoxystrobin (Quadris) particularly in combination with either mancozeb or chlorothalonil have appeared to result in excellent control of Alternaria purple blotch and perhaps Botrytis leaf blight. It presently appears that the future incorporation of Switch and Quadris into onion fungicide spray schedules may allow for the simultaneous control of all of the four foliar diseases with specific combinations of the fungicides. Research, which develops a comprehensive understanding of the biology of *Stemphylium vesicarium* as an onion leaf pathogen is needed.
GRASSY REFUGE STRIPS AND NARROW SPECTRUM INSECTICIDE USE
CONSERVE GROUND BEETLE (COLEOPTERA: CARABIDAE) POPULATIONS
IN MICHIGAN ONIONS

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Summary

Onion maggot continues to be a severe pest in northern climates. This pest has developed high levels of resistance to nearly all insecticides, making it difficult to manage. Conventional tactics are no longer reliable by themselves and effective management requires additional control strategies for reducing onion maggot impacts. Cyromazine is an insect growth regulator used as a seed treatment to control onion maggot under section 18 registration. Our objectives were to:

1. evaluate cyromazine’s impact on biological control agents,
2. determine the potential of refuge habitats to increase ground beetle communities in Michigan onions, and
3. evaluate the combination of cyromazine and refuge strips in onions as a new system for management of onion maggot.

In 2000, we looked at the effect of newly established grassy refuges on ground beetle populations in a Michigan onion field. The ground beetle activity density within twobed refuge strip treatments was not significantly different from the activity density within twobed onion control strips (p>0.05). *Pterostichus melanarius* was the only species more abundant in the newly established refuges than in the onion control habitats (p<0.05). However, the presence of a grassy refuge increased beetle populations in the fourbed crop habitat including entomophagous predators like *Poeccilus chalcites* and *Bembidion quadrimaculatum* (p<0.05) (Fig 1). In 2001 we examined the relationship between refuge habitats established in 2000 and insecticide treatments and quantified their impacts on ground beetle and onion maggot populations. Conservation practices including the use of narrow spectrum insecticides and refuge strip habitats will help to optimize the role of generalist predators in the control of onion maggot.
WEED CONTROL IN ONIONS  2001 and 2002
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Herbicides were tested for preemergence and postemergence weed control in onion. Our primary focus is to find herbicides that are safe on onions and that control weeds that are not currently well controlled with registered products.

We had a Section 18 specific exemption for FRONTIER (dimethenamid) in onions in Michigan in 2001. We tested FRONTIER and the related product OUTLOOK (sdimethenamid) for preemergence weed control. Both products are safe on onions and give good suppression of grasses and yellow nutsedge. OUTLOOK probably will be registered on onions in the future. It will be applied after the two leaf stage, either alone or in combination with PROWL.

STARANE (fluroxypyr) and VALOR (flumioxazin) were tested postemergence on onion. Both appear to be safe when applied to onions after the four leaf stage. Both eventually may be labeled on onion. Goal remains the primary postemergence broadleaf herbicide for onions.

Onion weed control recommendations for 2002 will be similar to those for 2001.
BACTERIAL DISEASES AND BLACK MOLD OF ONIONS
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Bacterial Diseases – A number of bacteria can cause either leaf diseases and/or storage decays of onions. In New York on organic soils cropped to onions the most important bacterial pathogen at the present time is *Burkholderia cepacia* which causes bacterial canker of onion plants and sour skin decay of onion bulbs. *B. cepacia* resides in the soil. Particles of soil containing the bacterium frequently are deposited into the leaf axils of onion plants when windy and rainy conditions occur. If water soaking of the leaf axil area of a plant occurs and relatively warm to hot weather prevails, *B. cepacia* will invade the tissues of the base of the leaf resulting in blighting of the leaf and movement of the bacterium into the tissues of the upper part of the developing bulb causing that part to decay while the plant remains in its growth stage. When onion plants are topped and harvested (mechanically or by hand) from fields in which onion plants are infected by *B. cepacia*, the neck tissues of those onions without completely dry necks (inside neck tissues) can become infected with *B. cepacia* which has contaminated the cutting blades used for topping the onion plants. Undercutting and windrowing onion plants, so that the inside tissues of the necks of the plants are completely dry before topping and harvesting, will prevent infection of the onions through the neck wounds by *B. cepacia* from a source which is either contaminating the cutting blades or resident in soil particles that are deposited on the neck wounds during the harvest procedure.

Because bacterial canker levels can run between 520% in some fields, it is mandatory that a procedure be utilized to minimize occurrence of the disease. Because *B. cepacia* is resistant to copper fungicides and most antibiotics, it appears that a potential procedure for controlling the occurrence of canker is to greatly reduce the population level of *B. cepacia* in soils cropped to onions. Recent studies conducted in New York have indicated that when organic soils are maintained in continuous onion production, population levels of *B. cepacia* in the soils increase and then diminish during the growing season and then rise again for a yet to be determined time period after harvest of the onions. In soils with a rotation practice of either lettuce or sudan grass, soil populations of the bacterium generally have not increased during growth of the plants. The results of an experiment conducted during 2000 using plants grown in small cylinders indicated that rye increases the population level of *B. cepacia* in the soil and oats decreases the level. A different miniculture procedure presently is being used to determine which potential rotational crops and plant species regulate population levels of *B. cepacia* in New York organic soils that are cropped to onion. The procedure thus far has indicated that corn will greatly increase the levels of *B. cepacia* in the soil while several other crops will maintain or either somewhat increase or decrease the levels. Sampling of field soils during 2001 has indicated that a field cropped for many years to lettuce and radish has extremely low population levels of *B. cepacia* in the soil even through the field is located in the middle of a number of fields that usually are cropped to onion each year.

Black Mold – In experiments conducted in New York during 1998/2000, when onion flowers at different stages of development were inoculated with spores of *Aspergillus niger* (the black mold fungal pathogen of onion), the fungus subsequently was detected on and in seed produced from the flowers. The levels of
detection differed depending on the flowering stage at which the inoculation occurred. In a typical experiment conducted during 1999, eight treatments were utilized to evaluate the timing of infection by *A. niger*. The treatments were as follows: N1 (control – no inoculum applied); N2 (seed stalks injected with a spore suspension of *A. niger*); N3 (inoculation of tight flower heads); N4 (inoculation as the umbels broke open, flowers tight); N5 (inoculation when in full flower); N6 (inoculation as flowers faded); N7 (inoculation at young seed capsule formation); N8 inoculation at mature seed capsule formation). Seed stalks of plants in treatment N2 were inoculated with a conidial suspension of *A. niger* by injection of the spores into the lacuna of the stalk. Treatments N3 to N8 involved brushing conidia of the fungus onto the flower parts, with only the timing of inoculation varying with the treatment. Umbels were collected at seed head maturation, dried, and the seed separated. One third of the seed from each treatment was plated on acidified potato dextrose agar (APDA) with no manipulation of the seed (Plain). The next third of the seed was rinsed in agitated water for 10 minutes and then plated on APDA (Rinsed). The last third was surface sterilized in a solution of 10% Clorox for 3 minutes, rinsed in water, and then plated on APDA (SS). Higher levels (51%) of *A. niger* were detected in the Plain seed in the control treatment (N1) than in the Plain seed in a 1998 study (11%). The source of this contamination is believed to be due to a much higher level of occurrence of *A. niger* as an airborne background fungus in the greenhouse in which the plants were grown and the inoculations conducted during 1999 than in 1998. The levels of infection in the 1999 control treatment decreased substantially in the Rinsed and SS seed (31% and 4% respectively) as compared to the level in the Plain seed. The N2 treatment indicated as in the 1998 experiment that when *A. niger* is injected or present in the lacuna of the seed stalk, the fungus can ultimately infest and/or infect the seed. Moderately high levels of *A. niger* were detected in the N3 and N4 treatments. The levels of infection for the N5 treatment were 100% in the Plain seed, 95% in the Rinsed seed, and 77% in the SS seed. The presence of *A. niger* in treatments N6, N7, and N8 (full flower through mature seed capsule formation) was detected with levels of 100% in the Plain seed, 98% in the Rinsed seed, and 87% in the SS seed.

During the past three years when onion seed contaminated with *A. niger* was planted in soil not containing the fungus, or when onion seed not contaminated with *A. niger* was planted in soil artificially infested with *A. niger*, the roots, basal plates, cotyledons, and leaves of the resulting seedlings became infected with the fungus. Results of experiments conducted during the past several years have indicated that *A. niger* is a fungus that can grow and survive in the tissues of onion plants without producing macroscopic signs of the fungus or causing disease symptoms until the plants become mature and the bulbs reach maximum size at which time symptoms of black mold may become apparent either then or shortly after the onions are harvested. Onion plants grown from seedlings infected with *A. niger* from both seedborne and soilborne sources of *A. niger* have been detected during all subsequent stages of growth to harbor the fungus in a symptomless manner in all areas of the plants (leaf tips, upper leaf area, lower leaf area, bulb tissue, basal plate, and roots). Physiological changes in onion plants as they mature and/or environmental conditions such as high temperatures and moisture most likely regulate the change of *A. niger* from this endophytic symptomless behavior to that of a pathogenic nature. The results of other studies conducted during the past two years have shown that the propagule levels of *A. niger* in soils of fields cropped to onion differ substantially between the fields, perhaps due to differences in cropping patterns or other cultural practices. These differences could lead to divergent occurrence levels of black mold on onions grown on the different fields.
THE LATEST IN COLORADO POTATO BEETLE CONTROL
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Colorado potato beetle has been the most costly and difficult to control insect pest of potatoes in the northern U.S. and Canada. In Michigan, control costs and losses for this insect alone were $8 to 14 million/year in 1991 through 1994, before registration of imidacloprid (Admire; Bayer). Research emphasizes evaluation of new insecticides, monitoring resistance to imidacloprid, and looking for alternatives to insecticides, including resistant potato varieties and biological control.

New insecticide registrations have been received for thiamethoxam (Platinum, liquid at planting; Actara, foliar; Syngenta) and for seed piece applications of imidacloprid. Unfortunately, imidacloprid and thiamethoxam are related insecticides. Beetles that are resistant to imidacloprid are also somewhat resistant to thiamethoxam. This "cross resistance" is not 100%, but shows that resistance to the two products is related and alternating between the two would not be a good resistance management strategy. Monitoring resistance to imidacloprid in beetles from a number of locations in the U.S. and Canada indicates that resistance is not increasing or increasing only slowly except on Long Island NY, where it is a serious problem.

We are studying this resistance to better learn how to manage it and to learn why it appears not to be increasing in most locations. Resistance is much lower in larvae from Long Island than in adults of the same beetle strain (figure). If we cross the Long Island beetles with susceptible beetles, resistance is also much lower in the offspring than in the Long Island parents it is inherited as a recessive genetic factor. Crop rotation appears to be very important; if we practice good crop rotation, beetles will be forced to disperse and any resistant beetles will likely mate with susceptible beetles, producing susceptible offspring.

Resistance of Colorado potato beetles from different locations to imidacloprid.

The susceptible strain came from an organic farm in Michigan's Upper Peninsula. The Michigan selected strain has been selected by treatment with imidacloprid in the laboratory for 12 generations. LI x S are adults from a cross between Long Island and susceptible beetles.

Biological control research by Nathan Cottrell and Dr. Haddish Melakeberhan, Department of Entomology, Michigan State University, is studying the effectiveness and limitations of a nematode that attacks Colorado potato beetle larvae, pupae and adults in the soil. This nematode, *Heterorhabditis merelatus*, is a new species discovered in Oregon and is highly effective if the soil is wet when the
nematode is applied and when timing of nematode applications is within a few weeks of when Colorado potato beetle life stages will be in the soil (mature larvae entering the soil to pupate, pupae, or newly emerging adults). This nematode is very easy to rear in laboratory culture and may be a possible biological control agent in the future.

We continue to work with Dave Douches’ program, evaluating host plant resistance to Colorado potato beetle. He has several different sources of resistance, including genetically engineered factors and traditionally bred resistance factors. Resistance ranges from very high levels of resistance and mortality of adults and larvae on these lines to low levels of resistance and even situations where beetles seem to avoid a line in a small plot trial where they have a choice, but may readily accept it and cause significant damage if a whole field was planted to the potato line.

Using multiple approaches to management of the Colorado potato beetle, we hope to be able to manage it effectively and economically well into the future.

Reference
CURRENT WEED CONTROL ISSUES IN POTATOES
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Volunteer Potatoes

Control of volunteer potatoes in corn is critical for the management of late blight disease in potatoes. Volunteer potatoes will harbor the disease and allow it to be transmitted to a potato crop the following year. No single herbicide will provide full season control of volunteer potatoes. However, herbicides used in combination with other management practices, such as cultivation and crop rotation will help reduce the volunteer potato numbers. Selection of herbicides to control volunteer potatoes depends on the crop rotation schedule for the field.

If the field is scheduled for corn in 2002 and for potatoes in 2003, several herbicides can provide suppression of volunteer potatoes in corn this year. Roundup Ultra in Roundup Ready corn and Liberty in Liberty Link corn provide good suppression as the volunteer potatoes grow larger in the standing corn crop. Both of these products work fairly well on potato plant approximately eight to ten inches tall. Neither of these programs provides residual activity. Cultivation should follow about 7 days after application of each of these herbicides. Cultivation alone (preferably conducted twice) will reduce volunteer potato numbers by about 50 percent and stop daughter tuber formation. One popular herbicide for control of volunteer potatoes has been Starane. However, Starane is not expected to receive a Section 18 special use permit in Michigan in 2002. Banvel (or Clarity) will provide fair to good suppression of volunteer potatoes. Distinct provided suppression of volunteer potatoes equal to that of Starane. Distinct is typically safer on corn than Clarity. Aim herbicide and Tough herbicide both cause some foliar damage, but the potato plants will typically recover and grow. Atrazine applied at 1 lb ai/A followed by Clarity and 2,4D provided about a 95% reduction in tuber weights. Atrazine at 1 lb ai/A has a 10 month rotation restriction to potatoes.

If the field is scheduled not scheduled for potatoes in 2003, then several other herbicides can be used to suppress volunteer potatoes. Basis Gold (a premixture of Accent + Matrix + atrazine) has an 18 month rotation restriction to potatoes. Accent Gold (a premixture of Accent + Matrix + Hornet) has an 18 month rotation restriction to potatoes. Hornet or Scorpion III will suppress volunteer potato but both herbicides have an 18 month rotation restriction to potatoes. Beacon or Beacon + Banvel will suppress volunteer potatoes but also has an 18 month rotation restriction to potatoes if the Beacon rate is greater than 0.36 oz/A. Lighting in IMI or Clearfield corn will provide better suppression of volunteer potatoes. However, Lightning has a 26 month rotation restriction to potatoes.
Select Herbicide in Potatoes

Select herbicide recently received a label for postemergence grass control in potatoes. Select has the same mode of action as Poast herbicide. Both of these herbicides are ACCCase inhibitors and control only grass species. Select and Poast have similar activity on most annual grasses; however, Select has better activity on quackgrass than Poast. Select herbicide will be added to the 2002 Weed Control Guide for Field Crops. A summary of using Select herbicide in potatoes was summarized in the Field Crops CAT Alert (http://www.msue.msu.edu/ipm/CAT98_field/C041698.htm#9) and Vegetable Crops CAT Alert (http://www.msue.msu.edu/ipm/CAT01_veg/V041801.htm#10).

Nightshades in Potatoes

The standard recommendation for control of eastern black nightshade and hairy nightshade has been Dual + Lorox preemergence. However, this combination provides only fair control of nightshades. Matrix applied postemergence provides fair control of eastern black nightshade. The herbicide combinations Matrix + Sencor + Prowl and Matrix + Sencor + Dual applied preemergence provide excellent control of hairy nightshade. Matrix + Sencor applied postemergence also provides excellent control of hairy nightshade.

Researchers at MSU are looking at two ways to improve control of nightshades in potatoes. The first approach is to investigate several herbicides have provided good control of eastern black nightshade in other crops. The herbicides Authority/Spartan, Outlook, and Valor herbicides were tested in potatoes. Authority/Spartan did not reduce Snowden yields but did reduce Russet Burbank yields. Outlook reduced Snowden yields. Valor at low rates did not reduce Snowden yields, but at higher rates reduce yields. The second approach is to investigate the biology of the both eastern black and hairy nightshade. Eastern black nightshade germinates later in the spring; usually later than redroot pigweed. There may be a few hairs on the leaves or stems, but usually hairs are absent. Berries turn black at maturity. Eastern black nightshade grows well in shaded conditions. Hairy nightshade does not grow well in dense shade.
Producing the highest quality tubers is critical to success in the potato industry. High quality at harvest, and maintaining quality through extended storage over many months is particularly important for chip potatoes. Calcium nutrition is thought to be the foundation of high quality, blemish free potato tubers. This is logical, as calcium is crucial to building cell wall and membrane integrity and it may enhance resistance to storage rots. There is some evidence that calcium may help optimize tuber reconditioning (Palta, 1996). However, the benefits of applying calcium are debated. Frequently no clear yield benefits are obtained and quality benefits may be erratic.

It is not straightforward to improve calcium nutrition in tubers. Calcium moves with water, it is driven by transpiration. Tubers do not transpire, making it difficult for calcium to be taken up by tubers. Calcium fertilizer sources tend to be applied early in the growing season and calcium may not be available at high concentrations in the soil when the tuber demand is greatest. Application of calcium as a foliar spray later in the season is not necessarily effective, as transpiration moves calcium up, not down into the tuber. Another complicating factor is that calcium sources tend to contain nitrogen as well, and calcium and nitrogen nutrition may interact to influence growth rate and tuber maturity.

To address this complex issue I am investigating calcium and nitrogen nutrition both at the Montcalm research farm, and through onfarm monitoring. The chip variety ‘Pike’ was grown at a sandy site to evaluate if addition of 200 lb actual calcium could reduce internal defects in this variety. Pike was used as it is susceptible to internal necrosis or a brown netlike defect. The calcium treatments compared were: no calcium fertilizer to gypsum (calcium sulfate) applied once or multiple splits, calcium nitrate + calcium chloride applied once or multiple times, and poultry compost (at 12% calcium this is slow release calcium fertilizer). All calcium treatments were evaluated for effectiveness at two nitrogen fertility levels, 180 lb per acre and 360 lb per acre. In addition to yield quality and quantity measurements, a bruising evaluation was conducted.

As shown in figure 1 below, nutrition did not influence potato yields other than a slight (but significant) increase associated with the high calcium poultry compost. This is not surprising as benefits from calcium are expected to be in tuber quality improvements, not quantity. There was limited levels of internal necrosis or brown spot in any treatment: only 2.5% in the control (no calcium added), 0.6% with gypsum, 1% with calcium nitrate/calcium chloride and 1.4% with compost. Potato bruising was not consistently influenced by any calcium source or nitrogen treatment either (data not shown). Color ratings and sugar levels will be monitored over many months and the data is not yet available. An interesting observation from last years onfarm monitoring of Pike tubers from around Michigan is that potato tuber color rating was maintained at acceptable (white) levels in tubers that were high in calcium, at least 250 ppm (Figure 2).
Tuber quality measurements will be conducted over the next eight months of storage in the Cargill demonstration storage facility. The tuber quality monitoring research is being conducted in close collaboration with Techmark, Inc. Support for this research by the Michigan Potato Industry Commission is gratefully acknowledged.

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y = -0.0091x + 4.3768 \\
R^2 = 0.45
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STEWART’S BACTERIAL WILT PROJECT REPORT: The Corn Flea Beetle in 2001
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The corn flea beetle is a very small, black beetle that feeds on a variety of grass plants, including: sweet corn, field corn, and other grasses (crabgrass, rye grass, orchard grass, etc.). Feeding produces linear areas of skeletonization in the leaves, and severe infestations can occasionally kill seedlings. But, most importantly, the corn flea beetle is both a vector and the overwintering source of the bacteria that cause Stewart’s Wilt in sweet corn.

The corn flea beetle spends the winter in the soil and litter near corn fields and Stewart’s Wilt bacteria spend the winter in the gut of the corn flea beetle. The bacteria are spread to a corn plant while a beetle feeds. Plants are most susceptible when they are very small, so the number of flea beetles that survive the winter and the proportion that carry the bacteria are crucial in determining the amount of disease.

Stewart’s Wilt is a sporadic problem in Michigan corn fields. During the mid to late 1990’s, Stewart’s Wilt became an increasing problem in many Michigan counties. This was attributed to a series of mild winters, which increased the overwintering survival of corn flea beetles.

In 2000 we began a 3 year research project to help growers understand and control Stewart’s Wilt disease in sweet corn. Our objectives included developing a more accurate model for predicting the risk of Stewart’s wilt each year and developing a more useful and accurate technique for sampling for corn flea beetles in sweet corn.

During the spring of 2000 and 2001, we placed 6 x 10 inch yellow sticky traps in corn fields and surrounding areas at 2 locations (Monroe County and Macomb County) in Michigan. Traps were collected and replaced weekly throughout the summer and fall. The numbers of corn flea beetles caught on these traps was counted and recorded. We also periodically placed 2 varieties (Jubilee and Illini) of potted corn plants at each location for 35 days throughout the growing season. These corn plants were removed from the field, corn flea beetle feeding scars were measured and counted, and the plants were then placed in the greenhouse and observed for development of Stewart’s Wilt symptoms.

We found corn flea beetles in relatively high numbers in and around sweet corn fields from early spring until late fall in 2000. Lots of feeding was observed on potted corn plants and moderate amounts of Stewart’s Wilt symptoms were observed in the field and in the potted plants in the greenhouse. In 2001, the number of corn flea beetles caught on traps in the spring and early to mid summer was considerably lower than in 2000. Little feeding on corn was observed. Corn flea beetle populations grew dramatically in late summer, but by that time the corn in the field was too mature to be affected by Stewart’s Wilt. Despite sometimes heavy feeding on the small, potted corn plants, no Stewart’s Wilt symptoms were observed.
In both years we found that the number of corn flea beetles trapped in different locations sometimes varied significantly. Very soon after sweet corn germinated, corn flea beetles moved from the field borders into corn fields. In late summer, the corn flea beetle population in the two sweet corn fields exploded to about 10 times the level of spring populations.

Comparing 2000 to 2001, the number of corn flea beetles was much higher early in the season in 2000. Fewer flea beetles in 2001 may have been caused by a more severe winter, resulting in lower overwintering survival. However, even when the 2001 flea beetle population peaked in late summer, no Stewart’s Wilt was evident. A lower proportion of corn flea beetles presumably were infected in 2001 than in 2000.

The yellow sticky traps have proven to be an effective, reliable method for estimating corn flea beetle populations. This tool, coupled with tests of the proportion of flea beetles infected, will help growers more accurately assess the risk for Stewart’s Wilt disease in sweet corn.
CAN YOU REALLY PRODUCE AND MARKET CORN FOR $1.00 PER DOZEN?

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This presentation will review both the methods used to gather the cost of production and the cost of production found. The budget presented will represent the full cost of production including fixed costs and returns to owner labor and management. The information on sweet corn cost structure and yields was developed using a focus group of growers with a good knowledge of the industry and good field, enterprise, and financial records. The process was initiated by defining a sweet corn production system and strategic planning context representative of Monroe County, Michigan. Subsequently, both the sequence of decisions and the information necessary to make these key decisions was collected. These key decisions covered fall activities as well as decisions within the production year. This process resulted in a list of inputs and input prices that were then translated into costs. Buildings, machinery and services were priced to the enterprise on a "custom" basis. Further, services such as land preparation were priced to the enterprise as a "bundled" service or task reflecting both the machinery and labor components of the service. Costs were verified against grower records. The results of this presentation will be available in the Michigan State University Department of Agricultural Economics Staff Paper 0145, “Cost Of Fresh Market Sweet Corn Production In Monroe County, Michigan.” A paper copy can be requested from Tobin Mellberg at 517.432.0848 or can be found by clicking on the “Staff Papers” link at:

http://www.aec.msu.edu/agecon/pubs.htm
ASTER LEAFHOPPERS VECTORING ASTER YELLOWS ON VEGETABLES IN MICHIGAN

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The aster leafhopper (*Macrosteles quadrilineatus*) is the most important migratory insect pest of several vegetables, such as carrots, lettuce, celery and onions, in Michigan. Aster leafhoppers vector aster yellows, the most common disease symptoms are stunting, abnormal growth and light green or yellow coloration of the leaves. For carrots, aster yellows cause distorted growth, many hairs and bitter taste in the roots.

In May and June, 2001, yellow sticky traps were set up in 3 locations (East Lansing, Kalamazoo and Oceana) in different hosts (carrots, wheat, blueberry, weeds, Christmas trees etc.). The aster leafhoppers arrived at the above three locations at the same time with three apparent immigration peaks (May 14 to 15, June 4 to June 6 and June 12 to June 15). However, the number of leafhoppers on yellow sticky traps don’t reflect population densities in the fields; few leafhoppers were caught on the traps and we did not find any host preference from analysis of numbers caught. This suggests that when immigrant leafhoppers land, they do so randomly. More males were found, suggesting males move more frequently than females during the dispersal process. To study the host preferences of the leafhoppers, sticky traps were also set up at MSU muck farm in July and August. Statistically, there were no differences in numbers of aster leafhoppers caught in corn, carrots, onions, potato and celery. However, potato leafhoppers showed strong host preferences, preferring potato.

Simulation model showed the proportion and total number of infected immigrant leafhoppers appeared to be primary determinants of aster yellows the following season in Michigan. The proportion of infected immigrant leafhoppers was less than 3% (2 positives from totally 72 tested leafhoppers caught) on June 15, 2001, in Oceana County. There may have been some local overwintering of leafhoppers as eggs, but they would have been uninfected (Tested some wild carrots, ragweed, etc. which were suspected to be aster yellows hosts, but got negative results, suggesting that there are few local sources of the phytoplasmas), they appear to be less important for the aster yellows than migrants. However, without collaboration with southern states that supply the emigrant leafhoppers, we could not answer questions such as: why the immigrant infection levels vary yearly and when? Where? and from which hosts do the leafhoppers get infected in the source areas? The above information would be helpful for forecasting aster yellows infection in the northeastern and north central US.

There were no relationships between leafhopper numbers and the proportion of diseased plants in a 16 carrot varieties trial. The average proportion of plants with root symptoms were lower (around 15.8%) than those with foliage symptoms (around 33.5%). Compared to the short growing period of lettuce, temperature plays a more important role in aster yellows development in carrots.

From observed weather patterns, Ohio and Michigan may fall in the same immigrating areas in the same times (especially in May). However, numbers of the immigrating may be different in different
locations. We found lower immigration numbers in Oceana County in 2000 compared with numbers in Celeryville, Ohio in 2000. We used the same infected proportion (58% in Ohio in 2000) of leafhoppers to run the model for Michigan and the simulation results conformed to the field data well. In the greenhouse, chemical tests were conducted. Celery plants were treated with 5 insecticides, Actara, Baythroid, Provado, Calypso and Asana. The mortality of nymphs and adults were observed on each of the treated plants at 0 (immediately after spraying), 1, 3, 5, 7 days after application. From our preliminary results, Actara, Asana and Baythroid control the adults and nymphs more effectively and has a relatively good residual activities. Provado and Calypso are less effective for adults, however, they are effective on nymphs. More field application tests of the above insecticides will be done in the coming seasons.

Our results indicate that monitoring and control of the immigrating infected leafhoppers (in May and June) is the key to controlling the aster yellows in Michigan carrots. Detail information will be also presented as a poster at the 2001 ESA meeting.

The project is being supported by USDA CSREES, many thanks to Rick and Tom Oomen in Oceana county for the carrot varieties trial. Any comments or suggestions, please contact: Liyang Zhou, 444 Natural Science Building, Michigan State University, E.Lansing, MI 48824. E.mail : zhoul@msu.edu. Phone: (517)4323662, Fax: (517)3534354.
MANAGEMENT OF LEAF BLIGHT DISEASES AND ROOT-KNOT NEMATODE ON CARROTS IN NEW YORK
George Abawi, John Ludwig, Julie Carroll, and Tim Widmer
Department of Plant Pathology, NYSAES, Cornell University, Geneva, NY 14456

Leaf Blight Diseases

Leaf blights are the major diseases impacting carrot production in New York. Leaf blight diseases are caused by the fungi *Alternaria dauci* and *Cercospora carotae* and the bacterium *Xanthomonas campestris pv. carotae*. In recent years, *Alternaria* leaf blight had occurred frequently causing significant damage and requiring repeated fungicide applications. Prior to the 2000 growing season, *Cercospora* leaf blight had also been observed annually, but only in a few fields and at low severity levels. Similarly, the occurrence of bacterial leaf blight has been erratic and generally of low severity. However, *Cercospora* leaf blight was severe during both the 2000 and the 2001 growing seasons, whereas bacterial blight was most severe in 2001. Collaborative and extensive research efforts on carrots in New York were initiated in 1995 and have dealt primarily with the cost-benefit of control options, scouting protocols, timing and efficacy of fungicides, varietal resistance, and the impact of selected cultural practices.

Yield losses can be significant if blight development occurs early in the season. In addition, the development of severe blight diseases will result in pre-mature defoliation of carrots, thus reducing the efficiency of harvesting the crop and increasing yield losses. Management of these diseases has been based primarily on the use of fungicides, including copper for bacterial blight, usually starting in late June and continuing throughout the season. Until recently, Bravo 720 (2 pt./acre) has been the most often used fungicide in New York. Good control of fungal leaf blight diseases was also obtained with Quadris in alternation with Bravo. Both BAS 500 and BAS 516 also gave good control of these blight diseases. Kocide gave good control of bacterial leaf blight and also reduced fungal leaf blights.

The reported Canadian Monitoring Program for leaf blight control (J. C. Sutton, T. J. Gillespie and their colleagues) was evaluated and demonstrated with collaborating growers during 1997-1999. The grower’s and the IPM plot sections in each field were scouted once a week using a “V” or “W” pattern. Generally, a total of 50 leaves from 10 sites along the sampling pattern were examined. The initial fungicide spray in the IPM plots was applied only when the critical threshold density of 25% of leaves became infected. After the initiation of the first spray, leaf blight severity was recorded on a scale of 1 (no lesions, healthy) to 9 (>50% of leaf tissues/area affected). Additional sprays to the IPM plots were applied only when disease severity had increased, rainfall (>30% probability) and high night temperature (>16 C, about 61 F) were forecasted for the following 5 days, and allowing 10-14 days between sprays. The results obtained confirmed the validity of the threshold level of 25% infected leaves as the trigger for the first fungicide application to effectively control fungal leaf blight diseases of carrots. The IPM scouting program resulted in the application of fewer fungicide sprays and this was also influenced greatly by the carrot variety.
As was previously reported from Wisconsin and other production regions, results obtained from experimental and commercial field evaluation in New York clearly demonstrated that available carrot varieties differ in their susceptibility to Alternaria and Cercospora leaf blights. A number of the carrot varieties tested reached the disease threshold level later and required fewer fungicide sprays as compared to the more susceptible varieties. The varieties Bolero, Neal and Fullback exhibited a tolerant reaction to both Alternaria and Cercospora leaf blights, whereas Fontana and Napa were among the most susceptible to both blights. Carson and Bergen were among the varieties that were the most tolerant to \textit{Alternaria} and \textit{Cercospora}, respectively. These results have dictated that the leaf blight scouting program be based on each variety in a field.

Harvesting carrots on time and immediately plowing under the crop debris will contribute to reduced survival of leaf blight pathogens and reduced disease severity. Also, it is important to practice a minimum 2-year rotation out of carrots to reduce fungal and bacterial leaf blight pathogens and their diseases. In addition, it is critical to use vigorous, disease-free and treated seeds, in order to reduce this possible inoculum source for leaf blight pathogens. Practices that contribute to reducing dew wetness duration and soil moisture (wider row spacing, breaking compacted layers, etc.) will be beneficial. In addition, keeping carrots vigorously growing (proper fertility, gibberellic acid application) and without injury from chemical applications will aid in the control of Alternaria leaf blight.

\textbf{Root-Knot Nematode}

The northern root-knot nematode (\textit{Meloidogyne hapla}) is an important pathogen of carrots throughout the production areas in New York. Severe infections and damage by this nematode to carrots have occurred annually, especially in organic soils. Growth of carrots in heavily infested fields is patchy and often resulting in reduced yield. Severely infected carrots exhibit forking, galls on main and fibrous roots, hairiness, and stubby roots. Depending on the level of soil infestation by this nematode, marketable yield of carrot was reduced by as much as 43\% in commercial fields where the nematicide Vydate was not applied.

Field microplot data demonstrated that the incidence and severity of infections were increased and marketable yield of carrots was decreased as the initial population of the northern root-knot nematode was increased from 0 to 8 eggs/cc soil, in both organic and mineral soils. In organic soil, marketable yield of carrots was reduced by 13, 27, and 53\% by \textit{M. hapla} at initial population densities of 1, 2, and 8 eggs/cc soil, respectively. However, \textit{M. hapla} at 1, 2, and 8 eggs/cc of mineral soil caused a yield reduction of 26, 68, and 77\%, respectively. It was calculated, from the same data, that the damage threshold density of \textit{M. hapla} to carrot is 0.4 egg/cc organic soil and 0.8 egg/cc mineral soil. In the same tests, the application of Vydate was found to be effective in controlling the root-knot nematode and its damage to carrots at all infestation levels included in these tests and in both soils.

The method of application and the cost-benefit of Vydate use against \textit{M. hapla} in New York were evaluated (1996 and 1997) in large plots and in collaboration with carrot growers. Results obtained showed that Vydate applied as a broadcast spray and then incorporated was most effective against this
nematode. Vydate applied as an in-furrow drench treatment was less effective, although it significantly increased marketable yield. In one test in 1997, a total of 43.3% carrots were unmarketable in the untreated plots, 18.8% were unmarketable in the Vydate drench treatment plot, but only 0.3% and 0.5% of the carrots were unmarketable in the Vydate broadcast and the drench + broadcast treatments, respectively. In this same test, the investment of $110/A in the broadcast Vydate treatment resulted in a profit of $1434/A. However, Vydate is not cost-effective in fields with low infestations of *M. hapla*.

A two year rotation with a non-host or antagonistic crop will greatly reduce the population of the northern root-knot nematode and its damage to carrots and other vegetables. All grain crops tested to-date were found to be non-hosts to this nematode. In addition, soil incorporation of green manures of sudangrass (cv. Trudan 8), rapeseed (cv. Jupiter), marigold (cv. Polynema and cv. Nema-gone) and several accessions of white clover were found effective against this nematode. The primary mechanism involved in the suppression of *M. hapla* by green manure of sudangrass (also white clover and flax) was due to the production of hydrogen cyanide during their decomposition in soil.
USE OF TOM-CAST DISEASE FORECASTER IN MICHIGAN CARROTS
R. Bounds, and M.K. Hausbeck, Department of Plant Pathology
Michigan State University

Proptec versus Conventional Spray Technology

A prototype Proptec carrot sprayer was developed and built by MSU Ag Engineering in 2000 and used in small research plots. This sprayer combines high speed props and low volumes of water resulting in more thorough spray coverage with minimal drift. This study was conducted in a commercial carrot field planted to ‘Goliath’ and utilized three row beds planted on 64 inch bed centers. Rows in the bed were spaced 18 inches apart with an inrow plant spacing of 1.6 inch. Individual treatment plots were 7 beds wide and 40 feet long with a buffer of 10 feet between spray blocks. The center bed of the plot was used as an untreated drive row and the three beds on the left were sprayed with a conventional boom mounted with twelve 8003 flat fan nozzles. The remaining three beds on the right side of the drive row were sprayed with a boom with three Proptec nozzles spaced 64 inches apart. The conventional boom was calibrated to deliver 20 gallons per acre at nozzle pressure of 20 psi and a speed of 3.0 mph. Proptec treated rows were sprayed at the same time as the conventional treated rows with 10 gallons per acre at 3.0 mph. Pressure for the spray solution for the conventional boom was supplied by a CO₂ charged 5 gallon tank. Proptec solutions were mixed in a poly 30 gallon tank and pumped through a hydraulic roller pump to the nozzles. Both booms were mounted on a trailer spray rig that was pulled by a small 40 hp high clearance tractor that straddled on bed of carrots. Ground speed and spray volume were monitored by an electronic spray controller mounted on the tractor. Treatments were applied seven times on a 10 day spray schedule starting on 12 Jul and finishing on 13 Sep. Foliar ratings, petiole health, and incidence of infected petioles were taken from the center ten feet of the center row of the center spray bed for each treatment and boom type on five different dates throughout the spray season (see graph, below). Yields were taken from the same ten feet as the ratings and carrots were handharvested, topped, and weighed on 9 October.
TomCast Disease Forecaster versus Calendar Sprays

Minimizing fungicide use is a goal of growers, processors, and consumers. Disease management programs that reduce the number of fungicide applications also reduce grower costs, potential residues on the produce, and risk of development of fungicide resistance in the pathogens. One way to reduce the number of necessary fungicide applications without compromising disease control is through the use of disease warning systems that predict potential outbreaks or increases in disease severity based on the weather.

Studies have been initiated at MSU to test the disease forecasting system, TomCast, for use in managing foliar blights on carrot. TomCast is derived from the disease forecasting system (FAST) originally developed to help time fungicide sprays for early blight (Alternaria solani) on tomato. TomCast has been used commercially in tomato production, and has recently been adapted for use in disease management of asparagus. The TomCast program uses the duration of leaf wetness and the average air temperature during the wetness period for each 24-hour period (11:00 AM to 11:00 AM) to determine a disease severity value (DSV) of 0 to 4, corresponding to an environment unfavorable to highly favorable for disease development.

Processing carrots ‘Early Gold’ were planted with a precision vacuum seeder at the MSU Muck Soils Research Farm in three rows 18 inches apart on a raised bed that was 50 feet long. Carrot beds were spaced on 64 inch centers and inrow seed spacing was 1 inch. Each of the four replications of the experiment were located in separate blocks of carrots that consisted of 36 beds. Seventeen treatment beds 20 feet long were randomly placed in a checkerboard pattern in each replication. Treatments were applied with a CO₂ backpack sprayer that was calibrated to deliver 50 gallons per acre of spray solution using 8002 flat fan nozzles. Treatments consisted of an untreated and different schedule applications of Bravo Ultrex 82.5WDG (22.4 oz/A) alternated with Quadris 2.08SC (6.2 fl oz/A). The chemical program was applied on a 10 day calendar program as well as when predicted by the TomCast disease forecaster. Three different prediction thresholds of 15, 20, and 25 DSVs were used to time fungicide applications. When the cumulative daily DSV values reached the determined threshold a spray would be applied. Each treatment regime was initiated at four different levels of disease pressure (0%, trace, 5%, and 10% foliar blight). The first treatments were applied on 2 July and the last application of any treatment was made on
21 September. Ten feet of each center row of the spray blocks were marked before the first application and were used for weekly disease ratings (see graphs, below). Yields were taken from the same ten feet section of row by handharvesting the carrots and topping and weighing.

This research was supported by funds from Project GREEEN (Generating Research and Extension to meet Economic and Environmental Needs) for the Research Project entitled, “Carrots for Michigan’s Future: Developing Expanded Markets and New Pest Management Approaches,” and the USDA CSREES projects entitled, “Reducing Use of B2 Carcinogens in Michigan Carrots” (Pest Management Alternatives Program), and “A Partnership Among Eastern US Carrot Stakeholders to Develop and Implement IPM” (FQPA Risk Avoidance and Mitigation for Major Food Crop Systems Program).
WEED CONTROL IN CARROT 2001 AND 2002
Bernard Zandstra, Department of Horticulture Department
Michigan State University

LOROX is the primary herbicide for carrot. It is very effective and safe on carrot and currently has no problems at EPA. However, when a crop depends completely on one herbicide, it remains vulnerable to sudden decisions by regulators. Therefore, we continue to test new herbicides and methods to improve our ability to control weeds in carrot.

VALOR (flumioxazin) is the main herbicide that we are testing for use on carrot. It is very active and gives good weed control at rates of 0.005 lb/acre. Other herbicides that were somewhat safe on carrot were PROWL, DUAL MAGNUM, AUTHORITY, DOMAIN and GOAL.

SELECT (clethodim) is now registered for grass control in carrot.

Carrot weed control recommendations for 2002 remain the same as for 2001, with the addition of SELECT for grasses.
This presentation will review both the methods used to gather the cost of production and the cost of production found. The budget presented will represent the full cost of production including fixed costs and returns to owner labor and management. The information on carrot cost structure and yields was developed using a focus group of growers with a good knowledge of the industry and good field, enterprise, and financial records. The process was initiated by defining a carrot production system and strategic planning context representative of northwestern Michigan. Subsequently, both the sequence of decisions and the information necessary to make these key decisions was collected. These key decisions covered fall activities as well as decisions within the production year. This process resulted in a list of inputs and input prices that were then translated into costs. Buildings, machinery and services were priced to the enterprise on a "custom" basis. Further, services such as land preparation were priced to the enterprise as a "bundled" service or task reflecting both the machinery and labor components of the service. Costs were verified against grower records. The results of this presentation will be available in the Michigan State University Department of Agricultural Economics Staff Paper 0149, “Cost of fresh market and cutandpeel carrot production in northwestern Michigan.” A paper copy can be requested from Tobin Mellberg at 517.432.0848 or can be found by clicking on the “Staff Papers” link at:

http://www.aec.msu.edu/agecon/pubs.htm
A Farm Bill Policy for Fruits and Vegetables

On May 3, 2001, the nation’s fruit and vegetable industry collectively presented to the U.S. House of Representatives Committee on Agriculture a blueprint for Farm Bill policy to serve the industry for the coming decade. This document represented the culmination of work over the preceding year by United Fresh Fruit and Vegetable Association’s Farm Bill Working Group, consisting of regional, commodity and sector trade associations from throughout the produce industry.

The testimony included 11 key issue areas and over 50 legislative recommendations developed by the Working Group. From a budgetary sense, this blueprint offered a $3.58 billion outline of policies to drive consumer demand for fruits and vegetables while providing a menu of options that growers can use to strengthen their current economic condition. More importantly, this blueprint provided the opportunity for the federal government to elevate its financial investment in program priorities for the produce industry and work cooperatively in achieving the industry’s continued growth and prosperity, without direct subsidies and traditional farm programs that could encourage overproduction or insulate producers from market economic signals.

Through the development of these consensus positions and our drive to participate in farm policy, the produce industry’s recommendations are at the forefront of the Farm Bill debate occurring today. While fruits and vegetables have not been a traditional player in Farm Bill policy as have the program crop commodities, this is a critical opportunity to bring needed resources to produce industry priorities, while channeling investment into increasing marketplace demand, not sustaining or subsidizing overproduction.

Farm Bill Progress To Date

On July 27, the House Agriculture Committee completed its work on the Farm Bill, which was subsequently passed with minor amendment by the full House. We believe the House bill begins to move the industry in the right direction and helps ensure economic stability within the specialty crop sector. Specifically, the bill:

◆ Retains the planting restriction on fruits and vegetables on program crop acres.
◆ Provides the Secretary sole decision authority to combat outbreaks of plant and animal diseases with emergency funds helping to ensure that our food supply remains safe from invasive pests and diseases.
◆ Provides an additional $200 million per year for commodity purchases providing needed support to the agriculture community while at the same time providing food for those in need.
THE INCREASING ROLE OF FRUITS AND VEGETABLES IN FARM BILL POLICY AND AGRICULTURAL PROGRAMS

- Increases the Market Access Program (MAP) from $90 million to $200 million per year. This program aids in the creation, expansion, and maintenance of foreign markets for U.S. agricultural products and is very important to the fruit and vegetable industry.

- Creates a Technical Assistance Specialty Crop (TASC) fund ($30 million over 10 years) to address the barriers to exports that U.S. producers of specialty crops face. The purpose of TASC is to provide direct assistance through public and private sector projects to facilitate increased exports of U.S. specialty crops within the global marketplace.

- Increases conservation funding by 80 percent overall with significant increases going to EQIP, the Conservation Reserve Program (CRP), the Wetlands Reserve Program (WRP), the Wildlife Habitat Incentives Program (WHIP) and the Farmland Protection Program (FPP). In addition, H.R. 2646 includes increased funding in EQIP to address ground water conservation issues, including cost share for more efficient irrigation systems.

- Provides $15 million per year through 2011 for the Seniors Farmers’ Market Program—a program administered through States that provides vouchers, or coupons to seniors to purchase fresh fruits and vegetables at farmers markets.

As the Farm Bill process continues, the Senate has the opportunity to invest in many additional produce industry priorities which are important to addressing the challenges facing fruit and vegetable farmers across the country. Moreover, the cost associated with some of these priorities is well within reason compared to the assistance being provided to other commodity sectors in the House bill.

FY01 Farm Aid Package

On August 13, 2001, President George W. Bush signed into law a $5.5 billion agriculture economic assistance package, H.R. 2213. A key part of this assistance package was an appropriation of $169 million for the benefit of specialty crop growers through a state block grant system allocating funding based on fruit and vegetable production. Through negotiations within the House Agriculture Committee, United helped develop this new concept of providing direct assistance to state Departments of Agriculture to be used for local fruit and vegetable needs. This provision was passed by a 2423 vote in the House Agriculture Committee on June 21, with the strong support of United and the fruit and vegetable industry.

Through the Farm Bill and budget process, the produce industry has continued to stress the economic dynamics facing the industry and the need to provide tools and programs that support a broad range of specialty crop producers across the U.S. The block grant provision accomplishes this goal and will provide much needed assistance based on individual state needs and priorities.

LongTerm Agriculture Policy Impact on the Produce Industry

While the Farm Bill blueprint represents the most comprehensive effort to date by the produce industry to develop a consensus plan to address federal farm policy needs, there are still strong debates in the industry regarding the role of government in our daytoday business.
There are contrasting views; the majority of the produce industry still supports policies that would drive demand for our products without subsidizing production, while providing tools and options for growers to strengthen their economic condition. Yet, others look to government for direct farm payments such as received by corn, wheat, and soybean growers. While we are proud of the policy consensus achieved throughout the industry thus far, there are important issues to be faced as we move down the path of advancing federal policy recommendations for the fruit and vegetable industry.

As the industry increases our visibility in developing federal farm policy and pushing for our “fair share” of federal funding to address industry priorities, we also must address the potential consequences of this action. With government, there is no such thing as a “free lunch.”

For more information about federal fruit and vegetable policy issues and how you can help shape your business future, please contact Robert Guenther, vice president of government and public affairs, rguenther@uffva.org, or Lisa Causarano, member services and trade relations manager, lcausarano@uffva.org at (703) 8363410. Please also visit our website at www.uffva.org.
WEED CONTROL IN PLASTICULTURE SYSTEMS

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With the increased use of plastic culture for the production of various vegetable crops, it is very important to keep in mind a few points for proper weed management.

1. If methyl bromide or Vapam fumigation was used under the plastic strips, there is no need for a herbicide under the plastic. If soil fumigation was not used and black plastic is utilized, it may also not be necessary to put a herbicide under the plastic (excessive nutedge or intense weed pressure could change this). If clear or white plastic, without soil fumigation, is utilized then a herbicide will be required under the plastic mulch. To get the best results, the following steps for herbicide application should be taken:
   a. prepare pressed bed
   b. apply the herbicide to the bed surface
   c. activate the herbicide with rainfall or overhead irrigation (at least one half inch); if the herbicide needs to be incorporated, do so and re-press the bed.
   d. apply the plastic mulch

   NOTE: It is possible that some herbicides, when used under plastic mulches or row covers, may volatilize and cause crop injury. Be careful to observe any precautions on the product label, and, wherever possible, try it only on a small scale first.

2. If weeds are present between the plastic strips before planting, use a banded or broadcast application of Gramoxone plus surfactant, Scythe, or Roundup (if registered for stale bed use) to kill all existing vegetation. Depending on the level of weed vigor, a second application of Gramoxone plus surfactant or Scythe may need to be applied before planting. If Roundup is used as a broadcast application, overhead irrigation or rainfall is required, before planting, to wash the excess Roundup off the plastic. Also, DO NOT USE ROUNDUP if the holes for the crop have already been punched in the plastic mulch. Flaming may also be used between strips of plastic mulch. The major problem with flaming is the control of weeds directly next to the plastic strips. Heat that is sufficient to kill weeds may also melt the plastic. Cultivation is frequently used between plastic mulch. Again, the major problem is effective control of weeds next to the mulch and the potential to rip the plastic with the cultivator tines.

3. For weed control between the plastic strips, after planting, use a registered preemergence herbicide for that crop. DO NOT USE NON-REGISTERED HERBICIDES in these middles as the crop roots will grow in that zone and, in many cases, the crop will be damaged or killed. NOTE: DO NOT SPRAY THE SURFACE OF THE PLASTIC WITH ANY PREEMERGENCE HERBICIDES! The excess herbicide around the holes where the crop plants are, will wash into the holes during a rainfall, greatly concentrating the herbicide rate. Thus, the crop will be damaged or killed. When banded applications of herbicides are used, remember to adjust the amount of the herbicide sprayed to
conform to the actual ground area being sprayed (with 30 inch beds and 30 inch middles, only half the normal amount of herbicide would be required per acre since only half the amount of soil area per acre is actually being sprayed).

4. Backpack sprayers or modified boom sprayers are often used for herbicide applications in plastic culture systems. Be sure to calibrate them properly and maintain a constant pressure by monitoring a pressure gauge, especially on hand pumped models.

5. Use caution when spraying Gramoxone with a backpack or hand held sprayer. Wear rubber boots, gloves, and a mask or respirator. Avoid skin contact with the spray. Where contact occurs, immediately rinse the area with water or rub soil on the skin. Soil will help soak up and bind the chemical, preventing its absorption into the skin. Spray when the wind is calm to avoid spray drift to desirable crop plants. Also, always use a surfactant and plenty of water with Gramoxone or poor control will result.

6. Methyl Bromide, which can be used for weed control under the plastic, is registered for use only on the following field produced vegetable crops:

   asparagus  cauliflower  dry bulb onion
   broccoli    eggplant   pepper
   cantaloupe  lettuce    tomato

   NOTE: Methyl Bromide may be applied to plant beds that are used to produce transplants of any vegetable crop. The key to this registration is that the plants will then be transplanted to a non-treated area.

   Vapam is not recommended for use in the spring if the plastic is to remain in place. Under the cool soil conditions at this time of year, the soil will not aerate properly and the crop will be damaged. In plastic culture, this material will be best used if the plastic is applied the fall before planting.

7. Herbicide use under row covers can be dangerous. Although several herbicides can be safely used under row covers, some can cause crop injury and even crop death. Generally, ventilated covers are safer from an herbicide injury standpoint, than solid covers or hot caps. This is especially true with a herbicide that is moderately or highly volatile. Prior testing on a small scale is strongly recommended before making these applications on a large scale.

   A more complete version of this information is available in a publication named “Vegetable Production Using Plasticulture”. This is available through the ASHS Press, 600 Cameron Street, Alexandria, VA 223142562.
THE EFFECT OF PLASTIC MULCH COLOR ON TOMATO GROWTH AND DEVELOPMENT
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Introduction: In Michigan, about 2,500 acres of freshmarket tomatoes were planted in 1999. A large proportion of the production was on plastic mulch. Black plastic mulch is the most common type of film used by most growers. The positive effects of black plastic mulch over bare ground include earliness, weed suppression, reduction of fertilizer leaching, water and heat retention, all contributing to yield increase. Over the last few years, new films of different colors have been developed, and are commercially available. These include White, Silver, White on Black, IRT (InfraRedTransmitting) Green, and IRT Brown films. These new materials differ in their ability to filter sunlight. That is, their ability to reflect sunlight and allow only warming rays to penetrate the soil. Several studies have shown positive effects of plastic mulch over bare ground. However, few studies have compared the effect of different films on crop growth and development under Michigan conditions. Differences among film types (colors) might not be as great as that between plastic and bare ground. Experiments with black plastic as the reference would therefore provide more information on film colors than experiments with bare ground as the reference. The objective of this work was therefore, to study the effect of different film colors on tomato growth and development, using black film as the reference.

Materials and Methods: The experiment was conducted in 2001 at the Southwest Michigan Research and Extension Center. ‘Mountain Spring’ tomato was planted June 8 in plots covered with the following plastics:
- White
- Black
- White over Black
- Silver
- IRT Green
- IRT Brown

Data collected include:
- Plant growth and development (plant height, biomass, flower initiation, fruit set, tissue analysis etc.)
- Weed (weed population and species composition)
- Yield (total yield and yield of different grades)
- Root development and architecture
- Soil temperature (2 inches deep)
Results

**Soil temperature:** Soil temperature was monitored in all plastics (except White due to sensor failure) throughout the growing season at a depth of about two inches. Plastic color affected soil temperature. Soil temperature was greatest under Black, followed by IRT Green, IRT Brown, Silver, and White on Black was lowest.

**Tomato Height:** At early growth stages, the effect of film color on tomato height resulted in two groups: Tomato grown on White, Black, and White over Black were taller than plants grown on Silver, IRT Green, and IRT Brown plastics. At the end of the growing season however, plant height was similar, irrespective of film color.

**Tomato Blossom:** At 34 days after planting, the number of flower clusters per plant was counted. Again, plastics were separated into two groups using number of flower clusters. The group that resulted in significantly more flowers included the White, Black, and White over Black.

**Weed Control:** All plastic colors provided adequate weed control except White. Heavy infestations of large crabgrass developed under the White film, with populations of about 40 plants/m² and a dry biomass of about 160 g/m².

**Tomato Biomass:** Tomato dry biomass was greatest when plants grown on White, Black, and White on Black plastic, compared to those grown on the different colors tested.

**Tomato Yield:** Film color had little effect on fruit number, total yield, marketable yield, and No1 grade yield. However, significant differences were found on early fruit maturation. Yield was significantly delayed with the IRT Green and the Silver plastic colors, compared with the Black or the White over Black plastics. Similar results were observed for fruit number, total yield, and No1 grade yield. The initial advantage of the White over Black and Black film on earliness was lost after the third harvest that took place about 38 days after the first harvest. This result indicates that it is possible to use plastic color to delay or hasten tomato harvest peaks by up to 3 weeks. This can be used as an extra management tool to spread harvest peaks in case of labor shortage or bad environmental conditions, or to target different markets.

<table>
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<th>Film color</th>
<th>72DAP</th>
<th>95DAP</th>
<th>110DAP</th>
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</table>

IRT is Infra Red Transmitting, DAP is days after planting.
Weed management in vegetable crops is difficult regardless of the strategies used by growers. To obtain good control of weeds, growers must be aware of a variety of information and management tools that are available. In the absence of chemical tools, the task is more difficult. This presentation will highlight strategies that include an understanding of weed biology, physical methods of weed management, and cultural methods of weed management.

**WEED BIOLOGY**

Weeds are classified in several ways. One of the most basic is a separation into monocots and dicots. Monocots include all grasses as well as sedges. Although sedges, most notable nutsedge, are sometimes called grasses, they are not the same and will not be controlled by herbicides specific for grasses. Both of these types are identified by a single shoot or spike that emerges first from a germinating seed or a tuber. All other weeds are called broadleaf weeds. These are identified by a set of cotyledons or “seed leaves” which first emerge from a germinating seed.

To better describe these two main types, a discussion of weed life cycles will follow. All weeds fall into one of 4 life cycle categories. These include summer annuals, winter annuals, biennials, and perennials.

**Summer annuals** are weeds that complete their life cycle in 1 year or less. The cycle is from the spring to the fall. These weeds are triggered to germinate as the soil warms in the spring with most broadleaf weeds germinating before grass weeds. In the fall, these weeds will produce viable seeds that will overwinter and germinate the following spring. Most weeds common to vegetable planting fall into this category. Examples of important summer annual broadleaf weeds include carpetweed, galinsoga, jimsonweed, common lambsquarters, black nightshade, common purslane, common ragweed, redroot pigweed, Pennsylvania smartweed, and velvetleaf. Examples of important summer annual grasses include barnyardgrass, crabgrass, fall panicum, and foxtails (yellow, green, and giant).

**Winter annuals** are weeds that also complete their life cycle in one year or less. In this case, however, the cycle is from fall to spring. These seeds usually germinate as the soil cools. The weeds grow vegetatively during the fall, overwinter, and then produce viable seeds before the weather becomes hot the following spring and summer. Many weeds common to small fruit plantings fall into this category. Most are winter annual broadleaf weeds. Important examples include common chickweed, wild mustards, henbit and field pansy.
Biennials are broadleaf weeds that complete their life cycle in two years and are sometimes confused with winter annuals. They germinate and form a low rosette of leaves the first year and form upright seed stalk during the second year. They are not usually a problem in annual cropping systems since they need such a long time to produce viable seeds although they can be a problem in small fruit plantings. Examples include common burdock and wild carrot.

Perennials are weeds that live for three or more years. There are two types, simple and spreading. Simple perennials grow as individual broadleaf plants with a taproot and reproduce by producing viable seeds. The most common example of a simple perennial is a dandelion. Spreading perennials usually do not produce viable seeds but spread vegetatively. These are grasses, sedges and broadleaf perennial weeds. Important examples of spreading perennials include quackgrass (sometimes called witchgrass), yellow nutsedge, and field bindweed. Usually, no part of these weeds are exposed during the winter and they must grow each year to remain alive over several years.

Most weed management strategies are aimed at weed seeds that remain in the soil from year to year. Two aspects of seeds will be discussed, production and germination. Weeds, especially annual weeds produce a great number of weed seeds. A brief listing of the number of seeds produced per plant follows:

<table>
<thead>
<tr>
<th>WEED SPECIES</th>
<th>SEED/PLANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>REDROOT PIGWEED</td>
<td>117,400</td>
</tr>
<tr>
<td>PURSLANE</td>
<td>52,300</td>
</tr>
<tr>
<td>RAGWEED</td>
<td>3,380</td>
</tr>
<tr>
<td>PA SMARTWEED</td>
<td>3,140</td>
</tr>
<tr>
<td>FOXTAILS</td>
<td>2,420</td>
</tr>
</tbody>
</table>

These weed seeds are distributed in the soil to the depth of the plow layer in most cases. Life expectancy of these seeds can range from as little as 1 or 2 years to several decades depending on species and environment. Only a small percentage of weed seeds will germinate each year. Germination is influenced by many factors including seed depth, cultivation/light, soil compaction, and seed color.

Most weed seeds will not germinate if they are placed too deeply within the soil profile. In fact, most weed seeds will not successfully germinate if they are deeper than 7 times their maximum diameter. Cultivation influences weed seed germination by repositioning seeds closer to the soil surface so that they can germinate. For this reason, cultivations should be kept shallow. Also, some seeds such as redroot pigweed need light to germinate. Deeper seeds briefly exposed to light as the cultivator passes can be triggered to germinate.

Soil roughness and soil compaction have a great effect on weed seed germination. Twice as many seeds will germinate in smooth soil than in rough soil. Also, up to 60% more seed will germinate in compacted soil than in loose, friable soil. Common lambsquarters provides an example of how seed color influences weed seed germination. This weed produces both brown and black seed. The brown seed will germinate the year following its production, while the black seed will not germinate until at least the second year after its production. This insures the perpetuation of the species in case there is a
year with severe drought, early frost, or with some other unfavorable environmental condition.

**PHYSICAL WEED MANAGEMENT**

Physical weed management strategies include hand weeding and cultivation. Hand weeding is, of course, time consuming and expensive; however, it is often necessary for many reasons. These reasons include row weed control and roughing new species that may appear in a field.

Cultivation is an important component of weed control in vegetable crops, especially when use of chemical control is not possible. The timing of cultivation, equipment used, and accuracy of use are all important factors to consider. Weeds are best controlled when they are small. While all cultivation equipment will provide control of weeds between crop rows, equipment should be chosen based on its ability to provide control of as many inrow weeds as possible with minimal crop damage. Minimizing soil movement, especially deep soil movement, is necessary to minimize movement of weed seeds closer to the soil surface.

Several types of cultivation equipment are available. These include; rotovators, multivators, rolling cultivators, rotary hoes, sweep cultivators with discs, etine or Danish etine cultivators, basket weeders, finger weeders, springhoes or spyder weeders, springtine weeders, and wiggle hoes.

An excellent video describing each of these cultivators is available from the Vermont Extension System. Call Dr. Vern Grubinger at 802/2577967.

**CULTURAL WEED MANAGEMENT**

Cultural weed management includes organic and inorganic mulches, soil preparation, stale beds with flaming, crop spacing, use of transplants, fallowing and crop rotation. These will all be discussed.

**OTHER OPTIONS**

Other existing or future possibilities including allelopathy, biological control, biopesticides, and transgenic plants will also be discussed.
OVERVIEW OF AVAILABLE COVER CROPS

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Over the past six years the MSU/KBS cover crop program has been evaluating cover crop species. During the last two years we have expanded our research into vegetable production. This presentation discusses how to incorporate cover crops into vegetable systems. It will focus on some systems that Michigan farmers are practicing, and will provide information on new cover crops and how they may fit into future vegetable farming systems.
Numerous insect pests attack celery in Michigan. Aphids (green peach aphid and sunflower aphid) are especially problematic since infestations typically occur late in the season and can cause deformed growth and contamination at harvest.

Several insecticides are registered for control of aphids on celery, including Orthene, Lannate, Thiodan, malathion and pyrethrin. However, they have important limitations. Overuse of pyrethrin or Guthion (for control of other celery pests) may increase aphid problems. The number of applications permitted of Orthene and Thiodan is limited. Also, the preharvest intervals of effective insecticides range from 4 days (for Thiodan) to 21 days (for Orthene), so these are not useful when aphid problems occur suddenly just before harvest, as is often the case.

Imidacloprid® (Bayer) is a newer neonicotinoid insecticide registered for control of many different kinds of insects, including aphids, on many vegetable crops. We have tested the foliar form of imidacloprid (Provado) in experimental celery plots for several years. Provado has been effective against several different kinds of celery pests, including aphids and tarnished plant bugs, in these plots. However, Provado is not registered on celery. Admire, the atplant imidacloprid application, is registered on celery. However, at labeled rates it is expensive. Furthermore, because Admire is applied at planting, and aphid problems tend to occur late in the growing season, the residual effectiveness of Admire needs to be evaluated.

In 2001 we tested two different Admire applications to celery in a commercial celery field for control of aphids, tarnished plant bugs, and aster leafhoppers. Unreplicated demonstration plots were established in late June. Plots consisted of untreated celery, celery transplants that were treated with Admire (10 oz/A) in the greenhouse five days before transplanting into the field, celery that was treated with Admire applied at transplanting (16 oz/A) and celery subjected to the grower’s standard insecticide treatment program. Plots were sampled weekly for insects beginning July 17.

In general, insect pressure was low for most of the season. Very few aphids were observed on any of the plots during the season. The Admire plots (both application methods) had fewer aphids than the untreated or the standard insecticide treatment plot. The standard insecticide treatment plot had fewer tarnished plant bugs than both the Admire plots. The number of leafhoppers was lowest for the standard insecticide treatment plot and the plots where Admire was applied in the greenhouse prior to planting. The number of leafhoppers was much higher in the untreated plot and the plot with Admire applied at transplanting.

Because these plots were not replicated, and because of low insect pressure, no definitive conclusions can be made on the efficacy of Admire for control of aphids and other pests on celery. However, these results encourage further investigation and research, especially on the efficacy of Admire applied at lower rates in the greenhouse prior to transplanting.
THE IMPACT OF THE ENERGY CRISIS ON CALIFORNIA CELERY PRODUCTION
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Introduction: It is usually said that: “when you live in a room with a 500pound gorilla, everybody sneezes when he catches a cold.” When we consider US agriculture production in general and fruit and vegetables in particular, California is the 500pound gorilla with no doubt. The recent events of energy crisis and rolling blackouts in California last summer surely made the gorilla catch a cold. Michigan is a major player in US celery production. It is therefore important to look at the effects of the energy crisis on California’s production in order to predict potential impacts on our local production. In this analysis, I will attempt to answer the following questions:

1. Why did California have an energy crisis?
2. What were the effects of the crisis on agriculture in general?
3. How did the energy crisis affect celery production in California in specific?

Why did California have an energy crisis? The energy crisis in California was the result of several factors: In 2000, the price of natural gas rose dramatically and has stayed high ever since. In the spot market, the price went from $2 in 1999 to $14 in 2000, corresponding to a 600% increase. Due to the interrelationships among different energy sources, this price hike was quickly expanded to electricity, diesel and gasoline. Due to California’s demand for cleaner sources of electricity, there has been a proliferation of gaspowered generators. More than 30% of the California’s electricity is produced by natural gas (California Energy Commission, 2001). Last summer the electricity bill of the average California resident increased by about 30%. Gas prices during the summer reached a record high of $1.87/gal compared with $1.62/gal for the rest of the country. The total bill paid by California power users for electricity increased from $7 billion in 1999 to $27 billion in 2000. The bill is estimated to reach $50 to 60 billion in 2001 (Gray Davis, 2001). In the early 1990s when electricity was highly regulated, California Energy Commission approved only 11 power plants, and three of them were never built. Even those built were of very small size, generating no more than 220 megawatts. Since deregulation of electricity in 1998, the Energy Commission has approved 27 plants, and up to now, many of them are still under construction. Electricity supply in California over the past years did not keep pace with the growing population. The California energy crisis, which resulted in the “first statewide rolling blackouts since World War II” (Gray Davis 2001) was mainly due to the simple law of supply and demand.

The effects of the California energy crisis on agriculture: In California, agriculture is a $27 billion industry. In 2000, agriculture activities consumed about 14% of the total amount of electricity used in California (California Energy Commission 2001). Most of this is used during summer, when hot weather and the need for irrigation increase agricultural energy demand. This explains why the California Government launched last summer a $75 million program for agriculture in order to mitigate the effects of the energy crisis. The “Agricultural Peakload Reduction Program” was part of the general effort to
reduce electricity demand during peak periods (Noon to 6 PM). Electricity and diesel/gasoline are essential inputs in agriculture. Energy is required for production, storage, processing, distribution, retail, and consumption of agricultural goods. Many crop and animal production facilities operate around the clock. With animals and perishable crops, there is no room for electricity shortage without serious losses.

- Animals need continuous flow of fresh air in the summer, and milk has to be stored immediately.
- Greenhouse plant needs a steady flow of fresh air and regulated temperatures to survive.
- In the field, irrigation pumps are operated around the clock during hot spells.
- Refrigeration is required to remove heat from perishable fruits and vegetables.
- Packing and processing plants need continuous supply of energy for timely shipping of the product and to keep pace with harvest.

**The effect of the energy crisis on celery production in California:** Being a highly perishable vegetable, celery is therefore a good model to study the effects of the energy crisis. Celery requires a lot of water for production. Upon harvest, celery needs to be refrigerated immediately to remove the latent heat and packed for processing or shipment to the market. In order to study the effect of the energy crisis, I selected the selling price as an indicator. I followed celery price fluctuation for two years: one year prior to the crisis, and the other during the crisis. The data were compiled by Western Growers Association (2001). I followed the price paid to farmers, and the retail price in Los Angeles (Figure 1). The months of May, June, and July have the greatest demand for energy by the agricultural sector. This also corresponds to the period when rolling blackouts occurred in California. There was a spike in celery prices during the month of June. This was observed in the prices paid to farmers and the retail prices in Los Angeles. Although there is usually an increase in celery prices during the summer months in California, the increase observed this year was somewhat unusual and was probably due to the energy crisis. The high cost of energy and uncertainty of blackouts affected the selling prices both on the farm and on the retail market.
References

COST OF CELERY PRODUCTION IN NORTHWESTERN MICHIGAN.
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This presentation will review both the methods used to gather the cost of production and the cost of production found. The budget presented will represent the full cost of production including fixed costs and returns to owner labor and management. The information on celery cost structure and yields was developed using a focus group of growers with a good knowledge of the industry and good field, enterprise, and financial records. The process was initiated by defining a celery production system and strategic planning context representative of northwestern Michigan. Subsequently, both the sequence of decisions and the information necessary to make these key decisions was collected. These key decisions covered fall activities as well as decisions within the production year. This process resulted in a list of inputs and input prices that were then translated into costs. Buildings, machinery and services were priced to the enterprise on a "custom" basis. Further, services such as land preparation were priced to the enterprise as a "bundled" service or task reflecting both the machinery and labor components of the service. Costs were verified against grower records. The results of this presentation will be available in the Michigan State University Department of Agricultural Economics Staff Paper 0148, "Cost of celery production in northwestern Michigan." A paper copy can be requested from Tobin Mellberg at 517.432.0848 or can be found by clicking on the "Staff Papers" link at:

http://www.aec.msu.edu/agecon/pubs.htm
COST OF JACKOLANTERN PUMPKIN PRODUCTION
IN SOUTHEASTERN MICHIGAN.

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This presentation will review both the methods used to gather the cost of production and the cost of production found. The budget presented will represent the full cost of production including fixed costs and returns to owner labor and management. The information on pumpkin cost structure and yields was developed using a focus group of growers with a good knowledge of the industry and good field, enterprise, and financial records. The process was initiated by defining a pumpkin production system and strategic planning context representative of Macomb County, Michigan. Subsequently, both the sequence of decisions and the information necessary to make these key decisions was collected. These key decisions covered fall activities as well as decisions within the production year. This process resulted in a list of inputs and input prices that were then translated into costs. Buildings, machinery and services were priced to the enterprise on a "custom" basis. Further, services such as land preparation were priced to the enterprise as a "bundled" service or task reflecting both the machinery and labor components of the service. Costs were verified against grower records. The results of this presentation will be available in the Michigan State University Department of Agricultural Economics Staff Paper 0147, “Cost of jackolantern pumpkin production in southeastern Michigan.” A paper copy can be requested from Tobin Mellberg at 517.432.0848 or can be found by clicking on the “Staff Papers” link at:

http://www.aec.msu.edu/agecon/pubs.htm
WHAT HAPPENED TO THE 2001 PUMPKIN CROP?
Bernard Zandstra, Department of Horticulture
Michigan State University

The 2001 pumpkin crop was smaller than normal for several reasons, most of them weather-related. While we can’t do much about the weather, growers may be able to take some action in the future to overcome weather-related problems.

The cold, damp weather in May and early June delayed planting or caused stand reduction and poor growth in fields already planted. Either way, the crop got off to a poor start. Then hot, dry weather set in and pumpkins without irrigation grew poorly. The very hot (> 90°F) weather during flowering an pollination caused flowers to drop and bees to reduce foraging, resulting in fewer and smaller fruit. Then in mid August the weather became more normal, and cooler temperatures caused the fruit to mature slowly. The hot, dry weather during the summer resulted in less than normal fungal foliar diseases, which resulted in good quality fruit.

During the hot, dry summer, large infestations of aphids appeared in cucurbits and many other crops. They spread several viruses to pumpkins, including cucumber mosaic virus (CMV), watermelon mosaic-2 (WM-2), and squash mosaic virus (SqMV). The viruses caused late-planted crops to reduce growth rate or stop growing, and few fruit were produced. Infected fruit were blotchy green and lumpy.

The result was a smaller than average crop, but fruit quality overall was good. The small crop resulted in above average prices to growers, but probably not enough increase in value to make up for the smaller crop.

To avoid weather-related short crops in the future, growers should plant pumpkins in fields with irrigation, obtain at least one bee hive per acre, keep weeds under control, and control insects and foliar diseases as well as possible. Crop rotation is always a good idea.
INDIAN CORN: GROWING A TREASURE HUNT
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Since 1976 growing Indian corn has become a yearly event, becoming bigger and more colorful every year. Early varieties of Indian corn were very bland in color and had poorer yields. Colors consisted of mostly white with purple kernels mixed in. Harvesting started soon after the husks turned beige, there wasn’t much purple husk on early varieties. Stands of Indian corn went down early on weak stalks. Remember these early varieties were from the same corn that the pilgrims talk about in growing corn that was shown to them by the Native American Indians. This corn is what kept the early settlers alive during harsh winters.

These early varieties didn't change much until the last 15 years, when more color variation, purple husks and better standability were introduced. Many of these improvements came about from growers that recognized new colors and saved the seeds from those ears. Ears were also being selected for ear size and husk staying on the ear better. Stronger stalks were also being selected.

Isolation: Our mini Indian varieties came about from over 17 years of selecting and making crosses in breeding varieties. Hundreds of thousands of ears are handled each year to find unique colors to add to the selections. Some of the new varieties today are true hybrids and saving of seed for color or ear length can no longer be done.

Remember that when growing Indian corn it needs to be completely isolated from all other corns such as all types of sweet corn, commercially grown popcorn, and field corn. The added colors from Indian corn mixing in with popcorn or field corn could make the marketing of those difficult or cause severe dockage. Sweet corn, especially with the SE and SH2 varieties, crosspollinating with any type of Indian corn would make your sweet corn worthless. It results in hard doughy kernels and kernels of different colors. We isolate with distance (over 1000 feet away and not downwind) or we can isolate with time by planting early varieties of sweet corn and follow by planting your Indian corn three weeks later. You can plant side by side patches most years with this type of isolation but don't plant late varieties of sweet corn nearby after planting late Indian corn.

Pest Management: Pest management should consider corn borers, earworms, and aphids (causes discoloration of the husk) and for storage purposes keep in mind the meal moth and grain weevils. Spray materials should have a labeling for popcorn or sweet corn, and yes the large Indian corn is eaten by some as sweet corn. The bad part of growing Indian corn is the long duration of the pollination time. This is due to the different colored ears having different maturity days. Usually pollination lasts for 21
days plus versus sweet corns 7 to 10 days. Spray schedules can vary from 3 days to 5 days apart depending on weather conditions and on label recommendations of the spray used. Don't give up early too early, the last spray is very important. The moths locate your crop from the pollen smell and that smells the same to them if there are several hundred stalks or only a single stalk.

**Marketing:** Marketing your crop is also very important. Large Indian corn sales concentrate from late August through early or mid October. Mini Indian corn sales are almost year around, but for different uses. Large Indian corn sales are mainly for the decorative Halloween season and some is used for Thanksgiving celebrations. Some minor uses of Indian corn include necklaces, corn wreaths, and large Indian corn (flint type) is used for taco shell making and tortilla chips. We have year long sales for mini Indian corn used for Halloween, Thanksgiving, crafts, corn wreaths, potpourri, popcorn, and exotic bird food. We have sold over 1 million mini corn ears each year for the last five years.

Product sold should be dry and free from insect damage. The corn should also have good secure husk attachment with good bright husk color, few if any mildew spots or streaks. We sell product either single eared or bunched in threes. Tie the corn with rubber bands, or if your operation warrants (due to volume) use a tying machine. Tying machines are available and product tied mechanically can be stored long term without becoming loose like when rubber bands deteriorate and break. We also custom pack our corn under several labels and pack in different count cases (123’s, 163’s, 203’s, 243’s, or 323’s). It should be whatever the buyer wants, not just what you want to pack out. Also, pack the product in uniform containers, not just any old box of every different size you can muster up from the back of your local grocery store. Set up easy ways to ship if your customer does not pick up the product. Many freight lines can set up discount rates for you.

**Networking:** We network with several growers during Halloween to meet demand. Our networking group consists of growers that grow 1 acre to several hundred acres. This networking allows us to fill orders on a timely basis and not to have to refuse orders that may be too big to handle alone. We also have several seedsmen and breeders in our network to bring new and improved Indian corn to our mix and blends. Remember that buyers are becoming fewer and the ones that are left are needing larger amounts and usually only want to deal with one source for their needs.

**Things to consider:** Lastly, remember that as of September 11th the world has changed. This past Halloween season was very different. Stores placed smaller initial orders and some did not reorder due to customer concerns over what was to happen next, be it joblessness or terrorism. Many stores are not buying the volume that they had in past years. Some stores skipped Halloween and Thanksgiving and went straight to Christmas sales because of concerns with customer demand in Christmas sales.

A higher percentage of carry over inventory will be put into storage with several growers this year. This will affect what new crop will be needed for next season. It is always a guessing game in what is needed and next year it will be even harder to guess.
MARKETING OPPORTUNITIES FOR ORGANIC PRODUCE: PANEL
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Understanding the Organic Market: Researchers Paul Ray and Sherry Anderson, claim that we are witnessing the emergence of a new world view and culture, an Integral culture that is a new, constructive synthesis of Modernism and Traditionalism. They call its people Cultural Creatives. Compared to the rest of society, cultural creatives have values that are more idealistic and spiritual, are more concerned with relationships and psychological development, are more environmentally concerned, and are more open to creating a positive future. Ray and Anderson estimate that Cultural Creatives make up over 26% of today’s U.S. population. They also comprise a large market for ecoproducts. More information is available at www.culturalcreatives.org.

How do people’s concerns about the environment influence their decisions about what they buy and how they live? According to the Hartman Group, a market research company, consumers may say that the environment is important to their purchase decisions, but first they consider quality and price. Then, “Does it work, does it taste good, does it help me feel better?” Only after an item passes those tests can its ecoattributes influence a buying decision.

In the early 1990’s, over 75% of consumers selfidentified as environmentalists. But the importance of any ecoattributes to a consumer depended on his/her attitude toward the environment — that person’s particular shade of green. In 1996, the Hartman group identified six segments of people relative to food and the environment:

<table>
<thead>
<tr>
<th>Segment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Naturals</td>
<td>7%</td>
</tr>
<tr>
<td>New Greens</td>
<td>23%</td>
</tr>
<tr>
<td>Affluent Healers</td>
<td>12%</td>
</tr>
<tr>
<td>Young Recyclers</td>
<td>10%</td>
</tr>
<tr>
<td>Overwhelmed</td>
<td>30%</td>
</tr>
<tr>
<td>Unconcerned</td>
<td>18%</td>
</tr>
</tbody>
</table>

For more information on the Hartman Group and their research, see www.hartmangroup.com.

But real people’s lives don’t fit well in rigid segments. Early on, eating organic foods was marketed as a social statement, attuned to hardcore environmentalists, not necessarily to the broader market. Today’s organic food successes stories are products where companies have adapted their marketing messages to emphasize the nutritional and health benefits of eating organics. In 2002, people who purchased organic food/beverages indicated that they were motivated first by health and nutrition (66%), followed by taste (38%); food safety (30%); environment (26%); availability (16%); price (16%); appearance (12%); family (11%); and other (5%).

One way to understand this is to envision the wellness world as a sphere, with individuals and groups nearest its core most active in the world, and those closer to its periphery with minimal, less intense
involvement. Those in the middle want core ecoattributes in some, but not all ways. We would find about 13% of consumers near the core, 62% at midlevel; and 24% at the periphery.

Dimensions of the wellness world organize and affect consumers’ behavior, including: price, comparability, personal benefits, expert opinion, knowledge, community benefits, and authenticity. The context or frame of reference for periphery consumers, emphasizing price and comparability, is significantly different from that of midlevel (with more focus on personal benefits, expert opinion, and knowledge) or core consumers (focusing more on community benefits and authenticity), significantly influencing how they consider ecoproducts. Anticipation or expectation of a particular outcome also shapes the experience a consumer derives from using a product.

People lead “messy” lives that change over time. Periphery consumers may become midlevel consumers as their life experiences and circumstances change. Aging often leads consumers to adopt healthier lifestyles. People may become more core in some activities, while moving toward the periphery for others. There are no clear boundaries separating core from midlevel or midlevel from periphery.

Correlating how important a product is with how frequently it is used represents its role in consumer lifestyles. Periphery consumers grant ecoproducts little importance and use them infrequently. Transitioning to midlevel consumers, the importance increases quite a bit more (32%) than the frequency of use (10%). From midlevel to core, importance continues to increase (19%), but frequency of use increased much more (32%). For ecolabels to succeed, they have to speak to the values of the periphery and midlevel, more than to those of the core.

A product’s “ecobuzz” creates a sense of identity for the consumer, establishing a virtual ecocommunity of consumers with a common identity around shared environmental goals. Consumers need to be able to compare ecoproducts with conventional products in terms of their utility. Ecoproducts must work as well as the competition and consumers must believe this is true. Establishing common ground for comparison between conventional and ecoproducts sets the stage for creating the buzz high emotion when a consumer wants as well as needs the product.

Marketing ecoproducts effectively requires understanding what really matters to your target consumer and reaching the market with a message those consumers understand — a message that conveys the value of your product to today’s consumers in all shades of green.

Other panelists:
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MARKETING OPPORTUNITIES FOR ORGANIC PRODUCE

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Maple Creek Farm is an 80-acre certified organic community supported agriculture (CSA) operation based in Yale, Michigan, and serving the metro Detroit area. They plan 18 weekly deliveries between June and October 2002 to their supporting members. Each delivery provides seasonal organically certified produce such as broccoli, beets, romaine, garlic, onions, herbs, greens, gourmet green beans, tomatoes, peppers, eggplant and more. Danny and Michelle Lutz, their three daughters and CSA volunteers provide farm labor. 2002 will be the eighth growing season for Maple Creek Farm. Starting small in 1995, the CSA membership has been near 200 since 1999.

Organic Growers of Michigan provides Maple Creek Farm’s organic certification. Certification required a written application describing farm is operation crop rotations, soil testing & amending, transplant production, raising animals, field maps, supplying them with seed orders, pesticide & fertilizer records and receipts. Each year certified farms need to inform OGM about farm plans. Records for seeds, soil tests, crop rotations, soil amendments. fertilizer & pesticide applications, weed management must be kept and presented each year.

Maple Creek Farm markets about 90% of our crops to their CSA. They have one wholesale account to a small health food store, they donate produce to the Detroit Capuchins, and they are working on supplying produce to Project FRESH. Because their focus is a CSA, Michelle hasn’t done a lot of research on how or where to market. Few Michigan certified organic vegetable farms grow a large variety of vegetables, so folks interested in obtaining local organic produce look for us more than we look for them.

Consumers looking for organic produce are more educated about the impacts of food on their health and the benefits to the environment. They ask questions and expect farmers to know the answers. They regard their food more seriously than shoppers looking for just the cheapest food available. Buying certified organic foods is the only protection consumers have from eating GMO foods, an important reason that certification is beneficial and helpful in marketing. Look for markets where organic produce is desired and welcomed — health food stores, stores carrying organic products, upscale restaurants in areas where folks are environmentally conscious.

Michelle’s advice on going organic, borrowing from the Nike slogan Just do it! Seriously, working with known carcinogens is scary. Reduce the risk to your self and those around you. Farming organic lets you become part of the solution rather than part of the problem. Consumers are out there looking for good food, grown by people who care. When they find it, they are willing to pay a reasonable price. I think what scares growers the most about transition is thinking that they’ll have weeds galore or bugs that destroy everything. That’s not true. Growing organically lets you work with nature not against it, and it really makes farming easier.
SOIL FERTILITY, QUALITY AND HEALTH
John Biernbaum, Department of Horticulture
Michigan State University

The thirty minutes allotted to discuss soil health and quality provides an interesting challenge. After 25+ years of learning about plant nutrition and soil fertility and 4+ years learning about organic farming, there is a great deal that can be said. In a few words organic soil management works well.

Based on my personal observations of how farmers, students and home owners respond to information about organic farming, it seems important to start by stating that describing alternative methods of improving soil quality does not have to be an indictment or criticism of current farming methods. Discussions of organic farming methods in a classroom setting with a diverse group of students have typically resulted in one or more students from a farming background feeling like they or their family and the farming methods practiced are being criticized. This is not the intent. We continue to learn new and different ways and new and different reasons to do the things we do. There are reasons why farmers handle soil fertility and weed control the way they do. But a cultural practice done to support one line of reasoning may later become a cultural practice that is totally contrary to another line of reasoning.

Based on careful consideration of organic farming and gardening principles for maintaining soil fertility, we can say with confidence that they really do work. Not just for small plots or gardens where large quantities of compost or manure can be added, but for very large acreage where compost and manure applications are not sufficient and cover crops and green manures are used. There are well prepared published reports of controlled scientific studies (20+ years in Switzerland, 15+ years at the Rodale Institute in Pennsylvania, 10+ years at the Kellogg Biological Station in Michigan, and others) demonstrating that it is possible to produce economically viable yields of field crops using organic soil management techniques. There is more evidence for grain and bean crops then for fruit and vegetable crops. And there needs to be more work on intensively managed lands with frequent rotations of annual vegetables or long term perennial crops where there is less opportunity to modify or amend the soil. But the evidence is growing, including a recent report of similar yields of organic and conventional apples in Washington State.

Basic principles of soil fertility include maintaining the intensity of soluble nutrients readily available to the plant, the capacity or the reserve of nutrients in the soil that are slowly available to the plant, the availability or solubility of nutrients as influenced by the pH of the soil, and the balance or ratios of nutrients. Over 100 years ago it was demonstrated that crop plants could be grown just by providing the correct amount of the essential nutrients as fertilizers. This was partially accomplished with hydroponic growing methods or growing without soil. Unfortunately, a generation or more of university scientists and educators were trained that the way to grow plants was all about maintaining a chemical balance in the soil. Soil fertility, soil chemistry and plant nutrition courses at three major agriculture universities in three different regions of the country (North Carolina State, Penn State and Michigan State) did not provide what I have learned the last four years. Soil quality is more than soil fertility. The soil cannot be treated as a hydroponic system. A quality, healthy soil is alive and must be managed as such.
The importance of organic matter for maintaining soil structure, water absorption, water and nutrient retention, and to keep the soil from blowing or washing away is well recognized. Organic farming builds on those principles. The use of no-till management has demonstrated how not turning the soil profile can help build organic matter by keeping the microorganisms and the less degraded carbon at the soil depth where they belong. We also know that the over application of nitrogen fertilizers is destructive to organic matter. The presence of nitrogen stimulates what limited biological organisms that are present in low organic matter soils to speed up the breakdown of the organic matter present. Several factors together, including the low organic matter, the turning, the high nitrogen which favors certain types of organisms, and perhaps the use of pesticides and herbicides that might not only kill the target organism but might kill or weaken non-target organisms all lead to something less than a healthy soil.

Organic farming is not just about what is not used. Organic farming is about building soil quality and a diverse biological system. In order to have adequate levels of soluble nutrients for economic yields, the biological system must be working properly. There has to be a wide diversity of organisms and there has to be adequate amounts of a diversity of organic matter in a variety of stages of decay, as well as the balanced amount of nitrogen to allow an adequate but not excessive level of biological activity. Healthy soil is about bacteria, fungi, protozoa, nematodes, earthworms, and many other organisms working together to cycle nutrients. Recent research has helped to demonstrate that if one or more parts of the cycle are not working, the whole system will not work at the level necessary for organic farming. As each level of organism was added to previously sterilized soil in a flask, the cycling and availability of nitrogen increased. Healthy soil is about a diversity of both crop plants and cover or green manure plants being used to keep the soil supplied with the necessary foods for all the biological organisms.

In the case of vegetables and fruits, healthy soil can also mean alternative control strategies for soil born pathogens. Rather than fumigating soils to eradicate pathogens and most organisms, the soil can be managed to provide a diverse system. Frequent, intense cropping may need to be replaced with cover crops and green manures that help provide diversity.

As with any soil management strategy, there needs to be some method of testing and evaluation. The routine soil test that measures extractable nutrients will not provide the information necessary for developing an active soil. For contacting labs that test for other soil criteria such as the number and balance of living organisms, see the article mentioned below.

It is an exciting time to be a part of agriculture. Helping the soil system function properly takes time, it takes thinking and it takes a change in perceptions. Why bother changing if the current system works? The question needs to be, “Is the current system working?” “For how long?” Future farming will be based on adapting at least some of the principles of organic farming. We need management systems that are not necessarily designed to maximize yield or profitability for this year and the short term but are designed to support us and the soil for the long term. We need to think about “sustainable” management systems. Sustainability is not about maintaining the flow of resources to sustain the current status quo. Sustainability is about thinking how we can best manage food and farming systems so our grandchildren and their grandchildren will have something as good or better than what we have.
The ATTRA web site (www.attra.org) has a number of articles covering principles of soil quality:

**Sustainable Soil Management:** Covers the components of the living soil, soil organisms, organic matter, fertilizers, and soil quality. Provides ways to assess soil health, build soil, and manage the soil livestock. Complete with resource list of additional information.

**Alternative Soil Testing Laboratories:** A listing of labs in two broad categories: (1) humus, organic matter, and microbial analysis, and (2) mineral analysis and fertilizer recommendations. Resource listings include soil health, soil testing, and sustainable fertility management.
2002 AGRICULTURE AND NATURAL RESOURCES
ORGANIC WORK SHOPS AND CONFERENCE

John Biernbaum, Department of Horticulture
Michigan State University

In Depth Work Shops, Thursday, March 7 and Friday, March 8; 8:00 a.m. to 5:00 p.m.
Michigan State University Campus, Brody Complex (Across from Kellogg Center)

Fullday and halfday workshops on topics related to organic food and agriculture including:

- Assessing the risks and getting started in organic farming, half day, Patricia Whetham & MOFFA
- Farm business basics, half day, Phil Alexander & Glenn Kole
- Soil health & quality, half day, Dr. Richard Harwood & friends
- Market gardening, full day, Cissy Bowman
- Organic vegetable & flower transplant production, full day, Dr. John Biernbaum
- Small fruit in diversified farming systems, full day, Dr. Eric Hansen & friends
- Smallscale dairy processing, full day, Dr. John Partridge & friends
- Hoop houses for winter production, workshop & tour, Dr. John Biernbaum & Susan Houghton
- Pastured poultry, half day, MIFFS
- Ecologically based farming systems publication review, half day, Dr. Richard Harwood & friends
- Additional workshops still being confirmed

Each workshop participant will receive a package of supporting information and materials. Most halfday workshops are $40 per person; fullday workshops $75. Paid registration (by check, VISA or MasterCard) must be postmarked or faxed by February 20, 2002; lunches may also be reserved in advance. Each workshop will be limited to 50 people; any workshop with fewer than 20 registrations by February 20 may be canceled, with fees returned to those registered. After February 20, register at the door as space permits, and with an additional $15/person fee.
OneDay Conference, Saturday, March 9; 7:15 a.m. 4:30 p.m.
Michigan State University Campus, Brody Complex (Across from the Kellogg Center)

This conference is for organic farmers and gardeners, organic consumers, conventional farmers considering transition to organic, and educators who teach about organic approaches. Sessions will include organic production tips, marketing options, farming smarter not harder, cover crops, farmers’ markets, local and seasonal eating, farmer panels, certification updates, and more. Conference registration of $50/person includes keynote session, three 90-minute concurrent (5 to6) sessions, organic breakfast and lunch, registration materials, exhibits and parking. Paid registration (by check, VISA, or MasterCard) must be postmarked or faxed by February 20, 2002. After February 20, register at the door on a space available basis, with an additional $15/person fee. No meals guaranteed for on site registrations.

Additional details and registration information will be available at a web site currently under construction at http://www.msue.msu.edu/misanet/MIOC/ or phone Anne Conwell at 517 4321611.

Sponsors to date: Michigan State University, Michigan Department of Agriculture (MDA), Michigan Organic Food & Farm Alliance (MOFFA), Michigan Integrated Food & Farming Systems (MIFFS), Organic Growers of Michigan (OGM), Natural Resources Conservation Service (NRCS).
Organic Production Session – Thursday morning, December 6, 2001

MSU ORGANIC FRUIT AND VEGETABLE PROJECTS
John Biernbaum, Department of Horticulture
Michigan State University

Organic Apple Project: In spring of 1999, over 2500 apple trees were established in a high density, 5+ acre planting at the Clarksville Horticulture Research Station. Research and education priorities include documentation of changes in soil quality and fertility during the transition to organic, the relationship of orchard floor management techniques and root stock vigor, evaluation of cultivar susceptibility to apple scab, organic pest and disease control strategies, marketing strategies to insure economic viability, and holistic orchard management. A team of over 20 MSU faculty and staff, organic fruit growers, and other cooperators are working together to learn about organic production and marketing strategies. The plot is being certified by the Organic Crop Improvement Association (OCIA) and just completed the second year of the three year transition period. A small crop of apples is anticipated for the 2002 season.

Organic Transplant Production: Organic vegetable growers are now required to use transplants produced with certified organic production methods. As organic seed supplies increase, transplants must also be produced from certified organic seed. There are a number of options for root media and fertility management in the organic greenhouse. Peat based media without wetting agents or synthetic fertilizers can be used but media based on high quality compost produced specifically for potting media will likely provide the best results. The use of organic nutrient sources such as alfalfa meal, water soluble sources such as fish emulsion, and a variety of types and rates of compost are being studied. Recommendations for insect and disease management within organic certification standards are also being developed.

Hoophouse Winter Salad Greens Production: Unheated hoophouses or polyethylene covered coldframes can be used for season extension and winter production and harvesting. Two 20'x96' unheated coldframes located at the MSU Horticulture Research and Teaching Center in East Lansing are being used to grow 30 cold hardy crops for baby salad greens as outlined by Eliot Coleman in “The New Organic Grower” and “The Four Season Harvest”. Methods suitable for organic certification were used to prepare the soil and fertility treatments include either the use of compost or a commercially available alfalfa based fertilizer. Yield data will be used to determine crop blends, cost of production and profitability potential. Baby salad greens have high value market potential for local restaurants and community supported agriculture arrangements.

Compost Production and Utilization: Both the transplant and salad greens projects require a high quality compost that has been properly formulated and produced. A variety of compost handling techniques and starting materials were used during the 2001 season to produce compost. Composted waste from MSU dairy, beef and swine facilities are also being used for field trials with vegetable crops.
Student Organized Vegetable Production and Community Supported Agriculture Program: A group of students has also expressed interest in developing organic vegetable production with a community supported agriculture arrangement. We are developing a plan and looking for monetary support to start a program this summer at the Horticulture Research and Teaching Center.