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POLICY PAPER



Plasticulture: Boon for Indian Horticulture Sector

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Abstract

Plasticulture stand for use of plastics in Horticulture. It offers large number payback and is considered most important indirect horticultural inputs which results in moisture conservation, reduction in fertilizer consumption, precise application of water and nutrients, controlled environment horticulture. It also helps in plant protection through the use of plastic nets and innovative packaging solutions which helps in increasing shelf-life, collection, storage and transportation of horticultural commodities especially fruits, vegetables and flowers. Further, they require minimum energy in production as well as in conversion into finished products hence, economically viable.

Key words: Plasticulture, Moisture conservation, Fertilizer consumption, Shelf-life, Commodities

INTRODUCTION

The use of plastics in horticulture sector has made considerable headway during the last few decades. We are aware that plastics contribute from planting to post harvest handling and processing in many horticultural crops. Plastic is used at each and every stage of horticultural life cycle right from seeds packaging, planting, propagation, mulching, irrigation, harvesting, fruit packing, transportation and preservation. The application of plastics in agriculture or horticulture sector is popularly known as Plasticulture. India produces about 5 million tons of plastics annually and use about 0.35 million tones in overall agriculture sector. Plastics are used in polyhouses to promote growth and production, mulching to suppress weeds and maintain soil

temperature and moisture as well as in containers for seedling and soil solarization to reduce pest and diseases. Plastic is very useful because it can be colored, melted, shaped, squashed, cheapness, light weight, impermeable to moisture and gases, rolled into sheets or made into fibers. The unique advantages of plastic over conventional materials are higher strength/weight ratio, superior thermal insulation properties, excellent corrosion resistance, superior flexibility, resistance to most of the chemicals, excellent moisture barrier properties, favorable gas permeability, smooth surface resulting in reduction in friction losses, excellent light transmissibility, helps to enhance shelf-life of the produces, better visibility of the produce etc.

What is Plastic?

Plastic encompasses a wide variety of resins or polymers with varied characteristics. While there are natural polymers but only synthetic polymers are referred as plastics. The word 'PLASTIC' is derived from the Greek words 'PLASSIEN' and 'PLASTIKOS' meaning to mould or shape a soft substance permanent or temporary.

Advantages of Plastic over conventional materials

- Higher strength: weight ratio
- Superior thermal insulation properties
- Excellent corrosion resistance
- Super flexibility
- Impermeability to water, gas, etc.
- Resistance to chemicals
- Less friction due to smoother surface
- Extreme versatility
- Lighter weight than competing materials, reducing fuel consumption during transportation
- Extreme durability
- Good safety and hygiene properties for food packaging
- Excellent thermal and electrical insulation properties
- Relatively inexpensive to produce
- One tonne of plastics is equivalent to 20,000 two liter drinks bottles or 120,000 carrier bags

Types of plasticulture applications

1. Water management

- a) Lining of canals, ponds and reservoirs with plastic film
- b) Drip and Sprinkler irrigation
- c) PVC & HDPE pipes used for water conveyance
- d) Sub-surface drainage

2. Nursery management

- a) Nursery bags, pro-trays, plastic plugs, coco-pits, hanging baskets, trays etc

3. Surface cover cultivation

a) Soil solarisation

b) Plastic mulching

4. **Controlled environment horticulture**

a) Green houses, Polyhouses

b) Shade net houses

c) Low tunnels, High tunnels

d) Plant protection nets

5. **Innovative packaging**

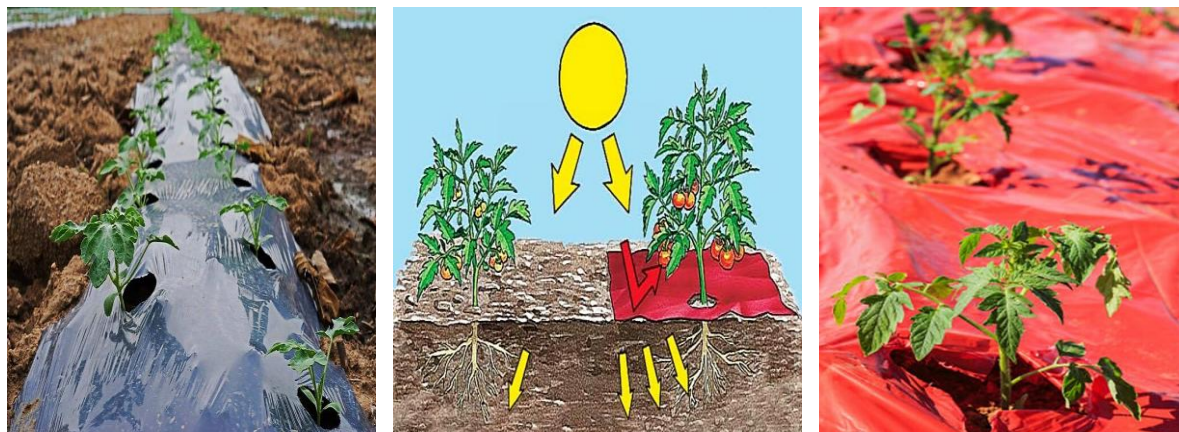
a) Plastic crates, bins, boxes, leno bags, unit packaging products etc.

b) CAP covers, controlled atmospheric packaging (CAP) & modified atmospheric packaging (MAP).

Uses of plastic in Horticulture Sector by advance techniques

Mulching

A protective covering (as of plastic film, sawdust, compost, grass, hay, dry leaves, or stones) spread or left on the ground to reduce evaporation, maintain even soil temperature, prevent erosion, control weeds, enrich the soil, or keep fruit clean. These prevent the loss of moisture and acts as a barrier between the soil and atmosphere. It helps in moderating the soil temperature and micro-climate in the plant root zone, which helps to increase yield and early maturity of crops. In addition to this plastic mulch can maintain soil moisture and prevent weed growth around plant.



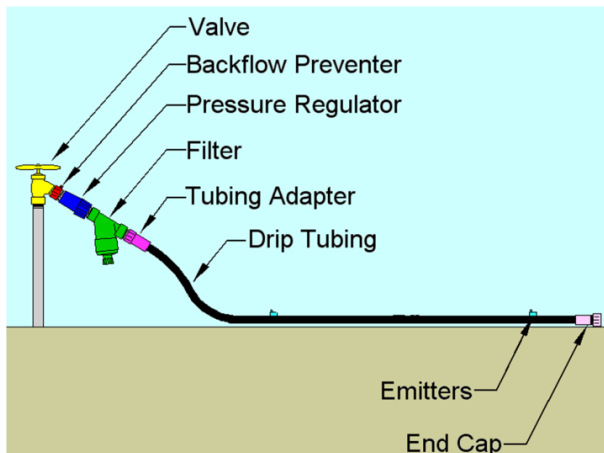
Generally black plastic mulch film is used in fruit production but two sided coloured plastics mulch films such as yellow/black, white/black, red/black or silver/black also used in specific crops, which determine its energy radiating behavior and also influence the micro climate around the plant. Plastic mulch film having different thickness and choose based on type and age of plant. It available from 7 to 100 micron thickness but for medium duration crop 25 to 50 micron and for long duration crop 50 to 100 micron thickness is suitable. It has some other advantages like provides favorable soil moisture for development of roots and plants and ideal environment for earthworms and other soil micro-organisms beneficial for crops, prevents weed growth, improves soil micro climate, conserves water, effective in dry land farming, increases crop yield and keeps the crop clean, improves quality of produce, prevents soil erosion and run off, reduces

soil compaction due to heavy rains. Nowadays LDPE (Low Density Polyethylene) and LLDPE (Linear low-density polyethylene) plastic covers use in mulching. The thickness used for plastic mulch is 25 to 40 micron in fruit cultivation.

Drip irrigation

Precise and regulated application of irrigation water and plant nutrients at low pressure and frequent intervals through drippers/emitters directly into the root zone of plant with the help of close network of pipes is known as drip irrigation system. The advantages of drip irrigation are to improve quality, ensure early maturity of the crops, water saving up to 40% - 70%, controls weed growth, saving of fertilizer (30%) and labor cost (10%), fertigation /chemigation can be made efficiently, control diseases, use of saline water is possible, soil erosion is eliminated suitable for uneven/undulating land, high water use efficiency and increase in production and productivity of fruit crops. The most important feature of plastics in drip irrigation system is the units made by plastics are rust proof, therefore it can also use for inline irrigation (sub-surface irrigation). The other quality like resistant to UV radiation, wide pressure compensation range, easy fitting of accessories, crack resistant and easy to roll back. This system is mostly made up of HDPE plastics. The sub lines and lateral lines having wide range of wall thickness from 0.5 to 2 mm.

Components of Drip Irrigation



Soil solarisation

Soil Solarisation is normally done during summer months when the air temperature more than 35°C. This is done by covering the moist soil with a transparent polyethylene film exposed to sunlight. Soil solarisation can prevent weeds growth, occurrence of bacteria, fungi, nematodes and other soil borne pathogens and pests, helps in reducing usage of weedicides/herbicides and pesticides. The effectiveness of soil solarisation enhances plant growth by improving soil color, structure, temperature, moisture etc. Soil moisture, day length, temperature and intensity of sunlight are the factors effecting soil solarisation. Suggested polyethylene film for soil solarisation is 25 micron transparent polyethylene film.



Protected cultivation

Greenhouse is a framed structure covered with glass or plastics film (transparent and translucent) in which plants are grown under the partially or fully controlled environment. The greenhouse technology has been considerable importance in better space utilization, growing crops in extreme climatic conditions and high rainfall areas. The plastics film used in greenhouse act as selective radiation filters. The solar radiations pass through it and trap the thermal energy inside the greenhouse, which is emitted by the objects that are kept inside, this phenomena is known as "greenhouse effect". The properties of cladding material are UV stabilized, transparent to light, anti-fogging and anti-algae. Green house cultivation is very important because it can moderates temperature and humidity, increases yield, quality and reduces crop duration, conserve moisture thus needs less irrigation, cultivation of off-season crops possible, helps to grow crops in different climatic conditions as it provide favorable condition to plant and to grow high value crops for export market. Moreover, it helps in raising early nurseries for different crops and also helps in hardening of tissue cultured plants and grafts. Shed net are used in rising of nursery structure which is made up of polythene threads. To reduce light intensity different shed net are available such as 15 %, 35 %, 40 %, 50 % and 90 %. It is also available in different colors like green, white, black, blue or red and different color combinations like green × black, black × black,

green × green or white × green. It helps to control pests and diseases, manipulation of microclimate and insect proof feature and creates self-employment opportunities for educated youth. Fruits that can be grown are Peach, Papaya, Strawberry etc. In vegetables cucurbits, cabbage, capsicum, cauliflower, chili, coriander, spinach, tomato etc. In flowers carnation, gerbera, marigold, orchid and rose can easily be grown. It has been estimated that the yield under polyhouse or greenhouse farming can be achieved at a higher level, say about 4-5 times as compared to farming done in open field conditions.



Propagation and Nursery

In the propagation plastics are generally used in layering and grafting. In grafting polythene strips are used to tie stock and scion. Different colors of poly-wrappers used in layering. Red, blue and black poly-wrappers having higher success in rooting and survival by increasing physiological activities (etioloating effect) which is essential for cell division and cell enlargement. In nursery plastics are used in form of nursery bag, pro tray, crate and hanging basket. It is easy to handle, planting, transplant and transport. This plastic nursery bags can be used in different size and thickness depend on crop. Plastic plant bags are cost saving, space saving, durable, economical etc.

Pro-trays are used for the production of good variety seedlings and to save place. The block of plastic tray is in cone shape which helps in the proper growth and development of the roots. For tomato, brinjal and all types of vine vegetables use pro-trays having blocks of 1.5-2.0 m² dimensions and for capsicum, chilly, cauliflower crops use pro-trays having blocks of 1.0-1.5 m² dimensions. By this method seedlings are grown in soil less media. The medium is made by mixing coco peat, vermiculite and perlite @ 3:1:1.



Packaging



Packaging is one of the most critical areas in the distribution and marketing of agricultural produce. More than 30% of agricultural produce is lost between the chain of farm and consumer. The packaging must stand up to long distance transportation, climate, storage condition, multiple handling during distribution and marketing of agricultural produce. Traditional packaging techniques such as wooden crates and jute bags have many disadvantages like untreated wood can easily become contaminated with fungi and bacteria, material may be too hard or rough for produce like soft fruits, need of disposal of the crates after use so not reusable and ultimately cost of such material is more. Generally LDPE (Low Density Polyethylene), PVC (Polyvinyl Chloride), PP (Polypropylene), LLDPE (Linear low-density polyethylene), HDPE (High Density Polyethylene) and PA (Polyamide) are used as plastic material in fruit packaging. Plastic packaging is very important because plastics are flexible, light weight, cost effective, hygienic, transparent so product visible from outside, easy printable, reusable, increases shelf-life of the produce. It provides invaluable support during processing, used in making of different packaging materials like flexible plastic films, tray with over wrap, punnets, net bag, foam sleeve, crates and also used in storing, preserving and transporting of fresh as well as processed fruits.



Sleeving

Sleeving technique involves a cylindrical plastic bag of 16-18 micron thickness having both end open and is useful for protection of banana bunch from wind, rain, hail, dust, pest etc. It applies at the stage when finger start curl upward. It protects the skin of the

fruit against leaf insect and bird damage as the fruit matures. Due to sleeving fruit size is more uniform and larger throughout the bunch and also fruit gets better color.



Future Thrust for Plasticulture

- Encouragement of environmentally degradable material in horticulture
- Promotional policies for packaging like shrink packaging
- Green house design to suit different crop and climatic condition along with energy efficient environment control system
- Availability of Low cost polyhouse/ greenhouse construction material
- Retrieval, reuse and recycling of used agriculture plastic
- Design of equipment and system for precise application of water, fertilizer and agrochemical to meet crop requirement
- Plastic based system for storage and handling of horticultural produce
- Biotechnology for production of ecofriendly plastics and ecofriendly disposal of waste plastic

CONCLUSION

For qualitative and quantitative horticultural production, plastics can be used for various purpose i.e. mulching, cladding materials for protective structures, nets, pressurized irrigation, soil solarization, plastic traps, propagation, sleeving and packaging. By using plastics in fruit culture not only increase production but also minimize the pest, diseases and weed population and extend shelf life of fruits as well as saving fertilizers and water, minimize the use of herbicides and pesticides as compared to conventional methods.

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