COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF ALASKA FAIRBANKS

# PLASTIC MULCH & ROW COVERS

## for Vegetable Production in Alaska

FGV-00647

The supply of energy from the sun is continuous and free except for the cost to harness it and use it (Branton 1972). In Alaska, we can capture radiation from the sun in the spring and extend our growing season by using plastics. Solar and net radiation studies conducted at Palmer over an eleven-year period show that net radiation increases from April 1 to June 21, (See Figure 2, page 2). From June 22 on, net radiation decreases throughout the remainder of the growing season.

A cropping system using plastic mulch and row covers, which can greatly increase production and returns, has been developed. The system can be readily adapted to a home vegetable garden or a commercial operation.

***Contents***



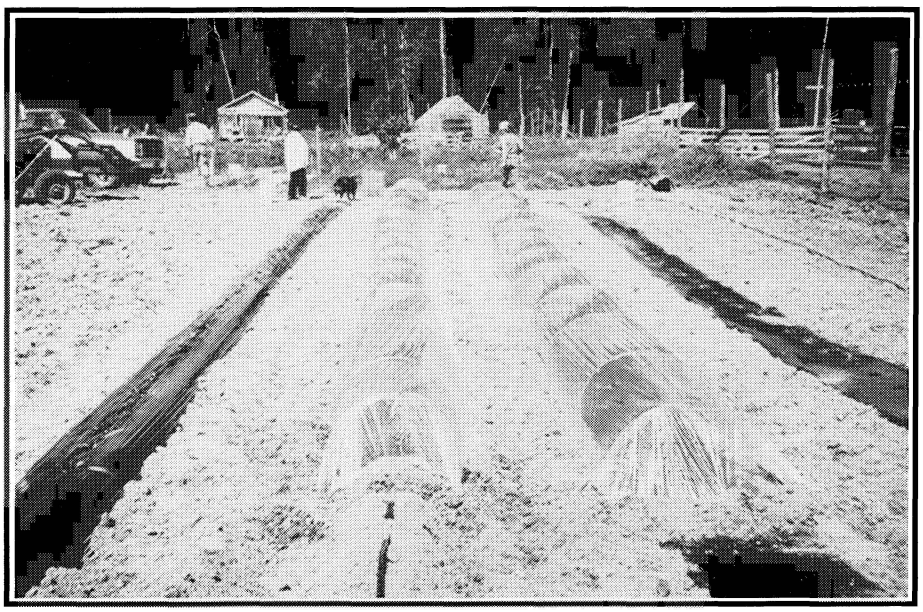

***Figure 1.***
*Plastic mulch demonstration comparing tunneled and non-tunneled treatments. Palmer, Alaska.*

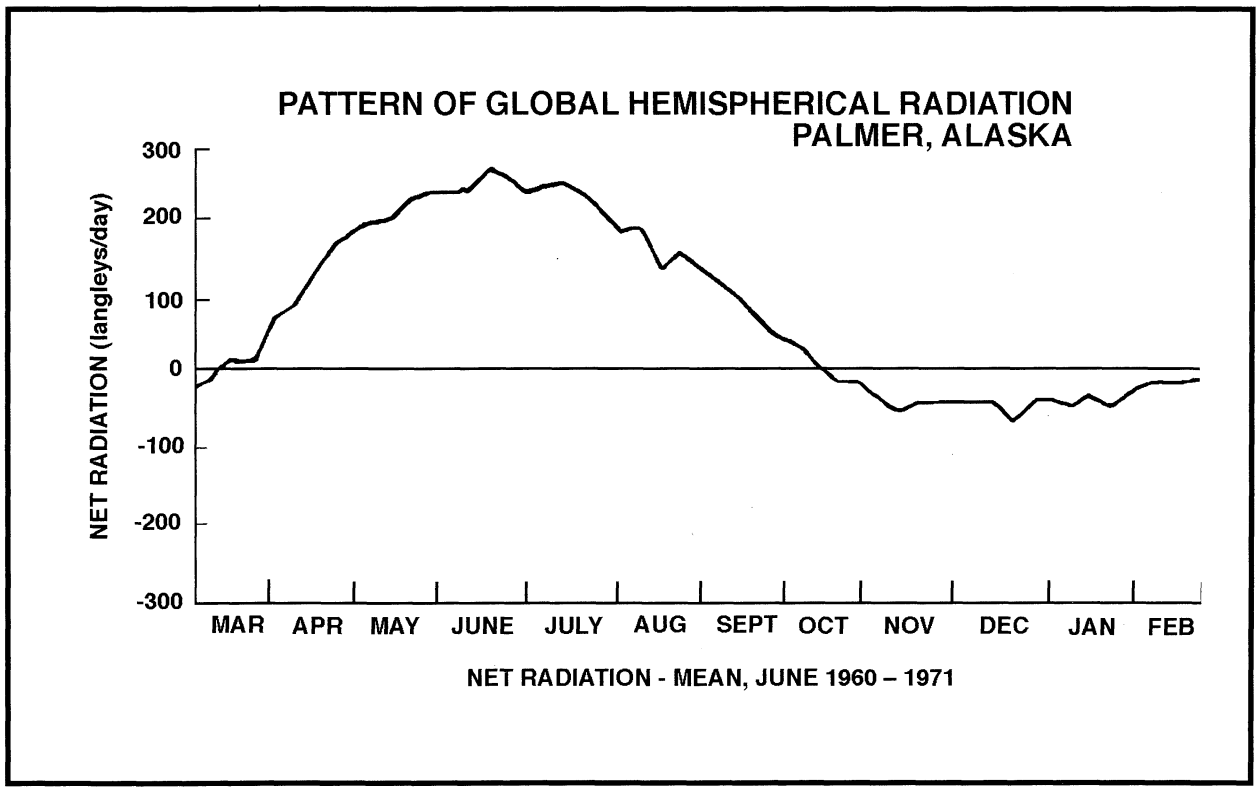


*Figure 2. Pattern of Global Hemispherical Radiation.*

# BENEFITS OF PLASTIC MULCH AND ROW COVERS

**Earlier Crop Production**

Research and demonstration trials conducted at Palmer show that the use of plastic mulch and row covers results in a 7 to 21 day earlier harvest than the same vegetables produced on bare soil (Purser and Comeau 1990, 29-34).

**Increase Yields per Acre**

The yields can be 2 to 5 times greater with plastic mulch for some crops. In field trials, cucumber production has increased almost 8 times above the yield from bare soil plantings (Purser and Comeau 1990, 29-34).

**Efficient Fertilizer Use**

Using trickle irrigation under plastic mulch along with added fertilizer elements makes fertilizer use more efficient. Plastic mulch also reduces the loss of fertilizer nutrients from leaching.

**Reduce Soil Erosion**

Plastic mulch and tunnels provide protection from wind and water erosion.

**Increase Quality**

Plastic mulch allows growers to produce vegetables that are cleaner and more uniform in shape and size by providing a buffer for water, wind, erosion, and fertilizer leaching.

**More Efficient Water Use**

Drip irrigation lines allow water to be placed directly in the root zone of plants. The plastic mulch on the soil surface produces a physical barrier between the soil and atmosphere that retards water evaporation from the soil. Even, uniform soil moisture and increased soil temperature gives the seedling a boost, resulting in increased growth rate, earlier flower production and increased yield.

**Fewer Weed Problems**

Weed problems are eliminated or greatly reduced with black or wavelength-selective plastic mulch. Weeds growing in and around transplant holes and between rows of mulch can be easily controlled.

**Root Maggot Control**

When row covers are used (solid or perforated) you can reduce or eliminate damage from root maggots. Row covers provide a barrier that is very effective against the adult flies that lay eggs at the base of host plants (Purser and Comeau 1990 45,-46).

**Wind Protection for Transplants**

Plastic tunnels provide wind protection for young transplants. This can be a significant consideration in windy areas.

**Greater Transplant Survival and Reduced Cold Injury**

Plants weakened by cold injury are more susceptible to soil-borne plant pathogens such as *Pythium* and *Rhizoctonia*. Even if a cold-shocked plant does not die, early growth may be suppressed for several days while it regenerates a healthy root system and new leaves.

## PLASTIC MULCH TYPES

Plastic mulches have been used for vegetable production since the early 1960s (Lamont April 1990, 58-62). Although a wide variety of vegetables can be grown successfully using plastic mulches, the greatest benefit in Alaska is the ability to produce warm season crops such as cucumbers, snap beans, tomatoes and sweet corn (Maurer and Frey 1990; Purser and Comeau 1989, 16-18). Most of the cole crops grown in Alaska will also benefit from using plastic mulch treatments but increases in yield and earliness of crops produced is not as great as the warm season crops. For example, cabbage and broccoli grown with plastic were harvested 7 to 10 days earlier than plantings without plastic. For crops such as zucchini squash, the yields from tunneled plastic mulch treatments is 7 to 14 days earlier and 2 to 3 times greater than the yield from bare soil treatments.

Three basic mulch types are commonly used, clear, black and wavelength-selective. Clear plastic has been the most popular for years because it warms the soil. Research at Palmer shows that the use of clear plastic increases soil temperatures 8 to 10 °F above soil treatments with no plastic mulch (Purser and Comeau 1989, 16-18). The main disadvantage of clear mulch is that it requires the use of an herbicide to prevent weed growth beneath the mulch.

The popularity of black plastic is based on the excellent weed control it provides. The disadvantage is that it does not warm the soil like clear or wavelength-selective mulches. Black plastic absorbs solar radiation and transmits the energy to the soil by means of conduction and long wave radiation (Chevriev et al. 1990). Black plastic blocks the direct movement of solar radiation into the soil and therefore is not effective in raising soil temperature. Much of the radiant energy falling on black plastic is not transmitted to the soil but is lost to the atmosphere by re-radiation and convection. Clear plastic is almost transparent to solar radiation and transmits energy in the form of shortwave radiation directly into the soil. Clear plastic transmits 85 to 95 percent of the radiant energy and consequently absorbs very little (Maurer and Frey 1990).

A newer plastic mulch, wavelength-selective, fills a niche between the clear and black mulches. It controls weeds as the black mulch does and warms the soil similar to clear mulch. Wavelength-selective mulch transmits rather than absorbs most solar infrared radia-

tion. Similar to black mulch, wavelength-selective mulch absorbs solar radiation and blocks that part of the solar spectrum necessary for photosynthesis and growth of weeds. The wavelength-selective mulch was designed to maximize solar heating of the soil while minimizing weed growth. Research indicates that weed seeds will germinate under wavelength-selective mulch, continue to grow slowly in Spring but are killed by the high temperatures under the mulch surface in late June and early July (Purser and Comeau 1990, 29-34).

Plastic mulches generally come in rolls 3 to 5 feet wide and 2,000 to 2,400 feet long. Garden suppliers and seed catalogs offer plastic mulch in small rolls or 100 to 1,000 feet long for home gardeners. The thickness varies from 0.8 to 2.5 millimeter (mil) depending on manufacturer and intended use.

## ROW COVERS

**Solid Clear Plastic Mulch**

Tunnels and row covers provide protection from wind, insects and cold, while warming the soil an additional 3 to 6 °F depending on mulch type and row cover design.

The basic types of row covers include clear plastic mulch, clear perforated plastic mulch, and floating row cover materials. These materials are placed over vegetables in a tunnel design (See Figure 3).

Solid clear plastic row covers are usually constructed as follows:

1 The plastic mulch (4-foot wide) is placed on the soil surface for ground cover.
2. One 3-foot wide length of clear plastic mulch is placed on top of surface mulch and one outside edge is lined up even with the edge of the ground mulch. Secure the side edge with soil.
3. A second 3-foot wide length of clear plastic mulch is laid over the ground mulch and lined up with the other outside edge. This side edge is also secured with soil. The two 3-foot pieces will overlap in the middle.
4. Wire hoops are set.
5. Each of the three foot pieces of clear plastic are pulled over outside edge of wire hoops and joined at top with clothes pins (See Figure 4) creating a tunnel.

This design allows growers the freedom to raise and lower tunnels for ventilation and protection from wind and cold throughout the growing season. The sides can be raised or lowered to any setting that conditions may require.

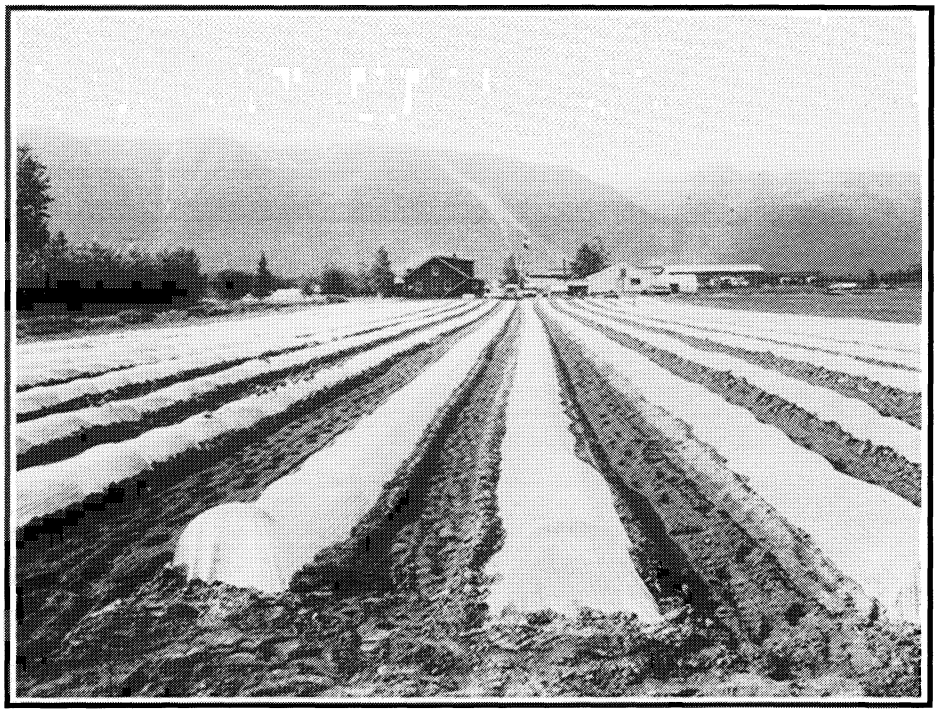

***Figure 3.*** *Clear perforated row covers used for vegetable production. Palmer, Alaska.*

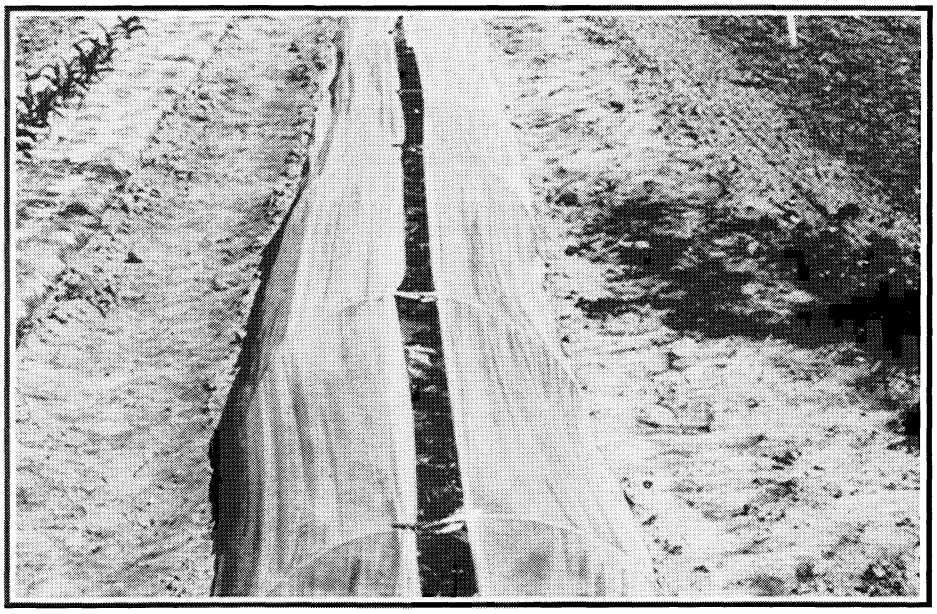

***Figure 4.*** *Plastic row covers held together at the top by clothes pins. Fairbanks, Alaska.*

**Clear Perforated Plastic Mulch**

Perforated clear plastic tunnel material is stretched over wire hoops and secured at outside edges with soil. The small holes provide ventilation that is adequate in spring and early summer. However, the perforated polyethylene tunnels do not provide frost protection (Purser & Comeau 1989, 16-18). Once vegetable plants grow and contact the top or sides of the mulch, the cover is slit at the top in sections which provides for additional growth room for crops such as corn. As plants continue to grow the tunnels are removed.

**Slit Polyethylene Covers**

Slit polyethylene covers are also commercially available. These covers with slits also require hoops and have to be managed like the perforated materials. (See Figure 5.)

*Figure 5*
*A slit row cover that allows for ventilation of air and moisture.*

**Floating Row Covers**

To eliminate the need for manual venting using clothespins, a variety of materials have been developed These materials can be applied over several plant beds as a floating row cover or modified for use as tunnels over rows with wire hoops. Kimberly Farms™, a white spun-bonded polypropylene; Reemay™, a spun-bonded polyester; Agronet™ , a floating ultraviolet resistant film/net of nylon reinforced threads with a polypropylene base; and Agryl P17™, a floating non-woven sheet, are popular brands that are currently on the market (See Figure 6). Most of these self-ventilating materials are light-weight, porous to water, permit transmission of up to 80% of available light and offer protection from frost down to 30° F. They also protect plants from many garden insect pests.

There are a few disadvantages to using floating row covers. It is difficult to manage weeds under the covers and the wind may cause abrasion to the growing terminal and foliage of plants. Less abrasion damage occurs on crops that do not have a vertically growing terminal such as broccoli and cauliflower.

If you live in an area of high humidity, poor air circulation under plastic covers can contribute to algae growth on soil and foliage fungal diseases on vegetable crops.

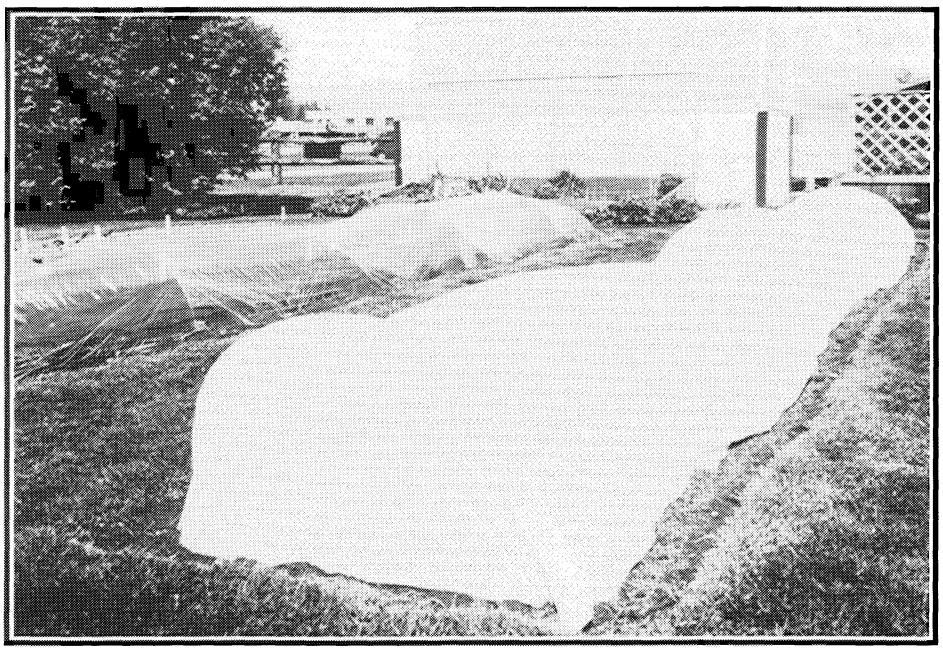

***Figure 6.***
*A floating row cover supported by wire hoops.*

Row covers are supported over the plastic mulch and vegetable transplants with wire hoops. If a 4-foot plastic mulch is used, wire pieces should be 6 feet in length and spaced every 4 to 5 feet along the row. The wire should be 9-gauge or larger. The hoops should be placed in soil so all centers are 16 to 20 inches high for maximum strength and wind protection. (See Figure 7). A tunnel that is level across the top with no sags or folds and is buried with plenty of soil at edges will provide maximum protection from wind. The first wire at each row end should be doubled for added strength since this is where most of the pressure on hoops is exerted by the row covers.

***Figure 7.***
*Clear perforated row covers held in place by 9-gauge wire on 4-foot centers.*

# DRIP IRRIGATION

Drip irrigation is a very important component of the plastic mulch system. A drip irrigation system can reduce the volume of water used by 1/3 to 1/2 compared to an overhead sprinkler irrigation system. Using a fertilizer injection system along with drip irrigation lines, permits more effective fertilizer management.

Plastic irrigation line with pre-punched emitter holes is used to moisten a continuous strip along the row underneath the plastic mulch. The irrigation line is from 4 to 25 mil and has emitter holes every 6 to 12 inches. Most irrigation lines are tossed after one year's use. Some home gardeners are able to get two or three year's use from drip irrigation lines when they are handled, cleaned and stored properly.

Irrigation water can come from wells, streams, ponds, lakes or municipal lines. Regardless of the source, a filter in the water line will be needed to remove foreign particles. Some growers use water from barrels or tanks in order to temper the water. Water stored in above ground tanks is 12 to 16° F warmer than well water temperature of 38 °F (Purser 1990, 4).

Drip irrigation lines require a low pressure of 4 to 12 pounds per square inch (PSI) for lightweight lines and 4 to 15 PSI for heavy-weight lines in order to work properly. Since the water pressure on most homes and farm systems ranges from 40 to 90 PSI, pressure reduction valves generally will be required. These devices are readily available, inexpensive and easy to install.

Place the drip irrigation line under the plastic mulch as close to the transplant holes as possible. Drip line ends should extend beyond the plastic row ends to facilitate plugging on the far end and hook-up with the water source (See Figure 8). For safety reasons, growers should always install a back-flow prevention device to keep the irrigation system isolated. The soil surrounding the root system of vegetable plants is covered with plastic mulch, so it is not easy to know when to apply water.

The soil may appear moist on the surface but be dry underneath due to condensation of water on the mulch surface nearest soil. Growers should use tensiometers (used to measure soil moisture) to monitor water requirements.

*Figure 8.*
*Drip irrigation line and water filter attached to a water hose supply line.*

## FERTILIZATION

Before planting, take a soil test to determine lime and fertilizer requirements. Soil test kits are available from your local Alaska Cooperative Extension Office.

Approximately 35 percent of the total nitrogen and potassium fertilizer and all of the phosphorous may be applied prior to laying the mulch if fertilizer is going to be added through the drip irrigation lines (fertigation). If fertigation is not planned, all of the fertilizer will need to be applied before the mulch is laid.

The amount of fertilizer to use depends on the crop grown and length of its growing season. Applying small amounts of fertilizer on a frequent basis throughout the season results in more efficient nutrient utilization and tends to reduce potential problems from soluble salt injury. Normally lower concentrations are applied first and increased as the season progresses. The goal of fertilization is to tailor the fertility to the needs of each crop, thus achieving maximum efficiency with minimum fertilizer leaching.

## BED PREPARATION

It is extremely important to properly prepare your land before laying plastic mulch and irrigation lines.

**Spacing** Beds can be prepared in a number of ways from a hand shovel to sophisticated double disc hillers. Several garden tractor manufacturers make bed forming attachments that work well for home garden use. The beds should be on 4- to 6-foot centers depending on your equipment. This spacing is needed to accommodate plastic mulch on the ground and still leave room for foot traffic.

**Uniformity** The beds should be a uniform height and density. Be sure that the bed is packed enough to have sufficient structure to maintain good sharp corners. This permits close contact of plastic to soil. A loose fit will allow air spaces that act as insulation preventing the soil from warming. The seed bed should be slightly moist to ensure that seeds or transplants do not suffer from dehydration early in the season.

**Shape & Size** Beds can be constructed in a variety of shapes and heights. A common shape and height that is used for vegetable production is 4 to 6 inches high, 24 to 30 inches wide and has a slope of 1.25 inches from center to edge (Lamont May 1990).

A raised bed results in earlier soil warming in the spring and the slope allows excess water from rainfall to run off the plastic mulch.

# PLANTING METHODS

**Before Planting**

The following tasks must be accomplished before planting:

- Test the soil
- Spread and incorporate fertilizer and lime
- Rototill or disk field
- Form beds
- Apply herbicide if clear plastic is used
- Install drip irrigation and plastic mulch

After fertilizer and lime are applied, the soil should be rototilled and made as smooth and level as possible. The more contact you have between mulch and soil, the more effective the soil warming.

**Transplants**

Vegetable crops can be established under plastic mulch by transplanting or direct seeding. Whenever possible, transplants should be used in Alaska for earlier production and increased yields. Transplanting can be done by hand or by a mechanical pot or punch transplanter. A bulb planter works well if planting by hand. A hole, 3 to 4 inches, is cut through the plastic mulch deep enough to set the transplants. Add a starter solution of soluble fertilizer to help the plants get off to a fast start. A water soluble fertilizer high in phosphorous such as a 10-52-17 or 10-20-10 analysis is preferred.

**Direct Seeding**

Direct seeding can be done through the mulch, but it is easier to plant seeds before the mulch is applied. After seeds germinate and seedlings emerge under the mulch, release the plants by slitting the mulch. If this method is used, row covers will have to be the open top design that is clipped with pins. Otherwise, there is no access to the plants through the tunnels. If you are using perforated row covers and direct seeding, the ground cover should be a slit material that will allow seed to grow through the slits.

A third option is to seed directly in the soil and cover with solid plastic ground mulch. After the seeds germinate under the plastic, release the seedlings by slitting the plastic, and then place the tunnels over the released seedlings.

## HARVESTING

Harvesting should be done on a timely basis. Many vegetables need to be harvested twice per week.

## FALL CLEAN-UP

At the end of the growing season the plants, wire hoops and plastic mulch should be removed.

There are some photodegradable mulches on the market. Testing to date has shown that most of these materials are unacceptable because they either break up too fast or not at all (Stockwin 1987, 28-29). Growers in Alaska should use conventional plastic until a better photodegradable product comes along.

Do not disk-in non-degradable plastic because small pieces of plastic will remain in the soil forever. These products break down very slowly, especially in Alaska where cool soils and long cold winters inhibit photodegradation.

The drip line connectors, supply lines, fertilizer injector and water filters should be cleaned and stored.

**Keep records** It helps to keep a written record of successes, failures and areas for improvement. Remember that plasticulture is a developing technology; there are new products and materials available each year. Staying informed and up-to-date is very important for continuing success.

## COMPANION VIDEO AVAILABLE

*Plastic Mulch and Row Covers for Vegetable Production in Alaska*, a companion video to this publication, is now available for loan. Please contact the local Alaska Cooperative Extension District Office nearest you or the ACE Distribution Center, University of Alaska Fairbanks, P.O. Box 756180, Bunnell Building, Fairbanks, AK 99775-6180. 907-474-7268.

## REFERENCES CITED


Branton, Ivan C., R. Shaw, and L. Allen. June 1972. *Solar and Net Radiation at Palmer, Alaska.* Institute of Agricultural Sciences Technical Bulletin No. 3: 3.

Chevriev, G., L. Rankin, G. Rend, and S. Cox. 1990. *Evaluation of New and Conventional Plastic Mulches for the Production of Cucumbers and Muskmelon.* Hoyt, Nebraska: Agricultural Research Station.

Lamont, W. April 1990. More Production on Less Acreage. April 1990. *American Vegetable Grower*, Volume 38, No. 4.

————. May 1990. Bed Preparation and Cropping Combinations. *American Vegetable Grower,* Volume 38, No. 5.

Maurer, A. R. and B. M. Frey, B.M. 1990. *Brown Plastic Mulch Increases Early and Total Cantaloupe Yield.* Agassiz, B.C; Ag Canada Research Station, Technical Report #77.

Purser, J. 1991, The Effect of Painted Storage Tank, Exposed Distribution Lines and Trickle Irrigation Lines Under IRT Plastic Mulch on Temperatures of Irrigation Water. *1991 Demonstration and Research Report*, University of Alaska Fairbanks Cooperative Extension Service.

Purser, J and M. Comeau. 1989. The Effect of Raised Beds, Plastic Mulches and Row Covers on Soil Temperatures. *1989 Demonstration and Research Report*, University of Alaska Fairbanks Cooperative Extension Service.

————. 1990. The Effect of Raised Beds, Plastic Mulches and Row Covers on Soil Temperatures. *1990 Demonstration and Research Report*, University of Alaska Fairbanks Cooperative Extension Service.

————. 1990 The Effect of Mulches and Row Covers on Root Maggot Infestation in Broccoli. *1990 Demonstration and Research Report*, University of Alaska Fairbanks Cooperative Extension Service.

Stockwin, W. November 1987. Photodegradable Mulches Show Improvement. *American Vegetable Grower*, Volume 35, No. 11.


**Disclaimer**

Mention or display of a trademark, proprietary product, or firm in text or figures does not constitute an endorsemant by the Alaska Cooperative Extension and does not imply approval to the exclusion of other suitable products or firms.

*For more information, contact your local Cooperative Extension Service office or Julie Riley, Extension Faculty, Agriculture and Horticulture, at 907-786-6306 or afjar@uaa.alaska.edu. This publication was reviewed by Julie Riley in June 2008.*

*The research for this publication was partially funded by a grant from the Alaska Science and Technology Foundation, grant # 90-3-143,* Plastic Mulch and Row Covers For Commercial Vegetable Production.

**Visit the Cooperative Extension Service website at www.uaf.edu/ces or call 1-877-520-5211**

1/93/JP/200

Reprinted May 2009

UNIVERSITY OF ALASKA FAIRBANKS

America's Arctic University