

Crop Profile for Watermelons in North Carolina

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General Production Information

- North Carolina ranked ninth nationally in the production of watermelons in 2003, representing 2.9 percent of U. S. production. A total of 1,100,000 cwt. of watermelons were produced in the state in 2003.
- In 2003, 7,800 acres of fresh market watermelons were harvested in North Carolina.
- In 2003, a total of 975,000 cwt. of fresh market watermelons were produced in North Carolina for a value of \$6,825,000.

Production Regions

Most watermelons are grown in the Coastal Plain of eastern North Carolina or in the northeastern region of the state.

Production Practices

Watermelons can be grown on a wide range of soil types with sandy soils being preferred. However, highest yields will generally be produced on well-drained clay loam soils. Coarse, sandy soils are generally low in fertility and subject to moisture stress and require special care (more frequent, timely irrigation) to grow a good crop. The soil pH should be 5.8 to 6.2.

Fertilizer:

Fertilizer should be uniformly mixed into a 2 to 3 foot band in the row or side dressed either preplant or in increments before and after planting. Application rates should be determined by a soil test. The general recommendation is for 40 to 60 pounds each of nitrogen and phosphorus and 80 to 100 pounds of potassium. At layby (4 to 6 week postplant) apply 25 to 30 pounds of N as a sidedressing. If leaching rains have occurred, a sidedressing with a material containing both nitrogen and potassium such as 15-0-14, 8-0-24, or 13-0-44 is often needed. Additional sidedressing may be needed if heavy rains persist.

Planting and Spacing:

Soil temperatures should be 60 to 65 degrees F before seeding. Seed is drilled uniformly in the row at a 1 to 1½ inch depth (¾ to 1 inch depth for small seeded varieties). Once plants are actively growing, thin to a final stand leaving 25 square feet per plant. Spacing will depend on irrigation availability and cultural management practices. Irrigation is strongly recommended; however, if no irrigation is available or used, allow 40 to 50 square feet per plant. Transplanting is a common practice when aiming for an early crop.

Plastic Mulch and Row Covers:

Plastic mulch with drip irrigation results in earlier melons (1 week) and helps increase yields (total yields may reach 80,000 pounds per acre). Other benefits from using black plastic mulch include: higher quality fruit, reduced blossom-end rot, and better placement and use of fertilizer. Approximately 5 to 10% of the state's crop is grown in this manner.

Pollination:

Supplying bees for pollination has been very successful. Most farmers will realize noticeable increases in yield from placing one strong colony of bees every 2 acres in or alongside the field when blooms begin to appear.

Worker Activities

In North Carolina, watermelon production activities begin in March. Many North Carolina growers produce watermelon transplants in greenhouses. Worker activities include filling the transplant trays with soil-less media and sowing of seed. In many cases, the grower sows the seed, irrigates and fertilizes the transplants. In conjunction with greenhouse transplant activities, land preparation begins in March. Moldboard plowing and disking are common tillage practices employed before rows are laid out in the field. Approximately 75% of plantings are made on bare ground, while about 25% 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 workers 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 a watermelon 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.

Field planting operations begin in mid-April and are mostly complete by late May. In plasticulture, transplant equipment typically is 1 or 3-row, while some transplants are set in the field by hand. In bareground, transplants are set with two-row equipment. Several workers are needed when mechanical equipment is used to set transplants and even a greater number of workers are needed if transplants are set by hand. Worker exposure occurs to plants that possibly are treated with pesticide. When watermelon fields are established by sowing seed, only one worker is needed to operate the tractor and worker exposure is negligible.

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

Irrigation is more labor intensive when watermelon is 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 watermelon 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 beginning May until harvest. Fungicide and insecticide applications are usually applied together. Applications are usually made on a 7 to 14 day interval with an average of four total sprays. Herbicides are typically applied immediately after planting. Workers are potentially exposed to pesticides in a watermelon crop during hand weeding which

is usually a one-time event during the 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 late June and is completed by August. Worker exposure in a watermelon crop is greatest as fruit are handled and removed from fields. This requires much physical labor, especially in fields in which larger fruit are produced. Typically four workers are needed to cut the fruit and remove them from the vine and 8 to 10 workers to pick the fruit up and place in the truck.

Insect Pests

Cucumber beetles [*Diabrotica undecimpunctata howardi*, the spotted cucumber beetle and *Acalymma vittata*, the striped cucumber beetle] overwinter as adults in North Carolina, feed on seedlings and can inflict serious reductions in stands. The use of carbaryl (Sevin) baits and sprays are effective if well timed when 3 adults are seen in 10 feet of row. Carbofuran (Furadan) granules (for nematode control) has provided some good control of beetles early. Imidacloprid (Admire) and foliar sprays of imidacloprid (Provado) offer reduced risk pesticides and systemic control. Late season feeding is not a problem as the crop can overcome insect feeding. Disease spread is usually not serious.

Rindworms are the larvae of several insects that attack the bottom of the fruit that contacts the soil. Drenches of diazinon are helpful. Also control of adult populations and growing watermelons on plastic or straw offers some protection.

Soil insects consist of **seed corn maggots** and **whitefringed beetles**. They reduce stands through attack of seed and seedlings. Seed treatments help some. Rotation, avoidance of high organic soil and manure additives, and seeding at proper depth and soil temperature offer some control.

Twospotted spider mites (*Tetranychus urticae*) are a serious pest during hot, dry periods in eastern North Carolina. Mites build up on grasses and weeds around fields; hot, dry conditions can cause mite populations to build and feed on small plants under stress. Mowing and weed control together with rotation offer some preventive control. Selective miticides can be used.

Flower thrips (several species) are sporadic pests during cool, wet springs. Thrips can move to planting in May and June from small grain. Monitoring and thrips management in fields will prevent and serious loss of stands.

Several **aphid** species are sporadic pests during hot, moist periods. Aphids can move from cotton to melons and cause plant death. Some aphicides exist and when timed and thoroughly applied will give excellent control.

Diazinon (Diazinon, Spectracide) and dimethoate are organophosphates used for **aphid** control on watermelons in North Carolina. Endosulfan (Phaser, Thiodan) is an alternative, but is slow and is not as effective. These products also are effective against **leafminers**. Abamectin (Agri-mek) is an effective alternative for leafminers.

Sevin is effective against **cucumber beetles**. However endosulfan (Phaser, Thiodan), esfenvalerate (Asana XL) and permethrin (Ambush) are excellent alternatives.

Dicofol (Kelthane) and dimethoate are used for **mites**. Abamectin (Agri-mek) is an effective alternative; however, it is very expensive.

Methomyl (Lannate) and carbaryl (Sevin) are used for **cutworms**. Esfenvalerate (Asana XL) and permethrin (Ambush) are effective alternatives.

Crop rotation, the use of Adios bait and monitoring for **cucumber beetles**, the availability of imidacloprid (Admire and Provado) for cucumber beetle in the future, management of the area near plantings (to avoid mowing and movement of mites from ditchbanks into fields) and the promotion of rapid plant stands and optimal growing conditions will help plants overcome insect pressures. IPM and the integration of several new reduced risk pesticides will helpful tools for the watermelon grower in the future.

Table 1. Insecticide Use on Watermelons 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.)
Carbaryl	4	1.5	0.69	1.06	0.4
Esfenvalerate	29	1.8	0.03	0.05	0.1
Permethrin	13	1.5	0.12	0.19	0.2

¹Planted acres in 2002 for North Carolina were 10,100 acres.

Current Insecticide and Miticide Recommendations for Watermelons

Current North Carolina Cooperative Extension Service recommendations for insecticide and miticide use

on watermelons (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>)

Diseases

Diseases usually are much more severe in the summer than in the spring crop. Disease pressure and resulting losses can also vary greatly from year to year and season to season. This variation is primarily weather-dependent, but is also related to crop rotation, seed quality, and availability of effective management tools (e.g., fungicides, resistant varieties). Important diseases are anthracnose, *Cercospora* leaf spot, damping-off, downy mildew, gummy stem blight, rind necrosis, root knot and *Fusarium* wilt. Powdery mildew has become more of a problem in recent years.

Root knot nematode (*Meloidogyne* spp.):

Growers use nematicides to manage nematodes in watermelon. The decision to treat is based on nematode populations in the soil. Carbofuran (Furadan), Telone C-17, dichloropropene (Telone II), ethoprop (Mocap), methyl bromide, and oxamyl (Vydate) are used.

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

Watermelon seed is often treated with thiram or captan to control fungi that cause damping-off. They are occasionally treated with mefenoxam (Ridomil Gold, Apron). Watermelon is fairly tolerant of damping-off, but it can occur when prolonged periods of cool, wet weather occur in the early spring.

Leaf spots:

Anthracnose (Colletotrichum orbiculare), Cercospora leaf spot (Cercospora citrullina), Gummy stem blight (Didymella bryoniae)

Chlorothalonil (Bravo) and mancozeb are applied on a 7 to 14-day schedule starting at vine running in the summer crop. Use of mancozeb has risen as growers realize that this material is quite effective when applied timely and thoroughly and is less expensive than Bravo. However, Bravo does provide slightly better control of leaf spots than mancozeb.

Azoxystrobin (Quadris) was registered for use on watermelons in 1999. It is more effective than Bravo or Mancozeb on leaf spots and also controls powdery mildew. By 2001, *D. bryoniae* had developed resistance to azoxystrobin and pyraclostrobin (strobilurin fungicides) and these products are no longer recommended for use against this disease. As of 2005, Pristine (pyraclostrobin + boscalid) alternated with

chlorothalonil or mancozeb is the most effective method of controlling gummy stem blight.

Downy mildew (*Pseudoperonospora cubensis*):

This disease is more sporadic than the leaf spots and rarely requires fungicides for control. Mefenoxam (Ridomil Gold) is used, but lacks good efficacy due to resistance. Chlorothalonil (Bravo) and mancozeb usually provide good results if applied timely with thorough coverage. Several products have good activity against this disease, including Tanos (famoxadone + cymoxanil), Previcur Flex (propamocarb) and Gavel (mancozeb + zoxamide).

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

This disease has become more common in the last few years. Myclobutanil (Nova) and trifloxystrobin (Flint) and triflumizole (Procure) are effective products. Resistance has developed to myclobutanil and trifloxystrobin, but this has not resulted in complete failure.

Table 2. Fungicide Use on Watermelons 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	9	1.4	0.15	0.23	0.2
Chlorothalonil	28	2.5	1.31	3.30	9.2
Mancozeb	8	1.0	1.33	1.40	1.2
Chloropicrin	4	1.1	35.02	40.89	16.3
Methyl bromide	2	1.3	127.54	174.46	31.7

¹Planted acres in 2002 for North Carolina were 10,100 acres.

Current Fungicide and Nematicide Recommendations for Watermelons

Current North Carolina Cooperative Extension Service recommendations for fungicide and nematicide

use on watermelons (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

Annual grasses and broadleaf weeds are common problems in watermelon fields in North Carolina. Broadleaf weeds are more troublesome to growers than grass weeds. Late season weeds are most troublesome because it difficult to control these weeds due to the extensive development of the crop and the large weed size. The critical weed-free period for smooth pigweed in watermelons appears to be 0.5 to 3 weeks after emergence. Interference from weeds during that period of watermelon growth greatly reduces yield and quality of watermelon fruit, leading to up to a 70% yield reduction. 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. Cultivation is not commonly an option in plasticulture watermelon but is used extensively in bareground watermelons.

Mechanical Control

Cultivation and hand weeding are used to manage weeds. Watermelons in bareground culture are usually cultivated three times and hand weeded 1 to 2 times.

Chemical Control

Preplant herbicides:

Paraquat (Gramoxone Max) is labeled for preplant application to non-selectively kill emerged weeds before watermelon emergence. This herbicide is used on less than 5% of the watermelon acreage. This low usage is probably because producers rely on tillage to kill sprouted weed seed and emerged weeds. Killing weeds prior to watermelon planting is critical since weeds that survive the planting operation can

drastically reduce watermelon yield. Certain formulations of glyphosate are also registered preplant in watermelon for non-selective kill of emerged weeds. The label lists precautions on when growers can plant after glyphosate application.

Preplant incorporated herbicides:

Bensulide (Prefar) gives preemergence weed control of most annual grasses and small seeded broadleaf weeds. It can also be applied to the soil surface after watermelon seeding and then followed by irrigation or rainfall for more effective weed control. Preplant incorporation of Prefar is difficult because most watermelons are grown on beds, which may explain why its use is less than 5% of cucumber acreage in North Carolina.

Naptalam (Alanap) is sometimes applied with bensulide (Prefar) for control of more broadleaf weed species than Prefar alone.

Preemergence herbicides:

Ethalfluralin (Curbit) is applied preemergence immediately after watermelon seeding for controlling most annual grasses and small seeded broadleaf weeds. Naptalam (Alanap) is sometimes applied with Curbit for control of more broadleaf weed species than Curbit alone. Clomazone (Command) is sometimes applied with ethalfluralin to the soil surface after watermelon seeding for broadspectrum weed control. Command is also registered for preplant application in transplanted watermelon. The active ingredients of Curbit and Command are also available as a commercial mixture with trade name of Strategy.

Naptalam (Alanap) is applied preemergence on watermelons. It improves control of common ragweed and common cocklebur by ethalfluralin (Curbit) alone. Alanap does not give good control of annual grasses, thus is usually applied with either Prefar or Curbit or Command.

Postemergence herbicides:

DCPA (Dacthal) or trifluralin (Treflan and various other trade names) is an option for application when watermelon has at least 4 to 5 true leaves. These herbicides are registered in bareground culture and have potential to give late season weed control. They have only had limited used in North Carolina.

Sethoxydim (Poast) or clethodim (Select) is applied on watermelons for postemergence grassy weed control. Both give effective control of grasses.

Naptalam (Alanap) can be applied for preemergence control of some broadleaf weed control and control of small common lambsquarters and pigweed.

Halosulfuron (Sanda) is registered in watermelon for postemergence control of yellow and purple nutsedge and broadleaf weeds (wild mustard, wild radish, common ragweed, galinsoga, and cocklebur).

It is most effective postemergence on yellow and purple nutsedge compared to preemergence application. It can only be used in the middles between rows as it has potential to injure watermelon if applied over the top of watermelon plants.

Certain formulations of glyphosate are registered for weed control in row middles of watermelon. This herbicide controls most plants; thus must not contact the crop. It has had limited used in North Carolina due to the potential for crop injury.

Table 3. Herbicide Use on Watermelons 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	20	1.0	0.20	0.21	0.4
Ethalfluralin	48	1.0	0.74	0.75	3.6
Glyphosate	6	1.0	0.69	0.70	0.4
Naptalam	10	1.0	2.33	2.33	2.4
Sethoxydim	12	1.0	0.14	0.14	0.2
Chloropicrin	4	1.1	35.02	40.89	16.3
Methylbromide	2	1.3	127.54	174.46	31.7

¹Planted acres in 2002 for North Carolina were 10,100 acres.

Current Herbicide Recommendations for Watermelons

Current North Carolina Cooperative Extension Service recommendations for herbicide use on watermelons (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>

Contacts

Gerald J. Holmes
Extension Specialist
Department of Plant Pathology
North Carolina State University
Campus Box 7616
Raleigh, NC 27695-7616
Telephone: (919) 515-9779
E-mail: Gerald_Holmes@ncsu.edu

David W. Monks
Extension Specialist (Weed Management)
Department of Horticultural Science
North Carolina State University
Campus Box 7609
Raleigh, NC 27695-7609
Telephone: (919) 515-5370
E-mail: David_Monks@ncsu.edu

Jonathan R. Schultheis
Extension Specialist
Department of Horticultural Science
North Carolina State University
Campus Box 7609
Raleigh, NC 27695-7609
Telephone: (919) 515-1225
Fax: (919) 515-2505
E-mail: Jonathan_Schultheis@ncsu.edu

Kenneth A. Sorensen
Extension Specialist
Department of Entomology
North Carolina State University
Campus Box 7626
Raleigh, NC 27695-7626
Phone: (919) 515-1662
Fax: (919) 515-7746
E-mail: Kenneth_Sorensen@ncsu.edu

Allan C. Thornton

Extension Associate
Department of Horticultural Science
Sampson County Extension Center
369 Rowan Road
Clinton, NC 28328
Telephone: (910) 592-7161
E-mail: allan_thornton@ncsu.edu

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2. E. M. (ed.). 2004. North Carolina Agricultural Statistics 2004. Publication No. 204. North Carolina Department of Agriculture & Consumer Services, Raleigh.
3. Terry, E. R., Stall, W. M., Shilling, D. G., Bewick, T. A. and Kostewicz, S. R. 1997. Smooth amaranth interference with watermelon and muskmelon production. Hort. Sci. 32:630-632.
4. 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)

Watermelons, Horticultural Commodity of North Carolina

<http://www.agr.state.nc.us/markets/commodit/horticul/melons/>)

Prepared by:

Gerald J. Holmes, David W. Monks, Jonathan R. Schultheis, Kenneth A. Sorensen, Allan C. Thornton, and Stephen J. Toth, Jr. (ed.)

The image of cut watermelon is provided by the Department of Communication Services at North Carolina State University.