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Role of Plasticulture in Vegetable Production

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SUMMARY

Plasticulture is a method of producing crops in such a way that the use of plastic polymers provides a major benefit. The discovery and development of polyethylene polymer in the late 1930s, followed by its introduction in the early 1950s as plastic films, mulches, and drip-irrigation tubing and tape, transformed the commercial production of various vegetable crops and gave rise to plasticulture. Other polymers, such as polyvinyl chloride, polyproplene, and polyesters, were later discovered and used in pipes, fertigation equipment, filters, fittings and connectors, and row coverings, which further increased the usage of plastic components in this manufacturing system. Plastic mulches, drip irrigation, fertigation, fumigation and solarization, windbreaks, stand establishing technology, seasonal-extending technology, pest management, cropping strategies and postharvest handling are all part of the plasticulture system.

INTRODUCTION

To compete in today's market, vegetable growers must always strive for excellent quality, superior yields, and prolonged production cycles that include spring and autumn crops. Plasticulture is a management strategy that allows vegetable farmers to achieve higher returns per unit of land.
Such a system may offer many benefits:

- Crop production begins early (7 to 21 days earlier)
- Increased yields per acre (two to three times higher)
- Produce that is cleaner and of superior quality
- Increased efficiency in the use of water resources
- Less fertilizer leaching, particularly on light, sandy soils
- Fertigation technology allows for more efficient use of fertilizer inputs.
- Less soil and wind erosion
- Possible reduction in illness incidence
- Improved control of certain insect infestations
- Fewer weed issues
- Less soil compaction and no need for root trimming
- Possibility of double- or triple-cropping with maximum efficiency

The grower must integrate the many components of a plasticulture system in order to reap these benefits. Plastic mulches, drip watering, fertigation, and soil fumigation or solarization are among the components. Windbreaks, stand establishing technology, season-extending technology, pest management, cropping techniques, and marketing are also important components. Growers with little or big land holdings can benefit from the plasticulture system. Regardless of the size of the operation, the essential concepts and intense management necessary to successfully operate a plasticulture system remain the same. Muskmelon, tomato, pepper, cucumber, squash, eggplant, watermelon, and okra are among the crops that have shown substantial gains in earliness, yield, and/or fruit quality with the application of plasticulture. Other crops with comparable responses, such as sweet corn, snap beans, pumpkin, gourds, crucifer crops, and herbs, may lend themselves to double- or triple-cropping tactics.

Plastic Mulches

Since the early 1960s, plastic mulches have been employed commercially on vegetables. Linear high-density polyethylene is used to minimize weight and expense, and it is stronger than low-density polyethylene of the same thickness. Plastic mulches have a direct impact on the microclimate around the plant by altering the surface's radiation budget (absorbitivity vs. reflection) and minimizing soil water loss. The most common colour utilized in vegetable production is black plastic mulch, which is an opaque blackbody absorber

and radiator. Most ultraviolet (UV), visible, and infrared wavelengths of incoming solar light are absorbed by black mulch, and absorbed energy is re-radiated as thermal radiation or long-wavelength infrared radiation. Through radiation and forced convection, much of the solar energy captured by black plastic mulch is lost to the atmosphere. By optimizing conditions for transporting heat from the mulch to the soil, the efficiency with which black mulch raises soil temperature can be increased. To manage weeds, use clear plastic mulch in conjunction with a herbicide, soil fumigant, or solarization.

Not only does light reflectivity influence crop development, but it also influences insect reactions to plants cultivated on mulch. Yellow, red, and blue mulches, for example, all enhanced green peach aphid populations. The yellow tint proved highly appealing to pests, attracting a rise in the number of striped and spotted cucumber bugs. Yellow has long been used to monitor insects in greenhouses. Mulches with a printed silver surface, as well as bright silver coextruded mulches, have been proven to repel specific aphid species and prevent or postpone the occurrence of aphid-borne viruses in summer squash. Gray mulches, like white mulch, may transmit enough sun radiation to need the use of a herbicide or fumigant to prevent weed growth. There is still a lot of research to be done on the influence that different colours have on the microclimate, crop growth, and yields.

Drip Irrigation

Drip irrigation is a critical component of a plasticulture production system. For the best results, use it with plastic mulch. Drip irrigation can save up to 80% of the water consumed by other techniques of irrigation. You can even double or treble crop by fertilising consecutive crops with a fertiliser proportioner through drip irrigation tape or tubing. This enables for more output with the same investment in plastic mulch and drip watering technology. The following are the key components of a drip irrigation system:

- Drip tubes and tapes
- Media, screen, or disc filters
- Pressure regulators (swing or valve)
- Valves—manual, hydraulic, or electric
- Controllers, which can range from simple time clocks to complicated computer-controlled equipment running many zones.

Chemicals and nutrients are introduced into the irrigation system using injectors. Due to the fact that vegetables are planted in rows, a drip tube or tape is utilized to moisten a continuous strip down the row. Drip tape is typically 8 mm thick, and it is used for one year before being destroyed. Drip tube is heavier, 20 mm thick, and has been used for many years. The exit holes are spread between 20 and 60 cm, with 30 cm being the most frequent spacing for vegetable crops.Bacteria, algae and other aquatic life can be found in surface water such as streams, ponds, pits and rivers. As a result, the usage of agricultural sand media filters with surface water is required. In general, these filters are more expensive than screen or disc filters. Help from an irrigation dealer or extension agent who is acquainted with drip irrigation system design and installation is strongly suggested and can be very beneficial in avoiding problems later. Crop water management is another key consideration. This is determined by the kind of soil and the stage of crop growth.

Fertigation

It makes economic and environmental sense to fertilize the crop with irrigation water after installing a drip irrigation system. If done correctly, this results in more efficient fertilizer use and, most likely, less fertilizer contamination of groundwater. The crop absorbs more nutrients, and fewer leak below the plant root zone. Fertigation, in its broadest meaning, refers to the practice of feeding a crop by infusing soluble fertilizers into the irrigation system's water. Depending on the type of pump used — tiny electric pumps or those powered by irrigation water, venturies, pressure differential tanks, bladder tanks, and gravity — there are numerous techniques for delivering chemicals into a drip system. Each drip system may employ a unique mechanism or a combination of methods. If fertigation is to be successful, irrigation timing must be precisely linked with the crop's nutritional needs. To be a good fertigator, a grower must first be an excellent irrigator.

Strip Fumigation and Soil Solarization

Plastic mulch is used in conjunction with chemical fumigants or as a cover during soil solarization. The amount of material actually applied per hectare in row or strip application of a fumigant will be proportional to the broadcast rate and will depend on the row width. The soil temperature should be at least 10°C, and the soil should be properly worked, clear of undecomposed plant debris, and moist enough for seed germination. If the weather and soil are both warm, the fumigant should be able to pass through the plastic mulch in 12-14 days. Fumigation is usually used to manage nematodes, but a multipurpose fumigant can also effectively control soil-borne illnesses. Solarization is a hydrothermal method of soil cleansing that happens in damp soil that is covered by a mulch film (typically clear) and exposed to sunshine during the hot summer months.

Wind Breaks

Windbreaks, whether permanent (trees) or annual (grain crops), are an important aspect of the plasticulture production system, but are sometimes disregarded. Windbreaks of winter wheat, rye, or barley are frequently planted to shield young vegetable seedlings from prevailing winds. Wind profiles can be influenced by a combination of permanent and seasonal windbreaks, as well as temperatures and other microclimate factors. Windbreaks can also provide a home for both beneficial and nuisance insects. Grain strips should be planted in the fall for optimal effectiveness. Each grain crop strip should be 3 to 3.5 m broad (the width of a sowing drill). There should be enough space between the strips for five or six mulched vegetable beds, each around 2 m wide.

Stand Establishment Technology

In a vegetable plasticulture production system, crop establishment is accomplished through either transplanting or direct seeding. Vegetable transplants grown in suitable containers are an essential component of this production system. Large seedlings in large individual containers (cells) of 9-10 cm across are recommended for early harvests of pepper and tomato. A cell size of roughly 5 cm in diameter is a reasonable general recommendation for various vegetable crops. Transplants can be set manually or mechanically. Tomatoes, peppers, eggplant, watermelon, muskmelon, honeydew, summer squash, cucumber, onion, and okra have all been successfully transplanted. Other crops, such as sweet corn, herbs, leaf lettuce, and cole vegetables, can be transplanted in speciality or niche marketing scenarios. Mechanical seeders, which plant directly through the plastic mulch, are available in single and multirow variants. This equipment is suitable for direct seeded sweet corn and cucumber crops, as well as other crops.

Technology for Extending the Harvest Technology

By producing a mini-greenhouse effect, row covers, high tunnels, and low tunnels can allow for earlier vegetable production. The first row covers were solid polyethylene sheeting that needed to be supported and vented during the day. A variety of materials have been developed to avoid the requirement for manual venting, including slitted polyethylene covers that require wire hoops, floating nonwoven sheets, a white point-bonded polypropylene material, a spunbonded polyester fabric, and a polyethylene sheet with microscopic pores. Row covers also help to keep insect pests at bay. Another alternative for growing vegetables in a plasticulture system is high tunnels. They can be used to lengthen the growing seasons in the spring and fall. A single sheet of polyethylene film covers the high tunnels.

Pest Management

A good integrated programme for pest, disease, and weed control is required for the plasticulture system. To achieve good insect and disease control, it is critical to employ a sprayer that creates enough pressure to allow pesticide sprays to penetrate and cover the entire crop. Reflective plastic mulches, such as silver mulch, have been demonstrated to impede aphid mobility. Aphids are common virus disease vectors on a variety of vegetable crops.

Cropping Strategies

Double- or triple-cropping

Another significant component of the vegetable crop plasticulture system is double- or triple-cropping. In the United States, one cropping system that has been examined includes broccoli or cabbage followed by yellow summer squash, which is then followed by broccoli, cabbage, or Chinese cabbage. Strawberry is another cropping pattern, followed by muskmelon. If the first crop fails, double- or triple-cropping is a method of recouping investment in plastic mulch, drip tape or tubing, and fertilizer. Fertilizing with a drip system makes it reasonably simple to deliver enough nutrients for a second or third crop. Tape or tube, as well as fertilizer Fertilizing with a drip system makes it reasonably simple to deliver enough nutrients for a second or third crop.

Disposal of the Used Plastics From Plasticulture

The biggest question raised by gardeners interested in employing plastics in vegetable production is, "What do I do with the plastics when I'm done using them?" This is unquestionably a global issue. Many attempts have been made to solve the problem, including the development and use of photodegradable or biodegradable materials (which simply disappear), the use of plastics several times (delaying the problem), reducing the weight of films (less material to deal with), recycling (converting the material into other products), and incineration. Plastic mulches and drip irrigation tapes are the most difficult to work with. These materials are unclean and often moist after a season in the field, making recycling difficult. One option is to incinerate them to recover their high fuel value. A pound of plastic contains the same number of BTUs (thermal units) as an equivalent amount of fuel oil. Plastic waste has been burned in waste-to-energy plants, however this causes "hot spots" in the waste stream.

CONCLUSION

Plasticulture production of vegetable crops is unquestionably a production system with high input costs and layers of management, and it is susceptible to mismanagement and risk, just like any other production system. The option exists to reduce the acreage of an existing enterprise and maybe boost revenues employing efficient production techniques with appropriate planning, attention to details, and dedication to all areas of the plasticulture system.

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