**Hawai'i Cooperative Extension Service**

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# VEGETABLE CROPS UPDATE

Volume 6 August1996 No. 4

# Plasticulture

*Articles on Plasticulture Systems Technology from the Illinois Fruit and Vegetables News and Penn State Hort Newsletters. For a presentation on Drip Irrigation Systems see the March 1994 issue of the UHM Veg Crops Update Newsletter (Vol. 4 No. 2).*

**Considering the Advantages and Disadvantages of Plastic Mulch**

Plastic mulch has been used on vegetables since the 1960s. In the plasticulture system, it is one of the key physical components in addition to row covers, drip irrigation lines, pumping and filtering systems. Most vegetable crops are suited to life on plastic. In particular warm season crops such as tomatoes, melons, eggplant, okra, peppers and squash have been shown to have the most significant increases in earliness, yield and quality. In commercial production three basic types of plastic are used: black, clear, and white on black. Black plastic is the most popular because of its soil warming properties and weed suppression. Clear plastic is used in cooler, northern areas where it provides for even more soil warming. However its major drawback is weed growth, making herbicide use under the plastic necessary. A fine soil seedbed and good soil/plastic contact will sometimes decrease weed success under clear plastic by "cooking" young seedlings. White on black plastic provides a cooler soil temperature than black or clear plastic, and is useful in establishing fall crops under high summer temperatures. Its reflective surface also gives some benefit in late season aphid control.

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Other types of mulch technology include photo-degradable plastics, which over time, degrade in sunlight. This is a promising product, which may help to alleviate the disposal problem in plasticulture, which is coming under greater restrictions. One drawback is that degradation of edges covered with soil is limited, and it may take several seasons to break down. Other types of specialty mulches are silver reflective (again aphid control) and the newer wavelength-selective mulches. These combine the qualities of black plastic weed suppression with the greater soil warming properties of clear plastic. Typically the colors are brown or green. Research is also ongoing as to the effects of different plastic colors such as red, blue, orange and yellow on plant growth, yield and insect control. Mulch comes in rolls 4-5 feet wide and 2000-2400 feet long. The standard thickness is 1.25-1.5 mil, though thicker or thinner plastic can be found. The mulch is either slick, or has an embossed (diamond-shaped) pattern on the film which helps hold the film to a raised bed. Special equipment is needed to lay plastic mulch and form the seedbed. A roto-tiller, bed shaper and commercial mulch layer which puts down the plastic and drip tape at the same time are essential. Specifics of mulch application will be covered in more detail later. (Tony Bratsch, author) Darin M. Eastburn, Editor, Illinois Fruit and Vegetable News, Vol. 1, No. 10, June 21, 1995.

**In Other News:**



Need Additional Info on Plasticulture? --See pg. 5

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**Crop culture: Considering specific advantages of plastic mulch**

So what are the advantages and disadvantages of using plastic mulch? We already have considered some general differences among specific mulch types. What are other more specific field advantages to mulch?

1. Probably the most important advantage is earlier crops. Higher soil temperature means faster crop development and earlier yields. Black plastic can advance harvest by 1 to 2 weeks, clear plastic by 3 weeks. This is important when early market prices are high. Growth is also increased by carbon dioxide build-up under plastic. Planting holes are the only means of escape for this gas, which creates a chimney like effect around plants. $C0_2$ is an important growth enhancer and is a limiting factor in plant growth.
2. Moisture loss is reduced under plastic. This creates more uniform water availability, and reduces irrigation frequency. However keep in mind that plant growth in plasticulture can be twice that of bare soil culture. These larger plants will require more total water, and irrigation (drip) is a necessity.
3. Weeds and herbicide use reduced. Black mulches will reduce light penetration and weeds cannot survive. Some weeds, notably nutsedge, will puncture the plastic and push through. Weeds in planting holes should be pulled early to prevent competition and damage by pulling. Herbicides are generally not required under plastic, but areas between strips should be sprayed.
4. Increased fertilizer efficiency. Fertilizers are not leached under plastic and remain available for plant uptake. With a slight slope, water is shed from the plastic and entry into plant holes is limited.
5. Soil is not compacted under plastic mulch. Once covered, the soil remains loose, friable and well aerated. Root access to oxygen is an important and limiting factor in crop growth.
6. With cultivation eliminated, root pruning does not occur. Root pruning on bare soil can delay and slow growth and maturity. Cultivation between rows is recommended, as well as herbicide application.
7. Root drowning is eliminated. Heavy rains are shed off plastic, keeping roots from being waterlogged in periods of rainy weather.
8. If a fumigant is used, plastic mulch will act as a barrier to gas escape. This is considerably more effective than roller- packed or irrigation sealed methods to contain fumigation materials.
9. Plastic mulch results in a cleaner product. Less contaminating soil is splashed onto ripening vegetables, which can cause fruit rots.
10. Less insect damage. Colored and reflective plastic mulches have been shown to repel certain insects.
11. Plastic mulch can be re-used on site to double or triple crop. With planning, two to three crops/season can be planted to reclaim the annual expense of laying plastic mulch and drip tubing. Fertilizers can be run through the system, and additional tillage is not required with each crop. (Tony Bratsch) Darin M. Eastburn , Illinois Fruit and Vegetable News, Vol. 1, No. 11 , June 28, 1995.

**MORE ON PLASTIC MULCH... A Few Disadvantages:**

Previously we have considered the advantages of producing vegetables using the plasticulture system. Yet there are a few disadvantages that should be considered as well.

1. *Removal*. Removal of mulch at the end of the season creates an additional expense. Clear plastics become brittle with age and can be disked into the soil, but small pieces of plastic remain in the field for years. Standard black plastic mulch does not break down readily and should be removed. In recent years, photodegradable black mulch that does break down over the course of a season has been developed. Its major drawback is that edges under the soil do not degrade as rapidly, leaving pieces in the field; these must be chopped and brought to the surface. Biodegradable plastics are in development and may be a future trend in ag plastics. New paper mulches also may be an answer to some of the problems associated with removal or disposal.
2. *Disposal*. Ag plastics (mulch and drip tape) are disposed of by burning or burial, or they are sent to landfills. Landfill disposal and burning have come under restrictions in many areas. We will likely see continued problems in finding a suitable way to dispose of these materials. Recycling and incineration of plastics to retrieve BTUs' are potential alternatives to disposal.
3. *Greater initial costs.* For any given crop, plasticulture increases the cost of producing that crop. Not only the annual costs of plastic mulch and drip irrigation tape must be considered, but also the investment in specialized equipment. This includes the mulch layer, bed press, mulch transplanter, pumping, piping and filtration equipment. For there to be an economic advantage to plastic mulch, these additional costs must be offset by increased income from earlier production, higher yields, and better quality produce. (Tony Bratsch) Darin Eastburn, Illinois Fruit and Vegetable News Vol. 1, No. 13 , July 12, 1995.

**Chemical News**

◊ Gramoxone Extra (Zeneca) supplemental label in Hawaii now allows precision directed spray on eggplant, tomato, and peppers (third label registration no longer required). Contact Dr. J. DeFrank at 808-956-5698, fax 808-956-3894, defrenk@hawaii.edu for a copy of the supplemental label.

◊ TERR-OGAS 98 EPA Reg. No. 5785-22 (EPA SLN NO. HI-910006) SLN registration was renewed by the EPA for use in Hawaii as a preplant soil fumigant, at dosage rates of 350-375 lb/Ac, and with an aeration period of 14 days.

**PLASTICULTURE CONSIDERATIONS: BED PREPARATION**

In a commercial setting, plastic mulch and drip irrigation tubing are applied by a machine. There are several considerations prior to plastic application. These are soil preparation, pre-plastic fumigation, and bedding and pressing the soil. Soil preparation prior to laying plastic involves normal field cultivation practices which create a fine, clod free planting bed. Plastic will stretch out better on a well worked soil. Field-prep can include the entire field or only the area where the plastic mulch strips will be applied (strip tillage with a roto-tiller).

In sandy soils, which are abrasive to plants under windy conditions, windbreaks may be advantageous. Winter wheat, barley, or rye should be planted at about the width of a small grain drill. Allow room between the strips for the rows of plastic, which will be laid at 5-6' centers. Alternatively, the area can be drilled to a solid stand of small grains, and planting strips can be tilled out at the desired on-center distance in the spring, leaving the windbreak intact. Grain strips planted in the fall will promote earliness as well as give protection to tender transplants. Spring fertilization of windbreak strips by topdressing will promote a better stand. Fumigation is usually recommended in plasticulture. Increased soil temperatures under plastic mulch can enhance the activity of certain soil insects and soil-borne diseases. Plasticulture creates a limited and altered soil environment which can aggravate a given problem. In addition, the investment in the plasticulture system may make fumigation a necessary insurance. Also, for reasons not yet fully understood, even in the absence of known pathogens, crop growth following fumigation can be better than in non-fumigated areas.

Fumigation of planting strips can be done prior to the laying of plastic, in the fall or spring, or in conjunction with plastic application in the spring. Fall and spring pre-plastic fumigation should be followed by soil pressing and a water seal. When fumigation is combined with plastic mulch application, the plastic provides the seal. Sealing in fumigation materials is critical to their effectiveness. The water seal method has the advantage of allowing cultivation and aeration later, which means faster re-entry. If the fumigation materials are sealed by plastic mulch, they are generally more effective, but take longer to dissipate. With proper fumigation, herbicide application under clear or white plastic is unnecessary.

Prior to laying plastic, the soil should be formed into beds and pressed. There are implements which will do both operations at the same time. Otherwise, the soil can be first raised using hilling discs or double-disc hillers on a tool bar. The bed is then pressed-out to a uniform height and density using a bed- press pan implement. It is important that the soil is pulled up enough to create good, sharp bed corners. Beds are commonly raised and pressed at 4-6" high and 30" wide, with a slope of 1- 1.25" from center to edge. This will allow for rain-water runoff. Spacing of bedded rows should be at 5-6' centers, depending on your equipment. Drive rows for boom spraying should also be considered. It is important to remember that prior to final field tillage and the hilling operation that soil moisture be sufficient for seed germination. (Tony Bratsch) Darin Eastburn, Illinois Fruit and Vegetable News, Vol. 1, No. 15, July 26, 1995.

**Plastic Mulch Application**

After planting beds have been shaped and pressed, plastic mulch and drip irrigation tubing are put in place simultaneously. As mentioned previously, soil moisture must be adequate and air temperature should be at least 50 degrees, which allows the plastic to stretch. The tool-bar implement used for laying plastic opens a furrow for the edges of the plastic as it unrolls from a reel. Wheels press it tight on both edges and coulters cover the edge with soil. Alignment of both front and rear disc coulters and the press wheels is important for proper application. The “finish” should be tight and soil from covering discs should not be thrown on top of the plastic.

The drip tape, also on a reel, is rolled out just in front of the plastic mulch roll. For single row crops such as tomatoes, cucumbers, and melons, the tube should be placed 4-5" off center and 2-3" deep, with the holes facing upward. The shank which directs the tape into the soil can be adjusted to any depth desired. With double row crops such as okra, eggplant and peppers, the tape should be placed in the center of the bed. Usually a roll of drip tape is about 7500 ft. long, depending on the manufacturer. Plastic mulch comes in rolls 4 to 6 ft. wide, and 2000 to 2400 ft. long. On 5-ft. centers, there are 8712 linear ft of row per acre, requiring about 3.5 rolls of plastic mulch and 1.25 rolls of drip tape per acre. On 6-ft. centers, the total would be 3 rolls of plastic and 1 roll of drip tape. After the implement is adjusted properly, anchor the starting end of the plastic with soil and the drip tape with a stake, or have someone hold the drip tape “tail”. Use a slow tractor speed, and be on the lookout for trash which may puncture the plastic. Keep the rows straight. Wind can be a problem; a cross-wind is preferable to a head wind or tail wind. Finish the row by cutting off the plastic and drip tape, leaving enough drip tape to extend past the plastic. This end-point tail will be an indicator for the condition of the line when the system is running and serve as a flush out point during maintenance. (Tony Bratsch) Darin Eastburn, Illinois Fruit and Vegetable News Vol. 1, No. 17; August 9, 1995.

**Product News**

◊ Heart of Palm approved for export: “[semi-processed] fresh or frozen palm hearts may move from Hawaii to other areas provided they are inspected, are free of quarantine pests, and consist of sections of palm stems that are white to off-white in appearance and are peeled or trimmed (to remove outer green tissues). Palm hearts should not be allowed movement if they are fresh and not processed as described” (USDA-APHIS-PPQ, 7-2-96).

**Planting and Weed Control in Plasticulture**

Vegetable crops can be established on plastic by direct seeding or, more commonly, by transplanting. For either method, growers can purchase machinery that punches holes and plants through the plastic; alternatively, this can be done by hand. For small acreages, investment in equipment should be compared with labor expenses. For extra earliness in tomatoes and peppers, large transplant container cells of 2-3 inches should be used. A 1- to 2-inch container is recommended for other crops. When planting by hand, any type of steel or pvc cylinder can be adapted for making holes in plastic and soil. A long-handled bulb planter (kept sharp) works very well. The hole should be 3-4" wide and deep enough to accommodate the transplant. Some growers will separate this into two steps, one to measure spacing and cut the hole, the other to dig and set the plant. Note: all plastic disc cutouts should be picked up. For some sensitive transplants, the discs can blow and lodge against the plant stem, and the heat build-up from the black plastic can scorch tender stems. It goes without saying that for this reason, plants should be centered in holes. When using peat containers, the lip should be removed to prevent wicking, and the top of the root ball should be lightly covered with soil. Take care to not rip plastic as plants are placed. A strong wind can widen these tears. Plants should be pressed down, and followed up with a starter fertilizer solution that is high in phosphorous. This can be done overhead or through the drip system. Take care when watering by hand that root balls are not washed out.

Weed control is probably one of the most frustrating aspects of plasticulture. Although weeds coming through the plastic are not a problem (unless its clear plastic), the weeds that emerge through the planting holes and between rows through the season must be managed. Keep in mind that only approved herbicides can be used with each particular crop. The area between the rows is not considered to be fallow.

Weeds that emerge through planting holes can be managed by hand, but care should be taken when pulling these weeds to prevent damage to crop plants. Shade from the developing crop canopy will eventually limit weed germination. Often, fumigation done prior to planting will provide a good measure of weed control. Weed control between rows is more difficult. Pre-emergent herbicides can be incorporated prior to plastic application, but the effects of bed making should be considered. These include the moving of soil from edges to make the bed, a process that may increase herbicide concentrations under the plastic, and leave exposed, disturbed edges without chemical cover. A better approach may be to apply surface-activated, pre-emergent materials after the plastic is laid, either before or after planting. Spray boom nozzles should be adjusted to direct sprays between rows. Keep in mind that sprayer drive rows should be created during the field planning process. Herbicide and insecticide application will be necessary. Hoeing, rototilling or other means of cultivation between plastic strips may be needed as the season progresses. Weeds which are “let go” can limit growth and production, harbor insects, increase disease (humidity) and make harvesting difficult. (Tony Bratsch) Darin Eastburn, Fruit and Vegetable News, Vol. 1, No. 18, August 16, 1995.

**Irrigation and Fertility in Plasticulture**

Irrigation frequency in successful plasticulture varies with soil type according to the moisture-holding capacity of each soil. Irrigation needs also vary with stages of crop growth — water uptake is greater when growth is at a maximum. An obvious final factor in water demand is weather, with heat and humidity affecting plant growth and therefore water uptake. The key point in this overview is that irrigation under plastic should be precise, and over or under watering should be avoided. Consistently applying adequate water is essential. An excellent summary on determining irrigation needs is provided in the article “Water Management in Drip-Irrigated Vegetable Production” by T.K. Hartz in the publication “Using Plasticulture Technology in Intensive Production of Vegetable Crops” (see p. 140).

Keep in mind that use of plastic mulch without drip irrigation is not recommended. Rainfall through planting holes is limited, particularly as plants begin to grow and cover the holes with stems and foliage. Lateral movement of water is limited, especially with the barrier of plastic buried at the edges of the bed. In some cases, deep-rooted crops that are drought resistant, such as watermelons, may root down to moist soils in high water table areas. Even in this situation, early, rapid growth, as well as ease of fertilizer and insecticide application through a drip system, makes it worthwhile to install. Total fertility requirements in plasticulture are not different than in open soil culture. With a drip irrigation system, however, application can be much more precise and timed with crop development. Many growers will broadcast a granular base fertilizer prior to laying out plastic, and then follow through the season with several liquid injections to fill out seasonal requirements. A fertilizer concentrate is pumped into the line, and filtered to remove particulates which can clog the line. Rates and timing vary with soils, crop type and stage of growth. The science of liquid fertilization is precise and technical — growers must accurately calculate injection and flow rates. Crop type determines total rates; stage of growth, soil type, and nutrient-holding capacity are main determinants of timing and frequency. In some cases, fertilizers are injected daily at low rates (1-2 lbs/acre on light, sandy soils), or total rates may be split only once or twice through the season (ex. 90 lbs/acre split into three 30 lb. applications on clay loam). For most situations, current information can be adapted, but a season or two may be needed to iron out the details for a given cropping system. (Tony Bratsch). Darin Eastburn, Illinois Fruit and Vegetable News, Vol. 1, No. 20, August 30, 1995.

**Double Cropping and Yield Estimates in Plasticulture**

Although this set of articles is by no means complete in addressing all of the details involved in plasticulture, it is meant to be a rough set of guidelines and to serve as basic information for the grower who is evaluating this production method. Through this series I have covered a number of topics, from considering the advantages and disadvantages of plasticulture to equipment needs, laying plastic mulch and drip tape, planting the crop and considerations such as weed control, irrigation and fertilization. The final topics are double-cropping and yield estimates.

Growers wishing to maximize production and increase returns against the annual cost of installing plastic mulch and drip tape should consider the potential for double cropping. This "intensive cropping" allows two crops or more through the growing season. After the first crop is finished, it can be burned down quickly with Roundup or Gramoxone or removed by hand. Care should be taken when pulling roots out and planting the second crop to avoid damaging the drip line and the plastic. The new crop must be fertilized entirely through the drip system. Never plant to the same crop twice in one year. Rotation between crop families of 3-4 years is advised to break disease cycles.

A few suggestions for double cropping:

| Spring | | Fall |
|---|---|---|
| peppers | > | summer squash, cukes, cole crops |
| tomatoes | > | cukes, s. squash, cole crops |
| summer squash | > | pumpkin, tomatoes, cole crops |
| eggplant | > | summer squash |
| cukes | > | tomatoes, pumpkin, summer squash |
| melons | > | tomatoes |
| cole crops | > | summer squash, pumpkin, melons, tomatoes |
| lettuce | > | summer squash, pumpkin, melons, tomatoes |
| snap beans | > | summer squash, pumpkin, melons, tomatoes |
| sweet corn | > | summer squash, tomatoes, okra, cukes |

## More Info?

For copies of any of the following additional articles contact Hector Valenzuela at tel 808-956-7903, fax 808-956-3894, hector@hawaii.edu:

◊ Components of a Plasticulture System
◊ Injecting chemicals into Drip Irrigation Systems
◊ Water management in Drip Irrigation Systems
◊ Fertility management in Drip Irrigation Systems
◊ Weed management in Plasticulture Systems
◊ Fumigation and solarization in Plasticulture Systems

Strawberries on plastic are not common yet in the area, however they can be followed by each of these crop groups. A third crop in the season is possible, but spring and fall crop frost tolerance should be considered, as well as rotation of crop groups. An example may be a sequence of lettuce, tomatoes and Brussels sprouts.

One of the advantages we have discussed about plasticulture is an increase in earliness, in some cases by several weeks, depending on the crop. This contributes to the overall increase in yield from enhanced growth and the extended cropping season This overall yield increase should be considered by growers. A few potential yield expectations on plastic mulch with drip irrigation are:

| Crop | Average Yield/Acre |
|---|---|
| Large, ribbed muskmelons: | 8000 - 9000 fruits - (32,000 - 54,000 lbs) |
| Small,smooth muskmelon: | 12,000 -15,000 fruits - (36,000 - 60,000 lbs) |
| Cukes: | 1200 bushel (55 lb/bu or 66,000 lbs) |
| Peppers: | 1600 bushel (25 lbs/bu or 40,000 lbs) |
| Squash: | 800 bushel (45 lbs/bu or 36,000 lbs) |
| Tomatoes: | 3200 boxes (20 lb/box or 64,000 lbs) |
| Watermelon: | 3000 fruit (24,000 - 60,000+ lbs) |



The above yield estimates and double cropping suggestions were taken from "Plastic Mulches for Vegetables", by Charles Marr and William Lamont, Cooperative Extension Service, Kansas State University. Yield under Illinois conditions may vary from these estimates. Other information for this series was also adapted from this publication, as well as from "Using Plasticulture Technology for the Intensive Production of Vegetable Crops," published by the American Society for Plasticulture and the American Society for Horticultural Science. (Tony Bratsch), Darin Eastburn, Illinois Fruit and Vegetable News Vol. 1, No. 20, August 30, 1995.

**OPPORTUNITIES FOR PLASTICULTURE IN ORGANIC FARMING SYSTEMS**

*Dr. William J. Lamont Jr*, Kansas State University, Dept. of Horticulture, Forestry and Recreation Resources.

*Introduction* — "Does modern plastics technology have a place in organic vegetable farming systems research and farming enterprises?" is a raised frequently among university personnel and the organic farming community. The answer will in many instances depend on the personal philosophy of the individual respondent—ranging from an absolute, emphatic "no" for the organic purist to "yes" from a producer who considers "organics" mainly as limited or nonuse of pesticides and synthetic fertilizers.

For those of us at the universities who are involved in research programs aimed at developing new organic farming systems, and extension personnel that are extending this information to growers, this question needs to be addressed.

*Discussion* — Before the advent of modern commercial synthetic fertilizer (i.e., prior to World War II), vegetable producers routinely used considerable amounts of livestock manures, soil-improving legumes in rotation with vegetables and other agronomic crops, and green manure crops in their farming operations. After World War II there was a shift away from integrated or mixed farming operations that produced vegetables, livestock, and agronomic crops to more-specialized or single-commodity-type farm enterprises. This change resulted in a scarcity of manure, which led to a rapid increase in its price. This shift also resulted in the decreased use of nitrogen-supplying legumes by many vegetable producers. This situation prompted researchers to determine if acceptable yields were possible using new synthetic fertilizers. The general conclusion drawn from the research was that synthetic fertilizers were capable of replacing, to a large extent, the nutrient value of manures and soil-improving legumes.

The commercial agriculture sector is again, I believe, experiencing a fundamental change, as producers look for alternative cropping systems that not only make sense from an economic standpoint, but are more compatible with the environment. The question becomes—do we include modern plastic technology, i.e., plastic mulches, drip irrigation, and row covers, in these new organic farming systems? I believe that we should, for the following reasons.

First, the use of plastic mulches, drip irrigation, and row covers are management tools that offer both organic and nonorganic vegetable growers many benefits. Some of the more obvious are: 1) earlier crops, 2) higher yields, 3) higher-quality produce, 4) weed control, 5) reduced water use, 6) reduced soil erosion, 7) reduced disease incidence, 8) reduced fertilizer leaching, and 9) increased opportunity for insect management. The major drawback or negative side to plastics is proper disposal of the used product and it concerns me as a researcher and as a citizen. This issue is being addressed vigorously by the plastic industry and in our own society, the American Society of Plasticulture, which has formed a Plastics Disposal Committee made up of representatives of the major manufacturers of agricultural plastic products. They are approaching the disposal problem from two directions; 1) recycling and 2) energy reclamation of used agricultural plastics. The value of the plastic product is not lost if it is recycled or incinerated to reclaim the BTU' locked inside. The proper disposal of plastic waste is by no means limited to the agricultural sector.

As the agricultural sector seeks redirection, I believe that the opportunity exists to evaluate new production systems that incorporate the latest in plastics technology with organic fertilizers and ask "Can we maximize the yields of selected vegetables (tomatoes, muskmelon, watermelon, cucumber, pepper, eggplant, okra, etc.) per unit of land using the latest plasticulture technology and various organic fertilizers?"

I believe that, by using plastics technology and organic fertilizers, growers will be able to double or triple productivity per unit of land while conserving limited water resources. There will be the opportunity to reduce fertilizer leaching and thus prevent groundwater contamination. The need for mechanical weed control is reduced, resulting in labor savings for organic producers. Another attractive benefit is assistance in insect management afforded by reflective mulches and row covers. Disease pressure can be lessened by creating a microclimate around the crop that is unfavorable for diseases. Plasticulture systems can also promote and enhance soil productivity and reduce soil erosion by wind and water.

*Conclusions* — In closing, I believe that plastic technology has and will have, an even greater role in both modern organic and non-organic based vegetable production systems. It may be that plastic technology (plastic mulch, drip irrigation, row covers and high tunnels) will be the common bridge that links both the organic and non-organic production systems. I firmly believe that both production systems are moving closer together and plastic technology is a management tool that allows all producers to maximize yields, improve quality of their produce, and minimize negative influences on the environment such as, leaching of fertilizers and potential contamination of water resources.

A final point is that plastics consume certain input/resources during their manufacture and it is imperative that after being used, they are either recycled or properly incinerated to capture the energy locked inside these products. (Penn State Horticulture Vegetable Newsletter, Michael D. Orzolek, Vol. 6 No. 10, 1994)

**Hydroponics Corner: Aluminum does not Accumulate in Lettuce foliage**

Aluminum Does not Accumulate in Lettuce Foliage when grown by a Non-circulating hydroponic method in recycled Aluminum Beverage Cans, by B.A. Kratky, L.A. Petersen, and A.R. Krueger.

Abstract: 'Red Fire' leaf lettuce foliage tissue Al concentrations were similar when grown in plastic containers or new aluminum cans filled with growing medium and immersed in 6 cm of non-circulating nutrient solution. Using aluminum beverage cans as planting containers for lettuce production with a non-circulating hydroponic method is another way to recycle aluminum cans. (J. Haw. Pac. Agric. 6:1-8(1995)).

## AGRICULTURAL POLYETHYLENE MULCH MANUFACTURERS

*M. D. Orzolek*

This list contains the name and address of the basic manufacturers of agricultural polyethylene plastic mulch. Distributors of the manufactured plastic mulch are not included in this list because of the large numbers in the U.S.

1. Mid South Extrusion
   2015 Jackson St. , Monroe, LA 71202
   1-800-256-7239 FAX - 318/325-7524
   Products - Black, white or clear mulch in a wide range of sizes and gauges. Embossed or smooth.
2. Climagro
   3235 Sartelon Street
   St-Laurent, Quebec, Canada H4R 1E9
   Phone - 514/454-5352 FAX - 514/454-6638
   Products - wide range of colors and sizes including IRT films.
3. AT Plastics Inc.
   111 Hilltown Village Center
   Chesterfield, MO 63017
   Phone - 314/532-4008 FAX - 314/532-7556
   Products - Greenhouse plastic film
4. Four Seasons Agricultural Products
   870 The Exchange, Suite 200
   Atlanta, GA 30339
   phone - 404/953-4567 FAX - 404/618-7080
   Products - Black, clear, and white smooth. Black embossed. Range of widths and thickness.
5. PlastiTech
   Box 750
   St-Remi, Quebec, Canada J0L 2L0
   phone - 514/454-3961 FAX - 514/454-6638
   Products - Wide range of colors, widths, and thickness for mulch, row covers and bale wrapping.
6. Tredegar Film Products
   1100 Boulders Parkway
   Richmond, VA 23225
   Phone - 804/330-12356 FAX - 804/330-1201
   Products - Greenhouse plastic film
7. Plastigone Technologies, Inc.
   P.O. Box 165618
   Miami, FL 33116
   Phone - 305/274-1233
   FAX - 305/598-3404
   Products - wide range of colors and sizes including Photodegradable films.
8. Agplast - Leco
   36 Tidemore Ave.
   Rexdale, Ontario, Canada M9W 5H4
   Phone - 416/742-3060
   Products - wide range of colors and sizes including Photodegradable films.
9. Edison Plastics
   Box 52890, South Plainfield, NJ 07080
   phone - 908/752-6660
   FAX - 908/752-3756
   Products - wide range of colors and sizes.
10. AEP Industries, Inc.
    125 Phillips Ave.
    South Hackensack, NJ 07606
    phone - 800-999-2374
    Products - wide range of colors and sizes including silver films.
11. North American Film Corp.
    19 Depot St.
    Bridgeport, PA 19405
    phone 610/277-3155
    Coextruded white/white black/silver, and silver/white mulch.
12. Polyon Inc.
    Kibbutz Barkai, Israel 31860
    U.S. Rep - PolyWest31106 2nd St.
    Encinitas, CA 92024
    Phone - 619/943-7795
    FAX - 619/633-1265
    Products - wide range of colors and sizes including IRT films.
13. CT Films (Consolidated Thermoplastics)
    R.D. 2, Box 67
    Harrington, DE 19952
    phone 302/398-8115
    Products - wide range of colors and sizes including Photodegradable films.
14. Rochelle Plastic Film Inc.
    Box 606, Hwy 38 W.
    Rochelle, IL 61068
    Phone - 815/562-7848
    FAX - 815/562-7849
    Products - wide range of colors and sizes
15. Sonoco Products Co.
    1 North Second St.
    Box 160
    Hartsville, SC 29550
    phone - 803/339-6134
    FAX - 803/332-1277
    Products - wide range of colors and sizes including bale wrapping films.
16. Blako Industries Inc.
    Box 179
    Dunbridge, OH 43414
    Phone - 419/833-4491
    FAX - 419-833/5733
    Products - wide range of colors and sizes.

(Penn St Horticulture Vegetable Newsletter, Michael D. Orzolek, Peter A. Ferretti, Vol. 7, No. 1, 1995)

# AG PLASTICS AND DRIP IRRIGATION: IS IT FOR US?

For this season most vegetable growers have already decided on the crop production system most suited for their situation. There have been, however, a number of inquiries from growers considering or who are for the first time this year giving plastic mulch and drip irrigation a trial run. In a series of articles in the newsletter this summer, it is hoped that some of the mysteries and considerations involved in using this production system be brought to light. In recent years a handful of growers in the state have tried plastic mulch and drip irrigation, and have either been successful or unsuccessful in implementing this type of system.

A number of growers in southern Illinois have been very successful in raising peppers and tomatoes this way, but water quality and line plugging has been a hurdle. Other growers are experimenting and committing limited acreages to plastic and drip. Growers in Indiana are adapting melon culture to life on plastic as well. But for the most part, open soil culture of vegetables still reigns in the Midwest, particularly with lower value vegetable crops such as cabbage and pumpkins. Due consideration should be given however, to the pros and cons of "plasticulture" especially when it comes to higher value vegetable crops and the realities of market competition. Through the American Vegetable Grower magazine all of us have read about the extensive and almost exclusive use of this technology in certain crops, particularly in the western and southern growing regions. Plasticulture technology though has been slow to catch on in the Midwest and eastern states. This may be for a number of reasons, with economics and cost a major limitation, followed by climate, soil and water quality factors, disposal problems and crop suitability. Lack of good information, available expertise and help in implementation has in some cases been a limiting factor for growers. However in recent years this technology has been better refined and adapted to Midwestern conditions and many of the "bugs" have been worked out, making this technology more accessible and feasible as a viable production system option. Keep in mind that plasticulture is an inclusive term, which for our purpose involves not only the use of plastic mulch, but also plastic drip irrigation tape and associated equipment as essential components. For all practical purposes the two (mulch + drip) are inseparable components of the plasticulture "system". Rarely is one recommended without the other. For this series however, each aspect of the system: plastic mulches, drip irrigation, fumigation, fertigation and considerations in system implementation, adaption and maintenance will be discussed separately. (Tony Bratsch) Darin Eastburn, Illinois Fruit and Vegetable News, Vol. 1, No. 9, June 14, 1995

# A Manufacturer's Experience with Disposal of Plastic Mulch

Keith S. Williamson, Sonoco Products Company, Hartsville, SC 29550

Since its entry into the plastic mulch market in 1990, Sonoco Products Company has actively dealt with the problem of mulch disposal. Among Sonoco's efforts have been recycling, incineration, machinery development, laboratory analysis, and source reduction.

As one of the world's largest recyclers of paper and plastic film, Sonoco has thoroughly investigated recycling plastic mulch and carried it out on a limited scale. Used film has been taken to commercial recyclers for cutting, washing, drying, and repelletizing. While the quality of resin from recycled mulch seems adequate for making some less technically demanding products, we have concluded that the current economics of mulch recycling are unfavorable even for these limited applications.

Incinerating mulch to produce electricity has been done, by Sonoco, on a much larger scale than recycling. The high BTU value of plastic makes this an attractive alternative assuming the material is in a form that can be handled by the incinerator. The economics of disposal are adversely affected by the freight costs to the incineration facilities and tipping fees. A grower charge has helped Sonoco offset these expenditures.

Disposal by landfilling is a viable option for most mulch users because of the convenience of landfills and the comparatively low costs of freight and tipping fees. Also, the more compact the material, the better suited it is for landfills.

Sonoco has developed a portable baler to increase the ease of handling used mulch. This piece of machinery reduces the costs of collection, storage, freight, loading and unloading Measures have been taken to ensure the environmental safety of mulch firm disposal. Only licensed incinerators have been utilized. Independent laboratory tests of samples of used Sonoco mulch have indicated that this material is non-hazardous for recycling, storing, and landfilling. The reduction of the source material is another way that Sonoco has impacted mulch disposal. By utilizing a material technology that reduces the thickness of plastic needed to provide a given level of performance, Sonoco has proportionately reduced the quantity of plastic for disposal. This source reduction is as great as 50 percent for some products. In its role as a responsible manufacturer of plastic mulch, Sonoco is committed to continuing to address the disposal issue. (Horticulture Vegetable Newsletter, Michael D. Orzolek, Vol. 6 No. 10, 1994)

**AGRICULTURAL PLASTICS DISPOSAL**

A current list of plastic recyclers is listed below. The name of the company and/or contact is included; these companies have taken used agricultural films under certain conditions. For more information, contact the company/person
for specific details on their plastics disposal policies.
Tech Polymers, Naples, FL - Marcel Vezina, 813/597-2000
Arkansas Plastic Recyclers, Stuttgart, AR - Brent Blackmon, 501/673-7458 (now Orion Pacific Co.)
A to Z Recycling, Marshfield, WI - Jim Cherney, 715/384-9308
Advanced Environmental Recycling Technology, Rogers, AR - Doug Brooks, 501/636-1552
Poly Pro Products, Thornton, IL - Charlie Ward, 815/727-3739
Andros Engineering, Santa Margarita, CA (trickle) - Matt Andros, 805/438-4222
Talco Plastics, Whittier, CA - John Shedd, 310/699-0550
American Poly Inc., North Reading, MA - Bob Popalo, 508/664-4233
Thermacycle, Fort Meyers, FL (burning systems) - Vinson Clifford, 813/337-1697
Plastic Recycling Services, Parkersburg, WV - Dick Bonnet, 304/485-8062
Webster Industries, Montgomery, AL - Sonny Boyd, 508/532-2000

**Verticillium Wilt Spreading in Coastal California Cauliflower**

*Randy Hamasaki*

Cauliflower growing in certain areas of the coastal region of California began to exhibit unusual disease symptoms in 1990. Two years later, the disease has spread throghout the coastal areas of California, and threatened the state's cauliflower industry which has a gross value of more than $158 million. The disease causing fungus was identified as *Verticillium dahliae*. Disease symptoms do not develop until the plant develops flower heads. At that stage, the lower leaves turn yellow and begin to dry and fall off. The entire canopy may wilt during the heat of the day. In California, the symptoms develop only on summer and fall cauliflower crops and have not been observed during winter or early spring. Internal symptom is an extensive black discoloration of the vascular areas of stems and roots. Diseased plants are stunted and produce small heads of low quality. The fungus is able to survive for a long time in soil as durable resting structures called microsclerotia.

Bok choy, head cabbage, and Chinese cabbage were also highly susceptible to this disease. Broccoli often exhibited internal discoloration but not the leaf yellowing, defoliation, wilting, or stunting. The fungus has not been recovered from broccoli plants with the internal symptom. California researchers will be doing further work in determining the host range of the disease, investigating whether this disease is a distinct strain of the fungus, and evaluating the use of broccoli amendments for reducing soil inoculum levels. Hawaii growers noticing similar symptoms on brassica crops should have such plants tested in a laboratory. Source: California Agriculture 50(2):24-27.

**USDA Honolulu County FSA Office**

*Randy Hamasaki*

The Honolulu County Farm Service Agency (FSA) has moved to the Hawaii Agricultural Research Center (formerly Hawaiian Sugar Planters' Association building) in Aiea. The following is their new address and phone numbers: USDA Honolulu County FSA Office, 99-193 Aiea Heights Drive, Suite 114, Aiea, Hawaii, 96701, Tel. 808-483-8609, Fax: 808-483-8615. Congress passed laws in 1995 requiring the USDA to restructure. The goal is to establish USDA Service centers in partnership with people and communities, to deliver agricultural, rural development and natural resource programs with a continuity and quality of service that will achieve maximum efficiency.

As a result of the restructuring process with the USDA, the Farm Service Agency has recently come into existence. The Farm Service Agency, referred to as FSA, is an agency comprised of what was formerly known as the Agricultural Stabilization and Conservation Service (ASCS) and Farmers Home Administration (FmHA). FSA will administer farm commodity, crop insurance, and conservation programs as well as farm ownership and operating loans.

In an effort to reach the objective of "One Stop Service," a USDA Service Center has been opened. FSA is now housed with the Natural Resource Conservation Service (NRCS), and Rural Development (RD) field offices at the HSPA Building in Aiea. The collocation of USDA agencies will enable the USDA to establish a one stop service center where agricultural, rural development and natural resource programs can be administered as if delivered by a single agency.

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## DISCLAIMER

Reference to a company or product name does not imply approval or recommendation of the product by the Cooperative Extension Service, College of Tropical Agriculture and Human Resources, the University of Hawaii and its employees, or the United States Department of Agriculture, to the exclusion of others which may be suitable.

The pesticide information provided here should be used only as a guide. This is not a recommendation; consult an expert. Before purchasing a pesticide, the user should carefully read the entire label to determine if the pesticide is appropriate (legal) for the particular use. Labels frequently change without notice.

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