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# Plasticulture for Vegetable Production: A Review

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**ABSTRACT-** Plasticulture is a method of producing crops in which the use of plastic polymers provides a major advantage. Plasticulture arose from of the late 1930s research and innovation of polyethylene polymer, which was later commercialized as plastic films, mulches, as well as drip-irrigation tubes but also tape in the early 1950s. Other polymers, like as polyvinyl chloride, polypropylene, as well as polyesters, were subsequently developed and used in pipes, fittings, fertilizer application equipment, connectors, including row coverings, extending the usage of plastic elements in this industrial system even further. Plastic mulches, fertigation/chemigation, drip irrigation, fumigation, solarization, windbreaks, stand creating technology, seasonal-extending technology, pest controls, cropping methods, postharvest handling, and marketing are all part of the plasticulture system.. Plasticulture-based vegetable crops production is undeniably a labor-intensive process with high input costs and management needs.

**KEYWORDS-** Drip irrigation, Fertigation, Plastic mulches, Season extension technology.

## I. INTRODUCTION

Vegetable producers must aim for excellent quality, better yields, as well as longer productions cycles that encompass spring and fall harvests to remain competitive in today's market. Plasticulture is an organization technique that allows vegetables growers to obtain more yield per acre of land [1]. A systems like this may have a lot of advantages[2]–[4]:

- Improved control of some insect infestations
- Produce that is cleaner and of better quality
- Crop production begins earlier.
- Weeds are less of an issue.
- Higher per-hectare yields
- Fertilizer inputs are used more efficiently thanks to fertigation technology.
- Increased efficiency in the utilization of water resources
- Possibility of doubling or tripling crop yield with optimum efficiency.
- Reduced leaching of nutrients, particularly on light, sandy soils
- Potential reduction in disease incidence
- Soil and wind erosion are reduced.
- Soil compaction is reduced, and root trimming is no longer necessary.

The grower must combine the different components of a plasticulture system in order to reap these advantages. Plastic mulches, chemigation/fertigation, drip irrigation, soil fumigations, as well as solarization are some of the elements that may or may not be necessary depending on the location [5]. Stand-laying out innovation, editing processes, Windbreaks, season-broadening innovation, bug the board, as well as promotion are some of the other components. Cultivators with little or large land holdings may find the plasticulture approach useful. The main concepts and detailed administration required to manage a successful plasticulture framework remain the same regardless of the size of the firm. A component list for a ten-hectare plastics mulch/dribble water structure model is shown in Table 1 [6]. cucumber, peppers, Muskmelon, aubergine, watermelon, tomato, okra and squash, are only a couple of the harvests that have shown critical expansions in earliness, yield, and additionally organic product quality when plasticulture has been used. Sweet corn, snap beans, pumpkin, beautifying gourds, crucifer yields, and spices, for instance, may loan themselves to twofold or triple-editing frameworks [7]–[9].

Table 1: Illustrates the components of plasticulture vegetable production system [6]

| Component description | Quantity | Unit | Unit price (US$) | Total price (US$) |
|---|---|---|---|---|
| Engine and pump (14-hp engine and Berkley pump) | 1 | 1s | 4,000.00 | 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. | 131.62 | 31.62 |
| PVC tee (Sxt), 4" x 3" | 4 | ea. | 14.34 | 57.36 |
| Insert ELL, 4" | 2 | ea. | 21.25 | 42.50 |
| Insert x slip adapter - 4" | 6 | ea. | 11.26 | 67.56 |
| PVC bush, 4" x 2" | 2 | ea. | 5.35 | 10.70 |
| PVC tee (S x T) - 3" | 4 | ea. | 10.87 | 43.48 |
| PVC nipple, 3" x 4" | 8 | ea. | 5.52 | 44.16 |
| Insert x slip adapter, 3" | 8 | ea. | 8.92 | 72.36 |
| Insert male adapter, 3" | 8 | ea. | 5.30 | 42.40 |
| PVC ELL (S x T), 3" | 8 | ea. | 6.80 | 54.40 |
| PVC bush, 3" x 2" | 8 | ea. | 2.28 | 18.24 |
| PVC nipple, 2" x 4" | 10 | ea. | 1.49 | 14.90 |
| Air relase 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 x layflat connectors | 480 | ea. | 0.95 | 456.00 |
| Layflat holepunch | 2 | ea. | 75.00 | 150.00 |
| Subtotal | | | | 18,278.04 |
| Tax 1% | | | | 182.78 |
| Total | | | | 18,460.82 |

### *A. Plastic Mulches*

Plastic mulches have been used mechanically on crops since the mid-1960s. Going before 1960, most early school focus on zeroed in on the effects of concealing, similar to dull or clear plastic film, on soil and air temperature, moistness upkeep, and gather yields. Most plastic mulches in the United States are made of straight low-or high-thickness polyethylene. They are.012 to.031 mm thick, 122 to 152 cm wide, and 607 to 1463 m long, dependent upon the thickness of the mulch. Straight high-thickness polyethylene is lighter and more monetarily sagacious than low-thickness polyethylene of a comparative thickness. The plastic mulch is either (smooth) or adorned with a valuable stone shaped plan. This development forestalls the mulch in the raised bed from slackening because of extension and constriction[10], [11]. The raised bed is customarily 10 to 15 cm high and 75 centimeters wide, with a 3 centimeter slant from concentration to edge. The soil under a raised bed warms up speedier in the spring and exhausts excess water out of the focal point of the bed, keeping the gather plants drier and preventing thing quality incident [12], [13].

By changing the surface's radiation monetary arrangement and restricting soil water mishap, plastic mulches influence the microclimate around the plant [14]. The shade of a mulch immensely affects how much energy it discharges and how it influences the microclimate encompassing a food plant. The surface temperature of the mulch and the temperature of the central soil are both affected by concealing [15], [16]. Ham et al. found that the level of contact between the mulch and the dirt, which is ordinarily estimated as a warm contact obstruction, fundamentally affects the mulch's presentation [17]. On the off chance that an unpleasant soil surface makes an air hole between the plastic mulch and the dirt, soil warming might be less effective than expected[18], [19].

### *B. Drip Irrigation*

A plasticulture manufacturing system would not be complete without drip irrigation. To get the most out of it, combine it with plastic mulch. Drip irrigation may save up to 80% of water compared to other irrigation techniques [20]. You may even double- or triple-crop by utilizing a fertilizer proportioner to nourish successive crops via drip irrigation tape or tubing. This means that the same amount of plastic mulch and drip irrigation technology may produce more. The following are the main components of a drip irrigation system:

- Controllers, which may be as basic as time clocks or as sophisticated as computer-controlled devices that govern several zones.
- Drip tubes.

- Filters - media, screen or disc.
- Chemical and fertilizer injectors, which add chemicals and fertilizers to the irrigation systems.
- Pressure controllers
- Valves

A trickle cylinder or tape is utilized to saturate a consistent strip along the column since vegetables are planted in lines. Dribble tape is ordinarily 8 mm thick and is expected to be utilized for one year prior to being eliminated. Dribble tubing is thicker, estimating 20 mm in distance across, and has been used for a long time. The leave openings are put anyplace somewhere in the range of 20 and 60 centimeters separated, with 30 centimeters being the most run of the mill dispersing for vegetable harvests. It's basic to have a dependable wellspring of water for dribble water system. Wells, lakes, lakes, as well as metropolitan water frameworks are for the most part models. Well water is typically very unadulterated, and eliminating ppapers may simply require a straightforward screen or circle channel. It's critical to figure out whether there are any precipitates or other pollutants in the water that may create a clogging issue. Before building a drip system, you must first do a water analysis. Water quality is usually documented by municipal sources, making it simpler to identify possible issues.

### *C. Fertigation*

After a dribble water system framework has been introduced, it makes financial as well as natural sense to prepare the yield utilizing water system water. This, whenever done accurately, leads in more proficient manure utilization and, doubtlessly, less compost contamination of groundwater. The harvest ingests more supplements, and less hole beneath the plant root zone.

Fertigation, in its widest definition, refers to the practice of feeding a crop by infusing soluble nutrients into irrigation water [21]. To disseminate synthetic substances into a dribble framework, many kinds of siphons, for example, little electric-driven siphons or siphons controlled by water system water, bladder tanks, pressure differential tanks, vents, as well as gravity may be generally utilized. Each drip system may use a particular technique or a mix of techniques. Irrigation schedule must be carefully linked with the crop's nutritional requirements if fertigation is to be effective. To be an effective fertigator, a grower must first be an effective irrigator.

### *D. Strips Fumigation as well as Soil Solarization*

In different delivering region of the United States, eminently in California and the Southeast, cleaning the dirt in which nursery or mulched crops are developed is basic. Plastic mulches are utilized as soil solarization covers or in blend with compound fumigants. The amounts of material actually applied per hectare when applying a fumigant in a row or strip is governed by the rows width as well as being a percentage of the broadcast rate [22]. The soil should be at least 10°C, adequately cultivated, free of undecomposed plant debris, and moist enough for seed germination. If the weather and soil are warm, the fumigant might escape through the plastic mulch in 12 to 14 days. Fumigation is often used to get rid of nematodes, but a multifunctional fumigant might also help with soil-borne infections. One more technique for controlling soil irritations is to solarize the dirt. Solarization is an aqueous procedure of soil cleaning that happens in wet soil that is covered with mulch film and presented to daylight all through the late spring months.

### *E. Windbreaks*

Windbreaks, whether permanent or temporary, are an essential component of the plasticulture manufacturing system, yet they are often neglected [23]. Windbreaks made of pieces of the rye, winter wheat, or grain are regularly utilized in the United States to protect youthful vegetable plants from winning breezes. Wind profiles may be influenced by a mix of permanent and yearly windbreaks, as well as temperatures and other microclimate characteristics. Windbreaks may also provide a home for both helpful and harmful insects. Grain strips should be sown in the autumn for optimum efficiency. Each grain crop strip should be 3 to 3.5 meters broad. Between the strips, there should be adequate space for five or six mulched vegetable beds, each around 2 m wide. In the spring, topdressing the strips helps with propelling a thick grain stand.

The dirt ought to be something like 10°C, satisfactorily developed, liberated from undecomposed plant trash, and soggy enough for seed germination. Assuming the climate and soil are warm, the fumigant could escape through the plastic mulch in 12 to 14 days. Fumigation is regularly used to dispose of nematodes, however a multifunctional fumigant could likewise assist with soil-borne contaminations.

## II. DISCUSSION

### *A. Technology for Extending the Harvest Technology*

By generating a mini-greenhouse effect, row covers, high tunnels, and low tunnels may allow for early vegetable harvests. Solid polyethylene sheeting was utilized for the first row coverings, which required support and ventilation throughout the day. To eliminate the need for manual venting, slitted polyethylene covers with wire hoops, a white point-bonded polypropylene materials, floating nonwoven sheets, a spunbonded polyester fabrics, as well as a polyethylene sheets with little holes have all been developed [24]. In a plasticulture system, high tunnels are another alternative for growing veggies. They may be used to prolong the growth seasons in the spring and autumn. A single sheet of polyethylene film covers the high tunnels. High tunnels are widely used in various areas of the globe, particularly in Asia and the Spanish and Italian nations.

### *B. Pest Management*

Insect, disease, as well as weed control must all be considered while designing a plasticulture system. For fruitful bug and illness the board, it's imperative to have a sprayer with satisfactory solidarity to ensure that synthetic showers infiltrate and cover the entire harvest. Sprayers with siphons fit for creating north of 200 psi and spouts of fitting size are required. Chemical sprays must be used successfully to kill the targeted insect without hurting the environment. In an incorporated bug the board plan, illness safe cultivars should be used in mix with compound as well as organic control measures, crop pivot, and powerful observing. Just permitted herbicides for the yield being

cultivated ought to be utilized between columns of pulped vegetable beds since this is anything but a desolate region. Low-pressure sprayers with protected pesticide splashing are suggested for the spaces between vegetable beds. This approach will shield the mulched crop from herbicide, ensuring that any herbicide focus in the establishing opening chime won't harm it.

### *C. Cropping Strategies*

#### *1) Double or Triple Cropping methods*

Twofold or triple editing is a significant piece of the vegetable harvest plasticulture framework. One trimming plan that has been examined in the United States is broccoli or cabbage followed by yellow summer squash, broccoli, cabbage, or Chinese cabbage. One more cultivating methodology is strawberry, trailed by muskmelon. In the event that the principal crop falls flat, you might twofold or triple-yield to recover your interest in plastic mulch, trickle tape or tubing, and manure. It's quite easy to offer adequate nutrients for a second or third crop when you use a drip system to fertilize.

### *D. Marketing*

In spite of the way that plasticulture assists ranchers with arriving at higher vegetable yields prior in the season, they need lay out their advertising methodology and channels prior to establishing any harvest. In the event that there isn't sufficient preparing of time for where to sell a lot of an early harvest, there may be an advertising issue. Plasticulture production may be a marketing advantage. Muskmelons produced in Texas, for example, are advertised and sold in individual melon boxes. Plastic mulch and drip irrigation were used to produce these melons. Growers believe that this advertising offers consumers the idea that the product is of high quality and that the company is environmentally conscious.

### *E. Plasticulture's Destruction of Utilized Plastics*

"How would I handle the plastics after I'm done with them?" is the most common question raised by ranchers interested in using plastics in vegetable production. Without a doubt, this is a broad problem. Many initiatives have been undertaken to address the problem, including the use of photodegradable or biodegradable materials that almost disappear, the reuse of plastics, film weight reduction, reusing, and burning. The hardest to handle are plastic mulches and dribbling water system tapes. These materials get dirty and clammy after a season on the field, making reuse difficult. One option is to burn them to recover their high fuel value. A pound of plastic has the same amount of BTUs as a pound of fuel oil. Used plastics are burned in waste-to-energy facilities, however they create "problem regions" in the waste stream, which would be a concern. A group of academics at Pennsylvania State University is working on the creation of a "fuel piece" that might be used to improve coal or other byproducts or to heat other buildings on its own. More research is anticipated into the best method to acquire, prepare, as well as transport polymers from the point of origin to the processing factory, and then to the crematorium. Despite the facts that burning may be the solution to the waste problem, there is still much work to be done.

## III. CONCLUSION

Plasticulture is a practice that has been used for a long time and has shown to be useful to fruit and vegetable growers. Plasticulture preserves soil properties and nutrient availability, according to research. The effect of plastic mulching increases plant physiology, morphology, as well as yield due to the increased soil microclimate. Farmers, on the other side, have expressed concern about the cost of plastic, as well as the transport and disposal of plastic objects. As a consequence, biodegradable plastic mulches are advised for maintaining production while also lowering pollution. Plasticulture-based vegetable crop production is definitely a high-input, high-management production technology that, like any other, is vulnerable to mismanagement and danger. With cautious preparation, scrupulousness, and commitment to all parts of the plasticulture framework, a current activity's land may be diminished while incomes could be expanded through more effective creation methods. The article also provided some yields from several plasticulture-grown vegetable crops.

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