

College of Agriculture & Life Sciences
Department of Horticultural Science

USING PLASTIC MULCHES AND DRIP IRRIGATION FOR VEGETABLE GARDENS

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Muskmelons, tomatoes, peppers, cucumbers, squash, eggplant, watermelons, and okra are vegetable crops that have shown significant increases in earliness, yield, and fruit quality when grown on plastic mulch. Some less-valuable crops such as sweet corn, snap beans, southern peas, and pumpkins have shown similar responses. Some of the advantages and disadvantages of using plastic mulches are outlined below.

Advantages

1. **Increased soil temperature** — At a 2-inch depth: 4 to 5°F under black mulch, 5 to 8°F with infrared transmitting (IRT) (clear green), or 8 to 10°F under clear mulch.
2. **Reduced soil compaction** — Soil under plastic mulch remains loose, friable and well-aerated. Roots have access to adequate oxygen and microbial activity is excellent.
3. **Reduced fertilizer leaching** — Water runs off the impervious mulch, resulting in maximum utilization of the fertilizer.
4. **Reduced drowning of crops** — Water is shed from the row area and excess water runs off the field thus reducing drowning and other excess soil water stresses.
5. **Reduced evaporation** — Soil water does not escape from under plastic mulch.

Plant growth on mulch is often at least twice that on bare soil. The resulting larger plants will require more water, so mulching is *not* a substitute for irrigation.

6. **Cleaner product** — A mulched crop is cleaner and less subject to rots due to elimination of soil splashing on the plants or fruits. **Note:** Beds should be firm and tapered away from the row center. Plastic should be tight to promote run-off. **There should be no puddles on the mulched beds!**
7. **Root pruning eliminated** — Cultivation is not necessary except for the area between the mulched strips. Therefore, roots are not pruned.
8. **Reduced weed problems** — Black and IRT plastic mulch provides good weed control in the row. Clear plastic will require use of a herbicide, fumigation or lifting the mulch and cultivating. Often, weeds between mulch strips can be controlled by a herbicide.
9. **Earlier crops** — Black plastic mulch can result in 2 to 14 days earlier harvest while clear plastic can result in a 21-day earlier harvest.
10. **Increased growth** — Plastic mulch is practically impervious to carbon dioxide (CO₂), a gas that is of prime importance in photosynthesis. Very high levels of CO₂ build up under the plastic, because the film does not allow it to escape. It has

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to come through the holes made in the plastic for the plants and a “chimney effect” is created, resulting in localized concentrations of abundant CO₂ for the actively growing leaves.

Disadvantages.

1. **Costly to remove**—Plastic mulch and drip irrigation tube must be removed from the field annually. Black plastic does not break down and should never be tilled into the soil. Clear plastic does break down with time but leaves a messy garden. Photo- and bio-degradable plastics hold promise.
2. **Greater initial costs** — Plastic mulch and drip irrigation will increase cost of production. These costs should be offset by increased income due to earlier harvests, better quality fruit and higher yields.
3. **Increased management** — Plastic mulch and drip irrigation must be carefully monitored (daily) to be successful.
4. **Increased soil erosion** — Soil erosion increases in middles between plastic strips.
5. **Increased crop/weed competition** — Weeds can grow out of the holes in close proximity with crops.

Preparation of the Soil— The first step is to take 2 soil samples in early fall. Have one sample assayed for mineral content and one for nematodes. If the soil test suggests applying lime, apply enough in the fall to reach pH 6.0 to 6.5 using dolomitic lime if magnesium is low.

Fertilization— Using the soil test report as a guide, apply fertilizer during bed preparation. Consult Horticultural Information Leaflets for specific crop recommendations. Amounts to be sidedressed need to be included in the total fertilizer requirements. **Caution:** Using fertilizers with ammoniacal N in fumigated soils can result in ammonium toxicity to the crop. Normally, at least 50% of the nitrogen (N) should be in the nitrate (NO₃) form. Use calcium nitrate (15.5-0-0), sodium nitrate (16-0-0) or ammonium nitrate (33.5-0-0) as a nitrate sidedress source.

When using drip irrigation with plastic mulch, one half of the N and K and all of the P should be incorporated at bedding. The remaining N and K should be applied

through the drip tube using soluble fertilizers (e.g. calcium nitrate, sodium nitrate, 20-20-20, 15-0-14, or potassium nitrate). Overhead irrigation and fertigation can be used by perforating the plastic. One can make a small hole about 6 inches from the plant in the plastic and apply 1/4 cup of fertilizer. The entire amount of fertilizer may be incorporated in the bed but utilization by plants might be less efficient than with fertigation.

Bedding the Soil — Raised beds should be used. Be sure that enough soil is pulled up so that the bed has good sharp corners. Bedded rows should be spaced on 5- or 6-ft centers. A bed with a 30 inch top should slope from the center to the edge with a drop of 1.25 inches, allowing excess rainfall to run off the mulch.

The plastic mulch is generally 4 or 5 ft wide, 1.25 to 1.50 mil thick, *embossed* (diamond-shaped design on film, which helps hold mulch tight against the soil) or *slick*.

For single-row crops such as tomatoes, cucumbers, muskmelons, honeydews, watermelons and pumpkins, the drip tube should be placed 4 to 5 inches from the center of the bed and 1 to 2 inches deep with the emitters facing upward. For double row crops like summer squash, okra, eggplant, peppers, beans, peas, lettuce and sweet corn, the drip tube should be placed directly on the center of the bed and buried 2 to 3 inches deep. Take time to adjust the plastic so that it is held firmly against the bed and soil is placed halfway up the side of the bed but not on top of the bed. Also, anchor the plastic and drip tube when starting applications. Covering them with soil by digging a trench perpendicular to the row direction and putting soil on top provides a good anchor.

Pest Management

Weed Control— For information on weed control under clear plastic mulch and in the row middles between black plastic mulch consult the *1999 North Carolina Commercial Vegetable Recommendations* (AG-586) or your county Extension center. Only approved herbicides can be used between rows of plastic, because this is not a fallow area.

Insect and Disease Control — Good insect and disease control is essential. Consult the current SCVRB or your county Extension center for recommendations.

Transplanting — For extra earliness in peppers and tomatoes, large containers (cell sizes 3 to 4 inches) should be used. For the other vegetable crops use 1 to 2 inch cell sizes. Transplants can be set by punching a hole in the plastic and placing the plant in the hole. When transplanting by hand, several tools can be used to make holes in the plastic such as a long handled bulb setter or a sturdy can or cylinder welded onto the end of a handle. The hole should be 2 to 4 inches wide and deep enough for the plants to be transplanted. A hand tobacco plant setter or long handled bulbsetter works well. The use of a “starter solution”, a soluble fertilizer high in phosphorous (P) will often get the plants off to a good start. Examples are 12-52-12, 10-20-10, or 12-48-8.

Irrigation — Drip irrigation is recommended for use with plastic mulches although other types can be used successfully. The frequency of irrigation will depend on soil type and stage of crop growth. Irrigators at the 6-inch and 12-inch depth in the mulched bed are recommended as an aid in determining irrigation needs. Frequent probing with a soil tube near the plant row will also help to keep a check on soil moisture. Normally, the area around the drip tube is very soft to the touch and the side of the row away from the tube should be only slightly soft. For more detailed information on trickle/drip irrigation, consult Horticultural Information Leaflet Nos. 33-A and 33-B, *Plasticulture for Vegetable Crops* (AG-489), *Trickle Irrigation in the Eastern United States* prepared by Northeast Regional Agricultural Engineering Service, Cornell University, Ithaca, NY 14853, an irrigation specialist, or your county Extension center office. **Do not use plastic mulch without irrigation.**

Double Cropping the Plastic Mulch — Once the first crop has been harvested, it is recommended that a second crop be grown on the mulch (**See Table 1**). This “intensive cropping” results in two acres of production from each acre of actual land. The second crop can be fertilized (1) through the drip line using soluble fertilizers and a fertilizer injector, (2) through overhead fertigation, or (3) by placing fertilizer in holes in the plastic between plants. Consult Horticultural Information Leaflet No. 33-

C for additional information on injecting fertilizers through the drip line.

Windbreaks — Strips of rye should be established to protect vegetable seedlings from prevailing winds. Each rye strip should be 4 to 6 ft wide (6 to 8 rows) and far enough apart to plant 5 or 6 rows of vegetable seedlings. Well-grown rye strips planted in the fall will promote earliness and provide protection for the young transplants. Spring topdressing in February will help assure a good thick rye stand.

When laying plastic in the spring, plant the entire area with rye, but be sure to work up the crop area early enough in the spring to minimize crop debris interference with fumigating and plastic laying. Once wind protection is no longer required, mow the rye and use this area as a drive row for harvesting.

Reflective Plastic Mulches — The reflective properties of aluminum-faced plastic have been shown to interfere with the movement of aphids which spread the watermelon mosaic virus. This virus causes the green streaking in yellow squash during fall planting. By using this mulch, a gardener is able to harvest solid green or yellow squash for a longer period of time in the fall. Also, painting the plastic with aluminum paint or white paint increases its reflectivity and cools soil for later planted crops, thus causing less stress and resulting in better fruit quality.

Infrared Transmitting (IRT) Mulch — Infrared transmitting (IRT) mulch is a recent development. These plastics transmit the warming wavelengths of the sun, but not those that allow weeds to grow. These materials result in warmer soils than black plastic, but cooler soils than clear plastics. The IRT mulches retard the growth of weeds including nutsedge. Crops grown on IRT mulch will develop 7 to 10 days earlier than crops grown on black plastic.

Never plant a bed to the same crop twice in one year. Suggested spring-fall sequences are listed in Table 1 below.

Table 1: Suggested spring-fall sequences for planting.

Spring	Fall
Peppers	Summer squash, cucumbers or cole crops
Tomatoes	Cucumbers, summer squash or cole crops
Summer squash	Tomatoes or cole crops
Eggplant	Summer squash
Cucumbers	Tomatoes
Muskmelons	Tomatoes
Watermelons	Tomatoes
Honeydews	Tomatoes
Cole crops	Summer squash, pumpkins, muskmelons, tomatoes
Cauliflower	Summer squash, pumpkins, muskmelons, tomatoes
Snap beans	Summer squash, pumpkins, muskmelons, tomatoes
Southern peas	Summer squash, pumpkins, muskmelons, tomatoes
Lettuce	Summer squash, pumpkins, muskmelons, tomatoes
Sweet Corn	Summer squash, tomatoes, or cucumbers
Strawberries	Tomatoes, summer squash

Simply pull out the first crop and plant the second in holes appropriately spaced for the crop. **Note:** Take care to avoid damaging the trickle/drip tube when planting the second crop.

Final Comments — With proper planning, good management, *attention to details*, and dedication to all aspects of the cropping sequence, earlier and higher yields are possible using the “intensive” cultural methods described in this publication.