Practical Manual on Plastic Mulching

National Committee on Plasticulture Applications in Horticulture

Department of Agriculture & Cooperation

Ministry of Agriculture, Government of India

New Delhi

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Foreword

Mulching as a practice to conserve soil moisture, check weed control, moderate soil temperature & provide a micro climate to the plant is age old. With the advent of plastic films for mulching application, this practice has got further impetus. Research studies have shown, when mulching is practiced along with drip irrigation, it gives best results.

For the adoption of mulching by farmers, the Government of India has provided subsidy @ 50% of permissible cost of Rs. 20,000/ha limited to 2 ha per beneficiary under the centrally sponsored schemes of National Horticulture Mission & Horticulture Mission for North East & Himalayan States and other related schemes.

This Practical Manual on Plastic Mulching has been prepared keeping in mind the need of implementing agencies at the state level, farmers and other stake holders.

I am confident that it will serve the purpose for which it is meant and prove to be useful & beneficial to the users.

21st January, 2011

(Gorakh Singh)

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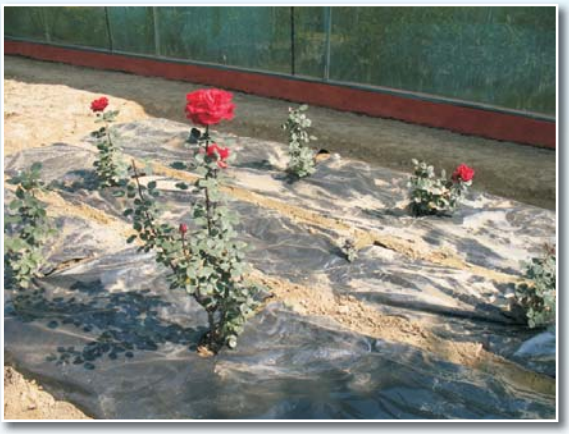
PLASTIC MULCHING

1. Introduction



For decades, farmers have been trying to use various materials such as dry leaf, paddy straw, paddy husk, jowar trash, saw dust, dry grass, dry sugarcane leaves, dry coconut leaves, coconut husk, paper for moisture conservation (reducing water evaporation losses), checking weed growth, and moderation of soil temperature. It creates a kind of micro-climate for the plant, which is suited for best performance by regulating soil water, soil temperature, humidity, carbon di-oxide enrichment and increased microbial activity in the soil. **Thus, mulching is the process of covering soil around the plant root area with a view to insulate the plant and its roots from the effects of extreme temperature fluctuations.**

All the available materials, though beneficial, were found to have inherent weaknesses and not easily available in large quantities. The plastic films, however, are easily available, easy to handle, transport & lay. This lead to the use of plastic films as mulches, which is today the most preferred material. Now a days LDPE and LLDPE plastic films are commonly used for mulching. LLDPE black colour mulch film is most popular, owing to the twin properties of down-gauging and better puncture resistance. While down-gauging leads to availability of thinner film at a lower cost, the puncture resistance and opacity check the weed growth under the film.

2. Benefits of Mulching

- Conserves soil moisture
- Moderates soil temperature by insulating the soil surface
- Control weed growth under mulch film

- Reduces soil compaction caused by equipment and people
- Reduces soil erosion from wind or water
- Preventing leaching of fertilizers
- Reduces incidence of disease by protecting above-ground plant parts from splashes that carry soil-borne inoculum
- Improves quality of produce, reduces fruit rot by eliminating contact between fruit and soil
- Reduces winter injury by minimizing temperature variation, reducing water loss in plants and decreasing heaving of plant crowns and roots
- Early Maturity
- Provides conducive environment for plant growth
- Improves seed germination
- Improves productivity

3. Types of Mulches

Basically, there are two types of mulches depending upon the material used as mulching. They are as under:

3.a Organic Mulches

The organic materials such as crop residues & by-products, farm yard manure & by-products of timber industry, when used for mulching, are known as organic mulches. Organic mulches create no post utilization disposal problem but their availability is an issue.

3.b In-Organic Mulches (Plastic Mulches)

The in-organic materials such as plastic films, when used for mulching, are known as in-organic mulches. While natural mulches may not be available at all times & places, plastic mulches can be made available in different colours & thickness to obtain the desired results.

4. Types of Plastic Mulches

4.1 Black mulches

4.2 Clear or transparent mulches

4.3 Two-side color mulches

a. Yellow/black
b. White/black
c. Silver/black
d. Red/black

4.4 Degradable mulches

a. Photo-degradable
b. Bio-degradable

Black film mulching in strawberry

By proper selection of plastic mulch composition – colour & thickness, it is possible to precisely control the soil environment.

4.1 Black Mulches

The black plastic film does not allow sunlight to pass through onto the soil. Thus, photosynthesis does not take place in soil in absence of sunlight below the black film. Hence, it arrests weed growth completely. The black plastic mulch is helpful in conserving moisture and controlling weed growth. However, it may increase the soil temperature.

It has been reported that during hot climatic conditions, using plastic nets and non-woven fabrics (layer of polyester or polyvinylalcohol) in place of black mulch film is also helpful in increasing yield marginally of vegetables, especially that of leafy vegetables.

Black film mulching

Mulching with black film

4.2 Clear or Transparent Mulches

The transparent film will allow sunlight to pass through and the weeds will grow. However, by using herbicide coating on the inner side of film weed growth can be checked.

The transparent film is quite successful as soil solarization film for disinfecting the soil in order to reduce soil borne diseases and some weeds. This application is quite successful in nursery raising by solarising the beds before sowing seeds for nursery raising, which gives near 100% seed germination & disease free nursery.

Soil solarization with clear film

While the black film has proved to be effective in plains to keep crop cool during summer, the transparent film is effective in hilly areas for raising soil temperature in cold climatic conditions during winter.

4.3 Two-side Colour Mulches

Wavelength selective or photo-selective films (also called two-side coloured) are designed to absorb specific wavelengths of the sun's radiation, which changes the spectrum of the sunlight passing through the film or being reflected back into the plant canopy. These light changes can have a marked effect on plant growth & development. These films enable growers to control different plant properties such as leaf & fruit size , clour, root development, yield, branching, plant height, growth, inter node length, time of flowering, bloom size, strengthen plant stems, encourage fruit to grow lower down on plants, and aid in disease control by keeping insects away. The effects are warming of soil temperature, blocking

Mulching with Silver film

Mulching with coloured films

weed growth, increasing color saturation of developing fruit & increasing carbohydrate transport to developing fruit.

Compared to black mulches, wavelength selective mulches re-emit less heat, thus maintaining lower leaf temperatures, alter red-far-red light balance leading to phytochrome mediated changes in the plant morphology, and reflect more ultraviolet rays, which repels insects & pests such as aphids, thrips & whiteflies, who transmit viruses. The white/black, silver/black, and aluminized black mulches generally maintain cooler root-zone temperatures, thus suitable for most Indian regions. Effects of some of the coloured mulches are given below:

Yellow/black – attracts certain insects & thus acts as a trap for them, which prevents disease.

White/black – Cools the soil.

Silver/black – Cools the soil, though not to the extent of white/black film & repels some aphids & thrips.

Red/black – Partially translucent allowing radiation to pass through & warm soil but also reflects radiation back into plant canopy changing ratio of R:FR light, which results in changes in plant vegetative, flower development & metabolism to early fruiting & increased yields in some fruit & vegetable crops.

In the recent past, coloured mulches have gained interest. However, research results with regard to their effectiveness have been mixed and inconsistent. Some research has indicated control over plant height and plant structure by certain colored films that vary the reflected light quality in the plant canopy. Some colored films have been implicated in reducing insect populations on plants. Some research has even matched mulch color with crops giving best yield responses. For example red for tomato and blue for brinjal. However, there is a need for trying further before making any recommendation on coloured mulches and comparing them with standard black or white-on-black or silver-on-black films currently in use.

4.4 Degradable Mulches

4.4.a Photo-degradable mulches

This type of plastic mulch film gets disintegrated under sunlight over the designated mulching period.

4.4.b Bio-degradable mulches

This type of plastic mulch film gets disintegrated under natural environmental conditions & gets mixed in soil after mulching period.

5. Selection of Mulch Films

Selection of film colour depends upon the specific purpose to be achieved such as weed control, raising of soil temperature or cooling it down or disease control or enhanced plant growth etc.

The film width should be such that the crop agronomic practices could be conveniently carried out. The width of 90 cm & 120 cm are more common. The aim is to make use of available width of mulch film in most effective manner.

6. Thickness of Film

In plastic mulching, the thickness of mulch film should be in accordance with type & age of crops. Economics suggest that the film thickness should be the minimum possible commensurate with desired life & strength. The recommended thickness of mulch films for different crops is as under:

Thickness (microns)	Crops Recommended
7	Groundnut
20-25	Annual - short duration crops
40-50	Biennial - medium duration crops
50-100	Perineal - long duration crops

7. Extent of Surface to be Covered under Film

% Coverage	Crops Recommended
20-25	All creeper crops
40-50	Initial stage of orchard crops
40-60	Fruit crops & cucurbitaceous
70-80	Vegetables, Papaya, pineapple etc.
90-100	Soil Solarization

8. Calculation of Mulch Film Requirement (Approximately)

Thickness			Area coverage (m^2/kg)	Weight (Gram/m^2)
Micron	Gauge	mm		
7	28	0.007	144	6.9
20	80	0.02	54	18.4
25	100	0.025	42	23
40	160	0.04	26	38
50	200	0.05	21	46
100	400	0.10	11	93
200	800	0.020	5.3	209
250	1000	0.025	4.29	233

9. Indicative Cost of Plastic Mulching

On the basis of 80% coverage of area under the film, indicative cost of mulching for vegetable crops would be approximately Rs.20,000/- per ha i.e. Rs.2/- per m^2. Similarly, on the basis of 40% area coverage for an orchard crop, indicative cost of mulching would be approximately Rs14,000/- per ha i.e. Rs.1.4/- m^2. As the Polymer prices change frequently for cost of plastic mulching would also keep on varying. However, the cost economics of plastic mulching is well establish in terms of off-setting the additional cost.

10. Indian Standard (BIS) for Mulch Film

Presently, the Bureau of Indian Standards has not come out with a standard for mulch film manufacture. However, it has compiled a code of practice - IS:15177:2002: Surface Covered Cultivation - Plastic Mulching - Code of Practice, which may be referred to.

11. Crop Response to Plastic Mulching

The results of research studies carried out on plastic mulching by Precision Farming Development Centres (PFDCs) located in different agro climatic zones all over India have shown that plastic mulching is useful in increasing productivity from 25% to 70%. Results of some research studies are given in annexure-1.

12. Subsidy on Plastic Mulching

Being capital intensive, the Government of India has provided subsidy @50% of permissible system cost of Rs.20,000/ha i.e. a net subsidy of

Rs.10,000/ per ha for the adoption of mulching by farmers with a ceiling of 2 ha per beneficiary the under National Horticulture Mission (NHM) and Horticulture Mission for North Eastern & Himalayan states (HMNEH) and other related schemes. These schemes are implemented through Horticulture Department in respective states.

13. Sources of Mulch Film

Mulch film is a short width film of one to two meters. It is being manufactured by processors in the packaging industry spread across the country. There are, however, dedicated processors also who specialize in the manufacture of different types of mulch films. List of some such processors is given in annexure-2.

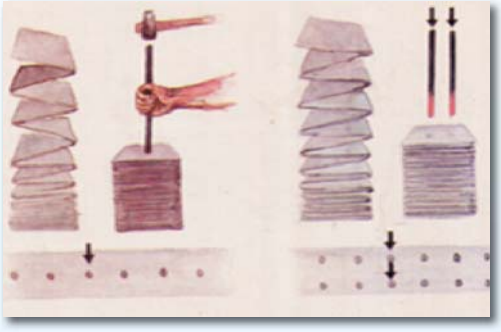
14. Laying of Mulch Films

Plastic films are laid before crop planting or transplanting. This includes preparation of seed bed, spread of mulch film and anchoring of edges of the film. These operations, if done manually, become very time consuming, costly & tedious. Therefore, tractor mounted mulch laying machines have been developed and are in use. Name & address of one such film laying machine manufacturer is also given in annexure – 2.

Mulch Film Laying Machine

14.a Laying of Mulch Film in Vegetable Crops

Thin film of 20 to 25 microns is used for mulching short duration crops like vegetables. Required length of film for one row of crop is taken and folded at every one metre or required spacing of the crop along the length of the film.



Punching of holes in films

Round holes are made at the centre of the film using a punch or a bigger diameter pipe and a hammer. Alternatively, a heated pipe end could be used. In case the plant spacing is less than one metre,

required number of holes could be made as per the spacing of the crop. For example, if the plant spacing is 45 x 45 cm, the folding could be done at every 45 cm along the length of the film. The holes are punched on two spots of the face of the film. Alternatively, the folding may be done at every 90 cm and four holes could be punched. In case of machine laying the punching of holes is done by the machine.

- One end of the mulch film is anchored in the soil and the film is unrolled along the row of planting.
- Till the soil well and apply the required quantity of FYM and fertilizer (make the furrows if required) before mulching.
- Mulching could be taken up before or after planting.
- Mulch film is then inserted into the soil on all sides to keep it intact.

Seeds are sown directly through the holes made on the mulch film.

Fixing of film on beds Planting/transplantation

In case of transplanted crops, the seedlings could be planted directly into the hole. In case the transplanted plants are not erect and steady, care should be taken to see that the saplings do not fall on the mulch film. This would lead to burning and mortality of the tender plants. In such cases, it is advisable to mulch after the

Mulching in vegetables

establishment of the plants (after 3 to 7 days of transplantation when the plants are steady and erect).

For mulching established seedlings, one end of the film along the width is buried in the soil and the mulch film is then unrolled over the saplings. During the process of unrolling, the saplings are held in the hand and inserted into the holes from the bottom side, so that it could spread on the top side.

In case the mulch film needs to be used for more than one season, the plant is cut at its base near the film and the film is removed and used.

Mulching in Row Crops (Vegetables)

Irrigation practices

The best way of irrigating mulched crops is through drip irrigation. Under drip irrigation, the laterals are kept under mulch film. Irrigation and fertigation could be carried out without any problem. In flood irrigation, the channels are made along the un-mulched area and irrigation is carried out. Irrigation through sprinklers is also possible.

Application of Fertilizer

In case of drip or sprinkler irrigation, fertilizer application is done in liquid form through drip or sprinkler irrigation system. However, under flood irrigation, all fertilizers & soil-applied chemicals are usually placed in or on bed before mulch is applied.

Removal & Disposal of used Mulch Films

Non-degradable mulch films do not disintegrate in the soil. Therefore, after use, mulch film should be removed & disposed off properly so as to avoid any plastic pollution problems.

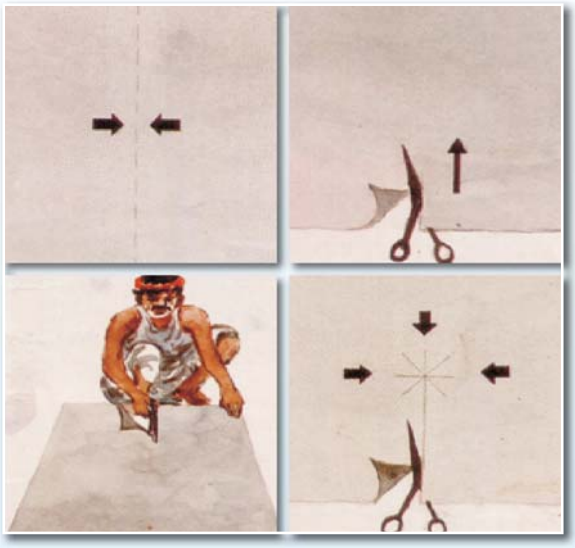
14 b. Laying of Mulching Film in Fruit Crops

Mulching area should preferably be equivalent to the canopy of the plant (larger the canopy, larger the area of mulching and vice versa).

Required size of mulch film is cut from the mulch roll. Maintain equal length and breadth.

Cut the film using a scissor from the middle from the middle of one side to the centre of the mulch film.

Cut the film in star shape as illustrated. The film could be cut either in the field or in a clean, neat place and carried to the field.



Cutting & sizing of film

Clean the required area by removing stones, pebbles, weeds etc. Till the soil well and apply a small quantity of water before mulching.

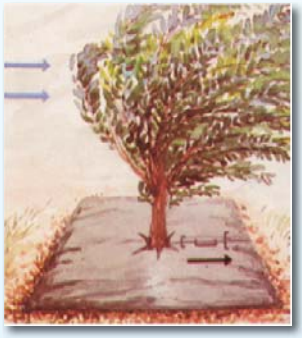
Cleaning area around plant & watering it before fixing the film

If required, a small trench could be made around the periphery of the mulching area to facilitate anchoring of the mulch film.

Fixing of film

Open the film from the cut portion and insert the tree/plant in between the cut portion and cover the entire area. The cut portion of the film should be overlapped upto 6 inches and the overlapped end should be buried in the ground. The overlapped portion of the film could also be sealed using a plastic tape or by using metal hooks made out of 1mm binding wires as shown in the illustration.

Semi circular holes could be made at the four corners of the film in order to facilitate water movement. The position of the slit or opening should be parallel to the wind direction. It should not be placed perpendicular to the wind direction as this could facilitate entry of air through the opening and result in tearing of mulch film.



Cover the corners of the film with 4-6 inches of soil on all sides to keep the film in position.

Irrigation practices

In drip irrigation, the lateral pipelines are laid under the mulch film. In case, inter cultivation needs to be carried out, it is advisable to keep the laterals and drippers on top of the mulch film and regulate the flow of water through a small pipe or through the holes made on the mulch film. The lateral pipelines are rolled and kept aside during inter cultivation. Fertilizer could be applied through drip irrigation system.

In flooding, the irrigation water passes through the semi circular holes on the mulch film. Rain water also passes through the holes on the mulch film as well as through the un-mulched area.

Mulching in Fruit Crops

Annexure - 1

Response of Plastic Mulch on the yield of Crops

Sl. No.	Crop	Thickness of mulch film (micron)	Increase in yield (%)
Vegetables			
1	Chilli	25	50-60
2	Potato	25	35-40
3	Cauliflower	25	40-50
4	Tomato	25	45-50
5	Capsicum	25	35-45
6	Okra	25	50-60
7	Brinjal	25	30-35
Fruits			
1	Apricot	100	30-35
2	Peach	100	30-35
3	Guava	100	25-30
4	Kinnow	100	45-50
5	Pomogranate	100	35-40
6	Strawberry	25	40-50
Others			
1	Sugarcane	50	50-55
2	Areca nut	50	25-30
3	Ground nut	07	60-70

Source: Based on Research Findings of PFDCs

Annexure - 2

Few Mulch Film Processors

Sl. No.	Name & Address	Contact Details
1.	**Archan Polymer Pvt. Ltd.** Survey No : 46/4-C, Opp Lodhika GIDC Estate Kalawad Road, At : VAD. VATADITal: Lodhika, Dist: Lodhika, Gujarat - 360 021	Tel : 02827 - 287648 Fax : 02827 - 287065 Email : arc_Polymers@yahoo.co.in Web : www.archanpoly.com
2.	**Arun Manufacturing Services Pvt. Ltd.** B-53, F.F. Complex, Rani Jhasi Road, Jhandewalan, New Delhi - 110 055	Tel : 011 - 23551699 / 23544555, Mob : 9313483363 Fax : 011 - 23638587 Email : amspoly@vsnl.com, amsdelhi@yahoo.co.in Web : www. perfilms-tarps-ropes.com
3.	**Bohra Agri-films Pvt. Ltd.** ADITI COMPLEX Phase II, Lane No.5, Industrial Complex, Bari - Brahmana, JAMMU - 181 133 , J & K	Tel : 01923 - 221553 Mob : 9469141978,9469211616 Fax : 01923 - 221553 Email : bapl@bppl.net.in Web : www.bohraagrifilms.com
4.	**Creative Polymers** 2500/18, G.I.D.C. Industrial Estate, Halol - 389 351, Gujarat	Tel : 02676 - 220207/221642 Mob : 9825031161 Fax : 02676 - 2710073 Email : kamal_cp@satyam.net.in
5.	**CTM Technical Textiles Ltd.** 205, New Cloth Market, Near Raipur Gate Ahmedabad - 380 002, Gujarat	Tel : 079 - 22165163 Mob : 9998880044 Fax : 079 - 22169326 Email : info@ctmagrotextile.com Web : www.ctmagrotextile.com
6.	**Essen Multipack Ltd.** Survey No. 209, Plot No.5, Industrial Area, Veraval (Shapar), Rajkot - 360 002, Gujarat	Tel : 02827-252018/252019/252610 Mob : 9879524474 Fax : 02827 - 252610 Email : essen@essenpoly.com Web : www.essenpoly.com
7.	**Navrang Polyfilms** Plot No : 830 opp. Jogni Mata's temple Near Uma marble, Santej, Gujarat - 382 721	Tel : 02764 - 286608 Mob : 9824097622 Fax : 02764 - 286608 Email : navrangpoly@hotmail.com Web : www.navrangpolyfilms.com

Sl. No.	Name & Address	Contact Details
8.	**Neo Corp International Limited** Industrial Area, Sector -1, Plot No. 62-63, Pithampur – 454775 Dist. Dhar, Madhya Pradesh	Tel : 07292 – 410400,410422 Mob : 9993095890 Fax : 07292 - 410499 Email : surakha@neocorp.co.in
9.	**Paharimata Packaging Industries** 109A/1A, B R B Basu Road (1st Floor), Kolkata - 700001	Tel : 033- 2242-9501, 2248-4911 Fax : 033 – 2242 7899 Email : vijayint@cal3.vsnl.net.in info@thepackagingcentral.com Web : www.thepackagingcentral.com
10.	**Sanhit Polymer** Sriniketan Road, Bolpur, Birbhum, West Bengal - 731204	Tel : 03463 - 255560 Mob : 9434012544 Fax : 03463 - 234517 Email : info@sanhitgroup.co.in Web : www.sanhitgroup.co.in
11.	**Shivam Polymers** 188/13, Waghodia GIDC Estate, Vadodara, Gujarat - 390060	Tel : 02668 - 262547 Mob : 9879590615 Email : shivam188@ymail.com
Mulch Film Laying Machine Manufacturer		
1.	**Mr Alpesh Patel** Agribiz Corporation NH No. 8, Near Water Canal Vasad – 388 306, Dist. Anand, Gujarat	Telefax : 02692-274507 Mob : 9898746676 Email : agribizcorporation @gmail.com