ATTRA Peanuts: Organic Production

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Contents

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People interested in growing peanuts and experienced peanut growers considering a switch to organic production may find a high demand for organic peanuts and enjoy higher premiums over traditionally grown peanuts.

Labor and management costs can be much higher for organic peanuts than conventionally grown peanuts. In place of off-farm inputs, organic peanut farmers can use intensive management, maintain high soil fertility, manage weeds through hand hoeing and specialized equipment and manage insects with alternative insect management strategies.

Peanut crop. Photo by Brad Haire, University of Georgia, **Bugwood.org**

Introduction

Organic production of peanuts, or any commodity, relies on management techniques that replenish and maintain long-term soil fertility by optimizing the soil's biological activity. This is achieved through crop rotation, cover cropping or composting and using organically accepted fertilizers that feed the soil and provide plants with nutrients.

In addition to producing high-quality crops, healthy and well-balanced soil can help plants develop natural resistance to insect pests and diseases. When pest controls are neccessary, organic farmers manage insects, diseases, weeds and other pests with cultural, mechanical, biological and, as a last resort, organically accepted biorational and chemical controls.

In 2002, the U.S. Department of Agriculture implemented its National Organic Program. The program regulates organic production nationwide. Farmers and ranchers that market their products as organic must be certified. An exception to this requirement is made for farmers who sell less than $5,000 annually. For more information on organic crop production and organic farm certification, see ATTRA's publications *Organic Crop Production Overview, Organic Farm Certification and the National Organic Program* and *Organic Certification Process.*

Related ATTRA publications

Alternative Agronomic Crops

NCAT's Organic Crops Workbook

Organic Field Crops Documentation Forms

Soil Management: National Organic Program Regulations

Biodiesel: The Sustainability Dimension

Oilseed Processing for Small-scale Producers

Organic Crop Production Overview

Organic Farm Certification and the National Organic Program

Organic Certification Process

Overview of Cover Crops and Green Manures

Part I: Markets, peanuts and premiums

Organic markets

There is very little published marketing research on emerging organic peanut markets. Anecdotal information shows that demand is high for organic peanuts and organic farmers enjoy high premiums over conventionally grown peanuts.

Some large organic food manufacturers seek dependable supplies of organic peanuts and may be willing to contract for organic production. The snack food industry, rather than the peanut butter sector, may be the larger market for organic peanuts.

This has implications for the type of peanut desired and for the geographical area most suited to its production. Since shellers and manufacturers are the principal contractors for peanut production in the South, a much different processing and marketing infrastructure may need to be developed to serve organic markets.

In general, peanut production in the United States is rising. According to the Peanut Council, American peanuts are considered to be the highest quality in the world (Ledbetter and Wallace, 2006). The United States exports from 200,000 to 250,000 metric tons of peanuts per year (American Peanut Council, 2002).

Peanuts-value of production in 2005

State rank	State	Value of production
1	Georgia	$368.1 million
2	Texas	$162.9 million
3	Alabama	$103.6 million
4	Florida	$69.8 million
5	North Carolina	$56.7 million

Source: National Agricultural Statistics Service, 2006

Several factors may have contributed to the increase, including:

- Reduced concern about fat in foods
- Studies linking peanut consumption to health
- Introduction of new products such as flavored in-shell peanuts
- Increased retail promotion by the industry
- Promotional emphasis on peanut health benefits (USDA/ERS, 2002)

In conventional peanut production, the battle for a share of the world peanut market is constant and influenced by price and quality of peanuts, on-time service to buyers and ample peanut supplies (Spearman, 2006a). The United States now ranks third in the world in peanut production, behind China and India.

Organic peanuts

Organic peanut production is traditionally confined to the Valencia cultivar in New Mexico, Colorado and West Texas.

Virginia, Runner, Spanish and Valencia are the four peanut cultivars. The main commercial peanut crop raised in the United States is the Runner type, used mainly for peanut butter. The Runner cultivar makes up 75 percent of the country's planted acreage, mostly in the Southeast. The Virginia type comprises 15 percent of the U.S. crop, grown mainly in Virginia and the Carolinas. Five percent of the national crop is Spanish peanuts, grown in the Southwest. The Valencia cultivar, grown in New Mexico, makes up 1 percent of the U.S. crop.

While several major market types of peanuts can grow in New Mexico, three Valencia strains were developed for the climate, soil and length of growing season in the state. Valencias, a red-skinned peanut undesirable for making peanut butter, are typically marketed as in-shell edible peanuts.

- Valencia A has a red seed coat and a bunching growth habit. The A200 cultivar, developed from the Tennessee Red peanut, was released in 1971 by New Mexico State University's Agricultural Experiment Station as New Mexico Valencia A. This variety of peanut has the greatest proportion of three- and four-seeded pods.

- Valencia C also has a red seed coat and emerges one to three days later than Valencia A. This strain is a 1979 NMSU release, developed from irradiated Colorado Manfredi seed with parentage of Colorado de Cordoba introduced from Argentina. Valencia C has a larger seed and a higher percentage of sound, mature kernels than other Valencia varieties. It matures at the same time as the Valencia A strain.
- The McRan Valencia cultivar is protected under the New Mexico Plant Variety Protection Act. The McRan cultivar produces three- and four-seeded pods that have limited constriction and contain full, touching, flattened seed (Baker et al., 2000).

History

The peanut, *Arachis hypogaea L.* (Fabaceae, subfamily of Leguminoseae), likely originated in Bolivia and already grew in the Americas when European explorers arrived in the 16th century. Peanuts, a tropical and warm-season temperate crop, soon were cultivated in Europe, Africa, Asia and the Pacific Islands.

In Africa, peanuts are called groundnut, but a related edible weed species *(Apios americana)* is also known as groundnut. Other related genera include *Amphicarpaea* (hog peanut), *Astragalus* (milkvetch), *Cajanus* (pigeon pea), *Canavalia* (jackbean and swordbean), *Caragana* (Siberian pea shrub), *Cicer* (chickpea), and all garden beans, including limas and fabas. Most of these plants have edible seeds or pods, but some peanuts can cause an allergic reaction in susceptible individuals.

A University of Georgia bulletin notes that peanuts have grown in that state since pre-colonial times (Georgia Cooperative Extension, 1982). Historical records indicate that the peanut was primarily a garden crop until after the Civil War. As a field crop, farmers grew peanuts only for hog pasture until about 1930 (Putnam et al., 1991). Peanuts are still recommended as an easy-to-grow home garden crop in the South and can mature as far north as central New York (Dawling, 2006). The noted scientist George Washington Carver, of Tuskegee Institute in Alabama, developed numerous products from the peanut, including foodstuff, dyes, medicines and fuels.

Peanuts need a minimum of 110 frost-free days to produce a crop, and Virginia-type peanuts require 2520 to 2770 growing-degree days above a base of 57 degrees Fahrenheit for successful production (Dawling, 2006). Other requirements include warm to hot growing conditions with adequate but not excessive water. Irrigation may be necessary in some years. Light, loose, well-drained soil is also highly desirable. Using the right rotation, or even interplanting another legume, often eliminates the need for additional fertilizer.

Dr. Mark Boudreau, a farm consultant with Hebert Green Agroecology, received a 2005 Sustainable Agriculture Research and Education grant from Southern Region Sustainable Agriculture Research and Education (SoSARE). Boudreau contends that peanut growers in the South can switch to organic production using whole-farm decision risk management and state-of-the-art techniques. He recommends:

- Using resistant cultivars
- Using cover crops and rotations
- Understanding diversification and insect management
- Checking weather-based advisories
- Using organic pesticides

Marketing challenges

It is difficult to find published marketing research results of any type, especially research on emerging organic markets. In New Mexico, Sunland Peanut Company contracts for 2,500 acres of organic peanuts from eight to 10 growers that are certified by Farm Verified Organic, a USDA-accredited organic certifier, and eligible for export to the European Union. Processing occurs in the certified-organic Sunland facility at Portales (Yancy, 2000).

An Overview of the North Carolina Organic Industry contained the results of a survey of 17 peanut buyers that handled organic peanuts east of the Mississippi:

> Six [buyers] typically bought bulk loads of organic peanuts…The six companies that bought organic peanuts preferred to buy 'Valencia' peanuts. Each company purchased different amounts of peanuts, with the two largest volume companies buying in excess of 150 tons of organic peanuts per year. Three companies bought smaller amounts ranging between 1 and 2 tons annually...Larger volume buyers preferred peanuts to be packaged in containers that held either 55 pounds of peanuts or [in] a bulk bin. Smaller volume buyers found smaller units such as a 25-pound box an acceptable container. Peanut buyers paid growers between $0.80 per pound and $1.50 per pound, with the largest volume buyer paying the lowest price to growers...Peanut buyers indicated that large proportions of organic peanuts were obtained from New Mexico growers because they believed that the aflatoxin risk was lower with New Mexico peanuts than with east-coast produced peanuts. Buyers also believed that organic peanuts were a complicated crop to grow using organic methods and encourage growers to improve quality to have a competitive edge in the organic market (Estes et al., 1999).

Alternative Uses

While nonfood products and by-products are derived from conventional peanut production, there is no indication at present that manufacturers of organic body-care products or livestock feed would constitute a significant market for organic peanut producers.

Forage peanuts

The perennial peanut (*Arachis glabrata* Benth; *A. pintoi*), a warm season, tropical perennial legume native to South America, is propagated by rhizomes since it does not set seed in temperate zones. The peanuts are called perennial because they are long-lived and do not require replanting once established. Perennial peanuts were introduced to Florida in 1936 from Brazil. Other types of peanut had long been used for grazing in the Southeast. Cultivars include Floragraze, Arbrook and Ecoturf.

Commercial production is limited to the warmer portion of USDA hardiness zone 8a and zones 8b, 9 and above, including the coastal plain from South Carolina to Brownsville, Texas and including all of Florida.

Perennial peanut hay is sold by the bale, but may also be pelleted and cubed. There is some demand for perennial peanut hay as ornamental material for turf. Perennial peanuts are also being used as a cover crop in citrus groves (Silva, 1998).

In 2005, 16,000 acres of perennial, or forage, peanuts were planted in the United States (Williams, 2005). Elide Valencia of the University of the Virgin Islands published extensively on forage peanut. In 2003, the USDA's Agricultural Research Service sent scientists to Paraguay for new germplasm of *A. glabrata*, and accessions are being evaluated at six locations in the United States (Williams, 2005). Organic production of forage peanut is not yet underway.

Peanut oil potential for biodiesel

As described in the ATTRA publication *Biodiesel: The Sustainability Dimensions*, peanuts rank in the first tier of oilseed crops, producing 109 gallons of oil per acre. This yield compares very favorably with that of other temperate oilseeds like rapeseed, which yields 122 gallons per acre and sunflowers, which yield 98 gallons per acre. The yield from peanuts is much higher than that of soybeans at 46, oats at 22 and corn at 18 gallons per acre.

Competing uses for peanuts and acreage limitations restricted the investigation of peanut oil as a motor fuel. However, it is quite feasible to produce biodiesel from used restaurant cooking-oil blends that contain peanut oil. Peanut oil was the prototype fuel used by Rudolph Diesel for the Paris World Exhibition in the late 19th century. For more information on this topic, see the **References** section at the end of this publication.

Organic demands and premiums

Organic peanut production, like conventional farming, is mostly done by contract. At the 2005 Nebraska Sustainable Agriculture Society meeting, peanut grower Jimmy Wedel of Muleshoe, Texas, quoted a 2004 organic premium of $225 per ton for his 650 acres of Valencias. The price for conventionally grown peanuts was $575 per ton (2005).

Wedel also said the price for 2004 organic Spanish peanuts was quoted at $800 per ton compared to $425 per ton for conventionally grown peanuts. Wedel estimated the five-year yield range for Valencia peanuts at 1 to 1.75 tons per acre. This means a gross income of $1,200. For Spanish peanuts, Wedel estimates a five-year yield of 1.25 to 2 tons per acre with a gross income of $1,400.

Since peanuts are part of a three-year crop rotation, Wedel also raises organic blue corn, white and yellow food corn, soybeans, wheat for grain, grazing and green manure, cotton and grass for wildlife habitat. Wedel devotes 10 percent of his 5,000 mostly irrigated acres to conventional alfalfa, silage corn, pinto beans, black-eyed peas and green beans. With this method, Wedel said he harvests "virtually the same yield that your conventional acres make" and receives "a huge premium over the conventional market" (2005).

Wedel is certified by the Texas Department of Agriculture and only has domestic contracts. Additional certification would be necessary if supply and demand ever indicated export opportunities. International Certification Services is the internationally accepted organic certifier for U.S.-grown peanuts. For more information, see the **Resources** section at the end of this publication.

Production budgets

Every peanut-producing state publishes annual production budgets for conventional production, but not organic production. Budgets vary by state, especially when irrigation costs are considered. Costs of off-farm inputs may also rise for conventional producers. For sample production budgets for flood-irrigated and sprinkle-irrigated peanuts in New Mexico, see Libbin in the **References** section (2001 a,b).

Wedel said he employs three additional full-time workers for his organic operation. He spent an additional $100,000 for seasonal, including migrant, labor including hoeing. Wedel also spent an additional $20,000 for repairs and fuel expense for equipment specific to organic production. This represents a cost of about $185 per acre more than conventional production, not accounting for lower costs associated with not using pesticides and fertilizers. Wedel said a good hoe crew is fundamental to managing weeds for good crop yields since peanuts are particularly susceptible to weed pressures.

Part II: Production of organic peanuts

Organic production of peanuts relies on management techniques that replenish and maintain long-term soil fertility by optimizing the soil's biological activity. This is achieved through crop rotation, cover cropping or composting, and by using organically accepted fertilizers that feed the soil and provide plants with nutrients. Organic farmers manage insects, diseases, weeds and other pests with an array of cultural, mechanical and biological options. As a last resort, peanut growers can use organically accepted biorational and chemical controls.

Soil and fertility

Organic peanut growers need to get a sense of their soil fertility by obtaining a soil test report with recommendations specifically for peanuts. Previous experience with rotational cover crops and compost or manure applications is also helpful. Organic peanut growers must work closely with crop advisers familiar with organic production and peanuts.

Growers should always consider the history of the field they select for peanuts, especially if it is a new site. In 2003, the North Carolina Department of Agriculture and Consumer Services warned new peanut growers about zinc buildup due to chicken litter application, especially in eastern counties.

Some fields that received heavy, long-term litter applications now have zinc-index (Zn-I) values approaching (Zn-I = 300 (12 ppm), caution advised) or exceeding the toxicity thresholds (Zn-I = 500 (20 ppm), critical toxic level) for peanuts. Growing peanuts on fields with Zn-I values above 300 is not advisable. Officials alerted growers that toxicity was more likely for soil pH below 6.0 (Hall, 2003).

Lime is essential for successful peanut production. Soil pH needs to be carefully monitored and should be in the 5.8 to 6.2 range for Southern growers. Large-seeded Virginia peanuts require high calcium content in the soil surface at pegging for pod development and quality. Land plaster or gypsum, a by-product of drywall, is not allowed as a source of calcium in organic production. Mined sources of gypsum are allowed.

Excessive levels of potassium within the fruiting zone, or the top 2 to 3 inches of soil, are associated with peanut pod rot. Potassium also competes with calcium uptake at pegging, resulting in a high percentage of pops, or unfilled shells. Any potash (K2O) is incorporated along with the preceding crop's fertilizer, if possible, in order to allow enough time for potassium to move below the fruiting zone before pegging.

Manganese deficiency may occur when soil pH exceeds 6.2. Again, careful soil monitoring and soil and plant analysis are recommended. The amount of boron recommended on a soil test report prevents hollow heart in peanuts. Boron can be applied as a pre-plant broadcast treatment along with other fertilizer applications, or as a foliar spray near blooming (Hardy et al., 2006).

Rotations

Rotations are critical in the fertility and pest management of organic production systems. Finding the right rotation crop in terms of profitability and agronomic characteristics can be challenging. Factors like geography, climate and irrigation capabilities are important to consider when choosing suitable rotational crops.

Relay crops are recommended by North Carolina State University plant pathologist Dr. Jack Bailey, a professor and extension specialist. Relay cropping is a cropping system that calls for two or more crops grown in sequence in the same field in the same year with little or no overlap in time. Relay crops keep the ground covered at all times and help control the No. 1 problem in organic production — weeds (Yancy, 2002).

To combat soilborne diseases endemic in the Southeast, Bailey recommended "the longest possible rotation, with crops such as cotton, wheat, corn and grasses." Otherwise, a field might be out of production for several years just to get rid of disease buildup, and long rotations are known to reduce leafspot problems.

Some rotation crops for peanuts are sweet corn, sweet potatoes, cotton, sesame, vegetables, small grains and pastures like Bahia grass. In Australia, tropical peanuts are grown as a companion crop for sugar cane, or as an optional cane fallow legume. In addition to being a profitable extra crop, peanuts provide nitrogen and are resistant to root knot nematodes that are blamed for declining cane yields in lighter cane soils (Peanut Company of Australia, 2006).

Symptoms of root knot. Photo by Howard F. Schwartz, Colorado State University, **Bugwood.org**

New techniques for managing migrating peanut pests

By Rex Dufour, NCAT California

Farmers who grow peanuts adjacent to cotton fields may want to plant sorghum between the peanuts and cotton. U.S. Department of Agriculture researcher Dr. Glynn Tillman found that rows of sorghum planted between cotton and peanut fields will act as a trap crop for stinkbugs that migrate out of the peanuts during harvest. Tillman's Georgia project is part of a Conservation Innovation Grant funded by the Natural Resources Conservation Service and managed by the National Center for Appropriate Technology.

Growers should sow two plantings of sorghum several weeks apart. That helps pests find the stage of sorghum that is most attractive during the entire cotton season. The sorghum also provides plenty of pollen for the minute pirate bug, an egg predator of stinkbugs. This combination of trap crop and beneficial insect habitat can protect cotton crops from damage by stinkbugs that are migrating from harvested peanut fields.

This photo shows a sorghum trap crop with ripe brown seed heads. Yellow pheromone traps for brown stink bug are placed in the first row of sorghum. Cotton is barely visible on the far side of the field in front of the trees. Peanuts are in the foreground. When peanuts are ready for harvest, the plants are turned upside down to allow the peanuts to dry. A few days later a combine comes through to remove the peanuts from the plant. In this photo, the peanuts are inverted. The four rows adjacent to the sorghum are yet not turned. As the peanuts in this field are dug, stink bugs will migrate from the plants into the adjacent sorghum, rather than into the cotton crop. Photo by Kristie Graham.

To achieve a similar effect, researchers are experimenting with another method that calls for sowing the entire sorghum planting in one day and then mowing half of the sorghum rows 70 to 80 days later. This technique mimics the two-plantings approach, but is easier to execute. The two stages of sorghum will provide beneficial and pest insects preferred habitats.

Growing in this field are, from left to right: peanuts, the first planting of sorghum with nearly ripe grain, the second planting of sorghum with seed heads still green and cotton. Entomologist Glynn Tillman (center) and field scouts Brittany Giles (left) and Kristie Graham evaluate the sorghum for stink bug populations. Photo courtesy of USDA ARS.

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Organic integrated pest management

Integrated pest management is a broad ecological approach to pest management using a variety of pest control techniques that target the entire pest complex of a crop ecosystem. Integrated management of pests ensures high-quality agricultural production in a sustainable, environmentally safe and economically sound manner (Bajwa and Kogan, 2002.).

Soil health is based on soil biology, which is responsible for the cycling of nutrients. The complex interaction of this biological community is known as the soil food web. The soil ecosystem is composed of bacteria, fungi, protozoa, nematodes, algae, arthropods (insects and mites) and large soil-dwelling mammals like moles, ground squirrels and gophers.

Photosynthesizers, the primary producers in this system, use the sun's energy to convert atmospheric carbon into sugars. Other organisms feed off these primary producers. Dead organisms and their by-products decompose and become the soil's organic matter that stores nutrients and energy. Plants use these nutrients, preventing them from accumulating in soil and water.

The life cycle of all these organisms improves the condition of soils by enhancing structure, water infiltration and holding capacity, and aeration. This results in healthy plants that are more productive and resistant to pests.

Related ATTRA publications

Alternative Control of Johnsongrass

Nematodes: Alternative Controls

Conservation Tillage

Cucumber Beetles: Organic and Biorational IPM

Farmscaping to Enhance Biological Control

Field Bindweed Control Alternatives

Flame Weeding for Agronomic Crops

Principles of Sustainable Weed Management for Croplands

Pursuing Conservation Tillage Systems for Organic Crop Production

Sustainable Management of Soil-borne Plant Diseases

Thistle Control Alternatives

Thrips Management Alternatives in the Field

Soil solarization

The technique known as solarization involves laying a clear plastic polyethylene tarp on moist soil and letting the sun's rays heat the soil. Heat trapped under the plastic raises the soil temperature and kills or debilitates pests. Most research worldwide concentrates on hot and arid areas, but anywhere with hot summers has the potential to use this system. Soil pasteurization usually takes four to six weeks, but the amount of time depends on factors such as rain, wind, day length, soil texture and the quality of the polyethylene tarp. Ultraviolet-protected plastic is recommended so that the tarp can be removed and re-used.

Certain types of organic matter can be added to the soil for bio-fumigation. Compost and residues from brassica crops such as broccoli and mustard show this bio-fumigant effect. When heated in the solarization process, some brassica crops release volatile compounds that are toxic to many pests.

Plant pathologist Daniel Chellemi (left) and organic grower Kevin O' Dare inspect the progress of a soil solarization treatment. Photo by Randall Smith, courtesy of USDA ARS.

Before solarization, the land where the crop will be seeded or transplanted must be prepared for planting. Growers must shape beds, install drip tape and level fields. This preparation is necessary to avoid stirring up the soil after solarization. Stirring would bring fresh pest organisms to the soil surface. Depending on the outside temperature, sunlight density and the type of pests, soil solarization can provide good pest control in 8 to 10 inches of soil, and best control is generally obtained down to 6 inches.

Special caution: Drip tape must be buried at least 1 inch deep to avoid damage from the sun's rays. In experiments when researchers placed tape on the surface of the bed and then covered the tape with the clear plastic, the magnifying effect of the sun on the water droplets that condensed on the plastic damaged the drip tape.

The North Carolina Peanut Project: On-farm research on pesticide alternatives in peanut production and methods of implementation

A multi-partner project to make North Carolina peanut production more environmentally benign and improve peanut profitability started in 1995, when it became evident that the USDA's peanut program was likely to change dramatically in the next decade. A strong support network and some funding were provided to individual farmers trying new approaches. Ten key goals for more sustainable, less chemical-dependent production came out of this project and set the groundwork for future organic production:

1) Convince producers that bottom-line return was more important in the long run than gross yield.
2) Improve soil fertility by utilizing cover, catch, relay and green manure crops, as well as composts and slow-release rock fertilizers to increase crop health and vigor and reduce the effects of weeds and pests.
3) Reduce soil erosion through a variety of conservation measures.
4) Implement a site-specific, biologically based whole-farm integrated pest management plan through beneficials enhancement, crop rotation and resistant cultivars as the first choice before using least-toxic, target-specific pesticides.
5) Scout frequently to improve an operator's ability to respond promptly and efficiently to pest problems.
6) Provide long-term habitat for beneficials through skip rows, field border management, relay cropping, reduction of broad-spectrum pesticide usage and other management techniques.
7) Add market value to all crops in the rotation to increase the producers' share of retail through market premiums for specific practices, niche markets and additional post-harvest handling and packaging.
8) Lengthen and improve crop rotations to provide cost-effective prevention against a wide range of pests, diseases and weed problems.
9) Develop and use a range of options for pest control intervention including biological control of weeds and insects, flame weeding and innovative cultivation equipment.
10) Increase cultivar pest resistance through selective breeding, plant spacing and seeding rates (Marlow, 1998).

Insects

Using biological and cultural insect controls for peanuts involves understanding the ecology of agricultural systems. Planting large expanses of a single, susceptible crop, or monocropping, encourages pest problems. A diverse farmscape involving many types of plants and animals considerably diminishes the likelihood of severe insect pest outbreaks.

Farmers must create production methods that complement natural systems. The use of beneficial insect habitats along crop field borders increases the presence of beneficial insects (Grez and Prado, 2000; White et al., 1995; Bugg, 1993). These habitats provide shelter, food (pollen and nectar) and act as refuges that attract the natural enemies of pests.

When farmers release beneficial insects, these field-edge habitats will encourage the beneficial insects to stay and continue their life cycles. This helps reduce pest populations. Some pests may also inhabit the field-edge habitats. These habitats should be monitored along with the crop. For additional information, request ATTRA's publication *Farmscaping to Enhance Biological Control*.

Caterpillar pests

Corn earworm, fall armyworm, velvetbean caterpillar, green cloverleaf worm, European corn borer, redneck peanut worm, saltmarsh caterpillar, soybean looper and cutworms are some of the caterpillar pests that attack peanuts. Caterpillars have many natural enemies that help keep their populations at low levels. Ground beetles, spiders, damsel bugs, minute pirate bugs, assassin bugs, bigeyed bugs and lacewing larvae attack caterpillars. The parasitic wasps *Trichogramma*, *Copidosom*, *Apanteles*, *Diadegma* and *Hyposoter* sting and parasitize eggs and larvae.

Some of these organisms are available commercially or may occur naturally in the environment. For information on suppliers of beneficial insects, visit the Suppliers of Beneficial Organisms in North America

The beneficial population may often keep the pest under the economic threshold, which is the level below economic injury to the crop. An application of a broad-spectrum insecticide may damage both the pest and beneficial insect populations.

Web site at *www.cdpr.ca.gov/docs/ipminov/ben_supp/ben_sup2.htm*

Biopesticides, or microbial controls, consist of *Bacillus thuringiensis* (Bt), insect-consuming fungi and viruses. Bt is a naturally occurring bacterium that produces a toxin that causes paralysis of a caterpillar's digestive tract. A caterpillar may continue to live for some hours after ingestion, but will not continue to feed.

Bt strains are available in a number of commercial products under various trade names. The following products are approved for organic production by the Organic Materials Review Institute: Prolong from Cillus Technology Inc., Britz BT Dust from Britz Fertilizers Inc., DiPel and Xantari from Valent Biosciences, and Agree, Deliver and Javelin from Certis USA. Additional information may be obtained at ATTRA's Ecological Pest Management Database at *www.attra.org/attra-pub/biorationals/biorationals_main_srch.php*

Bt degrades rapidly in sunlight and requires careful timing or repeated applications. Caterpillars must ingest Bt in sufficient amounts for the biopesticide to be effective. Growers must understand the feeding habits of these pests to use proper formulations and optimal timing of applications. Caterpillars in the early stages of development (first and second instars) are more susceptible to Bt. Older and bigger worms are more difficult to kill.

Entrust, from Dow Agrosciences, is derived from the soil organism *Saccharopolyspora spinosa*. It is OMRI-approved and registered for control of armyworm, corn earworm, loopers and other caterpillar pests on peanuts. Spod-X LC and Gemstar LC from Certis USA are nuclear polyhedrosis virus products available commercially and are OMRI-approved for the control of armyworm and corn earworm, respectively, on peanuts. Other naturally occurring granulosis viruses and nuclear polyhedrosis viruses sometimes occur in high-density caterpillar populations.

Beauveria bassiana, an insect-eating fungus, infects caterpillars if humidity and temperature are adequate. Commercial products include Naturalis L, Mycotrol and Botanigard. Botanical insecticides, including neem products such as Agroneem and Neemix, act as repellents, antifeedants and insect growth regulators. Pyrethrum and rotenone-based products are broad spectrum and will kill beneficial insects as well as pests, so monitoring is important.

Growers must also consider beneficial insect populations when a pest population is present. The beneficial population may often keep the pest under the economic threshold, which is the level below economic injury to the crop. An application of a broad-spectrum insecticide may damage both the pest and beneficial insect populations, and other minor pests may become a big problem. This is known as a secondary pest outbreak.

Other management practices to reduce caterpillar infestation include using floating row covers over a young crop to exclude egg-laying females, nocturnal overhead sprinkler irrigation, pheromone misters or emitters to disrupt mating and pepper, garlic and herbal repellents.

Organically accepted materials to combat caterpillars

Biopesticides	*Commercial products*
Bacillus thuringiensis	Agree, Deliver, Javelin, Dipel, Xantari, Prolong, Britz BT Dust
Spinosad	Entrust
Viruses	Spod-X, Gemstar
Beauveria bassiana	Mycotrol, Naturalis, Botanigard
Botanical insecticides	*Commercial products*
Neem	Neemix, Argoneem, Azadirect
Pyrethrin	Pyganic
Pyrethrin + Diatomaceous Earth	Diatect V
Repellents	*Commercial products*
Garlic	Cropguard, Garlic Barrier

Southern corn rootworm

Southern corn rootworms are the subterranean larvae or grubs of cucumber beetles. The adult cucumber beetle lays eggs at the base of the peanut plants and then the larvae move through the soil, feeding on the pods. Organic approaches to managing this pest include population monitoring, cultural practices, trap crops, baits, sticky traps, predatory organisms and organic insecticides and protectants. For detailed information check the ATTRA publication *Cucumber Beetles: Organic and Biorational IPM.*

Three-cornered alfalfa hoppers

The three-cornered alfalfa hopper, *Spissistilus festinus*, is a major pest in the South. It is a piercing and sucking triangular-shaped green insect that feeds on stems and leaves. It is also found on vegetables, soybeans, other legumes, grasses, small grains, sunflowers, tomatoes and weeds. On peanuts, it girdles the stem during feeding, causing a scab-like appearance.

Natural enemies include the bigeyed bug and damsel bug. The bigeyed bug has been observed causing the highest mortality, about 90 to 100 percent of the first and second nymphal stages, while the damsel bug attacked all nymphal stages of the three-cornered alfalfa hoppers (Medal et al., 1995). The kaolin clay product Surround is listed as an approved product to repel this pest.

Thrips

Although not a problem in Western peanut-producing regions, thrips control is essential in the Southeast since the insect spreads Tomato Spotted Wilt Virus. For control strategies, see the ATTRA publication *Thrips Management Alternatives in the Field.* Thrips control options were field-tested by peanut farmers in the North Carolina Peanut Project. As a result, 31 North Carolina growers substituted scouting-based control for blanket control on 3,728 acres, significantly reducing pesticide use, increasing profits and maintaining yields (Marlow, 1998). Neem and spinosad products approved for organic production are registered for the control of thrips.

Spider mites

Spider mites, *Tetranychus*, are tiny arachnids (related to spiders, ticks and scorpions) that live in colonies. Spider mites spin webs and feed under plant leaves. They have modified mouth parts that pierce the cells of the leaf to consume its contents. Yellow spots appear on the leaf's upper surface when the feeding is moderate. If the infestation is severe, mites can cause defoliation, stunting and reduced yields.

Insect predators of spider mites include minute pirate bugs, damsel bugs, bigeyed bugs, some midges, lacewing larvae, dustywings, spider mite destroyers, lady beetles, sixspotted thrips and western flower thrips. Other mites that prey on spider mites are *Amblyseius, Galendromus, Metaseiulus* and *Phytoseiulus.* Insecticidal soaps, narrow range oils, neem-based products such as Trilogy and sulfur are acceptable miticides in organic production. Check with a certifier regarding specific products. Cultural controls include keeping dust down along roads that border peanut fields. This is usually done by reducing traffic along those roads, watering down the roads or planting dust barriers such as corn or sunflowers between the field and the road.

Other insects that can be a problem in peanut production are aphids and whiteflies. If these organisms are causing a problem in organic peanut production, contact ATTRA for more information on how to manage these pests.

Diseases in plants occur when a pathogen is present, the host is susceptible and the environment is favorable.

Diseases

Diseases in plants occur when a pathogen is present, the host is susceptible and the environment is favorable for the disease to develop. Altering any one of these three factors may prevent the disease from occurring. Organisms responsible for plant diseases include fungi, bacteria, nematodes and viruses. If these organisms are present, manipulating the environment and making the host less susceptible helps sustainably manage diseases on peanuts.

Once again, soil health and management is the key for successful control of plant diseases. Soil with adequate organic matter can house uncountable numbers of organisms such as beneficial bacteria, fungi, nematodes, protozoa, arthropods and earthworms that deter harmful bacteria, fungi, nematodes and arthropods from attacking plants. These beneficial organisms also help create a healthy plant that is able to resist pest attack. For more information, see the ATTRA publication *Sustainable Management of Soil-Borne Plant Diseases.*

Soil health and management is the key for successful control of plant diseases.

Blackhull

Blackhull, a disease caused by the fungus *Theilaviopsis basicola,* affects the pods and mostly attacks susceptible Spanish peanut varieties in the West. Conditions that favor disease development are alkaline soils, poor drainage, low temperatures late in the season, heavy soils and a crop rotation with susceptible crops like cotton or alfalfa. Careful choice of planting location and appropriate crop rotations, as well as early planting, are important for organic production.

Verticillium and Fusarium wilts

Wilts can be a problem in New Mexico. Loss can be kept to a minimum if a farmer knows the disease or cultivation history of a field and peanuts are not planted following cotton or vegetable plants (including potatoes) in the crop rotation. The arbuscular mycorrhizal fungus *Glomus mosseae* protects peanut pods from infection by *Fusarium solani* (Abdalla and Abdel-Fattah, 2000). Commercial products include Mycorise, Activator BioVam, Mycor and Tag Team.

Leaf spot

Rainfall or irrigation followed by high humidity during the growing season can contribute to *Cercospora* leaf spot and web blotch *(Phoma arachidicola).* A study at Auburn University explored potential for biological control of early leafspot in peanuts using the bacteria *Bacillus cereus* and chiton as foliar amendments (Kokalis-Burelle et al., 1992). Cultural practices such as resistant varieties and crop rotation may alleviate the disease, as could foliar inoculation of microorganisms with compost teas or commercial products that include *Bacillus subtilis* bacteria, like Serenade. Copper and bicarbonate fungicides may also help.

Pod rots

Pythium myriotylum, Rhizoctonia solani and *Sclerotium rolfsii* are all capable of causing pod rots, which occur in every peanut-growing area. Pod rots, unlike Southern blight, do not exhibit above-ground symptoms. Occasional pulling of plants throughout the field, especially during pod maturation, is the only way to detect pod rots. Manures, compost and green manure crops will increase the organic matter of the soil and increase microorganisms that constitute the soil food web. This increase in organisms helps deter plant pathogens through competition and antagonism and reduces disease incidences in plants. Arbuscular mycorrhizal fungi may also provide some protection from these pod rots.

Southern blight (stem rot)

The disease is caused by the fungus *Sclerotium rolfsii.* The fungus spreads from infected plants to adjacent ones. Control methods in organic production include the use of a deep covering of crop residue, flat cultivation to avoid pulling soil and trash toward the plants and crop rotation with grain sorghum to reduce the number of infectious sclerotia. The fungus *Trichoderma harzianum,* the active ingredient in products such as PlantShield, RootShield and T-22 HC, inhibited mycelial growth and germination of sclerotia in vitro. Under screen house conditions, the fungus reduced the incidence of the disease by 33 percent compared to untreated control peanuts (Khonga et al., 1998).

Sclerotinia blight

Sclerotinia blight *(Sclerotinia minor)* occurs in parts of Oklahoma, Texas and North Carolina. Resistant cultivars such as Olin, a Spanish variety, and Tamrun OL 01, a Runner type developed by the USDA Agriculture Research Service at Stillwater, Okla., show promise in resisting sclerotinia blight (Pons, 2006). Research in North Carolina showed that pruning peanut canopies to alter microclimate or enhance fungicide penetration reduced disease and increased yield when *Sclerotinia minor* damage limited yields (Bailey and Brune, 1997). Good sanitation practices such as thorough cleaning and washing of peanut production equipment prior to entering an unaffected region are advised.

Tomato spotted wilt virus (TSWV)

TSWV is best controlled by new, resistant varieties that are superseding old standbys some growers still prefer, such as Georgia Green, Southern Runner ViruGard, Gregory and VC-2. The newest varieties are Georgia 02C and Georgia 01R, as well as Tift Runner (Culbreath, 2004).

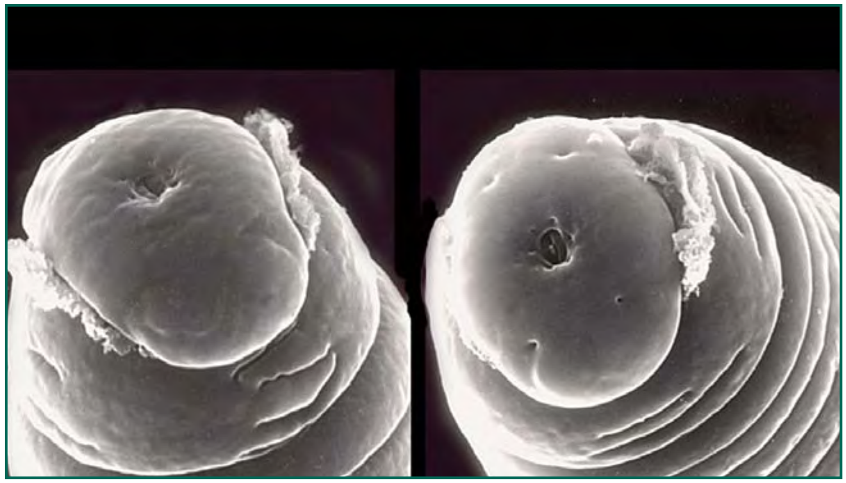
TSWV was severe in the Southeast in 2004, but speculation that it may be cyclical has no scientific basis. Thrips transmit TSVW from plant to plant throughout the winter season since TSVW overwinters on weed species. Researchers believe weather may have an effect on TSWV severity (Hollis, 2005; Mandal et al., 2002).

Cylindrocladium black root rot (CBR)

Long rotations and knowledge of field history are the best controls in attempting organic peanut production in humid regions of the United States. Avoid rotation with other hosts such as soybeans, alfalfa, clovers, beans and cowpeas. *Cylindrocladium* produces microsclerotia, which are persistent in the soil for many years. Non-hosts include corn, cotton, sorghum and pasture (bermuda or bahiagrass). In heavily infested soils, rotation for at least five years without hosts is recommended.

Nematodes

There are many types of nematodes in soils. Most are beneficial, but a few are peanut pests. Nematodes that attack peanuts include the root knot nematodes, *Meloidogyne arenaria; M. hapla; M. javanica,* lesion nematode *Pratylenchus brachyurus*, ring nematode *Criconemella* and sting nematodes *Belonolaimus longicaudatus.*



Scanning electron micrograph of the anterior ends of two male root knot nematodes. Photo by Jonathan D. Eisenback, Virginia Polytechnic Institute and State University, **Bugwood.org**

In sustainable production systems, growers can manage nematodes by crop rotation, resistant varieties and cultural practices. Where nematode infestations are heavy, sampling and laboratory analysis can be used to determine the length of rotations and the non-host crops to use.

Eventually a living soil will keep harmful nematodes and soil borne fungi under control (Yancy, 1994). Crop rotation is a good strategy, but it is important to identify the type of nematode in a field and rotate with a crop that is not an alternate host for that nematode. Check with seed suppliers to identify varieties resistant to the nematodes present in fields. Cultural practices include cover cropping with plants that are antagonistic to nematodes such as rapeseed or marigolds, controlling weeds, incorporating chicken litter and other manures and solarization. For more information, see the ATTRA publication *Nematodes: Alternative Controls.*

Weeds

Weed control in organic systems, especially in peanut production, relies heavily on crop rotations, cover crops and cultivation. Of these, cultivation is the most critical to reduce weeds in an established peanut stand. For cultivation to be successful, a straight, well-made bed, as well as straight seeding lines in a conventional diamond pattern, are necessary for cultivating implements to remove the most weeds while leaving the crop undisturbed.

Cultivation implements will cut, bury or turn over most young weeds, leaving the crop undisturbed while reducing competition. Hoeing between plants eliminates weeds in the planting row. For more information on weed control, read ATTRA's publications *Principles of Sustainable Weed Management for Croplands, Alternative Control of Johnsongrass, Thistle Control Alternatives* and *Field Bindweed Control Alternatives.*

Conservation tillage

Conservation tillage or strip tillage in peanuts increased in the Southeast due to the rise in fuel costs and the potential for conservation tillage to reduce labor costs, reduce soil erosion, increase soil quality and reduce disease pressure. Conservation tillage also works in other crops such as corn, cotton and soybean (Wright et al., 2002).

In conventional strip tillage, herbicides are a major tool to control weeds. For organic production, farmers must use other methods to deal with weeds. In no-till research conducted in Georgia in the 1990s by Dr. Sharad Phatak, researchers found that peanuts yielded well when planted into rye and Crimson clover. In follow-up research, the Crimson clover was flail mowed and C-11-2-39, a fast-spreading, quick-shading and disease-resistant peanut variety, performed very well when planted into the clover. However, even with superior varieties, researchers had to hand weed two times. (Culbreath, 2005).

Strip-tillage systems reduce most insect pest injury. However, burrower bugs (Heteroptera: Cydnidae) caused major economic injury to peanuts in some conservation tillage systems under drought stress (Chapin and Thomas, 2005). Conservation tillage or strip tillage reduced the incidence of Tomato Spotted Wilt Virus in peanuts by 42 percent when compared to peanuts grown using conventional tillage. This is significant because there is no single effective control measure for spotted wilt of peanuts. As a result, the University of Georgia Cooperative Extension Service added conservation tillage to its Tomato Spotted Wilt Risk Index (Johnson et. al., 2001).

For more information on conservation tillage, read the ATTRA publications *Conservation Tillage* and *Pursuing Conservation Tillage Systems for Organic Crop Production.*

Flame weeding and other thermal devices can reduce broadleaf weeds, but grasses still need to be mechanically removed. For a list of thermal devices and suppliers, see the

This Georgia farmer planted crimson clover as a cover crop, killed it, then strip tilled peanuts into it. This system attracts many beneficials, improves the soil, provides low-cost nitrogen, reduces soil erosion and conserves soil moisture. Photos by Rex Dufour.

Appendix section. For more information on flame weeding, read the ATTRA publication *Flame Weeding for Agronomic Crops.*

Irrigation

Peanut seedlings develop tap and lateral roots quickly. Seedlings need 20 to 30 inches of water per season. Daily water use is about 0.25 inches per day and 0.4 inches if the weather is extremely hot (Baker et al., 2000). The Peanut Company of Australia estimates peanuts use at 24 to 28 inches per season (2006).

Water availability is a limiting factor in Western peanut production. Jimbo Grissom of Gaines County, Texas, the winner of the 2004 Farm Press Peanut Profitability Award, suggests a low-energy precision application system to ease the effects of evaporation. Grissom aims to lose as little water as possible to evaporation. His modified LEPA system uses hoses, usually set about 80 inches apart, that dangle from a main center-pivot irrigation pipe to either drag along rows or spray water just above the peanut canopy. True LEPA systems, irrigation experts say, employ drag hoses that dribble water along alternate rows. Grissom's system uses wobbler nozzles to apply water just above the peanuts. Ground water availability from the aquifer that underlies West Texas is declining (Smith, 2004).

Peanut growers in Randolph County, Ga., use center-pivot systems to combat sporadic drought in the Southeast (Smith, 2004). Drought has become more prevalent in recent years, increasing the need to install farm irrigation systems.

In humid Florida, poor irrigation management can cause white mold and pod rots, leading to lower yields than without irrigation (Whitty, 2006).

Drought stress constitutes a serious threat for peanut production because of the danger of aflatoxin. This problem commonly occurs in the last days before harvest, when peanuts under drought stress are most susceptible. When fungi such as *Aspergillus parasiticus* and *A. flavus* infect peanuts, the fungi can produce aflatoxin, a natural toxin. Aflatoxin can mean financial losses for peanut growers.

The Peanut Advisory Board in Atlanta, Ga., estimated that aflatoxin contamination costs the nation's peanut growers $25 million annually. The Food and Drug Administration prohibits grain and finished products with 20 parts per billion or more of aflatoxin from being sold for human or animal consumption. One part per billion is equivalent to less than one drop in 10,000 gallons. Many states and export markets are setting stricter tolerance levels.

Until recently, the only methods for controlling preharvest aflatoxin contamination in peanuts were expensive irrigation or early harvest, which reduces quality and yield. A mutant strain of *A. parasiticus* was developed to treat soils and drive out virulent strains (USDA/ARS, 1992).

Aflatoxin contamination costs the nation's peanut growers $25 million annually.

Harvesting and post harvest handling

Organic handling is a complex issue. If organic peanuts are processed on-farm in any way, a second certification as a handler or processor may be required. For a more detailed explanation, see NCAT's *Organic Crops Workbook.*

Jim Riddle of the University of Minnesota, the former chair of the National Organic Standards Board, published some postharvest tips for organic field crop producers. These include the following (adapted for peanuts):

- Know the equipment. Know what the equipment is used for. This includes rented and borrowed equipment and equipment used by custom operators. Know how to clean all pieces of equipment, including planters, combines, wagons, trucks and other equipment. Clean equipment prior to use in organic fields and keep records to document equipment cleaning activities.
- Know crop storage. Carefully inspect storage units prior to use.

Thoroughly clean bins, dryers, cleaners and other storage units.

- Know the truckers. Carefully inspect and clean trucks and trailers prior to loading. Make sure that transport units, including overseas shipping containers, are free of foreign matter. Keep records to document trucks, including clean transportation affidavits and bills of lading.
- Know the farm's records. Document efforts to minimize contamination. With good records, farmers will have a better chance of limiting losses, identifying causes of problems and determining liability. Valid records of organic yields and sales may help establish claims for losses should contamination or comingling occur.
- Know the buyers. Know the contract specifications the organic crop is grown under. Know buyers' sampling and testing protocols. Communicate with buyers and organic certifying agents if any problems arise.

Summary

Strategies for successful production of organic peanuts will differ by U.S. region. Organic peanuts now come from New Mexico, Arizona and West Texas, where pest and disease pressures are much less than in the Southeast, where conventional production historically occurrs. Integrated pest management strategies are apt to be more successful in Western states, including California, than east of Interstate 35, about 98 degrees west longitude.

Development of pest- and disease-resistant varieties is crucial to any organic peanut production on a scale comparable to that of conventional production in the Southeast. Recent research in the Southeast focused on development of pest-resistant peanut varieties for alternative fuel, rather than varieties for organic production of an edible crop.

Planting milkweed along a field margin supplies nectar and pollen for a wide range of beneficial insects that provide free pest control.
Photos by Rex Dufour.

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Note: Peanut export figures given in the text were abstracted from the USDA FAS statistical reports in March 2006. Since then, the agency has completed harmonization with international HTS codes, consisting of "Raw peanuts, 15 types" and 15 food categories involving peanuts. Peanuts are now aggregated with grains under code 2008110029, and with processed vegetables under code 2008119000. This changeover to a new method of reporting made it cumbersome to determine simple export and re-export (after processing) totals for the U.S. peanut crop.

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Further resource:

International Certification Services, Inc.
doing business as Farm Verified Organic
Customer Contact Information:
ICS, Inc.
301 5th Ave SE
Medina, ND 58467
701-486-3578
701-486-3580 fax
info@ics-intl.com
www.ics-intl.com/fvo.htm

Appendix: Sources of thermal weeders

(adapted from Quarles, W. 2004. The IPM Practitioner. May/June. p. 8)

Handheld flamers

BernzOmatic
800-654-9011

Flame Engineering, Inc. (Red Dragon)
P.O. Box 577
LaCrosse, KS 67548
888-388-6724.
785-222-3619 fax
flame@awav.net • *www.flameeng.com*

Peaceful Valley Farm Supply (Flamers and supplies),
P.O. Box 2209
Grass Valley, CA 94945
888-784-1722 (toll-free)
contact@groworganic.com • *www.groworganic.com*

Rittenhouse & Sons (Weed Torch)
RR#3, 1402 Fourth Ave,
St. Catharines ON, Canada L2R 6P9
800-461-1041
prosales@rittenhouse.ca
www.rittenhouse.ca/asp/menu.asp?MID=88

Row crop flamers

Flame Engineering, Inc.
Two- to eight-row flamers for tractor operation (see above).

Thermal Weed Control Systems, Inc.
(four- to eight-row flamers for tractor operation, hooded models)
N1940 State Hwy 95
Neillsville, WI 54456
715-743-4163
jonesconsulting@juno.com

Flame Weeders
(push along)
Rt. 76, Box 28,
Glenville, WV 26351
304-462-5589
flame-weeders@juno.com • *www.flameweeders.cjb.net*

Infrared Weeders

Forevergreen (Ecoweeder, push along and handheld),
19974 12 Avenue
Langley, BC, Canada V2Z 1W3
604-534-9326
info@chemfree-weedcontrol.com
www.chem-free-weedcontrol.com

Rittenhouse & Sons (Infra-Weeder, push along and handheld) (see above)

Steamers

Sioux Steamer
One Sioux Plaza
Beresford, SD 57004
605-763-3333
888-763-8833
605-763-3334 fax
www.sioux.com

Hot Foam

Waipuna USA
715 N Independence
Romeoville, IL 60466
630-514-0364
jeffw@waipuna.com

OESCO, Inc. (Aquacide)
P.O. Box 540,
Route 116
Conway, MA 01341
413-369-4335.
800-634-5557
413-369-4431 fax
info@oescoinc.com

Infrared and Hot Water

Sunburst
P.O. Box 21108
Eugene, OR 97402
541-345-2272
info@thermalweedcontrol.com
www.thermalweedcontrol.com

Peanuts: Organic Production
By Martin Guerena and Katherine Adam
NCAT Agriculture Specialists

Holly Michels, Editor
Amy Smith, Production

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