

Crop Profile for Cucumbers in North Carolina

Prepared: January 1999

Revised: November 1999, June 2005



General Production Information

- Cucumbers in North Carolina are produced for two markets — processing (pickles) and slicing (fresh market), the latter products being consumed primarily as salad items without processing.
- Fruit for slicing cucumbers are generally longer, darker green, and have thicker skins than fruit for pickling cucumbers.
- Pickling cucumbers are produced on bare ground (no plastic), while some slicing cucumbers are produced on plastic.
- North Carolina ranked second nationally in the production of processing cucumbers in 2003, representing 10.9 percent of U. S. production.
- A total of 80,000 tons of processing cucumbers were produced in 2003, with a value of \$23.6 million.
- In 2003, 17,400 acres of processing cucumbers were harvested in North Carolina.
- North Carolina ranked fifth nationally in the production of fresh market cucumbers in 2003, representing 7.7 percent of U. S. production.

- A total of 78 million pounds of fresh market cucumbers were produced in 2003, with a value of \$13.3 million.
- In 2003, 6,500 acres of fresh market cucumbers were harvested in North Carolina.

Production Regions

Most cucumber production is in eastern North Carolina. A smaller center of production is in the mountains, south of Asheville.

Production Practices

Cucumbers are grown in two production seasons (spring and summer), and the average time from seeding to first harvest is 36 to 45 days. Cucumbers are adapted to a wide range of soils, but grow best on fertile, well-drained, loamy soils. Soil pH should be between 6 and 6.5. There are various options for fertilizing cucumbers grown in North Carolina. Pollination of cucumber flowers by bees is important for production of quality fruit. In North Carolina, most cucumbers are hand harvested.

Worker Activities

Cucumber field activities begin with land preparation in March in North Carolina. Both pickling and slicer cucumbers are grown, the former primarily for processing and the later for fresh market. Mold board plowing and disking are common tillage practices employed before rows are laid out in the field. Approximately 90% of plantings are made on bare ground, while about 10% utilize plasticulture management techniques. For plasticulture, approximately three to four workers are needed to lay plastic in a grower field when using one-row equipment. With three-row equipment as many as eight people may be needed for the application of plastic and fumigant. Telone II is commonly used as the fumigant for nematode control as well as In-line and Vapam, which can be injected directly into the drip irrigation line.

Land preparation for sowing an early cucumber crop on bare ground begins in March and April. After land has been plowed and/or disked, some growers may fumigate the soil for nematode control. These tillage and fumigation operations typically only involve a tractor operator.

After planting, fertilizer is typically applied two times when grown on bare ground, while fertilizer application in the drip tape is typically made weekly in the plasticulture system. Only one person is needed to drive the tractor and apply fertilizer when applying fertilizer to cucumber grown on bare ground. A trained person with technical expertise is needed to “fertigate” when production is by

plasticulture.

Irrigation is more labor intensive when cucumbers are grown on bare ground. A traveling gun is typically used to irrigate the crop as needed. About three to four workers are needed to move irrigation pipe and equipment in the field. Irrigation for cucumbers grown in a plasticulture production system is managed by a worker with technical expertise. A worker or two may help maintain the drip irrigation by scouting and repairing water leaks when located.

Pesticides are applied during the production season from May through harvest. Fungicide and insecticide applications are usually applied together. Growers typically average about three applications in early season plantings (April through May) applied in one to two week intervals. Late season plantings require more fungicide and insecticide applications because insect and disease levels build as the summer season progresses. As many as 10 to 12 spray applications may be needed on a weekly basis. Herbicides are typically applied immediately after planting. Workers are potentially exposed to pesticides in a cucumber crop during hand weeding, which is sometimes a one-time event during the first few weeks after planting during the growing season. However, the main worker exposure to pesticides is the tractor driver; the exception is during hand weeding.

The last field activity involves harvest, which begins in early June and is completed by early July. Worker exposure in a cucumber crop is greatest as fruit are picked and removed from fields. Typically from 10 to 40 workers are needed to harvest and move the cucumbers from the field to the packing shed. The number depends on the size of the field and number of acres a grower produces at a given time. In many cases, multiple plantings of cucumbers are planted through the summer to insure constant supply of product. Planting may occur until as late as early August with harvest usually being complete by ten weeks after planting.

Insect and Mite Pests

Seed corn maggots, cucumber beetles, and pickleworms are the most important pests of cucumbers in North Carolina. Seed corn maggot is a problem in the spring on seeds planted too deeply in cold, wet soils having a high percentage of organic matter. The overuse of animal manure and some bone meal fertilizers can attract adult flies. The use of seed treatments and correct seeding procedures will favor plant emergence and good stands over insect development and reduced stands. Drenches of diazinon will help neutralize heavy infestations.

Cucumber beetles (spotted and striped) overwinter as adults and await tender cucumber cotyledons. Again, seeding and early plant establishment will compensate for beetle feeding. The use of Furadan granules preplant, the addition of the new reduced risk insecticide Admire to the soil, or the foliar application of Provado will give season-long control of cucumber beetles. Adios feeding-attractant-and-bait offers some early detection and control of low beetle populations. Sevin or thiodan applications well

timed for adult feeding will give effective control.

Pickleworms are migratory pests that move into North Carolina in late June and July. They pose a serious threat to the processing industry, and, hence, zero pickleworms is the threshold established by consumers. Trapping and monitoring for pickleworm moths are in various states of development. A network forecasting service is planned along the coast of North Carolina to alert growers and processors to the population levels and movement of this economic pest. Frequent foliar sprays are needed to prevent pickleworms from entering and contaminating pickles. Sevin, thiodan, Asana, or Lannate are suggested materials that give good control when applied in a safe and timely manner.

Other pests exist but are not limiting factors in cucumber production in most years. These include aphids, leafminers, thrips, mites, and several lepidopterous caterpillars. They are usually controlled with treatments used for other insects.

Chemical Control

Diazinon (Diazinon, Spectracide)

This material is applied before planting to control seed corn maggots and wireworms, respectively.

Carbaryl (Sevin)

This material, plus esfenvalerate (Asana), endosulfan (Thiodan) and methomyl (Lannate), is used to control cucumber beetles and flea beetles.

Methomyl (Lannate)

This material, plus carbaryl (Sevin), esfenvalerate (Asana) and endosulfan (Thiodan), is applied in middle to late summer to control pickleworms. Pickleworms are not usually a problem in spring plantings.

Esfenvalerate (Asana XL)

This material, plus carbaryl (Sevin), endosulfan (Thiodan) and methomyl (Lannate), is used to control other insects (aphids, cabbage loopers, cutworms, leafminers, thrips, wireworms) and mites.

Abamectin

This material is used for leaf miners and mites.

Bacillus thuringiensis

Bacillus thuringiensis is used for worms.

Bifenazate (Acramite)

Acramite is used for spider mites.

Bifenthrin (Capture)

Capture is a miticide and is effective against cucumber beetles and worms.

Buprofezin (Courier)

This material is used for aphids and white flies.

Cyromazine (Trigard)

This material is used for leafminers.

Endosulfan (Phaser, Thiodan)

Endosulfan is a broad spectrum insecticide.

Fenpropathrin (Danitol)

Danitol is a miticide and is effective against beetles and worms.

Imidacloprid

Admire is used for aphids, white flies, and beetles.

Insecticidal soap (M-Pede)

This is used as a general insecticide.

Naled (Dibrom)

This is used as a general insecticide.

Permethrin (Ambush, Pounce)

This is a pyrethroid insecticide effective against beetles and worms.

Pymetrozine (Fulfill)

Fulfill is effective against aphids, whitefly and other sucking insects.

Pyriproxifen (Knack)

Knack is effective against aphids, whitefly and other sucking insects.

Spinosad (SpinTor)

SpinTor is used for worms.

Thiomethoxam (Platinum)

Platinum is used for aphids, whitefly and beetles.

Table 1. Insecticide Use on Cucumbers (fresh market) in North Carolina in 2002. Source: Agricultural Chemical Usage: 2002 Vegetables Summary. July 2003. U. S. Department of Agriculture, National

Insecticide Active Ingredient	Area Applied¹ (Percent)	Number of Applications	Rate per Application (lbs./acre)	Rate per Crop Year (lbs./acre)	Total Applied (1,000 lbs.)
<i>Bacillus thuringiensis</i> ²	*	6.3			
Carbaryl	13	1.5	0.79	1.22	1.2
Endosulfan	*	2.7	0.76	2.08	-- ³
Esfenvalerate	56	1.9	0.006	0.01	-- ³
Permethrin	3	1.1	0.15	0.17	-- ³

* Area applied is less than one percent.

¹ Planted acres in 2002 for North Carolina were 7,500 acres.

² Rates and total applied are not available because amounts of active ingredient are not comparable between products.

³ Total applied is less than 50 lbs.

Table 2. Insecticide Use on Cucumbers (processing) in North Carolina in 2002. Source: Agricultural Chemical Usage: 2002 Vegetables Summary. July 2003. U. S. Department of Agriculture, National Agricultural Statistics Service.

Insecticide Active Ingredient	Area Applied¹ (Percent)	Number of Applications	Rate per Application (lbs./acre)	Rate per Crop Year (lbs./acre)	Total Applied (1,000 lbs.)
Esfenvalerate	28	1.1	0.03	0.03	0.2
Permethrin	4	2.8	0.12	0.34	0.3

¹ Planted acres in 2002 for North Carolina were 18,500 acres.

Current Insecticide Recommendations for Cucumbers

Current North Carolina Cooperative Extension Service recommendations for insecticide use on cucumbers (including information on formulations, application rates, and precautions/limitations) are provided in the following table from the *North Carolina Agricultural Chemicals Manual*:

Table 5-10: Insect Control for Commercial Vegetables

(<http://ipm.ncsu.edu/agchem/chptr5/510.pdf>)

Other Pest Management Strategies

Early planting and harvest in June will avoid pickleworms. However, thorough and timely applications of approved insecticides with a high-pressure (200 pounds per square inch) sprayer will give good control. Aerial applications and low-pressure sprayers are used but are not as effective. Well-timed seeding and plant establishment will often overcome any feeding damage by cucumber beetles and seed damage by seed corn maggots. Biological control exists, but it is not timely and readily available to control these pests of this highly valued crop.

Diseases

Diseases usually are much more severe in the summer crop than in the spring crop. Disease pressure and resulting losses can vary greatly from year to year and season to season. This variation is primarily weather-dependent, but it is also related to crop rotation, seed quality, and availability of effective management tools (e.g., fungicides). Important diseases are root-knot nematode, downy mildew, target spot, belly rot, gummy stem blight, anthracnose, cottony leak, damping-off, powdery mildew, *Alternaria* leaf spot, and angular leaf spot. Bacterial wilt is also an occasional problem.

Root-knot nematode (*Meloidogyne* spp.)

Cucumber growers use nematicides to manage nematodes in cucumbers. The decision to treat is based on nematode populations in the soil. Products used, in order of acreage treated, include Telone C-17, Telone II, Mocap, methyl bromide, and Vydate.

Damping-off (*Pythium*, *Phytophthora*, *Rhizoctonia*, *Fusarium*)

Cucumber seeds are generally treated with Ridomil (metalaxyl), thiram, or captan to control fungi that cause damping-off. The disease usually occurs during cool, rainy weather in early spring. Ridomil Gold (mefenoxam) is sometimes incorporated into the soil preplant in the spring crop and the summer crop.

Both seed and preplant treatments are effective but provide only temporary protection. Prolonged periods of cool, wet weather will eventually overcome fungicidal protection. The seed treatment is considered essential since it requires such small amounts of fungicide and provides good protection against damping-off fungi.

Fungal leaf spots:

Alternaria leaf spot (*Alternaria solani*)

Anthracnose (*Colletotrichum orbiculare*)

Gummy stem blight (*Didymella bryoniae*)

Target spot (*Corynespora cassicola*)

Bravo (chlorothalonil) and Mancozeb are applied on a 7- to 14-day schedule starting at vine running in the summer crop. Some of the spring acreage is treated similarly, but disease pressure is generally much less in the early crop. Use of mancozeb has risen as growers realize it is quite effective when applied in a timely and thorough manner and is less costly than Bravo. Several other fungicides have been registered for use on cucumber over the last 5 years. Pristine (pyraclostrobin + boscalid) is highly effective against gummy stem blight and anthracnose. The strobilurin fungicides (Quadris and Cabrio) are not recommended for use on gummy stem blight because of resistance development.

Downy mildew (*Pseudoperonospora cubensis*)

Most varieties possess good resistance to the disease, but occasionally disease pressure is sufficiently high to warrant additional control. In 2004, a severe epidemic occurred which caused approximately 40% crop loss in North Carolina and the Delmarva region. This level of devastation has not been seen in at least 30 years and whether or not it will repeat is unknown at this time. Effective products for downy mildew include Tanos (famoxadone+cyprodonil), Previcur Flex (propamocarb), Gavel (zoxamide +mancozeb). These products should be used in combination and alternation with Bravo or mancozeb.

Powdery mildew (*Podosphaera xanthii*; syn = *Sphaerotheca fuliginea*)

Most varieties possess sufficient resistance to control this disease without fungicide applications.

Angular leaf spot (*Pseudomonas syringae* pv. *lachrymans*)

This is a rare disease that is seedborne. It is controlled through the use of pathogen-free seed. Fixed copper compounds are sometimes used in an effort to prevent further spread.

Bacterial wilt (*Erwinia tracheiphila*)

Bacterial wilt is vectored by cucumber beetles. The disease is controlled by controlling the vector. Fixed copper compounds are sometimes used in an effort to prevent further spread.

Fruit rots:

Belly rot (*Rhizoctonia solani*)

Pickle packers often consider this their greatest disease problem. Yearly outbreaks are sporadic, and the conditions that favor the disease are not well understood. Several severe outbreaks have occurred in the state, and effective disease control methods are badly needed. Quadris (azoxystrobin) is occasionally used. Bravo is no longer labeled for use on this disease. Topsin-M is registered, but not used as much. Good data on efficacy are needed. Materials are applied to the bed top before vine running.

Cottony leak (*Pythium spp.*)

Ridomil Gold (mefenoxam) is sometimes applied to the spring crop and the summer crop.

Table 3. Fungicide Use on Cucumbers (fresh market) in North Carolina in 2002. Source: Agricultural Chemical Usage: 2002 Vegetables Summary. July 2003. U. S. Department of Agriculture, National Agricultural Statistics Service.

Fungicide Active Ingredient	Area Applied ¹ (Percent)	Number of Applications	Rate per Application (lbs./acre)	Rate per Crop Year (lbs./acre)	Total Applied (1,000 lbs.)
Azoxystrobin	9	1.1	0.12	0.14	0.1
Chlorothalonil	69	1.8	1.56	2.90	15.0
Chloropincrin	*	1.0	42.50	42.50	2.1
Methyl bromide	*	1.0	86.28	86.28	4.2

* Area applied is less than one percent.

¹ Planted acres in 2002 for North Carolina were 7,500 acres.

Table 4. Fungicide Use on Cucumbers (processing) in North Carolina in 2002. Source: Agricultural Chemical Usage: 2002 Vegetables Summary. July 2003. U. S. Department of Agriculture, National Agricultural Statistics Service.

Fungicide Active Ingredient	Area Applied¹ (Percent)	Number of Applications	Rate per Application (lbs./acre)	Rate per Crop Year (lbs./acre)	Total Applied (1,000 lbs.)
Azoxystrobin	30	1.1	0.18	0.20	1.1
Dichloropropene	3	1.0	50.90	50.90	32.5

¹ Planted acres in 2002 for North Carolina were 18,500 acres.

Current Fungicide and Nematicide Recommendations for Cucumbers

Current North Carolina Cooperative Extension Service recommendations for fungicide and nematicide use on cucumbers (including information on formulations, application rates, and precautions/limitations) are provided in the following tables from the *North Carolina Agricultural Chemicals Manual*:

Table 6-17: Vegetable Crop Disease Control Schedule
<http://ipm.ncsu.edu/agchem/chptr6/612.pdf>

Table 6-19: Relative Effectiveness of Various Chemicals for Cucurbit Disease Control
<http://ipm.ncsu.edu/agchem/chptr6/615.pdf>

Table 6-24: Nematode Control in Vegetable Crops
<http://ipm.ncsu.edu/agchem/chptr6/617.pdf>

Weeds

The major weeds in North Carolina cucumbers are annual and perennial grasses (large crabgrass, fall panicum, and goosegrass), common lambsquarters, and pigweeds (Palmer, redroot, and smooth). Management becomes difficult when grasses are taller than 4 inches. As large crabgrass matures, it produces roots at each node (joint), making it difficult to manage by cultivation and postemergence herbicides. Other weeds in cucumbers are common ragweed, common cocklebur, and annual morningglory.

The critical weed-free period for common lambsquarters and pigweed in cucumbers appears to be 14 to 32 days after emergence. Interference from weeds during that period of growth greatly reduces yield and

quality. It also appears that if as little as 5 percent of the weeds are left to compete with cucumbers, a yield reduction of more than 50 percent can occur. Producers use three methods of managing weeds: 1) cultural control, including crop rotation; 2) mechanical control, including cultivation and hand removal; and 3) chemical control, including preplant-incorporated, preemergence, and/or postemergence herbicides.

Mechanical Control

Cultivation and hand weeding are used to manage weeds in cucumbers. Cucumbers are usually cultivated three times and hand-weeded once or twice.

Chemical Control

Preplant herbicides

Gramoxone (paraquat) is labeled for preplant application to non-selectively kill emerged weeds before cucumbers come up. Killing weeds before planting is critical because any weeds that survive can reduce cucumber yield drastically.

Preplant-incorporated herbicides

Prefar (bensulide) gives preemergence weed control of most annual grasses and small-seeded broadleaf weeds. It can also be applied in irrigated cucumbers and then followed by irrigation for more effective weed control. Preplant incorporation of Prefar is difficult because most cucumbers are grown on beds. Alanap (naptalam) is sometimes applied with Prefar for control of more broadleaf weed species than Prefar alone offers.

Preemergence herbicides

Curbit (ethalfluralin) is applied preemergence immediately after cucumber seeding for controlling most annual grasses and small-seeded broadleaf weeds. Command (clomazone) is also an option that can be applied preemergence after cucumber seeding for controlling most annual grasses and small-seeded broadleaf weeds. Strategy (ethalfluralin + clomazone) is a formulated mixture of the active ingredients of Curbit and Command, and is applied preemergence immediately after cucumber seeding. Alanap is sometimes applied with Curbit for control of more broadleaf weed species than Curbit alone provides. It improves control of common ragweed and common cocklebur by Curbit. It does not give good control of annual grasses and, thus, is usually applied with either Prefar or Curbit. Alanap also is applied for preemergence weed control and control of small common lambsquarters and pigweed. Sandea (halosulfuron) is registered preemergence in cucumber for control of certain broadleaf weeds such as pigweed and yellow and purple nutsedge. Sandea applied postemergence provides greater control of

nutsedge than Sandea applied preemergence.

Dacthal (DCPA) and trifluralin (Treflan and various names) are occasionally applied after cucumber reaches 4 true leaves for late season preemergence weed control.

Postemergence herbicides

Poast (sethoxydim) or Select (clethodim) is applied on spring cucumbers and summer cucumbers for controlling emerged grasses. Sandea (halosulfuron) is applied on cucumbers for postemergence control of yellow and purple nutsedge and broadleaf weeds such as cocklebur, wild radish, galinsoga, smartweed and common ragweed.

Table 5. Herbicide Use on Cucumbers (fresh market) in North Carolina in 2002. Source: Agricultural Chemical Usage: 2002 Vegetables Summary. July 2003. U. S. Department of Agriculture, National Agricultural Statistics Service.

Herbicide Active Ingredient	Area Applied¹ (Percent)	Number of Applications	Rate per Application (lbs./acre)	Rate per Crop Year (lbs./acre)	Total Applied (1,000 lbs.)
Ethalfluralin	8	1.0	0.93	0.93	0.6
Chloropicrin	*	1.0	42.50	42.50	2.1
Methyl bromide	*	1.0	86.28	86.28	4.2

* Area applied is less than one percent.

¹ Planted acres in 2002 for North Carolina were 7,500 acres.

Table 6. Herbicide Use on Cucumbers (processing) in North Carolina in 2002. Source: Agricultural Chemical Usage: 2002 Vegetables Summary. July 2003. U. S. Department of Agriculture, National Agricultural Statistics Service.

Herbicide Active Ingredient	Area Applied¹ (Percent)	Number of Applications	Rate per Application (lbs./acre)	Rate per Crop Year (lbs./acre)	Total Applied (1,000 lbs.)
Clomazone	4	1.0	0.28	0.28	0.2
Ethalfluralin	24	1.0	0.63	0.63	2.8
Dichloropropene	3	1.0	50.90	50.90	32.5

¹ Planted acres in 2002 for North Carolina were 18,500 acres.

Current Herbicide Recommendations for Cucumbers

Current North Carolina Cooperative Extension Service recommendations for herbicide use on cucumbers (including information on formulations, application rates, and precautions/limitations) are provided in the following table from the *North Carolina Agricultural Chemicals Manual*:

Table 8-15: Chemical Weed Control in Vegetable Crops
<http://ipm.ncsu.edu/agchem/chptr8/817.pdf>

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3. Schultheis, J. R., C. W. Averre, M. D. Boyette, E. A. Estes, G. J. Holmes, D. W. Monks, and K. A. Sorensen. 1998. Commercial production of pickling and slicing cucumbers in North Carolina. North Carolina Coop. Ext. Serv. AG-552.
4. Sherrell, E. M. (ed.). 2004. North Carolina Agricultural Statistics 2004. Publication No. 204. North Carolina Department of Agriculture & Consumer Services, Raleigh.
5. Toth, S. J., C. W. Averre, D. W. Monks, J. R. Schultheis, and K. A. Sorensen. 1994. Cucumber pest management 1990. North Carolina Cooperative Extension Service. AG-499.
6. U.S. Department of Agriculture, National Agricultural Statistics Service. 2003. Agricultural Chemical Usage: 2002 Vegetables Summary. July 2003.

On-Line Resources

Commercial Vegetables Recommendations for the Southeastern U. S.

(<http://ipm.ncsu.edu/vegetables/CommercialVegetables/SECommercialVegGuide.pdf>)

Sustainable Practices for Vegetable Production in the South

(<http://www.cals.ncsu.edu/sustainable/peet/>)

North Carolina Pest News

(http://ipm.ncsu.edu/current_ipm/pest_news.html)

Insects and Related Pests of Vegetables

(<http://ipm.ncsu.edu/AG295/html/index.htm>)

Insect Pests of Vegetables

(http://ipm.ncsu.edu/vegetables/pests_vegetables.html)

Insect Notes – Vegetables

(http://www.ces.ncsu.edu/depts/ent/notes/Vegetables/vegetable_contents.html)

Plant Disease Information – Vegetables

(http://www.ces.ncsu.edu/depts/pp/notes/Vegetable/vegetable_contents.html)

Know and Control Cucumber Pests

(<http://ipm.ncsu.edu/vegetables/Pamphlets/cucumber/cucumber.html>)

Cucumber and other Summer Vegetables, Horticultural Commodity of North Carolina

(<http://www.agr.state.nc.us/markets/commodit/horticul/sumveg/cucumbers.htm>)

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