What Are the Components of a Plasticulture Vegetable System?

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Summary. Plasticulture, simply defined, is a system of growing crops wherein a significant benefit is derived from using products derived from plastic polymers. The discovery and development of the polyethylene polymer in the late 1930s, and its subsequent introduction in the early 1950s in the form of plastic films, mulches, and drip-irrigation tubing and tape, revolutionized the commercial production of selected vegetable crops and gave rise to plasticulture. The later discovery of other polymers, such as polyvinyl chloride, polyproplene, and polyesters, and their use in pipes, fertigation equipment, filters, fittings and connectors, and row covers further extended the use of plastic components in this production system. The plasticulture system consists of plastic and nonplastic components: plastic mulches, drip irrigation, fertigation/chemigation, fumigation and solarization, windbreaks, stand establishment technology, season-extending technology, pest management, cropping strategies, and marketing.

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To be competitive in today's marketplace, vegetable growers must strive continually for high quality, superior yields, and extended production cycles that include spring and fall crops. Plasticulture is a management tool that enables vegetable producers to realize greater returns per unit of land. Such a system may offer many benefits:

- Earlier crop production (7 to 21 days earlier)
- Higher yields per acre (two to three times higher)
- Cleaner and higher quality produce
- More efficient use of water resources
- Reduced leaching of fertilizers, especially on lighter, sandy soils
- More efficient use of fertilizer inputs through fertigation technology
- Reduced soil and wind erosion
- Potential decrease in the incidence of disease
- Better management of certain insect pests
- Fewer weed problems
- Reduced soil compaction and elimination of root pruning
- Opportunity to double- or triple-crop with maximum efficiency

To realize these benefits, one needs to integrate the components of a plasticulture system. The components include plastic mulches, drip irrigation, chemigation/fertigation, soil fumigation or solarization (may or may not be needed depending on location), windbreaks, stand establishment technology, season-extending technology, pest management, cropping strategies, and marketing. The plasticulture system can be used effectively by growers with small or large acreage. The basic principles and intensive management required to operate a plasticulture system successfully are similar, regardless of the size of an operation. A component list for a 20-acre (8.1-ha) plastic mulch/drip irrigation system is presented in Table 1. The crops that have shown significant increases in earliness, yield, and/or fruit quality with the use of plasticulture include muskmelon, tomato, pepper, cucumber, squash, eggplant, watermelon, and okra. Other crops, such as sweet corn, snap bean, and pumpkin/decorative gourds, cole crops, and herbs, have shown similar responses and may lend themselves to double- or triple- cropping strategies.

Plastic mulches

Plastic mulches have been used commercially on vegetables since the early 1960s. Much of the early university research before 1960 was conducted on the impact of color (black and clear) on soil and air temperature, moisture retention, and vegetable yields (Emmert, 1957). Most plastic mulches used in the United States are made of either linear low- or high-density polyethylene and are 5 to 1.25 mil thick (0.012 to 0.031 mm), 48 to 60 inches (122 to 152.4 cm) wide, and on rolls 2000 to 4800 feet (607 to 1463 m) long, depending on the thickness of mulch. The linear high-density polyethylene is used to reduce weight and cost and is stronger than the same thickness of low-density polyethylene. The plastic mulch is either slick (smooth) or embossed with a diamond-shaped pattern. Thispattern helps reduce expansion and contraction, which results in the loosening of the mulch from the raised bed. The raised bed is generally 4 to 6 inches (10 to 15 cm) high and 30 inches (76 cm) wide and has a slope of 1.25 inches (3.2 cm) from the center to the edge. Soil under a raised bed will warm up quicker in the spring and also will shed excess water off the bed into the row middles, thus keeping the crop plants drier and preventing deterioration in quality of the product.

Plastic mulches directly impact the microclimate around the plant by modifying the radiation budget (absorbitivity vs. reflectivity) of the surface and decreasing the soil water loss (Liakatas et al., 1986; Tanner, 1974). The color of a mulch largely determines its energy-radiating behavior and its influence on the microclimate around a vegetable plant. Color affects the surface temperature of the mulch and the underlying soil temperature. Ham and Kluitenberg (1994) found that the degree of contact between the mulch and soil, often quantified as a thermal contact resistance, can affect greatly the performance of a mulch. If an air space is created between the plastic mulch and the soil by a rough soil surface, soil warming can be less effective than would be expected from a particular mulch.

The soil temperature under a plastic mulch depends on the thermal properties (reflectivity, absorbitivity, or transmittancy) of a particular material in relation to incoming solar radiation (Schales and Sheldrake, 1963). Black plastic mulch, the predominate color used in vegetable production, is an opaque blackbody absorber and radiator. Black mulch absorbs most UV, visible, and infrared wavelengths of incoming solar radiation and reradiates absorbed energy in the form of thermal radiation or long-wavelength infrared radiation. Much of the solar energy absorbed by black plastic mulch is lost to the atmosphere through radiation and forced convection. The efficiency with which black mulch increases soil temperature can be improved by optimizing conditions for transferring heat from the mulch to the soil. Because thermal conductivity of the soil is high relative to that of air, much of the energy absorbed by black plastic can be transferred to the soil by conduction if contact is good between the plastic mulch and the soil surface. Soil temperatures under black plastic mulch during the daytime are generally 5 °F (2.8 °C) higher at a 2-inch (5-cm) depth and 3 °F (1.7 °C) higher at a 4-inch (10-cm) depth compared to those that of bare soil.

In contrast, clear plastic mulch absorbs little solar radiation but transmits 85% to 95%, with relative transmission depending on the thickness and degree of opacity of the polyethylene. The

Table 1. *Components list for 20-acre (8.1-ha) plasticulture system.*[z]

Component description	Quantity	Type unit	Unit price ($)	Total price ($)
Engine and pump (14-hp engine and Berkley pump)	1	ls	4000.00	4000.00
24” media filter and fertilizer injector		pr	3200.00	3200.00
Layflat, 4"	1800	ft.	1.01	1818.00
Layflat, 3"	1500	ft.	0.81	1215.00
Drip tape (7500'/Roll)	20	ea.	135.00	2700.00
Plastic mulch (1.0 mil black embossed 4000'/Roll)	40	rl	80.00	3200.00
Zone control/PRV valve, 3"	4	ea.	180.00	720.00
Insert tee, 4"	1	ea.	31.62	31.62
PVC tee (S × T), 4" × 3"	4	ea.	14.34	57.36
Insert ELL, 4"	2	ea.	21.25	42.50
Insert × slip adapter - 4"	6	ea.	11.26	67.56
PVC bush., 4" × 2"	2	ea.	5.35	10.70
PVC tee (S × T) - 3"	4	ea.	10.87	43.48
PVC nipple, 3" × 4"	8	ea.	5.52	44.16
Insert × slip adapter, 3"	8	ea.	8.92	71.36
Insert male adapter, 3"	8	ea.	5.30	42.40
PVC ELL (S × T), 3"	8	ea.	6.80	54.40
PVC bush., 3" × 2"	8	ea.	2.28	18.24
PVC nipple, 2" × 4"	10	ea.	1.49	14.90
Air release valve, 2"	10	ea.	27.00	270.00
PVC ELL, 2"	2	ea.	1.38	2.76
Hose clamp, 4"	14	ea.	1.72	24.08
Hose clamp, 3"	16	ea.	1.47	23.52
Tape × layflat connectors	480	ea.	0.95	456.00
Layflat hole punch	2	ea.	75.00	150.00
Subtotal				18,278.04
Tax 1%				182.78
Total				18,460.82

[z]Only plastic mulch and drip irrigation components included. The plan assumes field to be level with surface water supply (pond) adjacent to field. System is basic with media filters, venuri injector, and 14-hp engine and pump. Additional equipment that should be cosidered includes secondary filters, additional pressure regulators, pressure gauges, and water meters. Water samples and field topography should be analyzed beefore actual drip design. No sales tax, freight, or field labor were included in the estimate. Source: Henry Johnson, Johnson Irrigation Co., Advance, N.C.

under surface of clear plastic mulch usually is covered with condensed water droplets. This water is transparent to incoming shortwave radiation but is opaque to outgoing longwave infrared radiation, so much of the heat lost to the atmosphere from a bare soil by infrared radiation is retained by clear plastic mulch. Thus, daytime soil temperatures under clear plastic mulch are generally 8 to 14 °F (4.4 to 7.8 °C) higher at a 2-inch (5-cm) depth and 6 to 9 °F (3.3 to 5.0 °C) higher at a 4-inch (10-cm) depth compared to those of bare soil. Clear plastic mulches generally are used in the cooler regions of the United States, such as the New England states. Using clear plastic mulch will require the use of a herbicide, soil fumigant, or solarization to control weeds.

White, coextruded white-on-black or silver reflecting mulches can result in a slight decrease in soil temperature [–2 °F (1.1 °C) at a 1-inch (2.5 cm) depth or –0.7 °F (0.4 °C) at a 4-inch (10-cm) depth compared to bare soil], because they reflect back into the plant canopy most of the incoming solar radiation (Ham et al., 1993). These mulches can be used to establish a crop when soil temperatures are high and any reduction in soil temperatures is beneficial. Depending on the degree of opacity of a white mulch, it may require the use of a fumigant or herbicide because of the potential weed growth.

Another family of mulches includes the wavelength-selective or photoselective mulches, which selectively transmit radiation in some regions of the electromagnetic spectrum but not in the photosynthetic wavelength (Loy et al., 1989). These mulches absorb photosynthetically active radiation (PAR) and transmit solar infrared radiation, providing a compromise between black and clear mulches. The infrared-transmitting (IRT) mulches afford the weed control properties of black mulch but are intermediate between black and clear mulch in terms of increasing soil temperature. The color of these mulches can be blue-green (IRT-76, AEP Industries Inc., Moonachie, N.J., or Climagro, Leco Industries, Inc., Quebec, Canada) or brown (Polyon-Barkai, Poly West, Encinitas, Calif.). These mulches warm up the soil like clear mulch but without the accompanying weed problem.

Additional colors that are being investigated currently are red, blue, yellow, gray, and orange, which have distinct optical characteristics and thus reflect different radiation patterns into the canopy of a crop, thereby affecting plant growth and development (Decoteau et al., 1989; Orzolek and Murphy, 1993). This light reflectivity can affect not only crop growth but also insect response to the plants grown on the mulch. Examples are yellow, red, and bluemulches, which increased green peach aphid populations (Orzolek and Murphy, 1993), especially the yellow color, which has long been used in greenhouses to monitor insects. Mulches with a printed silver surface color have been shown to repel certain aphid species and reduce or delay the incidence of aphid-borne viruses in summer squash (Lamont et al., 1990). Similar to a white color mulch, the degree of opacity of a gray mulch may require a herbicide or fumigant to be used to prevent weed growth. Some of these colored mulches (blue and red) have a dramatic impact on the soil temperatures, raising soil temperatures to 167 and 168 °F (60.6 and 61.3 °C), respectively, at the 2-inch (5.1-cm) depth when the ambient air temperature was 104 °F (25 °C) (Lamont, unpublished data).

Photodegradable plastic mulch is one alternative to conventional plastic mulches with their retrieval and disposal problems (Ennis, 1987). Although photodegradable plastic looks very much like other plastic mulches when it is installed, it can be broken down by ultraviolet sunlight. The actual rate of breakdown depends on several factors, including temperature, the proportion of the plastic shaded by the crop, and the amount of sunlight received during the growing season. When using photodegradable plastic mulch, keep in mind that decomposition of the buried edges (commonly referred to as the tuck) is initiated by lifting them out of the soil and exposing them to sunlight.

Research is being conducted currently on a photodegradable mulch overlay system, in which the top layer of black photodegradable mulch degrades and increases the exposure of a white nondegradable layer (Graham et al., 1995). This particular change would lower the soil temperature later in the growing season. The potential use for this would be in a double-cropping system, where the same mulch is used for spring and fall crops (such as bell peppers planted in the spring followed by squash in late summer). The concept could be pursued further with several color changes during the season. The color changes would be accomplished by having more than one coextruded layer of differently pigmented photodegradable plastic on top of the nondegradable mulch.

Drip irrigation

Drip irrigation is another cornerstone in a plasticulture production system. It should be used with plastic mulch to obtain the greatest benefit. Water savings with drip irrigation can amount to as much as 80% compared to other irrigation methods (Bogle and Hartz, 1986). You also can double- or triple-crop by fertilizing succeeding crops through the drip irrigation tape or tubing using a fertilizer proportioner. This allows greater production for the investment in plastic mulch and drip irrigation equipment. The major components of a drip irrigation are 1) drip tubes or drip tapes; 2) filters—media, screen or disc; 3) pressure regulators—spring or valve; 4) valves—hand-operated, hydraulic, or electric; 5) controllers—simple time clocks to complex computer controlled units that run many zones; 6) injectors—for introducing chemicals and fertilizers into the irrigation system.

Because vegetables are planted in rows, a drip tube or tape is used to wet a continuous strip along the row. The drip tape is generally 8 mil (.20 mm) thick and usually is used for 1 year and then discarded, whereas drip tube is heavier, 25 mil (0.64 mm) thick and retrieved and used again. The outlet holes can be spaced from 8 to 24 inches (20 to 61 cm) apart; 12 inches (30.4 cm) is a common spacing for vegetable crops. Companies like Roberts Irrigation Products, San Marcos, Calif.; T-Systems International, San Diego, Calif.; Chapin Watermatics, Watertown, N.Y.; and Hardie Irrigation, Laguna Calif.; manufacture drip tapes, and Netafim, Altamonte Springs, Fla., is a major manufacturer of drip tubing.

The source of the water supply for drip irrigation is extremely important and can include wells, ponds, lakes, municipal lines, or pits. Well-water sources generally are fairly clean and may require only a screen or disc filter to remove particles. It is very important to determine if precipitates or other contaminants in the water could cause a plugging problem. A water analysis is essential before installing a drip system. Municipal sources generally provide documentation of water quality tests, making it easier to spot potential problems.

Surface water such as streams, ponds, pits, or rivers contain bacteria, algae, or other aquatic life. Consequently, the use of agricultural sand media filters with surface water is an absolute necessity. These filters are generally more expensive than screen or disc filters. Assistance from an irrigation dealer or professional familiar with drip irrigation system design and installation is recommended strongly and can be very helpful in avoiding problems later. Other major considerations are crop water management and maintenance of the drip irrigation system.

Fertigation

Once a drip irrigation system has been installed, it makes economic and environmental sense to fertilize the crop via the drip system as needed. If done properly, this results in more efficient use of fertilizers and probably lessens fertilizer contamination of groundwater through leaching below the plant root zone (Hochmuth, 1992).

Table 2. ***Plant spacing for plasticulture.***

Crop	In-row spacing [inches (cm)] Single row	In-row spacing [inches (cm)] Double row	Between-row spacing on plastic beds [inches (cm)]
Common on plastic			
Cucumber (slicers)	12–18 (30.5–45.7)	9–18 (22.8–60.9)	12–14 (30.5–35.6)
Cucumber (pickles)	12–18 (30.5–45.7)	9–18 (22.8–60.9)	12–14 (30.5–35.6)
Eggplant	18–24(45.7–60.9)	18–30 (45.7–76.2)	14–16 (35.6–40.6)
Honeydew	18–24 (45.7–60.9)	---	---
Lettuce (leaf)	---	6–9 (15.2–22.8)	9–12 (3 rows) (22.8–30.5)
Muskmelon	18–24 (45.7–60.9)	---	---
Okra	12–18 (30.5–45.7)	18 (45.7)	14–16 (35.6–40.6)
Pepper	12–16 (30.5–40.6)	12–16 (30.5–40.6)	12–14 (30.5–35.6)
Pumpkin	24–48 (60.9–122)	---	---
Squash			
Summer	12–18 (30.5–45.7)	16–24 (40.6–60.9)	14–16 (35.6–40.6)
Winter	18–48 (45.7–122)	---	---
Tomato	18–24 (45.7–60.9)	---	---
Watermelon	24–48 (30.5–122)	---	---
Less common on plastic[z]			
Broccoli	---	8–12 (20.3–30.5)	9–12 (22.8–30.5)
Cabbage	---	9–12 (22.8–30.5)	12–16 (30.5–40.6)
Cauliflower	18 (45.7)	18–24 (45.7–60.9)	14–18 (35.6–45.7)
Chinese cabbage	12 (30.5)	9–12 (22.8–30.5)	12–14 (30.5–35.6)
Collard	9–12 (22.8-30.5)	12–18 (30.5–45.7)	12–18 (30.5–45.7)
Sweet corn	6 (15.2)	6–12 (15.2–30.5)	12–18 (30.5–45.7)
Greens	---	6–12 (15.2–30.5)	9–12 (2–3 rows) (22.8–30.5)
Onion	---	4–6 (10–15.2)	4–10 (3–6 rows) (10–25)

[z] *Used in double- or triple-cropping.*

In its broadest sense, fertigation is feeding a crop by injecting soluble fertilizers into water in the irrigation system.A variety of injectors [vacuum (venturi type) pumps—small electric powered or those powered by the irrigation water] are available to perform this operation. If fertigation is to be successful, irrigation scheduling must be coordinated closely with nutrient needs of the crop (Clark et al., 1991). To be a good fertigator, a grower first needs to be a good irrigator.

Strip fumigation and soil solarization

In many production areas, especially the southeastern United States and California, sanitizing the soil is a requirement. Plastic mulches are used with chemical fumigants or as covers during soil solarization. In row or strip application of a fumigant, the amount of material actually applied on an acre will depend on row width and will be a percentage of the broadcast rate. The temperature of the soil should be at least 50 °F (10 °C), and soil should be well worked and free from undecomposed plant debris and have adequate moisture for seed germination. If the weather and soil are warm, the fumigant should escape through the plastic mulch in 12 to 14 days. Fumigation is used primarily for nematode control, but, by using a multipurpose fumigant (e.g., Terr-O-Gass 67 or 98-2, Great Lakes Chemical Corp., West Lafayette, Ind.), it can provide good control of soil-borne diseases as well (Scoville and Leaman, 1965). Soil solarization is another way to control soil pests. Solarization describes a hydrothermal method of soil deinfestation that occurs in moist soil covered by mulch film (mainly clear) and exposed to sunlight during the hot summer months (Stapleton, 1991).

Windbreaks

The use of windbreaks, permanent (trees) and annual (small grain), is an important part of the entire plasticulture system, but often it is overlooked. Windbreaks consisting of strips of winter wheat, rye, or barley should be established to protect young vegetable seedlings from prevailing winds. A combination of permanent and annual windbreaks can modify wind profiles and influence temperatures and other microclimate features (Hodges et al., 1994). Also, windbreaks can serve as habitat for beneficial and pest insects (Dix and Leatherman, 1988).

For maximum effectiveness, the grain strips should be planted in the fall. Each grain strip should be the width of a small-grain drill [10 to 12 feet (3 to 3.6 m)], with strips far enough apart to accommodate five or six mulched beds on 5- to 6-foot (1.5 to 1.8-m) centers. Topdressing the strips in the spring helps to ensure a dense stand.

Another option is to plant a solid grain cover crop in the fall. It is important to till the crop area early enough in spring so that cover crop debris will not interfere with application of the plastic mulch and drip irrigation. Once wind protection is no longer required, the grain strips are mowed and used as drive rows for spraying for insect and disease control and for harvesting.

Stand establishment technology

Crop establishment in a plasticulture system involves either transplanting or direct seeding. Well grown, containerized vegetable transplants are integral parts of this production system. Information on the production of high-quality vegetable transplants is readily available from any state extension service. For extra earliness of pepper and tomato crops, containers with large cell sizes of 3 to 4 inches (9.6 to 10 cm) are recommended. For other vegetable crops, a cell size between 1 to 2 inches (2.5 to 5 cm) is a good general recommendation. Transplants can be set by hand or machine, with single or multirow units, e.g., Kennco's water-wheel plantsetter (Kennco Mfg. Inc., Ruskin, Fla.); mechanical mulch planter (Mechanical Transplanter Co., Holland, Mich.); or water-wheel (Rain-Flo Irrigation, East Earl, Pa.), with excellent results. The following vegetables have been transplanted successfully: tomato, pepper, eggplant, watermelon, muskmelon, honeydew, summer squash, cucumber, onion, and okra. In specialty or niche marketing situations, other crops such as sweet corn, herbs, leaf lettuce, and cole crops can be transplanted. Mechanical seeders are available in single or multirow models that will plant directly through the plastic mulch, such as the polyplanter (Ferris Farms, New Wilmington, Pa.) and the Stanhay/Stephens 4100 (Triangle M Equipment Ltd., Morocco, Ind.). This equipment is good for direct-seeded crops of sweet corn and cucumbers as well as other crops. Some spacing recommendations are shown in Table 2.

Season-extending technology

Rowcovers can increase earliness by creating a minigreenhouse effect. The first rowcovers used were solid polyethylene sheeting that needed support and required venting during the day (Hall and Besemer, 1972).

To eliminate the need for manual venting, a variety of materials has been developed: slitted polyethylene covers that require wire hoops; Agryl P17 (Sodoca Mfg., France), a floating, nonwoven sheet; Gromax (Gromax Plasticulture Ltd., Pensacola, Fla.), a white, point-bonded, polypropylene material; Reemay (Ken-Bar, Reading, Mass.), a spunbonded polyester fabric; Typar T-518 (Ken-Bar, Reading, Mass.), 1.25 oz/sq.yd. polypropylene; and Vispore(Tredegar Industries, Richmond, Va.), a polyethylene sheet with tiny pores (Wells and Loy, 1985). Another use of rowcovers is as physical barriers that exclude insect pests and protect the crop in the early stages of growth, (Natwick and Durazo, 1985).

High tunnels or minimally heated protective structures are another option in a plasticulture system. They can be used to extend the spring and fall growing season. High tunnels are covered with a single layer of polyethylene film (Wells, 1991).

Pest management

Another component of the plasticulture system is a good integrated program for insect, disease, and weed control. To obtain good insect and disease control, it is important to use a sprayer that generates sufficient pressure to provide good spray penetration and coverage. This means using sprayers with pumps capable of generating 200 to 400 psi (14 to 28 kg cm^{-2}) with appropriately sized nozzles. It is important to use chemical sprays when needed in as efficient a manner as possible to control the targeted pest or problem without damaging the environment. As in nonplasticulture growing systems, the use of an integrated pest management approach that combines use of disease-resistant varieties, chemical and biological control practices, crop rotation, etc., is recommended. Only approved herbicides should be used between rows of mulched plastic beds, because this is not considered a fallow area. The use of low-pressure sprayers coupled with shielded applica-

Table 3. ***Suggested spring–fall crop sequences.***

Spring	Fall
Pepper	Summer squash, cucumber, cole crops
Tomato	Cucumber, summer squash, cole crops
Summer squash	Pumpkin, tomato, cole crops
Eggplant	Summer squash
Cucumber	Tomato, pumpkin, summer squash
Muskmelon	Tomato
Watermelon	Tomato
Honeydew	Tomato
Cole crops	Summer squash, pumpkin, muskmelon, tomato
Lettuce	Summer squash, pumpkin, muskmelon, tomato
Snap bean	Summer squash, pumpkin, muskmelon, tomato
Sweet corn	Summer squash, tomato, okra, cucumber
Strawberry	Tomato, summer squash, cucumber, muskmelon, pumpkin, okra

Table 4. ***Yields of selected vegetables using plasticulture.***

Crop	Yields/A (ha)
Eastern muskmelon	8000–9000 fruit at 4–6 lb/fruit (20,320–22,230 fruit at 1.8–2.7 kg)
Western muskmelon	12,000–15,000 fruit at 3–4 lb/fruit (29,640–37,050 fruit at 1.4–1.8 kg)
Cucumber	1200 bu (55 lb/bu) (2964 bu (24.9 kg/bu)
Pepper	1600 bu (25 lb/bu) (3952 bu (11.3 kg/bu)
Squash	800 bu (45 lb/bu) (1976 bu (20.4 kg/bu)
Tomato	3200 boxes (20 lb/box) (7904 boxes (9.1 kg/box)
Watermelon	3000 fruit (7410 fruit)

tion of herbicides is recommended. This approach will prevent applying the herbicide material on the plastic bed, resulting in potential crop injury from increased concentration of herbicides in the planting hole.

Reflective plastic mulches, like silver-faced plastic mulch, have been shown to interfere with the movement of aphids, which often vector virus diseases to various vegetable crops [e.g., watermelon mosaic virus II, which causes green streaks in summer squash (Lamont et al., 1990) and mottling and green streaks in yellow squash, melons, and pumpkins].

Cropping strategies—Double- or triple-cropping

Double- or triple-cropping in regions where this is possible is another important component of the plasticulture system. With such a strategy, one can grow the equivalent of 2 or 3 acres (0.8 to 1.2 ha) of produce on 1 acre (0.40 ha) of land using the plasticulture system inputs (plastic mulch, drip tape) already in place.

One interesting cropping scheme that has been investigated in Kansas is broccoli or cabbage followed by yellow summer squash, which is then followed by broccoli, cabbage, or Chinese cabbage (Marr and Lamont, 1992).

Another cropping scheme is annual hill strawberries followed by muskmelons (Lamont and Poling, 1986). Also, in the event that the first crop is a failure, double- or triple-cropping is a potential means of recouping investments in such inputs as plastic mulch, drip tape or tubing, and fertilizer. Fertigating through the drip system makes it relatively easy to supply sufficient nutrients to a second or third crop. Some suggested spring–fall sequences are shown in Table 3.

Marketing

The opportunity to produce much higher overall yields beginning earlier in the season using plasticulture requires producers to have their marketing strategies and outlets as refined as possible before planting any crop. It is important for producers to realize that, if they planteed 50 acres (20.2 ha) of tomatoes on bare ground before switching to plasticulture, the potential earliness and increases in total yield could present a marketing problem if not properly anticipated. Also, when a crop is grown using plasticulture, it can be used as a marketing tool. For example, muskmelons grown in Texas are marketed in advertisements and on individual melon boxes: “These melons grown using plastic mulch and drip irrigation.” Producers feel this advertisement promotes product quality and environmental awareness to buyers and the buying public.

Summary

Plasticulture is a production system that involves high input costs and levels of management and is subject to mismanagement and risk, just as any production system. With proper planning, attention to details, and dedication to all aspects of the plasticulture system, the opportunity exists to reduce the acreage of an existing operation and possibly increase profits using efficient production techniques. Some yields of various vegetable crops using plasticulture are presented in Table 4.

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