

Plastic Mulches

for Horticultural Crops

V. A. Clarkson

W. A. Frazier



Station Bulletin 562 • September 1957

Agricultural Experiment Station • Oregon State College • Corvallis

Plastic Mulches

for Horticultural Crops

By V. A. Clarkson and W. A. Frazier*

WHAT IS PLASTIC OR POLYETHYLENE?

Polyethylene is a thermoplastic resin which is pliable, chemically inert, odorless, and nontoxic. Moisture does not penetrate it, but certain gases such as carbon dioxide and oxygen easily pass through. The plastic is available in several colors, including clear, white, and black.

WHAT WILL IT DO?

Weed control, soil moisture conservation, crop yields, and fruit-disease control of warm-season horticultural crops have all been increased or improved. This is based upon research trials with black plastic mulch at the Oregon Agricultural Experiment Station. Use of the plastic also may increase soil temperature, improve fruit cleanliness, and decrease soil compaction.

WHAT ARE ITS LIMITATIONS?

Polyethylene plastic is moderately expensive and may not pay on all crops. This, and other items such as cost of laying, handling, and hand planting, mean that it may be used to best advantage on high-value crops such as vegetables, small fruits, and ornamentals.

* *Research Assistant in Horticulture and Horticulturist, Oregon Agricultural Experiment Station.*

Which Mulch To Use?

A mulch is a material spread on the ground surface to protect a plant or plant roots. Most often a mulch protects a plant from low temperature injury and moisture loss by wind and soil evaporation. It may be applied to control weeds, aid soil structure and drainage, and improve fertility.

Use of natural organic materials such as straw and manure has been an accepted horticultural practice for many years. Straw and other similar materials are widely used as a winter protection for low-growing plants, and manure is used primarily as an organic fertilizer with incidental mulching properties if left on the soil surface. In the Pacific Northwest, sawdust—often easily obtained—is being used as a mulch material on numerous small- and tree-fruit crops as well as ornamentals.

Mulching materials do not have the same characteristics. Consider the various properties before choosing a suitable mulch. The use of one material in preference to the others depends upon crop requirements, costs, and the results desired.

If the incorporation of organic material into the soil is a primary objective, use manure, straw, or another easily decomposed organic material. If value as a fertilizer also is important, straw may not be an acceptable material. If growing warm season crops, soil temperature and moisture are important, black polyethylene film—which absorbs heat and is impervious to moisture—may be especially useful.

The table on page 11 shows some of the characteristics of various mulching materials, such as sawdust, straw, manure, paper, and black plastic.

Use Proper Width and Weight . . .

To insure adequate weed control and moisture conservation, as well as to protect ripening fruit from soil contact, use plastic that is 3 or 4 feet wide. In some instances it may be desirable to use a plastic that is considerably wider to protect fruits such as melons and squash from rot. If the plastic is removed each year, $1\frac{1}{2}$ (.0015") or 2 (.002") mils in thickness is adequate. With perennial crops such as straw-

berries, 4-mil (.004") plastic may last longer than 2-mil plastic.

Most papers used for mulching are sold in rolls 3 feet wide. Under the moist weather conditions of the Willamette Valley, all of the paper mulches tested disintegrated within a year's time. Plastic, which may be purchased in various widths, have lasted 3 or more years in experiments at the Oregon Agricultural Experiment Station.

How to Apply Plastic Mulch . . .



1. LEVEL soil before applying plastic. Seedbed must be well worked—tilled and rolled. Before laying polyethylene mulch, be sure to irrigate soil if it is dry to insure adequate moisture for seed germination and seedling or transplant growth.

2. PLACE a band of fertilizer before you lay plastic. With annual vegetable crops, be sure to apply enough to last throughout the growing season. Use string line to mark row center. Place fertilizer 3 or 4 inches under soil and to side of seeds or plants.



3. APPLY plastic, using guide line as aid for maintaining straight row. Place stake at end of row to mark fertilizer band. Work is underway to develop a tractor attachment for mechanical laying of plastic for commercial use.

4. COVER plastic edges with soil to prevent blowing. Plastic may need weights, such as bricks, laths, or large wire staples driven into soil to hold mulch down in windy areas. Growing plants will help hold polyethylene in place.



5. CUT hole in plastic large enough for transplanting. Water plants well. If seeding in hills, use a corn jabber or similar planter. When row planting, remove a plastic strip 1 inch wide by 2 to 3 feet long from center, leaving a 3 to 6 inch crosspiece of plastic between the strips.

6. GROWING plants in plastic is similar to normal cultural practices. Check plants for water needs, insect and disease damage. Transplanted head lettuce at right has been growing for 6 weeks. Irrigation water has carried soil onto plastic.



Use Normal Plant Spacing . . .

When planting through a polyethylene mulch, normal planting distances are usually used. One or more rows of plants may be placed in a single sheet of plastic. Strawberries in the Pacific Northwest are often planted in

a matted row, and the runners allowed to root in between the mother plants. The use of polyethylene makes it impossible for these runners to root into the soil and a hill system of planting must be used.

Plant Spacing in Plastic Mulches

	Method of planting	Plants per hill	Distance		
			Between hills	Between rows	Between plants in row
			<i>Feet</i>	<i>Feet</i>	<i>Feet</i>
Bush beans	hill	3-4	1	3-4	.....
Cabbage	row	.....	.....	4-5	2-3
Cantaloupe	hill	2-3	2-3	4-5	.....
Cucumber	hill	2-3	2-3	4-5	.....
Eggplant	row	.....	.....	3-4	1-1½
Pole beans	hill	3-4	1½	5	.....
Strawberries* ..	row	.....	.....	3	1
Summer squash..	hill	2-3	2-4	5	.....
Sweet pepper	row	.....	.....	4-5	1½-2
Tomato	row	.....	.....	4-5	2-3
Watermelon	hill	2-3	4-6	6	.....
Winter squash ..	hill	2-3	4-6	6-8	.....

* A double row of plants 1 foot apart on a 4-foot wide sheet of plastic.

Plastic Controls Weeds . . .

There is no advantage in cultivating under the plastic sheets once they are applied. Soil does not compact readily beneath the mulch, and if the black polyethylene is used there is no serious weed growth. There will be some weed growth in the immediate area of the holes or slits made in the plastic. This usually means one or possibly two

hand weedings. After weeds have been removed, competition by the crop is usually enough to discourage most weed growth.

Weed control is necessary between strips of plastic. Use a hoe or other shallow cultivating equipment. Be careful not to cut the edges of the plastic while cultivating.

With some crops, a weed control chemical between the strips of plastic may help. Since plastic is chemically inert, the application of chemicals should not affect it. If a weed killer is applied after plants are up, be sure that no spray or spray drift comes in contact with them.

In the trials of plastic materials at

the Oregon State College experimental farm, white polyethylene thin enough to allow low amounts of light penetration did not control weeds. With low light transmission and warm growing conditions under the white plastic, weeds grew remarkably well—evenually tearing the plastic—making it useless as a mulching material.



Mulched tomatoes, left, show weed control possible with plastic. Unmulched tomatoes, right. One hand weeding of mulched plants is often necessary to control weeds that grow through transplanting slit.

Less Irrigation With Plastic?

Much remains to be understood about irrigation of polyethylene-mulched plants. Experience has shown that with normal sprinkler irrigation, water does not limit production. How easily irrigation water enters the soil under the plastic depends upon drain-

age into the slits or holes in the plastic where plants are located.

Intervals between irrigations may be spread out considerably with polyethylene, but the demands of the various crops and climatic conditions will determine the frequency of irrigation.

Control Diseases and Insects . . .

Disease and insect control on mulched plants should be about the same as under nonmulched conditions. The plants are equally accessible for dusting or spraying of foliage predators. The effect mulches may have on soilborne diseases, and insects are not yet known.

One of the important disease condi-

tions common in some low-growing horticultural crops is the loss of fruit to various soilborne organisms. When paper or polyethylene is used as a mulching material, direct contact between the fruit and soil is broken. This has resulted in a lower percentage of rotted fruit in crops such as tomatoes, melons, and strawberries.

Plastic Mulches Not Toxic . . .

Since polyethylene is a chemically inert material, it has not been found to be toxic on the plants tested. Certain of the paper materials used as a mulch have exhibited marked toxic effects on some plants. Symptoms of toxicity are usually more pronounced

in young, low-growing plants such as melons, and may result in serious injury or death. This toxicity may be caused by the action of heat or water on the tar or creosote impregnants used in some papers. Conservatively used, organic mulches are non-toxic.

Use Normal Harvesting Methods . . .

The harvest of plants grown on a polyethylene mulch is the same as with nonmulched crops. The material resists tearing, although it may be easily cut with a sharp instrument. Normal walk-

ing or driving of rubber-tired machines over the plastic does not usually tear it. This is not true with some types of paper. Paper becomes brittle on exposure, while plastic remains pliable.

Plastic Pays With Higher Yields . . .

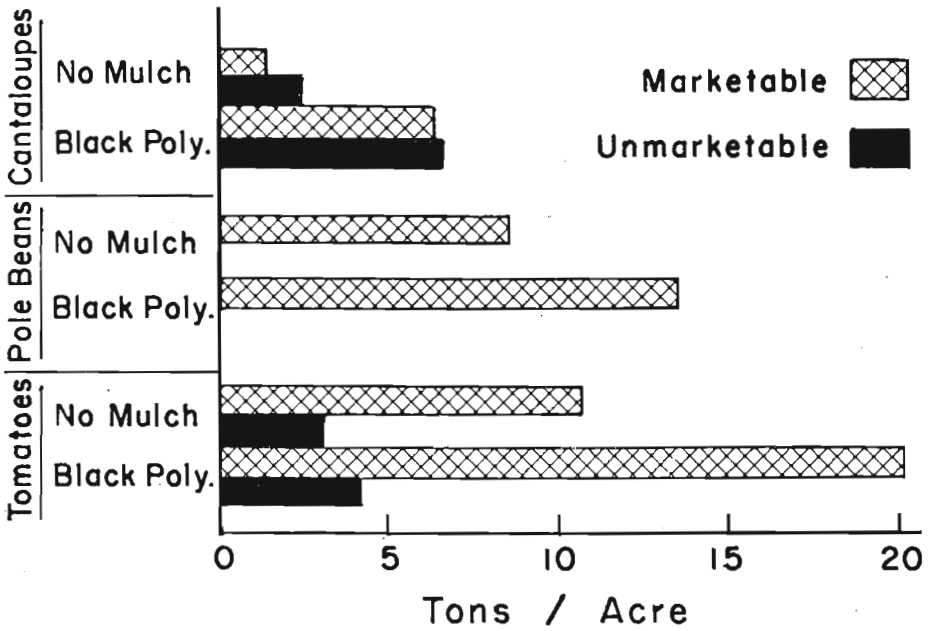
Types of plants which will respond to plastic or paper mulching have not been completely investigated. Most warm season crops such as tomatoes, melons, cucumbers, eggplants, bush and pole beans, and sweet peppers have responded well. Cool season crops such as late cabbage showed no increase in yield from the use of polyethylene. (See chart, page 9.)

With warm season crops tested, the amount of foliar growth on the

mulched plants and the amount of fruit set was much greater than on non-mulched treatments. The possibility of using black polyethylene on ornamental crops, both annual and perennial, has not been investigated. There appears to be no reason why it may not be used to advantage on a number of such crops.

Plastic-mulched crops grown on the OSC experimental farm did not mature earlier than nonmulched crops.

PLASTIC MULCH INCREASES YIELDS



Increase in yields of tomatoes mulched with plastic was marked, as shown in the above graph and this photo. Fruit in photo was from one mid-season picking of 6 plants. Fruit rot was better controlled.



Yield of cabbage, a cool season crop, was not increased with a plastic mulch. Weed control in mulched plots was excellent. Conditions for cabbage root maggot attacks, however, are better with mulch.

In most cases, however, there were more fruits and vegetables harvested from the polyethylene-mulched plants in the early harvests because of considerable yield increases. If the plastic

is applied and the crop planted before normal planting date, there may be some earliness since these mulches tend to warm the upper soil area, creating better conditions for germination.

Plastic May Be Reused . . .

Plastic can be reclaimed and reused. Initial cost can then be pro rated, thereby reducing the cost per year.

In the home garden with a relatively small area covered by plastic, the material may be easily cleaned off, rolled up, and stored until the next season. The home or commercial gardener also may be able to leave the plastic in place and replant the following season through the same holes.

The commercial vegetable grower also can pick up the plastic and store

it until next season. But removing vine or plant growth prior to the removal of the plastic may not pay. It may be necessary to burn both the plastic and plant growth with a weed burner or other similar tool. It is not known now whether it will be more practical to pick up the plastic or leave it in place for several years. Plowing under plastic is difficult and it tends to foul cultivating equipment. Since it does not disintegrate easily, it will remain in the soil for a long time.

Characteristics of Mulching Materials

Characteristics	Sawdust	Straw	Manure	Black paper	Black poly-ethylene
Longevity	Decomposes about $\frac{1}{2}$ "- $\frac{3}{4}$ " per year	Not more than one year	Not more than one year	One growing season or less	Two or more years
Water retention (reduction of surface evaporation)	Good	Poor	Poor-fair	Good	Good (impervious to water)
Heat absorption	Poor	Poor	Poor	Good	Good
Soil heat retention	Fair	Poor	Fair	Good	Good
Weed control	Fair	Poor	Poor	Good	Excellent
Water penetration	Good	Good	Good	Fair-poor	None
Fertilizer value	Poor	Poor	Good	None	None
Extra nutrients needed for decomposition	Nitrogen	Nitrogen	None	None	None
Toxic qualities	Usually none	None	Possibility, if applied too heavily	If oil, tar, or creosote impregnated	None
Incidence of rotted fruit over nonmulched plants	Lower	Unknown (probably lower)	Unknown	Lower	Lower
Cleanliness of fruit	Good	Good	Poor	Excellent	Excellent
Durability (can it be walked on?)	Good	Poor	Poor	Poor	Good
Effect on soil structure	Poor	Good	Good	Unknown	Excellent
Appearance of mulch	Good	Poor	Poor	Good	Good

Should I Use

A Black Plastic Mulch?

Yes, if you want to . . .

- grow warm season row crops.
- grow high value crops.
- help control weeds.
- conserve soil moisture.
- help control soil-contact fruit rot.
- maintain fruit cleanliness.
- slow soil compaction.

No, if . . .

- cost of material is too great.
- cost of applying and hand labor is too great.