Plasticulture

From Wikipedia, the free encyclopedia

The term **plasticulture** refers to the practice of using plastic materials in agricultural applications.

Plastic mulch used for growing strawberries.

The plastic materials themselves are often and broadly referred to as "ag plastics." Plasticulture ag plastics include soil fumigation film, irrigation drip tape/tubing, nursery pots and silage bags, but the term is most often used to describe all kinds of plastic plant/soil coverings. Such coverings range from plastic mulch film, row coverings, high and low tunnels (polytunnels), to plastic greenhouses.

Polyethylene (PE) is the plastic film used by the majority of growers because of its affordability, flexibility and easy manufacturing.[1] It comes in a variety of thicknesses, such as a low density form (LDPE) as well as a linear low density form (LLDPE). These can be modified by addition of certain elements to the plastic that give it properties beneficial to plant growth such as reduced water loss, UV stabilization to cool soil and prevent insects, elimination of Photosynthetically active radiation to prevent weed growth, IR opacity, antidrip/antifog, and fluorescent films.[1][2]

Contents

Greenhouses and walk-in tunnel covers

A Greenhouse is a large structure in which it is possible to stand and work with automated ventilation. High tunnels are hoop houses, manually ventilated by rolling up the sides. Greenhouse and high tunnel films are usually within the parameters of 80-220µm thick and 20m wide, and have a life span between 6–45 months dependant on several factors.[2] Monolayer polyethylene films are better suited for less extreme environmental

conditions, while multilayer covers made of three layers, one EVA19 layer inserted between two low-density polyethylene layers has been shown to have a better performance under harsh conditions.[3]

Small tunnel covers

Small tunnel covers are about 1m wide and 1m high, and have a thinner polyethylene film than the large tunnel covers, usually below 80μm. Their lifetime is also shorter than that of the larger versions, they usually have a duration of 6–8 months. Use of small tunnels is less popular than both the more expensive but durable greenhouses/walk-in tunnels and the cheaper plastic mulch.[2]

Plastic mulch

Mulching is when a thin plastic film is placed over the ground, poking holes at regular intervals for seeds to be planted in, or placing it directly over plants in the beginning stages of growth. The films remain in place for the duration of the cultivation (usually 2–4 months) and usually have a thickness of 12-80μm. The main functions of plastic mulch are to insulate and maintain a consistent temperature and humidity of the soil, preventing evaporation of moisture from the soil, minimization of seedtime and harvest, prevent weed growth, and to prevent erosion. Pigmented or colourless films can be used, each with specific advantages and disadvantages over the other.[2]

Black films prevent weed growth, but do not transmit light to heat up the soil; clear films transmit light and heat the soil, but promote weed growth. Photosensitive films have been developed that are pigmented to prevent weed growth, but still transmit light to heat the soil. These photosensitive films are more costly than either the clear or black polyethylene sheeting.[1] In a study using okra, the total yield of the okra and fruit number was two times more when using plastic mulching than without mulching.[4] They found that black plastic mulch controls evaporation from the soil, improves soil water retention. Plastic mulching proved to reduce irrigation requirements in pepper by 14-29% because of elimination of soil evaporation.[5]

Flowering time was also reduced in okra when black plastic mulch was used; the plants reached 50% flowering 3–6 days earlier than un-mulched plots. Plant height in okra was significantly increased with black plastic mulch use compared to those grown in bare soil. Evaporation from soil accounts for 25-50% of water used in irrigation, using plastic mulch prevents much of this evaporation and thus reduces the amount of water needed to grow the crop.[6] This conservation of water makes plastic mulch favourable for farmers in dry and arid climates where water is a limited resource. As the second most used ag plastic in the world, the volume of plastic mulch used every year is estimated at 700,000t.[2]

Origins and development around the world

The first use of plastic film in agriculture was to in an effort to make a cheaper version of a glasshouse. In 1948 Professor E.M. Emmert built the first plastic greenhouse, a wooden structure covered with cellulose acetate film. He later switched this to a more effective polyethylene film. After this introduction of plastic film to agriculture it began being used at a larger scale around the world by the early 1950s to replace paper for mulching vegetables.[2]

By 1999 almost 30 million acres worldwide were covered in plastic mulch. Only a small percentage of this was in the United States (185 000 acres), the majority of this plastic growth was happening in economically poor areas of the world and previously unproductive desert regions, such as Almeria in southern Spain.[7]

The largest concentrations of greenhouses around the world are mainly found in two areas, with 80% throughout the Far East (China, Japan, Korea), and 15% in the Mediterranean basin. The area of greenhouse cover is still increasing at a fast rate, during the last decade it is estimated that it has been growing by 20% every year. Areas such as the Middle East and Africa are growing in their use of plastic greenhouses by 15-20% per year, compared to the weak growth in more developed and economically stable areas such as Europe. China leads the world's growth at 30% per year, translating into a volume of plastic film reaching 1,000,000 t/year. In 2006 80% of the area covered by plastic mulch is found in China where it has a growth rate of 25% per year; this is the highest in the world.[2]

Since its introduction in the 1950s, plastic film has been designed and developed to increase produce yield, increase produce size and shorten growth time. Developments in plastic film include durability, optical (ultraviolet, visible, near infrared, and middle infrared) properties, and the antidrip or antifog effect. Recent developments in this area include UV-blocking, NIR-blocking, fluorescent, and ultrathermic films.[2]

Large-scale usage in southern Spain

The use of plasticulture in agriculture is growing rapidly, perhaps nowhere more visibly than around Almería in southern Spain. The eastern approaches to Almería, north of the airport, are densely covered, as is a large area further north-east, surrounding the towns of Campohermoso, Los Pipaces and Los Grillos (close to Níjar).

The densest concentration lies about 20 km south-west of Almería, where almost the entire Campo de Dalías, a low-lying cape, is now under plastic (an estimated area of 20,000 hectares). Further west, a similar, but smaller, coastal plain around Carchuna, southeast of Motril, is similarly enveloped. The technique is not restricted to the plains; it is also applied to wide terraces on the sides of shallow valleys, as the valley north of Castell de Ferro shows.

The "sea of plastic" covering 20,000 ha of the Campo de Dalías around El Ejido and Roquetas de Mar in southern Spain.

Elsewhere along the Costa Tropical and the Costa del Sol, particularly between Almería and Málaga, fruit trees growing on terraces in steeper valleys may be covered with vast tents of plastic netting.

Aerial photographs and coordinates

- Centre of Campo de Dalías - Google maps (http://maps.google.es/maps?f=q&hl=es&q=Las+Norias+de+Daza,+El+Ejido,+Almer%C3%ADa,+Andaluc%C3%ADa,+Espa%C3%B1a&sll=36.764192,-2.780228&sspn=0.248083,0.63858&ie=UTF8&cd=3&ll=36.782342,-2.743149&spn=0.248024,0.63858&t=k&z=11&om=1) Dense concentration of plastic greenhouses
- 36.86°N 2.38°W Eastern outskirts of Almería
- 36.91°N 2.15°W Níjar valley
- 36.70°N 3.44°W Carchuna
- 36.74°N 3.365°W Valley north of Castell de Ferro

Environmental aspects

Recycling

One significant component of plasticulture is the disposal of used ag plastics. Technologies exist which allow for many ag plastics to be recycled into viable plastic resins for reuse in the plastics manufacturing industry.[8]

See also

-  Agriculture and Agronomy portal

References

1. Allingham Yael (1992). [Plastic Sheets for use in Agriculture]. *United States Patent*.
2. Espí E, Salmerón A, Fontecha A, García Y, and Real A.I. (2006). Plastic Films for Agricultural Applications (http://jpf.sagepub.com/content/22/2/85) *Journal of Plastic Filming and Sheeting*, 22(85):e85-102.
3. Adam A, Kouider S.A., Hamou A, Saiter J.A. (2005). Studies of polyethylene multi layer films used as greenhouse covers under Saharan climatic conditions (http://www.sciencedirect.com/science/article/pii/S0142941805001054) *Polymer Testing*, 24(7):e834–838.
4. Mamkagh A.M.A. (2009). Effect of tillage time and plastic mulch on growth and yield of okra (Abelmoschus esculentus) grown under rain-fed conditions (http://www.fspublishers.org) *International Journal of Agriculture and Biology*, 11(4):e453-457.
5. Abu-Awwad A.M. (1998). [Effect of mulch and irrigation water amounts on soil evaporation and transpiration] *J. Agron. Crop Sci.*, 18:e55–59.
6. Ramakrishna A. et al (2006). [Effect of mulch on soil temperature, moisture, weed infestation and yield of groundnut in northern Vietnam] *Field Crops Res.*, 95:e115–125.
7. Miles C, Kolker K, Reed J, Becker J. *Alternatives to Plastic Mulch for Organic Vegetable Production* (http://agsyst.wsu.edu/AlternativeMulchReport05.pdf). Washington State University, 2005.
8. Plastic mulch film recycling process (http://www.rkoindustries.com/id26.html) Agricultural plastics recycling website, accessed 07.09.08

Further reading

- Hulse, Sara (2000). Plastics product recycling: a Rapra industry analysis report (http://books.google.ca/books?id=lY45ZWcJOo4C&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false). iSmithers Rapra Publishing. 1859572227, 9781859572221
- Shemilt, L.W. (1983). Chemistry and world food supplies: The Final frontier (http://books.google.ca/books?id=zh7M7eVRwyUC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false). Int. Rice Res. Inst. 0080292429, 9780080292427
- Otey, F.H. (1983). Starch-based plastics and related products for agriculture (http://hdl.handle.net/10113/25457).

External links

- American Society for Plasticulture (http://www.plasticulture.org/)
- NASA photograph of greenhouses covering the Campo de Dalía in 2004 (http://earthobservatory.nasa.gov/IOTD/view.php?id=4508)
- Satellite pictures comparing the same area in 1974 and 2000 (http://iberianature.blogspot.com/2005/06/greenhouses-in-almeria.html)
- Aerial photo of part of the Campo de Dalía, near El Ejido (http://www.panoramio.com/photo/24087689)

Categories: Agriculture | Environmental impact of agriculture | Plastics and the environment

---