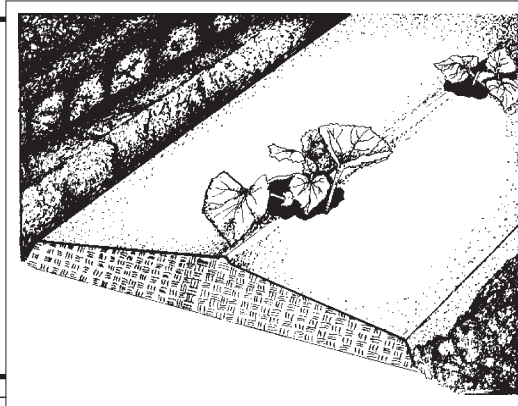


# PLASTIC MULCHES

## FOR VEGETABLES

BY  
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Plastic mulches have been used commercially on vegetables since the early 1960s. Although a variety of vegetables can be grown successfully using plastic mulches, muskmelons, tomatoes, peppers, cucumbers, squash, eggplant, watermelons and okra have shown significant increases in earliness, yield and fruit quality.

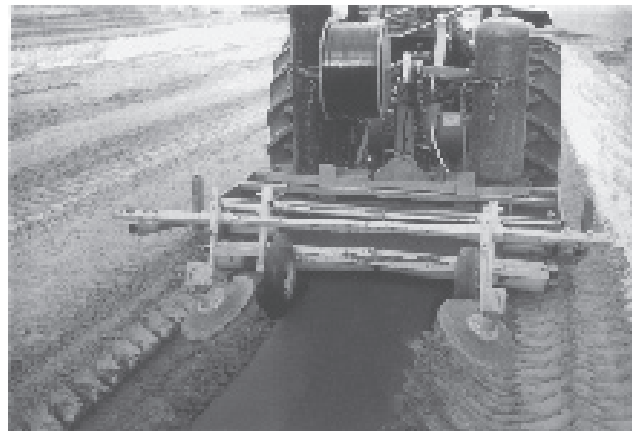
Three mulch types are used in commercial production of vegetable crops: black, clear, and white (or white-on-black) plastic. Black plastic is the most popular because it retards weed growth and warms the soil in the spring. Clear mulch is used in the northern United States because it provides an even warmer soil environment (mini-greenhouse effect). A drawback to clear mulch is that it will require the use of a herbicide or fumigation to prevent weed growth beneath the mulch. White or white-on-black mulch will provide a cooler soil temperature than either clear or black. It is good for establishing crops under hot summer conditions (i.e. fall tomatoes).

### Advantages of Mulch

1. Earlier crops. The greatest benefit from plastic mulch is raising the soil temperature in the planting bed, which promotes faster crop development and earlier yields. Black plastic mulch can result in an earlier harvest (7 to 14 days) while clear plastic can mean a 21-day earlier harvest in many conditions.
2. Reduced evaporation. Soil water loss is reduced under plastic mulch. As a result, a more uniform soil moisture is maintained and irrigation fre-

quency may be reduced. Plant growth on mulch can be twice that of unmulched soil. Because these larger plants will require more water, mulching is not a substitute for irrigation.

3. Fewer weed problems. Black and white-on-black mulches will reduce light penetration to the soil. Weeds generally cannot survive under the mulch. An exception is nutgrass, where the nut-like tubers provide enough energy for the seedling to puncture the mulch and emerge.
4. Reduced fertilizer leaching. Excess water runs off the impervious mulch. Fertilizer beneath the mulch is not lost due to leaching, so fertilizers are optimally used and not wasted.
5. Reduced soil compaction. Soil under the plastic mulch remains loose, friable and well-aerated. Roots have access to adequate oxygen and microbial activity is enhanced.



6. Root pruning eliminated. Cultivation is eliminated, except for the area between the mulched strips. Weed growth in these areas can be controlled by a labeled herbicide.
7. Cleaner product. The edible product from a mulched crop is cleaner and less subject to rots because soil is not splashed on the plants or fruit. Note: This is accomplished by a bed that is firm and tapered away from the row center and plastic that is tight to encourage water run-off. There should be no puddles on the mulched beds.
8. Increased growth. Mulch film is nearly impervious to carbon dioxide, which is necessary for photosynthesis. Research has shown that high levels of carbon dioxide may build up under the plastic. Because the film does not allow the gas to penetrate, it has to escape through the holes punched for the plants. This creates a "chimney effect," resulting in abundant C<sub>0</sub>2 for the actively growing leaves.
9. Aids fumigation. Mulches increase the effectiveness of soil fumigant chemicals. Because of the impervious nature of the plastic mulch, it acts as a barrier to gas escape and keeps gaseous fumigants in the soil.
10. Reduced drowning of crops. Water is shed from the row area by the tapered bed; excess water runs off the field, reducing drowning and other excess soil water stresses.

### Disadvantages of Mulches

1. Removal and disposal. A major problem with plastic mulch is removal from the field after cropping. Plastic mulch, especially black plastic, does not break down and should never be disked into the soil. Clear plastic does break down over time, but small pieces may remain in the field for several years. Research is addressing this problem and photodegradable and biodegradable mulches have been developed. Opportunities are also developing to recycle conventional mulch film.
2. Greater initial costs. The use of plastic mulch will increase the cost of production for a given crop. This is due to investment in some specialized equipment, including a bed press, mulch layer and mulch transplanter or plug-mix seeder. These costs should be offset by increased

income due to earlier harvests, better quality fruit and higher yields.

### Mulch Application

In commercial applications the mulch is typically applied by machine. There are basically three operations involved: (1) bedding the soil, (2) pressing the bed, and (3) laying the plastic mulch, drip tube and fumigating, if needed. These can be accomplished as separate or combined operations.

■ *Bedding and pressing the soil.* Among the bedding machines available to growers are the Kennco and Riddick companies' single- and multiple-row models. With some bedding machines, the soil is raised and then bedded in one operation ("superbedders"). In other situations the soil is first raised in one operation with hilling discs or double disc hillers on a tool bar. The bed is then compressed to a uniform height and density using a bed press pan. Note: be sure enough soil is pulled up so the bed has good, sharp corners. The bedded rows should be spaced on 5- or 6-foot centers, depending on the equipment. A bed 4 to 6 inches high, 30 inches wide, with a slope of 1.25 inches from center to edge is commonly used for vegetable production. The slope will allow excess rainfall to run off the mulch.

■ *Application of the mulch, drip tube and fumigating* (if required). The soil must have adequate moisture (enough for seed germination) when laying plastic mulch. Temperatures should be at least 50°F and soil should be well worked and free from undecomposed plant debris if you need to use a fumigant. If both weather and soil are warm, the fumigant should escape through the plastic mulch in 12 to 14 days. In addition to machines for laying plastic mulch, drip tube and fumigating the soil, custom applicators are also available.

Plastic mulch comes on rolls 4 or 5 feet wide and 2,000–2,400 feet long. Thickness is usually 1.25 to 1.50 mil. Mulch is available with an embossed (diamond-shaped) pattern on film which helps to hold mulch tight against the soil.

For single-row crops such as tomatoes, cucumbers, muskmelons, honeydews, watermelons and pumpkins, a drip irrigation tube should be placed 4 to 5 inches from the center of the bed and 2 to 3 inches deep with the holes facing upward. On

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double-row crops of summer squash, okra, eggplant and peppers, the drip tube should be placed directly on the center of the bed and buried 2 to 3 inches deep. There are approximately 7,500 feet of drip tube on a roll, depending on the manufacturer. On 5-foot row centers there are 8,712 linear feet of row per acre, so a grower would need about 3.5 rolls of plastic mulch and 1¼ rolls of drip tube per acre. On 6-foot centers, the per acre requirement would be 3 rolls of plastic mulch and 1 roll of drip tube.

*Laying the mulch:* Take time to adjust the machine so the press wheels hold the plastic firmly against the bed and the covering discs place soil halfway up the side but not on top of the bed. Also, when starting applications, anchor the plastic and drip tube by covering the end with soil and having a person stand on the drip tube. Use a slow tractor speed and be alert for sticks, rocks, or stakes which may puncture the plastic. Rows should be straight and the soil should “flow” along the mulch evenly. Excessive wind catching under the mulch may be a problem. A cross-wind is usually easier to work in.

*Weed control.* Only approved herbicides can be used between rows of plastic, as this is not a fallow area. For information on weed control consult North Central Weed Control Guide for Vegetable Crops, NCR 330, or your local Research and Extension office. Be sure a cultivator or hoe does not rip or tear the mulch.

*Planting the crop.* Vegetable crops can be established in mulch by transplanting or direct-seeding. Transplanting can be done by hand or by mechanical “pot” or “punch” planters or semi-automated transplanters. For extra earliness in peppers and tomatoes, large container cells (2- to 3-inch sizes) should be used. For other vegetable crops a cell size of 1 to 2 inches is a good recommendation. Consult the KSU Commercial Vegetable Production Guide *Vegetable Transplants* for details on transplant production. When setting plants by hand, several tools can be used to make holes in mulches. A long-handled bulb setter or a sturdy can or steel cylinder welded onto the end of a handle can be used. The hole should be 3 to 4 inches wide and deep enough to set the plants. A hand tobacco setter works well once the holes are made in the plastic mulch. With both hand and machine setting, 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 10-52-17, 10-20-10 or similar analyses.

Direct-seeding through mulch can be done by hand, with a “plug-mix” planter or “vacuum” seeder. With the “plug-mix” planter, seed is mixed with a peat-vermiculite (potting soil) material, wetted, and placed in the planter's hopper. The machine punches a hole in the plastic mulch and places a small amount of the “plug-mix” into the hole. The vacuum seeders will place individual seeds through the mulch. These machines are suggested for use in seeding large acreages but may be too expensive for a smaller grower.

*Irrigation.* Drip irrigation is recommended for use with plastic mulches. Irrigation frequency will depend on soil type and stage of crop growth. For more information, consult the KSU Commercial Vegetable Production Guide, *Drip Irrigation for Vegetables*. Note: Do not use plastic mulch without irrigation.

### **Other Cultural Considerations**

*Double cropping with plastic mulch.* Once the first crop has been harvested, a second crop should be grown on the mulch. This “intensive cropping” produces two crops from the annual expenses for mulch and drip tubing. The second crop can be fertilized through the drip irrigation line (“fertigation”) using soluble fertilizers and a fertilizer injector. Never plant a field to the same crop twice in one year. Disease or insect cycles can best be broken by rotations of three to four years. Suggested spring-fall sequences are listed on page 4.

Glyphosate or paraquat can be used to quickly kill the first crop, or it can be hand removed by pulling or chopping. Watch out for the drip tube when planting the second crop.

*Windbreaks.* Windbreaks, consisting of strips of winter wheat, rye or barley should be established to protect vegetable seedlings from prevailing winds. Each grain strip should be the width of a small grain drill. Allow some room between strips to plant five or six rows, 5 or 6 feet apart, center to center. Grain strips planted in the fall will promote earliness and give protection to young vegetable transplants. Spring fertilization of the strips by top-dressing will help assure a dense stand.

Another option is to plant a solid grain cover crop, but be sure to till the crop area early enough in spring so crop debris will not interfere with laying the plastic mulch. Once wind protection is

Double Cropping Suggestions	
Spring	Fall
Peppers	Summer squash, cucumbers, cole crops
Tomatoes	Cucumbers, summer squash, cole crops
Summer squash	Pumpkins, tomatoes, cole crops
Eggplant	Summer squash
Cucumbers	Tomatoes, pumpkins, summer squash
Muskmelons	Tomatoes
Watermelons	Tomatoes
Honeydews	Tomatoes
Cole crops	Summer squash, pumpkins, muskmelons, tomatoes
Lettuce	Summer squash, pumpkins, muskmelons, tomatoes
Snap beans	Summer squash, pumpkins, muskmelons, tomatoes
Sweet corn	Summer squash, tomatoes, okra, cucumbers
Strawberries	Tomatoes, summer squash, cucumbers, muskmelons, pumpkins, okra

no longer required, mow the grain and use it as a drive row for spraying and harvesting. With a boom sprayer, 2½ or 3 rows can be sprayed one direction and the same amount in the other direction. An airblast sprayer can also be used.

*Reflective plastic mulches.* The reflective properties of aluminum-faced plastic have been shown to interfere with the movement of aphids, which spread watermelon mosaic virus (I & II) and zuc-

chini yellows mosaic virus. These viruses cause a green streaking/mottling in melons, squash and pumpkins. By using reflective mulch, a grower may be able to harvest marketable produce for a longer period of time. Painting the shoulders of black mulch with aluminum paint increases its reflectivity and also works well in delaying the onset of virus symptoms in fruit.

*Row covers.* Rolls of slitted clear plastic, fine mesh materials made of spunbonded polyester, or polypropylene fibers can be applied over rows of early vegetables. Row covers, used in conjunction with mulch, have been shown to produce the earliest yields. The greatest potential of this practice is likely to be with muskmelons and watermelons.

*Significant yield increases.* Plastic mulch systems can produce significant yield increases, if managed properly. Some examples follow.

Crop	Average Yield (per acre, plastic and drip)
Large muskmelon (ribbed)	8,000–9,000 fruits at 4–6 lbs/fruit
Small muskmelon (smooth)	12,000–15,000 fruits at 3–4 lbs/fruit
Cucumbers	1,200 bu (55 lbs/bu)
Peppers	1,600 bu (25 lbs/bu)
Squash	800 bu (45 lbs/bu)
Tomatoes	3,200 boxes (20 lbs/box)
Watermelon	3,000 fruits

With proper planning, attention to details and careful management to all aspects of the cropping sequence, earlier and higher yields are possible using “intensive” cultural methods.

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