

## Use of polyethylene mulch for increasing the production potential of fruit crops under rainfed area

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Polythene mulch plays an important role in increasing the crop production and productivity. In present day context water scarcity for production of any crop is of great concern as water table is going down day by day. Thus,



implementing the improved technologies of organic mulch (polythene mulch) like transparent, white, black, photodegradable and photoselective mulches is required. Polythene mulch is the new technology developed in Japan. Now a days this technology is well adopted in many countries viz., China, USA, Australia, Spain, South Africa, Israel and India, etc. Polythene mulch in India was used for improving the quality and quantity of fruit crops. Presently this technology is quiet popular in Gujarat, Uttar Pradesh, Uttaranchal, Bihar, Maharashtra, West Bengal, Orissa, Punjab, Rajasthan, Tamil Nadu and rainfed Sub-tropics of Jammu and Kashmir.

One of the most successful uses of plastic films in agriculture is for mulching the soil against biotic and abiotic stresses. Various materials like straw, hay, trashes, dry leaves, etc., have been used for many centuries as a natural mulch is it impermeability which prevents direct evaporation of moisture from the soil. The conservation of soil moisture by application of mulches becomes essential for profitable cultivation under rainfed condition or semi-arid ecosystem. In spite no assured irrigation in these regions, the moisture conservation technique is not in practice. Mulches no only conserve soil moisture but also impart manifold beneficial effect, like suppression of extreme fluctuation of soil temperature, reduced water loss through evaporation, resulting more stored soil moisture, improved in growth and yield. Polythene mulch is the

new technology developed in Japan and mostly used in China. It increases the soil temperature by 2.2 to 3.6<sup>o</sup> C than the normal cultivation. It is creating better micro environment and better retention of soil moisture, increase in temperature leading ultimately to higher yield.

The polythene mulch helps to improve soil structure and soil micro-flora, reduces, evaporation of moisture and weed problem. It also reduces the leaching of fertilizer. Thus, it helps in increasing the levels of available nutrients and moisture in the soil. Therefore, polythene mulch has a positive effective on soil moisture conservation, growth, yield of Aonla. Transparent polythene mulch absorbs very less solar radiation and transmits about 85-95 per cent solar radiation through it. The under surface of transparent polythene mulch is usually cover with condensed water droplets. This water as well as polythene is transparent to the incoming short wave radiation but it is opaque to outgoing long wave radiation. The heat lost to the atmosphere from a bare soil is retained by transparent



Fig. : Eureka Lemon Plant Mulches with black polythene

polythene mulch and there fore the soil temperature is 4-8<sup>o</sup>C higher at 5 cm depth and 3-5<sup>o</sup>C higher at 10 cm depth, compared to uncovered soil.

### Types of polythene mulch:

**Transparent polythene mulch:** Depending upon thickness and degree of capacity of polythene it absorbs little solar radiation and transmits about 80-90 % solar radiation. There is condensation of water drops under the polythene mulch. This water is opaque to outgoing long-wave infrared radiation and transparent to incoming shortwave radiation. It retains heat lost from bare soil by infrared radiation. Soil temperature under this type of mulch during day time may be increased from 3 to 10<sup>o</sup>C depending upon depth of soil. Such type of mulching is used in cooler climatic zones as compared to black polythene mulch.

**White polythene mulch:** This type of mulch create a cooler soil temperature during day time by reflecting incoming radiation back into the plant canopy and hence, used when excessive soil temperatures.

**Black polythene mulch:** It absorbs UV, visible and infrared wavelengths of incoming radiation and radiates energy in the form of thermal radiation or long wavelength infrared radiation. Black polythene mulch increased the soil temperature by transferring heat from the mulch to the soil and its efficiency can be increased by close contact between mulch and soil surface. Soil temperature may be increased by 2-4°C during day time. It is helpful in controlling growth of weed.

**Photo selective mulches:** These are intermediate between black and clear mulch in terms of increasing soil temperature and provide weed control property of black polythene mulch. These absorbs pphotosynthetically active radiation (PAR) and transmit solar infrared radiation. Colors of these mulch are blue green or brown.

**Photodegradable mulches:** These mulches helps to overcome the disposal problems of conventional mulches and are broken down by UV light as well as temperature of soil. It is

important that the plastic edges buried in the soil will not be easily broken down until it is lifted out of the soil and then exposed to sunlight for degradation.

These mulches also have a overlay system, in which a top layer of black photodegradable mulch degrades leaving a white non degradable layer on the sun fall of soil. The same mulch can be used for both spring and fall crops as this would initially warm the soil temperature during day time cool, in spring and followed by day time cooling later in the summer.

#### **Advantage of polythene mulch:**

**High and early yield:** Plastic mulch increases the soil temperature that promotes faster growth of plants and leads to early maturity thereby increasing yields of horticultural crop. Days to harvesting may be reduced depending upon the fruit crop and environmental condition.

**Improvement in quality of the produce:** Mulches creates a barrier between the fruit and soil inhabiting organism and hence, reduced fruit rot. This helps in improving the physiological activities involved in sugar and protein

synthesis thereby increasing yield.

**Reduces loss of fertilizers:** Leaching problems are mainly associated with nitrogenous fertilizers as the nitrate is highly mobile when applied in large quantities. Fertilizers placed under polythene mulch helps to protect leaching loss either by rainfall or by volatilization. Practice of mulching along with drip irrigation system can maximize fertilizer use efficiency.

**Moisture conservation:** Mulches helps to reduce the evaporation losses from surface of the soil, which results in retaining the soil moisture and slightly reduces the frequency of irrigation.

**Weed control:** Polyethylene mulch reduces light penetration which helps to prevents growth of the weed due to want of sufficient light for physiological process involved in plant.

**Improvement in soil texture:** Polythene mulches protect the soil from crusting, compaction and erosion due to rainfall

as the drops do not directly come in contact with surface soil.

#### **Soil solarization:**

Polythene mulch creates a barrier preventing fumigant gasses to escape in the atmosphere and hence, increasing their effectiveness by increasing soil temperature when used

with fumigants to control soil born pathogen and insects. Clear polythene mulches is beneficial in increasing the temperature generated (solarization) properties than other opaque mulches.

#### **Disadvantages of polythene mulch:**

**Removal and disposal:** Removing of polythene mulch requires hand labour and disposal is problem because of shear value of waste material. Polythene mulch must be removed from the field to maintain the productivity, otherwise it will interfere the cultural operation in the field such as seedbed preparation, irrigation efficiency (penetration and infiltration) and fertilization.

**Furrow erosion:** When half of the soil is covered by mulch, then the amount of water concentrating in the half non mulched areas is doubled. This can lead to serious soil loss during high rainfall if conservation measures are not adopted properly.

**Specialized operation:** Sometimes it becomes necessary to go for specialized operation such as the edges of the polythene mulch must be buried sufficiently to prevent



**Advantage of plastic mulch on different horticultural crops**

Fruit crop	% weed control	% saving of water	Increasing yield %
Lemon	51	30	21.6
Aonla	-	-	22.0
Guava	-	-	26.0
Pomegranate	-	-	33.30
Kinnow	55	25	46.8
Banana	90	10	27.0
Pineapple	61	30-40	32.0

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uplifting by wind.

**How to mulch:**

- Mulch is used under the canopy of the tree or whole field.



- Before applying mulch, the field operations like tillage, removal of weeds, adding farm yard manure (FYM), irrigation and hoeing can be completed and land should be leveled to reduce contact angle between sheet and soil

for more effectiveness.

- In case of fruit plants plastic adjust the plant in center of the plastic mulch film from the cut portion of the film and cover whole area with plastic film. Care should be taken that the cut portion of film should not be in direction of wind. Otherwise, air may enter the film and there is a chance of damage to the sheet.

- Transplanting is also done in the hole of plastic film.

- If, mulching is done after the planting, care should be taken that plants are well established and they stand erect.

**Thickness of plastic sheet for different fruit crops:**

- Plastic film is used 50 micron (1-1) can be used for crops which have life span of about one year e.g. Banana, Pineapple Strawberry and Papaya etc.

- Most of the fruit plants are of perennial in nature e.g. Aonla, Pineapple, Mango, Ber, Citrus, Guava, Sapota, Grapes, pomegranate and Litchi require plastic film (100 or more micron) which can be used for a period of 1 or 2 year.

**Summary:** Polythene mulch technology is an efficient and useful method of water saving and weed management which has proved its superiority over the other organic mulch especially in fruit crops under rainfed sub-tropics owing to trunk of plant basin. Benefit of polythene mulch includes improved conservation of soil moisture, fluctuation of soil temperature, reduced water loss through evaporation and increasing the level of available nutrients, plant growth and development, higher yield and improved quality and also its flexibility in scheduling water application.

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