Crop Profile for Cucumbers in New Jersey

Production Facts

- Cucumbers (slicers and pickles) are grown for wholesale and retail markets.
- Most cucumber production in New Jersey is for fresh market, with minor processing acreage.
- In 2004, New Jersey ranked 7th in U.S. fresh market acreage (3100) and 6th in value of production ($15.5 million).
- In 2004, New Jersey ranked 5th in U.S. fresh market cucumber production (68,200,000 lbs.) and 3rd in yield (22,000 lbs./acre).
- New Jersey provides 7% of total U.S. fresh market cucumber production.
- New Jersey growers' rank 6th in price received for fresh market cucumbers ($.227/ lb).
- New Jersey, along with New York and Virginia supply much of the U.S. fresh market cucumbers during the summer months.

Production Regions

The majority of wholesale cucumber production is in the counties of Atlantic, Cumberland, Gloucester and Salem, with Gloucester having nearly half of all New Jersey cucumber acreage. Cucumbers grown in the remaining counties of the New Jersey are predominantly for the retail trade. Cucumber production in Gloucester County consists mainly of pickling varieties.

Cultural Practices

Cucumbers are a warm season crop that will not tolerate frost. Ideal growing temperatures are between 65-75°F degrees with soil temperatures between 60-95 °F acceptable for seed germination. Evening temperatures below 60 °F can result in poor pollination and misshapen fruit. Ideal soil for cucumbers is deep, well drained, and relatively high in organic matter. Cucumbers will tolerate soil pH between 6.8-5.5 with 6.5 as ideal.

Because cucumbers have male (pollen producing) and female (fruit producing) flowers, bees are necessary for adequate pollination of cucumbers. Where natural bee populations are determined to be inadequate, commercial hives may be imported to assist with pollination. In general, 1-2 colonies per acre are recommended, as more bees insure multiple visits to flowers, resulting in greater fruit set and better fruit size and shape.

Some commercial cucumber varieties are gynoecious (producing only female flowers). These varieties require male pollinator plants, but seedsmen provide the required mixture of pollinator and gynoecious seeds. New Jersey growers generally select cucumber varieties, whether slicers or picklers, based on days to maturity, and combinations of disease resistance/tolerance. Many varieties have good horticultural characteristics. Recommended slicing varieties in New Jersey include Encore, Indy, Speedway and Dasher II. Recommended pickling varieties include Magic and Eureka.

In New Jersey, cucumbers are generally seeded rather than set out as transplants, although this is occasionally done in small scale production. Seeding takes place after mid-April on lighter soils in the warmer southern New Jersey counties. In northern counties, seeding commences after mid-May. In all areas, successive plantings are made through early August.

Slicing and pickling varieties are seeded at a rate of 1.5 lbs. per acre (pickles may be as much as 2 lbs. per acre) with plant spacing of 9-12 inches for slicers and 6-8 inches for pickles.

Planting Beds, Irrigation and Plastic Mulch

The use of plastic mulch with trickle irrigation is a common cucumber production practice in New Jersey, resulting in earlier and increased yield. Typically, raised beds are made and a chemical fumigant, if utilized, is applied to them at least 30 days prior to seeding. The raised beds help prevent the accumulation of water in the root zone of the plants, thereby reducing the potential for soil borne fungal infections like *Phytophthora*. Fumigation helps limit weed growth, nematodes and soil borne diseases (see section IV). Trickle tape and clear plastic (for early season plantings) are laid on the moist beds immediately after fumigation. Black, white, or aluminized mulches may be used for late season plantings. Black plastic helps control weeds because it blocks sunlight from germinated seedlings. However, herbicides are still necessary to prevent weed growth through the planting hole, and are applied in a band as wide as the bed prior to laying plastic. Trickle tubes and plastic mulch are then laid on the beds. Planting holes are not punched through the mulch until the time of planting, permitting condensation to form inside the mulch and activating the herbicide.

Harvesting

Harvest of fresh market cucumbers in New Jersey may begin as early as 8 weeks after planting with good growing conditions, and fruit are harvested when they have achieved a length of 6-8 inches and a maximum diameter of 1.5-2 inches. Fruit are harvested every 1-2 days because maturity is sequential with pollination of flowers. Pickling varieties tend to mature more uniformly and may be machine-harvested when mature. If slicing cucumbers are to be shipped, rapid cooling after harvest is necessary to maintain quality. This is often achieved by hydro-cooling. Fruit may then be coated with edible wax and maintained at temperatures from 50-55°F to preserve quality.

Major Insect and Mite Pests of Cucumbers in New Jersey

Striped Cucumber Beetle (*Acalylmma vittatum*)
Spotted Cucumber Beetle (*Diabrotica undecimpunctata howardi*)

Occurrence: Annual, frequent.

Damage: These beetles, yellow-green in color with either black stripes or spots, are common pests of all cucurbit crops. Their damage may be direct, through feeding injury to cotyledons, true leaves, stems and fruit, or indirect, through transmission of the bacterium *Erwinia tracheiphila* that is responsible for bacterial wilt of cucurbits. Early feeding by the beetles on newly emerged cotyledons results in desiccation of the plants and frequently, acquisition of *E. tracheiphila*. Feeding that occurs later in the life of the plants can result in loss of vigor and injury to fruit skins, making them unmarketable. Crop loss can approach 100% where infestations are severe and uncontrolled, and all acreage is at risk from these pests. Fields should be monitored twice weekly from the 0-2 true leaf stage, and weekly afterward to detect cucumber beetle activity as quickly as possible. Foliar insecticide applications may be warranted if beetles are found at more than half of the monitoring sites, and damage is occurring. Systemic insecticides, if applied at planting, may alleviate the need for intensive monitoring for the first 2 weeks.

Alternative management strategies used in combination with chemical control:
Use of varieties resistant to bacterial wilt.
Crop rotation (away from cucurbit crops) to avoid local build-up of beetle populations.
A border (trap) crop of blue hubbard squash may be more attractive to beetles than cucumbers.

Chemical Control:

<u>Soil applied</u>

Carbofuran (Furadan 4F)
Percent acres treated: 17%
Active ingredient used (lbs.): 350.2
Rate and Frequency: 3.8 oz./1000 linear row feet of 4F – 1 time, at planting.
Method: In furrow or banded over row pre- or post-emergence.
REI: 48 hrs.
PHI: must be used at planting
Efficacy: Good, Special local needs 24(c) label necessary.
Notes: 24C – NJ980004. Issued 1998 and remains active.

Imadicloprid and thiamethoxam control cucumber beetles in the same manner, with lower human toxicity (tech 450mg/kg oral for imidacloprid and >2000 for thiamethoxam, >5000 dermal for imidacloprid and thiamethoxam; 8 mg/kg oral, >3000 dermal for carbofuran).

Imidacloprid (Admire 2F)
Percent acres treated: 5%
Active ingredient used (lbs.): 13.42
Rate and Frequency: 16-24 oz./A of 2F – 1time, at planting.
Method: In-furrow application, through trickle irrigation, or as transplant drench.
REI: 12 hrs.
PHI: 21 days
Efficacy: Good

Thiamethoxam (Platinum 2SG)
Percent acres treated: 2%
Active ingredient used (lbs.): .75
Rate and Frequency: 5-8 oz./A of 2SG – 1 time, at planting.
Method: In furrow or banded over row pre- or post-emergence.
REI: 12 hrs.
PHI: 30 days
Efficacy: Good

Foliar applied:

Bifenthrin (Capture 2EC)
Percent acres treated: 2%
Active ingredient used (lbs.): 1.07
Rate and Frequency: 2.6-6.4 oz./A of 2EC, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 24 hrs.
PHI: 3 days
Efficacy: Good

Carbaryl (Sevin 80S)
Percent acres treated: 9%
Active ingredient used (lbs.): 178.13
Rate and Frequency: 1.25 lb./A of 80S, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 12 hrs.
PHI: 3 days
Efficacy: Good
Note: Must be used when bees are not active (highly toxic to bees).

Diazinon AG500 (striped cucumber beetle)
Percent acres treated: 3 %
Active ingredient used (lbs.): 170.34
Rate and Frequency: 1 pt./A of AG500, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 48 hr.
PHI: 24 days.
Efficacy: Good

Endosulfan (Thionex 3EC)
Percent acres treated: 34%
Active ingredient used (lbs.): 798.19
Rate and Frequency: .67-1.33 qt./A of 3EC, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 24 hrs.
PHI: 2 days
Efficacy: Good

Methomyl (Lannate LV)
Percent acres treated: 10%
Active ingredient used (lbs.): 206.89
Rate and Frequency: 1.5-3 pt./A of LV, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 48 hrs.
PHI: 3 days
Efficacy: Good

Permethrin (Ambush 2EC, Pounce 2EC)
Percent acres treated: 8%
Active ingredient used (lbs.): 24.25
Rate and Frequency: 4-8 oz./A of 2EC, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 12 hrs.
PHI: 0 days
Efficacy: Good
Note: Repeated use of synthetic pyrethroid materials like peremethrin reduces predatory insect populations and may result in high aphid populations.

Seed Corn Maggot (*Delia platura*)

Occurrence: Annual, early-season, sporadic.

Damage: Adult seed corn maggots (flies) lay eggs where seeds have been planted, or at the base of emerging seedlings. The eggs quickly hatch, and the maggots bore into the seed or seedling, resulting in apparent poor germination or destruction of the newly emerged seedling. Damage is more common where soil moisture is high, and fields have high organic matter content as would be found where manure has been applied. Seed may not survive infestation, and losses up to 60% may occur early in the season if seed is untreated.

Alternative management strategies used in combination with chemical control:
Avoid the use of manure based fertilizers.
Avoid planting in fields that are not well drained.
Delay seeding or transplanting until soil temperature will allow for quick germination.
Use transplants as opposed to direct seeding.
Replanting may be advisable if the infestation reduced germination significantly.

Chemical Control:

Chlorpyrifos (Lorsban 50SL)
Percent acres treated: Data unavailable.
Active ingredient used (lbs.): Data not available.
Rate and Frequency: 2 oz./100lbs. of seed of 50SL as a slurry) 1 time, at planting.
Method: Seed treatment.
REI: Not applicable
PHI: Not applicable
Efficacy: Good

Aphids
Green peach aphid [*Myzus persicae* (Sulzer)]
Melon aphid [*Aphis gossypii* (Glover)]

Occurrence: Annual, frequent. Use of pyrethroid insecticides for control of other insects such as cucumber beetles may increase aphid populations.

Damage: Aphids are capable of transmitting several mosaic viruses to cucumbers and other cucurbit crops, which can cause significant yield loss. Additionally, aphids can build to high numbers under favorable conditions. This can result in the appearance of sooty mold, a fungal organism that utilizes the aphids' sticky droppings as a substrate, on the fruit. Sooty mold reduces the marketability of the fruit. High populations may also cause leaf curling, which can reduce yield.

Alternative management strategies used in combination with chemical control:
Reflective mulch may be used to disorient aphids until the vines run and cover the mulch.
Separate cucurbit fields as much as possible to reduce potential viral transmission.

Chemical Control:

Soil applied:

Imidacloprid (Admire 2F)
Percent acres treated: 5%
Active ingredient used (lbs.): 13.42
Rate and Frequency: 16-24 oz./A of 2F at planting.
Method: In furrow, at planting.
REI: 12 hrs.
PHI: 21 days
Efficacy: Good

Thiamethoxam (Platinum 2SG)
Percent acres treated: 2%
Active ingredient used (lbs.): .75
Rate and Frequency: 5-8 oz./A of 2SG, when pest exceeds tolerable limit.
Method: In furrow or banded over row pre- or post-emergence.

REI: 12 hrs.
PHI: 30 days
Efficacy: Good

Foliar applied:

Diazinon AG500
Percent acres treated: 3 %
Active ingredient used (lbs.): 170.34
Rate and Frequency: 1 pt./A of AG500, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 48 hrs.
PHI: 24 days
Efficacy: Fair

Endosulfan (Thionex 3EC)
Percent acres treated: 34%
Active ingredient used (lbs.): 789.19
Rate and Frequency: .67-1.33 qt./A of 3EC, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 24 hrs.
PHI: 2 days
Efficacy: Fair

Methomyl (Lannate LV) (melon aphid)
Percent acres treated: 10%
Active ingredient used (lbs.): 206.89
Rate and Frequency: 1.5-3 pt./A of LV, when pest exceeds tolerable limit
Method: Foliar spray.
REI: 48 hrs.
PHI: 3 days
Efficacy: Fair
Notes: Pymetrozine (Fulfill) and dinotefuran (Venom) are labeled for aphid control on cucumbers, but were released for use subsequent to the most recent pesticide use survey.

Oxydementon methyl (Metasystox-R 2SC)
Percent acres treated: 2%
Active ingredient used (lbs.): 33.4
Rate and Frequency: 1.5-2 pt./A of 2SC, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 48 hrs.
PHI: 3 days
Efficacy: Good

Pickle Worm (*Diaphania nitidalis*)

Occurrence: Annual, mid-late summer, sporadic. This pest rarely occurs in the northern counties of New Jersey.

Damage: Young larvae feed on foliage but bore into fruit when larger.

Alternative management strategies used in combination with chemical control:
No reliable alternative strategies other than scouting for first sign of activity.

Chemical Control:

Bifenthrin (Capture 2EC)
Percent acres treated: 2%
Active ingredient used (lbs.): 1.07
Rate and Frequency: 2.6 – 6.4 oz./A of 2EC once prior to fruit set, then weekly if damage has been observed .
Method: Foliar spray.
REI: 12 hrs.
PHI: 3 days
Efficacy: Good

Carbaryl (Sevin 80S)
Percent acres treated: 9%
Active ingredient used (lbs.): 178.13
Rate and Frequency: 1.25 lb./A of 80S once prior to fruit set, then weekly if damage has been observed.
Method: Foliar spray.
REI: 12 hrs.
PHI: 3 days
Efficacy: Fair
Note: Must be used when bees are not active (highly toxic to bees).

Endosulfan (Thionex 3EC)
Percent acres treated: 34%
Active ingredient used (lbs.): 789.19
Rate and Frequency: .66 – 1.33 pt./A of 3 EC once prior to fruit set, then weekly if damage has been observed.
Method: Foliar spray.
REI: 24 hrs.
PHI: 2 days
Efficacy: Fair

Esfenvalerate (Asana XL .66EC)
Percent acres treated: 6%
Active ingredient used (lbs.): 12.39
Rate and Frequency: 5.8 - 9.6 oz./A of .66EC once prior to fruit set, then weekly if damage has been observed.
Method: Foliar spray.
REI: 12 hrs.
PHI: 3 days
Efficacy: Good
Note: Repeated use of synthetic pyrethroid materials like esfenvalerate reduces predatory insect populations and may result in high aphid populations.

Methomyl (Lannate LV)
Percent acres treated: 10%
Active ingredient used (lbs.): 206.89
Rate and Frequency: 1.5 – 3 pt./A of LV once prior to fruit set, then weekly if damage has been observed.
Method: Foliar spray.
REI: 48 hrs.
PHI: 3 days
Efficacy: Good

Permethrin (Ambush 3.2EC, Pounce 3.2EC)
Percent acres treated: 8%
Active ingredient used (lbs.): 24.25
Rate and Frequency: 4 – 8 oz./A of 3.2 EC once prior to fruit set, then weekly if damage has been observed.
Method: Foliar spray.
REI: 12 hrs.
PHI: 0 days
Efficacy: Fair
Note: Repeated use of synthetic pyrethroid materials like permethrin reduces predatory insect populations and may result in high aphid populations.

Spinosad (Entrust 80W, Spintor 2SC)
Percent acres treated: 2%
Active ingredient used (lbs.): 8.72
Rate and Frequency: 2- 2.5 oz./A of Entrust 80W, or 6-8 oz./A of Spintor 2SC once prior to fruit set, then weekly if damage has been observed.
Method: Foliar spray.
REI: 4 hrs.
PHI: 1 day
Efficacy: Good

Thrips species, including *Frankliniella spp*. and *Thrips spp*.

Occurrence: Annual, sporadic.

Damage: Thrips are small, soft bodied insects that cause damage by puncturing plant tissue and feeding on the exuded sap. Many thrips species have a preference for flower tissue, but when conditions are favorable, population increases will occur and many tissues can be damaged. Under heavy pressure, leaves will develop a bronze color and dry up. Fruit may be scarred from heavy feeding as well.

Alternative management strategies used in combination with chemical control:
Anthocorids, such as the minute pirate bug (*Orius tristicolor*) are predators of thrips. Anthocorids also readily feed on pollen. Companion beds of plants that are attractive to anthocorids may be a viable strategy to increase predator populations in adjacent fields. Useful companion plants include dill and coriander.

Chemical Control:

Diazinon AG500
Percent acres treated: 3 %
Active ingredient used (lbs.): 170.34
Rate and Frequency: 1 pt./A of AG500, when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 48 hrs.
PHI: 24 days
Efficacy: Fair

Oxamyl (Vydate 2L)
Percent acres treated: 8%
Active ingredient used (lbs.): 180.36
Rate and Frequency: 2 – 4 pt./A of 2L when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 48 hrs.
PHI: 1 day
Efficacy: Fair

Spinosad (Entrust 80W, Spintor 2SC)
Percent acres treated: 2%
Active ingredient used (lbs.): 8.72
Rate and Frequency: 2- 2.5 oz./A of Entrust 80W, or 6-8 oz./A of Spintor 2SC when pest exceeds tolerable limit.
Method: Foliar spray.
REI: 4 hrs.
PHI: 1 day
Efficacy: Good
Note: Spinosad is less toxic to beneficial insect predators and parasites than broad spectrum insecticides such as oxamyl and diazinion.

Two-spotted spider mite [*Tetranychus urticae* (Koch)]

Occurrence: Annual, frequent.

Damage: Two-spotted spider mites damage plants by piercing tissue and extracting sap. These pests are favored by hot weather, and can multiply rapidly under such conditions. When heavy, mite populations will produce webbing on and between leaves and stems to facilitate their movement. Injury begins as pin spots on the upper surface of leaves. This proceeds to yellow areas as feeding persists. Ultimately, mite feeding desiccates entire leaves and plants.

Alternative management strategies used in combination with chemical control:
Avoid mowing or applying herbicide to adjacent vegetation strips, as this disrupts vegetation and can drive mites into nearby host crops.

Overuse of carbamate or pyrethroid insecticides may worsen mite outbreaks.

Chemical Control:

Bifenthrin (Capture 2EC)
Percent acres treated: 2%
Active ingredient used (lbs.): 1.07
Rate and Frequency: 5.12 – 6.4 oz./A of 2EC when 10-15% of plants are infested prior to fruit set, or >50% are infested as fruit mature.
Method: Foliar spray.
REI: 12 hrs.
PHI: 0 days
Efficacy: Fair

Oxydementon methyl (Metasystox-R 2SC)
Percent acres treated: 2%
Active ingredient used (lbs.): 180.36
Rate and Frequency: 1.5 - 2 pt./A of 2SC when 10-15% of plants are infested prior to fruit set, or >50% are infested as fruit mature.
Method: Foliar spray.
REI: 48 hrs.
PHI: 3 days
Efficacy: Fair

Notes: Spiromesifen (Oberon), bifenzate (Acramite) are labeled for use on cucumbers, but were released for use subsequent to the most recent pesticide use survey. Although abamectin (Agri-Mek), fenproparthrin (Danitol), and dicofol (Kelthane) were available for use on cucurbit crops prior to the most recent pesticide use survey, the survey indicates that they are not widely utilized.

Major Diseases of Cucumber in New Jersey

Fungicide Resistance Management:

Fungicides are organized into various classes called FRAC (Fungicide Resistance Action Committee) groups (see Table 1) based on chemistry. Members of a FRAC group are often analogs built from the same basic chemical structure, and generally have a similar mode-of-action, control similar type of fungi, and share the same risk for resistance development. Over- or misuse of some classes of fungicides such as the QoI's (FRAC group 11), DMI's (FRAC group 3), phenylamides (FRAC group 4) and benzimidazoles (FRAC group 1) may result in the development of resistant populations of fungi. Fungicides in FRAC groups such as these are referred to as "at- or high-risk" fungicides. Therefore, do not apply fungicides in these FRAC groups exclusively in a disease control program. Fungicides in high-risk FRAC groups should be tank-mixed or rotated with fungicides from other FRAC groups. Protectant fungicides (FRAC group M1, M3, M5), should be tank-mixed with at-risk fungicides whenever possible to delay the development of resistant strains of fungi. Do not use high-risk fungicides as rescue treatments for disease control.

In recent years in New Jersey, resistance in Phytophthora blight (*P. capsici*) to mefenoxam (FRAC group 4) and resistance in cucurbit powdery mildew (*P. xanthii*) to QoI's (FRAC group 11) have been reported. Therefore, use of fungicides in these FRAC groups has limited the ability to control important diseases in widely-grown crops in the State.

Table 1: 2007 FRAC Groups for Fungicides Labeled for Cucumbers in NJ

		Cucumber, Slicing and Pickling											
Fungicide	Chemical	FRAC grouping	Risk Management	Damping-off	Angular leaf spot	Belly rot	Cottony leak	Scab	Phytophthora fruit rot	Anthracnose	Gummy stem blight	Powdery Mildew	Downy mildew	Fungicide Resistance Management Guidelines
fixed copper	copper	M1	L		x				x					Multi-site MOA, use in tank mixes with high risk and in rotations with other FRAC groups
Mancozeb	EBDC	M3	L		x					x	x			
Gavel	zoxamide + mancozeb	M3 + 22	L-M						x				x	
chlorothalonil	chlorothalonil	M5	L					x		x	x		x	
Topsin M	thiophanate-methyl	1	H							x				High risk
Nova	myclobutanil	3	H									x		Hih risk, always tank mix, and alternate with other groups
Procure	triflumizole	3	H									x		
Ridomil Gold	mefenoxam	4	H	x			x							Hisk risk, Mefenoxam resistance in NJ
Ultra Flourish	mefenoxam	4	H	x			x							
Amistar / Quadris	azoxystrobin	11	H			x				x	x			High Risk, Possible PM and DM resistance in NJ. Tank mix with protectants. No consecutive applications.
Cabrio	pyraclostrobin	11	H							x	x			
Pristine	pyraclostrobin + boscalid	11 + 7	H							x	x	x		
Tanos	fomoxadone + cymoxanil	11 + 27	M						x				x	
Ranman	cyazofamid	21	M						x				x	Moderate risk
Curzate	cymoxanil	27	M										x	Moderate risk
Previcur Flex	propomocarb HCL	28	L										x	Low risk
Forum	dimethomorph	40	M						x					Always tank mix

FRAC group: M = multi-site MOA, numbered groups = chemistries with similar mode-of-action, specific site (MOA)

Risk management: L = low risk, M = moderate risk or H = high risk for fungicide resistance to develop

Fungicides with similar MOA (ie. same FRAC group number) should not be sprayed consecutively

Major Disease Pests of Cucumber in New Jersey

Damping-Off (caused by *Rhizoctonia, Fusarium, Phytophthora, Pythium spp*.)

Occurrence: Annual, sporadic.

Damage: **Soil-borne** fungal pathogens residing in the soil may be capable of killing seedlings before or after emergence if conditions (host and environmental) are favorable. In general, seedlings become less susceptible to damping-off with age as stem tissue toughens. Damping-off is more likely to occur when conditions are unfavorable for rapid germination and emergence. Signs of damping–off include poor seedling emergence, or collapse of seedlings after emergence. Some damping-off organisms such as *Pythium spp*. are favored by wet soil conditions.

Alternative management strategies used in combination with chemical control:
Avoid planting in saturated, very wet, or cold soil, as this delays germination and emergence, and favors some fungal pathogens. Consider germinating seedlings in soil-less mix and transplanting into the field.

Chemical Control:

Mefenoxam (Ridomil Gold 4E or Ultra Flourish 2E (FRAC group 4)
Percent acres treated: 25%
Active ingredient used (lbs.): 213.14
Rate and Frequency: 1-2 pt/A of Ridomil Gold 4E or 2-4 pt/A of Ultra Flourish 2E/A at planting.
Method: Banded over row.
REI: 48 hrs.
PHI: 0
Efficacy: Fair to good, depending on fungal pathogen.

Bacterial Wilt (*Erwinia tracheiphila*)

Occurrence: Annual, frequent.

Damage: Striped and spotted cucumber beetles serve as vectors of the wilt-causing bacterium. Beetle feeding on newly emerged plants (up to the 4 true leaf stage) is the primary means of transmission. Wilting of plants during the heat of the day is typically the first symptom of bacterial wilt. As vines begin to run, infected plants will wilt and not recover. There may be sticky bacterial exudate produced from cut stems of wilted plants.

Alternative management strategies used in combination with chemical control:
On limited acreage, floating row covers such as Reemay® may be used to exclude beetles while plants are small. Covers must be removed before flowering.
Avoid planting early crop near field edges where beetles may overwinter.

Chemical Control:
See cucumber beetle control – section II.

Angular Leaf Spot (*Pseudomonas syringae* pv. *lachrymans*)

Occurrence: Annual, sporadic.

Damage: The bacterium attacks the leaves, stems and fruit of cucurbit plants. On leaves the bacterium causes small, angular, water soaked areas that later turn brown or straw-colored. Leaf lesions are delimited by the veins, hence the angular appearance of the lesions. Affected leaf tissue often dries and drops out, leaving irregularly shaped holes in the leaves. Heavily infected leaves may turn yellow. Lesions may also occur on petioles and stems. Fruit lesions are circular and may, over time, result in a soft rot of the fruit.

Alternative management strategies used in combination with chemical control:
A number of slicing and pickling varieties are resistant to angular leaf spot.
Start with certified disease free seed.
Avoid working in fields when foliage is wet.
Avoid overhead irrigation.
Maintain a minimum 2 year rotation away from cucurbit crops.

Chemical Control:

Fixed Coppers [Example: Champ, Kocide (FRAC group M1)]
Percent acres treated: 57%
Active ingredient used (lbs.): 3037.71
Rate and Frequency: (Example) – 1 lb a.i./A at first sign of disease. Repeat at 7 day intervals.
Method: Foliar spray.
REI: 24 hrs.
PHI: 0 days – fixed copper.
Efficacy: Fair
Note: It is recommended that fixed copper be tank-mixed with 1.33 lb./A of 75DF mancozeb (Manzate) to increase efficacy. The addition of mancozeb increases the PHI to 5 days.

Mancozeb (Manzate 75 DF [FRAC group M3)]
Percent acres treated: 15%
Active ingredient used (lbs.): 1060.5
Rate and Frequency: 1.33 lb./A of Manzate 75 DF at first sign of disease. Repeat at 7 day interval.
Method: Foliar spray.
REI: 12 hrs. alone or 24 hr. when mixed with copper.
PHI: 5 days
Efficacy: Fair
Note: It is recommended that mancozeb be tank-mixed with a fixed copper (1 lb a.i./A) to increase efficacy.

Powdery Mildew (*Erysiphe cichoracearum, Podosphaera xanthii*)

Occurrence: Annual, frequent.

Damage: As plants begin to bear fruit, mature foliage generally develops white, powdery fungal lesions, composed of the asexual spores (conidia). Lesions may develop on upper or lower leaf surface, as well as on stems and petioles. Lesions will coalesce to cover entire leaves, resulting in premature death of foliage, poor fruit size, stem quality, and lower yield.

Alternative management strategies used in combination with chemical control:
A number of slicing and pickling varieties are resistant to powdery mildew.
Avoid planting cucumbers in close proximity to existing cucurbit crops.
Scout fields for the presence of powdery mildew. Begin treating when one lesion is found per 50 mature leaves.

Chemical Control:

Chlorothalonil [Bravo 6F, (FRAC group M5)]
Percent acres treated: 73%
Active ingredient used (lbs.): 4489.31
Rate and Frequency: 2-3 pt./A of 6 F when disease is suspected or anticipated. Repeat at 7-day intervals.
Method: Foliar spray.
REI: 12 hrs.
PHI: 0 days
Efficacy: Fair
Note: Chlorothalonil is an essential resistance management tool in cucumber fungicide programs.

Myclobutanil [Nova 40WP, (FRAC group 3)]
Percent acres treated: 5%
Active ingredient used (lbs.): 28.32
Rate and Frequency: 5 oz./A of Nova 40WP, or 4-8 oz./A of Procure 50WS when disease is suspected or anticipated. Repeat at 7-day intervals.
Method: Foliar spray.
REI: 12 hrs.
PHI: 0 days
Efficacy: Good
Notes: Nova should be used as a tank-mix with chlorothalonil to manage resistance.
Triflumizole (Procure, FRAC group 3), and a proprietary mix of pyraclostrobin + boscalid (Pristine, FRAC groups 11 + 7) are available for use on cucumbers but data were not available as of the most recent pesticide use survey.

Downy Mildew (*Pseudoperonospora cubensis*)

Occurrence: Most seasons, mid-late summer, sporadic.

Damage: Downy mildew does not generally occur most years until late summer in the mid-Atlantic. If conditions are favorable for infection (warm, with consistently wet foliage), downy mildew will develop earlier in the summer if spores are carried up from southern states. The disease is identifiable by sharp yellow lesions on the upper surface of leaves. If conditions are moist, there will be dark spores produced on the lower surface of the lesion. Lesions will rapidly coalesce, killing foliage in a matter of a few days, resulting in poor fruit production and quality. Fruit are not affected directly, but will scald as a result of loss of shading foliage.

Alternative management strategies used in combination with chemical control:
A number of slicing and pickling varieties are resistant to downy mildew.
Scout fields regularly, and access local extension bulletins for information on the presence or threat of downy mildew.

Chemical Control:
The following should be tank mixed with chlorothalonil (FRAC group M5) at 1.5-3 pt. /A of 6F:

Dimethomorph [Forum 4.18SC (FRAC group 40), formerly Acrobat (FRAC group 15)]
Percent acres treated: 9%
Active ingredient used (lbs.): 49.09
Rate and Frequency: 6.0 oz./A of 4.18SC when disease is suspected or anticipated. Repeat at 7-day intervals.
Method: Foliar spray.
REI: 12 hrs.
PHI: 0 days
Efficacy: Fair
Notes: Tank mix with other fungicides labeled for downy mildew control and rotate with fungicide having another mode of action against downy mildew. Do not apply more than 5 times per planting. Do not exceed 32 oz./A per growing season.

Dimethomorph is no longer recommended in New Jersey for downy mildew control in cucumbers.

A number of fungicides released subsequent to the most recent pesticide use survey are available for control of downy mildew on cucumbers. New materials recommended for downy mildew control in New Jersey include zoxamide + mancozeb (Gavel, FRAC groups 22 + M3), Previcur Flex (propamocarb HCL, FRAC group 28), famoxadone + cymoxanil (Tanos, FRAC groups 11 + 27), cymoxanil (Curzate, FRAC group 27), and cyazofamid (Ranman, FRAC group 21).

Pyraclostrobin [Cabrio 20WG, (FRAC group 11)]
Percent acres treated: 6%
Active ingredient used (lbs.): 30.85
Rate and Frequency: 8-12 oz./A of 20 WG when disease is suspected or anticipated. Repeat at 7-day intervals.

Method: Foliar spray.
REI: 12 hrs.
PHI: 0 days
Efficacy: Fair
Note: Pyraclostrobin is no longer recommended in New Jersey for downy mildew control in cucumbers.

Anthracnose (*Glomerella lagenarium*)

Occurrence: Annual, frequent.

Damage: The symptoms of anthracnose on cucumber leaves the spots start as water soaked areas and expand into brown spots that are roughly circular, reaching about 1/4 to 1/2 inch in diameter. Small, growing leaves may be distorted. Leaf petiole and stem lesions are shallow, elongate and tan. Lesions on fruit are roughly circular, sunken and contain pinkish spore masses in moist weather. Infested seed is often the primary inoculum source. Yield reduction can occur through premature loss of foliage, or directly through infected fruit.

Alternative management strategies used in combination with chemical control:
A number of slicing and pickling varieties are resistant to anthracnose.

Chemical Control:

The following should be alternated with chlorothalonil (1.5-3 pt./A 6F) or mancozeb (1.5-3 lbs./A 75DF) at 7 day intervals:

Azoxystrobin [Amistar 80WDG, Quadris 2.08F, (FRAC group 11)]
Percent acres treated: 30%
Active ingredient used (lbs.): 166.9
Rate and Frequency: 3.5-5 oz./A of Amistar 80WDG *plus* chlorothalonil or mancozeb *OR* 11-15.4 fl./A oz. of Quadris 2.08F *plus* chlorothalonil or mancozeb at above rates when symptoms are detected or at vine run.
Method: Foliar spray.
REI: 24 hrs. (mancozeb) 12 hrs. (chlorothalonil)
PHI: 5 days (mancozeb) 1 day (chlorothalonil)
Efficacy: Good
Note: FRAC group 11 materials should always be applied in conjunction with chlorothalonil or mancozeb to reduce the risk of fungal resistance.

Pyraclostrobin [Cabrio 20EG, (FRAC group 11)]
Percent acres treated: 6%
Active ingredient used (lbs.): 30.85
Rate and Frequency: 12-16 oz./A of 20EG *plus* chlorothalonil or mancozeb at above rates when symptoms are detected or at vine run.
Method: Foliar spray.
REI: 24 hrs. (mancozeb) 12 hrs. (chlorothalonil)

PHI: 5 days (mancozeb) 1 day (chlorothalonil)
Efficacy: Good
Note: FRAC group 11 materials should always be applied in conjunction with chlorothalonil or mancozeb to reduce the risk of fungal resistance.

Thiophanate-methyl [Topsin-M 70WP, (FRAC group 1)]
Percent acres treated: 7%
Active ingredient used (lbs.): 58.1
Rate and Frequency: 0.5 lb./A of 70WP when disease is suspected or anticipated. Repeat at 7-day intervals.
Method: Foliar spray.
REI: 12 hrs.
PHI: 0 days
Efficacy: Fair.
Notes: Topsin-M may should be used as a tank-mix with chlorothalonil for greater control. Pyraclostrobin + boscalid (Pristine) is available for use on cucumbers but was released subsequent to the latest pesticide use survey.

Phytophthora Fruit Rot (*Phytophthora capsici*)

Occurrence: Dependent on infestation level of soil, and conditions. Infested soil will likely result in some infection, but wet conditions will increase rate of infection dramatically.

Damage: The primary sign of phytophthora fruit rot in cucumbers is a whitish, yeast-like growth on fruit. This often starts where there is soil contact with fruit. As the infection progresses, fruit will be covered with this growth and begin to collapse. Symptoms often occur initially in low spots in the field where the soil stays moist, particularly when weather is warm. Entire fields may be destroyed if wet weather dominates. Fruit rots may be preceded by damping-off and crown rot of young plants.

Alternative management strategies used in combination with chemical control:
Avoid planting in low areas of fields.
Improve drainage in fields through row orientation, sub-soiling, or field leveling.
Practice a minimum rotation of four years away from solanaceous or cucurbit crops to reduce disease inoculum.

Chemical Control:
The following should be tank mixed with a fixed copper product (Example: Kocide at 1 lb a.i/A):

Dimethomorph [Forum 4.18SC, FRAC group 40, formerly Acrobat (FRAC group 15)]
Percent acres treated: 9%
Active ingredient used (lbs.): 49.09
Rate and Frequency: 6.0 oz./A 4.18SC when conditions are favorable.
Method: Foliar spray.
REI: 12 hours
PHI: 0 days

Efficacy: Fair
Notes: Several fungicides released subsequent to the most recent pesticide use survey are available for control of downy mildew on cucumbers. New materials include Zoxamide (Gavel, FRAC groups 22 + M3), Famoxadone + cymoxanil (Tanos, FRAC groups 11 + 27), and Cyazofamid (Ranman, FRAC group 21).

Scab (*Cladosponum cucumerinum*)

Occurrence: Annual, sporadic.

Damage: Scab is favored by cool, moist conditions. Scab can affect leaves, petioles, stems and fruit. On leaves and stems, pale-green water-soaked areas are the first sign of the disease. These spots gradually turn gray to white and become angular shaped. A chlorotic halo may appear around the lesion. Fruit lesions may ultimately result in a soft rot.

Alternative management strategies used in combination with chemical control:
New Jersey growers use a number of slicing and pickling varieties are resistant to scab.

Chemical Control:

Chlorothalonil [Bravo 6F, (FRAC group M5)]
Percent acres treated: 73%
Active ingredient used (lbs.): 4489.31
Rate and Frequency: 2-3 pt./A of 6F when true leaves form. Repeat at 5-7 day intervals when weather is favorable.
Method: Foliar spray.
REI: 12 hours
PHI: 0 days
Efficacy: Good
Note: Chlorothalonil is an essential resistance management tool in cucumber fungicide programs.

Belly Rot (*Rhizoctonia solani*)

Occurrence: Depends on infestation level of soil, and conditions.

Damage: Belly rot can occur where fruit lay on the surface of soil infested with *R. solani*. Under warm moist conditions, lesions may develop quickly, resulting in rotting of the fruit from the soil up within 72 hours. Lesions will turn scabby and crack if conditions become dry.

Alternative management strategies used in combination with chemical control:
Plastic mulch may help as a barrier between fruit and soil.

Chemical Control:

Chlorothalonil [Bravo 6F, (FRAC group M5)]
Percent acres treated: 73%
Active ingredient used (lbs.): 4489.31
Rate and Frequency: 2-3 pt./A of 6F at 1-3 leaf stage, then again at vine tip-over or in 10-14 days.
Method: Foliar spray.
REI: 12 hours
PHI: 0 days
Efficacy: Fair
Note: Chlorothalonil is an essential resistance management tool in cucumber fungicide programs.

Virus Diseases of Cucumber in New Jersey

Cucumber mosaic, papaya ringspot (watermelon strain), watermelon mosaic 2, and zucchini yellows mosaic

Occurrence: Annual, sporadic.

Damage: Viruses of cucumber may originate from aphids that pick up the diseases from wild or other crop hosts. Symptoms include foliar distortion and mottling that can range from superficial to severe. With some viral pathogens, fruit are also affected. This can include severe distortion and discoloration. In some cases, fruit are not produced.

Alternative management strategies used in combination with chemical control:
A number of slicing and several pickling varieties used in New Jersey are resistant to one or more viral pathogens.

Make new plantings as far from existing cucurbit fields as possible to minimize the transmission of viral pathogens between fields by aphids.

Chemical Control:

See aphid control – section II.

Nematode Pests of Cucumber in New Jersey

Many species of nematodes are potentially damaging to cucumbers, including sting (*Belonolaimus spp*.), root knot (*Meloidogyne spp*.), lesion (*Pratylenchus spp*.), and needle (*Longidorus spp*.) nematodes. While root knot nematodes can cause characteristic knobby root injury, many nematodes do not, and symptoms of infestation are stunted or unthrifty plants. It is critical to know the level of infestation, as well as the type of nematodes present before initiating control, because the diagnosis may affect the need for or type of control. Soil sampling is the best way to determine nematode presence. Typically, cores are taken from the root zone with a soil probe during the current crop cycle. A nematode diagnostic lab will sieve the sample and examine it for plant pathogenic nematodes and make recommendations for various crops.

Cultural Controls

Sanitation
Because nematodes are not easily controlled and nearly impossible to eradicate, often the best control method is to prevent establishment. Nematodes may be transported to other fields on farm equipment. It is very important that all tractors, plows, etc. that have been working ground that is suspected to harbor plant feeding nematodes be cleaned thoroughly prior to entering uninfested fields. This may be accomplished by pressure washing all implements.

Crop Rotation
A very good management technique for decreasing certain nematode populations is to rotate away from host crops. The best rotational choices are crops that are poor or non-hosts of the problem nematode species. Along these lines, it is also important to identify any weeds that may serve as hosts of the target nematode and make sure they are eliminated from the field as well.

Cover Cropping
Certain cover crops that are non-hosts for plant feeding nematodes or produce toxic compounds may be utilized to reduce nematode populations when the field is not actually being cropped.

Green Manures
Some plants, particularly those in the genus *Brassica*, as well as timothy and rye grass liberate toxic compounds as byproducts of decomposition in soil. If these plants are used as a cover crop, and tilled into the soil while still green, nematode populations may be reduced as allyl isothiocyanate (from *Brassica*) or butyric acid (rye and timothy) build to toxic levels in the soil.

Chemical Control:

Metam-sodium (Vapam HL)
Percent acres treated: 3%
Active ingredient used (lbs.): 6670.68
Rate and Frequency: 37.5-75 gal./A one time when soil temps. are between 50 °F and 80 °F at a depth of 6 in. Fall fumigation is preferable.
Method: Soil fumigant application.
REI: 48 hrs.

PHI: Pre-plant application only.
Efficacy: Fair
Notes: Soil should be moistened to 50-80% holding capacity. Tarping of fumigated soil will increase efficacy of the treatment. Do not seed or transplant for 21 days after fumigation. Other fumigants such as Telone, methyl bromide and chloropicrin are labeled for use in cucurbit crops, but no are not widely utilized, as indicated by New Jersey pesticide use data.

Oxamyl (Vydate 2L)
Percent acres treated: 8%
Active ingredient used (lbs.): 180.36
Rate and Frequency: 1-2 gallons/A of 2L one time pre-plant or 2 – 4 pt. /A of 2L 2 times at post-emergence at 2-3 week intervals when nematodes are suspected.
Method: Pre-plant incorporated to a depth of 2-4 in., or post-emergence foliar spray.
REI: 48 hrs.
PHI: 1 day
Efficacy: Fair

Mocap
Mocap is also labeled for use for nematode control on cucumbers in New Jersey, but is not widely utilized as indicated by 2007 State pesticide use data.

Major Weed Pests of Cucumber in New Jersey

Annual Grasses:

Crabgrass (*Digitaria* spp.)
Crabgrass species are summer annual grasses with prostrate or ascending growth habits. Seeds germinate when soil temperatures exceed 55°F for 7-10 consecutive days, and soil is adequately moist. Reproduction is by seed or rooted tillers.

Foxtail (*Setaria* spp.)
Foxtail species are clump forming annual grasses that have a prostrate to erect growth habit. Reproduction is by seeds, which germinate in the late spring and summer when soil temperatures are warm. All species are characterized by a bushy, "foxtail like" seed head.

Broadleaf Annuals:

Common lambsquarters (*Chenopodium album*)
Common lambsquarters is a summer annual growing to 3.5 ft. with light green, triangular leaves. Flowers are produced from July to Sept. and reproduction is by seed. Seed overwinters and germinates in disturbed soil the following spring.

Jimsonweed (*Datura stramonium*)
Jimsonweed is a summer annual growing to 5 ft. with broad, coarsely serrated leaves, white or purple trumpet shaped flowers, and oval, plum-sized seed pods covered with spines.

Reproduction is by seed. Seeds germinate the following spring when soil temperatures are sufficiently warm. The entire plant is toxic to humans and animals.

Galinsoga (*Galinsoga ciliate*)
Galinsoga is a summer annual growing to around 2 ft. with opposite, oval, toothed leaves and small yellow and white rayed flowers. Stems and leaves are hairy. Flowers are produced from June through autumn. Reproduction is by seed, which germinate during the current season, or the following spring.

Common cocklebur (*Xanthium strumarium*)
Common cocklebur is a summer annual that grows to 3 ft. with rough, heart-shaped, toothed leaves. Reproduction is by seed. Flowers are produced late summer through fall, and seeds are contained within bristly burs. One seed per bur germinates the following season, while others are dormant until the second year.

Ragweed (*Ambrosia spp.*)
Common and giant ragweed are summer annuals that may grow to 3 ft. and 15 ft. respectively. Leaves are deeply lanceolate. Reproduction is by seed. Flowers are produced from August through autumn, and seeds germinate the following spring and may remain viable for 5 years.

Pigweed (*Amaranthus spp*.)
The pigweeds are summer annuals growing to 4 ft., and are inhabitants of disturbed soils. Leaves are oval and somewhat rough. Inconspicuous flowers are produced from mid-summer through autumn. Reproduction is by seed. Thousands of seeds are produced by a single plant, and germinate the following spring.

Morning glory (*Ipomoea spp*.)
Morning glories are summer annuals having a vine-like growth habit. They become entangled in crop plants and can become difficult to control. Reproduction is by seed. Seeds are produced during the summer months and germinate in the spring.

Velvetleaf (*Abutilon theophrasti*)
Velvetleaf is a summer annual growing to 3-8 ft. Plants have large heart-shaped leaves and are completely covered with soft, fine hairs. Reproduction is by seed, and flowers are produced from July through October. Seeds germinate continuously through the season, as warm conditions permit.

Perennial weeds:

Yellow nutsedge (*Cyperus esculentus*)
Yellow nutsedge is a perennial that grows from tubers (nutlets) and rhizomes and may reach a height of 2 ft. Stems are triangular in cross-section, and leaves are yellowish-green in color. Yellow nutsedge tolerates moist conditions and is capable of forming dense stands. New plants may emerge through some types of black plastic mulch.

Quackgrass (*Elytrigia repens*)
Quackgrass is a rhizomatous perennial grass having an upright growth habit and may grow to 4 ft. Reproduction is by seed rhizome. Stems grow from nodes on the rhizomes, and may produce seed heads. Rhizomes may fork, expanding the patch.

Weed Control

Occurrence: Annual, frequent (depending on field conditions, weed and crop history).
Damage: Competition from weeds for nutrients, water, and sunlight can result in yield reduction and poor quality fruit. Additionally, weeds can block foliar pesticide treatments, and when dense, increase canopy moisture. Both are factors in decreased insect and disease control. Some weeds are alternate hosts for pests of cucumbers.

Timing of control measures: Pre-plant, pre-emergence, post-emergence, post-harvest.
Cultural controls: Crop rotation, hand weeding, cultivation, mulch.
Post harvest control measures: Non-selective herbicide for destruction of weeds and crop residue, cut-harrowing to destroy crop and weeds.

Chemical Control:

Bensulide (Prefar 4E)
Target weeds: Annual grasses and some broadleaf weeds.
Percent acres treated: 30%
Active ingredient used (lbs.): 1903.2
Average rate and frequency of application: .5-6 qt./A of 4E one time.
Method of application: Banded pre-emergence just prior to laying plastic mulch, or, if plastic mulch is not used, incorporate 1-2 inches deep before planting OR apply pre-emergence and overhead irrigate with ½ inch of water within 36 hrs.
REI: 12 hours.
PHI: Pre-emergence application only.
Efficacy: Good for annual grasses. Fair on lambsquarters, purslane, pigweed, and shepherd's purse. No control of other broadleaves or sedges.

Notes: When applying to a bed under plastic mulch, the mulch should go on immediately following the herbicide application. Condensation on the underside of the mulch should activate the herbicide. The higher rate is recommended for broadleaf weed suppression.

Halosulfuron (Sandea 75WG)
Target weeds: Annual grasses and some broadleaf weeds.
Percent acres treated: 25%
Active ingredient used (lbs.): 5.63
Average rate and frequency of application: 0.75-1 dry oz./A of 75WG one time (pre-plant and pre-emergence). and/or 0.5-0.66 dry oz./A of 75 WG one time when crop has 2-5 true leaves but has not yet run or bloomed (post-emergence).
Method of application: Banded pre-emergence just prior to laying plastic mulch, or, if no mulch is used, broadcast pre-emergence and/or post-emergence and incorporate fully at seeding. Foliar application (post-emergence).
REI: 12 hours.
PHI: 30 days for post-emergence application.
Efficacy: Good for yellow nutsedge, pigweed, velvetleaf, ragweed, galinsoga and jimsonweed. Fair on smartweed. No control of annual grasses, lambsquarters or nightshades.
Note: When applying to a bed under plastic mulch, the mulch should go on immediately following the herbicide application. Condensation on the underside of the mulch should activate the herbicide. Post-emergence applications must be made with a non-ionic surfactant equal to .25% of the total spray solution. Do not apply more than 0.66 dry oz. of Sandea post – emergence or more than 1.66 dry oz. of Sandea pre- and post-emergence in a single crop cycle. Do not apply Sandea to crops to which a soil applied organophosphate has been applied, or make a foliar application of an organophosphate insecticide to a crop within 21 days before or 7 days after an application of Sandea.

Clomazone (Command 3ME)
Target weeds: Annual grasses and some broadleaf weeds.
Percent acres treated: 5%
Active ingredient used (lbs.): 56.03

Average rate and frequency of application: 4-8 fl. oz./A of 3ME one time (pre-emergence on direct seeded crop). May be combined with Curbit 3E at a rate of 3.2:1 lbs. AI/A (Curbit: Command) for additional control of pigweed.
Method of application: Broadcast pre-emergence and incorporate fully at seeding.
REI: 12 hours
PHI: Pre-emergence application only.
Efficacy: Good for annual grasses, lambsquarters, velvetleaf, purslane, and jimsonweed. Fair on shepherd's purse (and pigweed if Curbit is used). Poor or no control of mustards, nutsedge, morning glory, or carpetweed.
Note: Application under breezy conditions may result in herbicide drift and obvious injury to non-target vegetation.

Ethalfluralin (Curbit 3E)
Target weeds: Annual grasses and some annual broadleaf weeds.
Percent acres treated: 10%
Active ingredient used (lbs.): 173.32
Average rate and frequency of application: 1-2 pts./A of 3E one time (pre-emergence on direct seeded crop).
Method of application: Broadcast pre-emergence and at seeding.
REI: 12 hours
PHI: Pre-emergence application only.
Efficacy: Good for annual grasses, purslane and carpetweed. Fair on shepherd's purse and pigweed. Poor or no control of mustards, nutsedge, morning glory, galinsoga, jimsonweed, ragweed, velvetleaf, nightshades. Other weeds will be controlled when mixed with Command 3ME or purchased as Strategy (see below).
Note: Do not pre-plant incorporate or use on cold or wet soils. Do not use under plastic. Irrigate after application if rainfall is not expected.

Proprietary mix - Ethalfluralin (Curbit) + Clomazone (Command) - (Strategy 2SC)
Target weeds: Annual grasses and some annual broadleaf weeds.
Percent acres treated: 40%
Active ingredient used (lbs.): 173.32
Average rate and frequency of application: 1.5-6 pts./A of 2SC one time (pre-emergence on direct seeded crop).
Method of application: Broadcast pre-emergence and at seeding.
REI: 12 hours
PHI: Pre-emergence application only.
Efficacy: Good for annual grasses, purslane and carpetweed, jimsonweed, velvetleaf, and lambsquarters. Fair on shepherd's purse and pigweed. Poor or no control of mustards, nutsedge, morning glory, galinsoga, ragweed, and nightshades.
Note: Do not pre-plant incorporate or use on cold or wet soils. Do not use under plastic. Irrigate after application if rainfall is not expected.

Naptalam (Alanap 2SC)
Target weeds: Pigweed, purslane.
Percent acres treated: <1%
Active ingredient used (lbs.): 107.37

Average rate and frequency of application: 1 gal./A of 2SC one time (pre-plant incorporated for direct seeded crop). 2 qts./A of 2SC one time when crop is ready to vine (post-emergence)
Method of application: Broadcast pre-plant incorporated at seeding, or post-emergence foliar application.
REI: 48 hours for post-emergence application.
PHI: Pre-emergence, or early post emergence applications only.
Efficacy: Fair-to-good on pigweed and purslane. Fair control on many annual broadleaf weeds, except shepherd's purse. No control of yellow nutsedge.
Note: Do not apply when rain is expected within 6 hrs. Do not apply with liquid fertilizer.

Paraquat (Gramoxone Max 3SC)
Target weeds: All emerged vegetation (broad spectrum desiccant).
Percent acres treated: 20%
Active ingredient used (lbs.): 534.8
Average rate and frequency of application: 1.5 pt./A of Gramoxone Max 3SC 1-2 times, or 2.4 pts. of Gramoxone Inteon 2SC/A (as a directed spray on emerged weeds between rows of established crop, or as a broadcast spray to crop after the last harvest as a burn-down treatment).
Method of application: Post-emergence as a directed spray between rows of established crop, or broadcast post harvest as a burn-down and clean-up treatment.
REI: 12 hours
PHI: 14 days
Efficacy: Good
Note: Available under a special local needs (24-C, # NJ-030001 issued in 2003 and remains active) label in New Jersey. Must be used with a non-ionic surfactant. Do not exceed 30 psi in spray pressure.

Clethodim (Select 2EC)
Target weeds: Annual and some perennial grasses.
Percent acres treated: 2%
Active ingredient used (lbs.): Data not available.
Average rate and frequency of application: 6-8 oz./A of 2 EC 1 or more times as necessary to control certain perennial grass weeds.
Method of application: Post-emergence foliar application.
REI: 24 hours
PHI: 14 days
Efficacy: Good on many grasses, except goosegrass.
Note: Must be used with an oil concentrate. Avoid applications during hot, droughty conditions. Oil concentrate may increase risk of crop injury under such conditions. Do not tank-mix or apply within 2-3 days of another pesticide.

Sethoxydim (Poast 1.5EC)
Target weeds: Annual and some perennial grasses.
Percent acres treated: 3%
Active ingredient used (lbs.): 14.95
Average rate and frequency of application: 1-1.5 pt./A of 1.5 EC 1 or more times as necessary to control certain perennial grass weeds.
Method of application: Post-emergence foliar application.

REI: 24 hours
PHI: 14 days
Efficacy: Good on many grasses.
Note: Must be used with an oil concentrate. Avoid applications during hot, droughty conditions. Oil concentrate may increase risk of crop injury under such conditions. Do not tank-mix or apply within 2-3 days of another pesticide.

Worker Activities

IPM scouts and others may visit fields 1-2 times a week until harvest starting at plant emergence and make recommendations for pest control until harvest. Field workers generally do not enter cucumber fields until the time when harvests begin. From this point on, growers will harvest every 1-2 days for several weeks.

Currently the longest REIs exist for the insecticides carbofuran, methomyl, oxydementon methyl, and oxamyl at 48 hours; and the fungicide mefenoxam in combination with mancozeb, and zoxamide at 48 hours. These products generally do not impact the activities of IPM scouts or other field personnel.

There is potentially an exposure problem when the REI is longer than the PHI. This is the case for the fungicide mefanoxam (48-hour REI/0-day PHI) and the insecticide/nematicide oxamyl (48-hour REI/1-day PHI). The shorter pre-harvest interval is not an issue for mefanoxam's use in cucumber as a control of damping-off because it is applied at pre-planting.

Similarly, when oxamyl is applied in soil just before planting or at planting, the shorter pre-harvest interval is not an issue. But, there is a potential worker exposure problem if the PHI of 0 days is heeded rather than the REI of 48 hours for oxamyl when it is used as a foliar spray. There are other options that may be substituted for oxamyl—such as spinosad for thrips. Spinosad has a 4-hour PHI, and is less toxic to beneficial insect predators and parasites than broad spectrum insecticides such as oxamyl. Given this, spinosad would be a preferred choice over oxamyl. However, State pesticide use for 2007 shows that there was a greater amount oxamyl versus spinosad applied overall. This would indicate that NJ cucumber growers are not opting for spinosad at the present time.

The insecticides fenproparthrin and endosulfan have 24-hour REIs as do the fungicides fixed copper, mancozeb, and the proprietary combination of mefenoxam and chlorothalonil. These REIs are not considered inhibitory to field activities.

It is roughly estimated that REIs greater than 3 days would negatively impact inspection by IPM personnel, and that products with long REI's are avoided during the harvest period.

References:

Crop Data Management Systems 2006. www.cdms.net/pfa/LUpdateMsg.asp.

Garrison, S.A., and Orton, T.J. eds. 2006. New Jersey Commercial Vegetable Production Recommendations – 2006. RCE Publication E001.

Hansen, M. 2000. Angular leaf spot of cucumber. www.ext.vt.edu/pubs/plantdiseasefs/450-700/450-700.html.Virginia Coop. Extension Publication 450-700.

Jones, D., et. al. 2005. Beneficial Lawn Care and Management (Annual Grasses). Purdue University www.purdue.edu/dp/envirosoft/lawn/src/pest/annual.htm.

Louws, F.J., et. al. 2002. Phytophthora blight of peppers and cucurbits. www.ces.ncsu.edu/depts/pp/notes/Vegetable/vdin027/vdin027.htm.
North Carolina State Coop. Ext. Veg. Disease Info. Note 27.

Maynard, D.M., and Hochmuth, G.J. 1997. Knott's Handbook for Vegetable Growers, 4th ed. John Wiley and Sons, Inc. N.Y.

Mills, H.A. 2001. Cucumber – *Cucumis spp*. www.uga.edu/vegetable/cucumber.html
UGA Dept. of Horticulture.

National Ag. Statistics Service (NASS) 2004. New Jersey Vegetable Summary. www.nass.usda.gov/Statistics_by_State/New_Jersey/index.asp.

New Jersey Department of Environmental Protection, Bureau of Pesticide Compliance, Pesticide Control Program. 2003. New Jersey private pesticide applicator survey data (unpublished).

North American Plant Disease Forecast Center – Cucurbit Downy Mildew. 2006. www.ces.ncsu.edu/depts/pp/cucurbit/index.php. NC State University Depts. of Plant Pathology and Marine, Earth, and Atmospheric Sciences.

Orzolek, M.D., et. al. 2000. Agricultural Alternatives: Cucumber Production. http://agalternatives.psu.edu/crops/cucumbers/Cucumbers.pdf.
Penn. St. Univ. Coop. Ext. Service.

Schulteis, J.R. 2000. Fresh Market Production Cucumbers. www.ces.ncsu.edu/depts/hort/hil/hil-14.html. North Carolina Coop. Extension Hort. Info. Leaflet #14.

Swiader, J.M., et. al. 2001. Producing Vegetable Crops 5th ed. Ch.1 7 – Cucumbers. Culinary and Hospitality Industry Publications Services. Weimar, Tx.

USDA Risk Management Agency. 1999. An economic assessment of cucumbers: executive summary. www.rma.usda.gov/pilots/feasible/txt/cucumber.txt.

Vegetable MD Online. Cucumber, Pickles: Disease Resistance Table. http://vegetablemdonline.ppath.cornell.edu/Tables/CucPicklesTable.htm. Cornell Dept. of Plant Pathology.

Vegetable MD Online. Cucumber, Slicers: Disease Resistance Table. http://vegetablemdonline.ppath.cornell.edu/Tables/CucSlicersTable.html. Cornell Dept. of Plant Pathology.

Westerdahl, B.B., et. al. 2005. Cucurbits: Nematodes. www.ipm.ucdavis.edu/PMG/r116200111.html#MANAGEMENT. Univ. of Calif. IPM Program UC ANR Pub. 3445.

Key Contacts:

Primary Contact:

Kristian E. Holmstrom
Project Coordinator II, RCE Pest Management Office
Blake Hall Rm. 243; 93 Lipman Dr.; New Brunswick, NJ 08901-8524
Holmstrom@aesop.rutgers.edu
732-932-9802

Reviewers and Contributors:

Entomology
Dr. Gerald M. Ghidiu; Specialist in Vegetable Entomology
Rutgers Agricultural Research and Extension Center
121 Northville Rd.; Bridgeton, NJ 08302-5919
Ghidiu@aesop.rutgers.edu
732-932-4000 X-4116

Pathology
Dr. Christian A. Wyenandt; Specialist in Vegetable Pathology
Rutgers Agricultural Research and Extension Center
121 Northville Rd.; Bridgeton, NJ 08302-5919
Wyenandt@aesop.rutgers.edu
732-932-4000 X-3133

Weed Science
Dr. Bradley A. Majek; Specialist in Weed Science
Rutgers Agricultural Research and Extension Center
121 Northville Rd.; Bridgeton, NJ 08302-5919
Majek@aesop.rutgers.edu
732-932-4000 X-4122