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**POPULAR ARTICLE**

## **Row Covers – A tool for integrated pest and viral disease management for enhancing farmers profitability**

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In recent years, organic agriculture has gained both popularity and attention among consumers and policymakers and is becoming the fastest growing agricultural sector. Globally, the demand for organically produced food is increasing along with a growing tendency to shift towards environmentally friendly production practices. It is always better to avoid using any chemical pesticides and adopt natural ways of deterring pests and diseases. Adopting such measures cause lesser harm to the environment and provides healthier food.

Vegetable production without using synthetic fertilizers and pesticides could be challenging and requires implementation of new techniques. Transitioning to organic cultivation often involves adjustments, technical know-how, and tools to better manage issues pertaining to soil fertility, weed and pest populations. Once a proper balance is established, organic production minimizes the use of external inputs, improves soil quality and aims to achieve economic viability with no or minimal impact on the environment.

One such innovation is a lightweight, non-toxic, spun bonded synthetic fabric commonly known as row cover or crop cover. It is also called floating row cover as it is designed to be light enough to float on the top of plants without crushing them and is pushed up by the plants as they grow. Its use is becoming popular in vegetable as well as fruit crop production. The row cover acts as an effective physical barrier for protection against pests, low temperature in temperate and solar radiation in the tropical regions. It also helps to raise the temperature of the covered area by 1-2°C, letting moisture and sunlight in and even protecting against wind damage. They are sometimes also called as season extenders as they can help to extend the growing

season by several weeks either way in spring and fall. They are easy to install, remove and store when not needed. Row covers are typically deployed immediately after transplanting and then removed at anthesis, so that pollinators can visit for the pollination process. Usually, at this growth stage the plants are sturdy to withstand pest pressure and have gotten the temperature boost that they required for fruit setting.

Until of late, row covers have been deployed and retrieved manually. Due to the labour intensive needs of row covers, their use has been limited to small fields on small-scale farms. The purpose of installing row covers in the temperate regions differs from that in the subtropical regions. In the temperate regions, row covers are used for protection from cold, frost, hail, wind, bird and insect attacks, suppression of transpiration and promotion of germination, growth and yield. On the other hand, their main purpose in the subtropics is to protect the crops from pests and for the attenuation of strong solar radiation.

### **DIFFERENT TYPES OF ROW COVERS**

Most row covers sold are made of either spun-bonded polyester or polypropylene. Spun-bonded row covers are a common choice for growers who want both microclimate modification and insect exclusion. Row covers generally come in different weights- from light to medium to heavy, usually between 15 to 55grams per square yard.

The heavier the fabric, the more it gives protection against frost. The heaviest fabrics are used only in the evening and are removed during the day to allow more light and heat access. Lighter fabrics do not trap as much heat inside in summer months and allow more sun and water to permeate. The lighter covers are used during the warmer growing months primarily as an insect barrier. However, they are light enough to not need support and are allowed to 'float' on top of plants. The choice of fabric depends on crop type and regional climate. Most commercial organic farmers use a lighter-weight row cover that lets in 80-90% light.

**Lightweight All Season Pest Control** – they are thick enough to prevent easy tearing, but light enough to prevent overheating. It can also be used over crops which need insect pollination. It lets 85% of sunlight through to the plants and provides frost protection down to -2°C.

**Frost Protection Season Extender** – it is a slightly heavier cover with better tear-resistance. Since it only lets in 70% of sunlight and traps more heat, it is best used as a season extender, rather than an all season pest control. It also protects against frost down to -2°C.

**All Purpose Garden Fabric** – it is on the heavy side of row covers providing heavy-duty insulation, in fact it acts as a quilt. It keeps the plants insulated from early and late frosts, as well as in high wind areas. Light transmission is 60% and frost protection is listed as down to -4°C. This fabric is a nice substitute for a cold frame, and is used to harden off tender plants in spring and to keep greens growing a little longer in the fall.

Size of Row Cover

Size of the cover depends on how wide the beds are and how tall the plants will be. For a 4 foot (1.2 m) wide bed with the cover 1 foot (30 cm) above the bed, a cover that is 7.2 feet (2.2 m) wide is used. For length, at least 1 foot (30 cm) for each end is added. If a super long or super wide cover is needed, two pieces can be used by overlapping them by at least 6 inches (15 cm) or so.

### Installing Row Covers

Row cover doesn't take much time to install. For low growing crops, the cover is unfurled over the row and the edges of the fabric are secured with mounded soil. The cover should not be stretched tightly over the row, it should be left loose slightly to expand as the plants grow. Taller plants, like tomato, chilli, capsicum and eggplant require support to install the row cover. Usually supports are put at a distance of 10 feet in order to avoid hindrance to agricultural operations like weeding, watering or other maintenance around the crops. Steel hoops (thin-gauge smooth galvanized wires cut into half circles) are lightweight, easy to store and can be easily inserted into the ground at least 15 cm or more to secure them well. A bailing wire or string is used to tie everything together. PVC pipe which is readily available can also be used for support. For PVC pipe T and + shaped connectors can be used to create a more sturdy support structure. The cover is clipped in the middle at both ends of the bed as a start. The cover should reach down on both sides and be centered lengthwise to cover both ends evenly. The edges should be secured with soil. To keep the row cover up off the ground and above the plants so as to not weight down on them as they grow.



Fig 1. Row cover installation.





Fig 2. Muskmelon crop under floating row cover.



Fig 3. Crop grown under row cover using wire support.



Fig 4. Chilli crop grown under row cover supported with wire hoops.

### **Storing and Re-Using Row Covers**

The row cover can be stored by rolling on an appropriately sized piece of PVC pipe. The wider sized row covers can be folded like a bedsheet. The shorter stretches (60 meters or less) can be stored using manual technique “the weave” in which the row cover is wrapped in a figure-8 weaved around arms. It can then be slip off onto wall-mounted tool hangers or simply onto a flat surface. When executed correctly, the weave unravels with ease and avoids tangling the row cover unnecessarily or ripping its edges, as is risked when rolling onto a PVC pipe.

#### **Functions of Row Cover**

##### **Beneficial Effects**

### **Climate Resilient Cultivation and Microclimate Modification**

One of the most critical effects of row cover on plants is in the improvement / modification of environmental factors such as light, humidity, soil and air temperature, and air movement. All these factors directly affect plant growth and development. Row covers create warm air around the plants, and can even warm the soil within the row, though the extent of warming is dependent on the thickness of the row cover. Row covers have been reported to significantly alter air temperature, thereby affecting plant growth through changes in leaf characteristics, biomass accumulation, and relative growth rate. Common crops that farmers cover for giving them a temperature boost in the spring include cucumbers, squash, zucchini, peppers and eggplant.

Row covers help to trap warmth in the soil and the surrounding air during the day. Then at night time, the plants benefit from the heated soil and air that cools down more slowly under the cover. Application of row covers reduces evaporation and helps in

moisture retention so the crops do not need to be watered as often. The main advantage is seedling can be transplanted or seed can be sown directly several weeks earlier than covered crops. This allows to harvest earlier and longer. In fall, the growing season can be extended and less hardy fall crops can be taken longer into the late fall and even winters.

### **Increase in Yield and Early Harvest**

Row covers have been shown to increase yields in various vegetables such as fresh beans, muskmelon and watermelon. They also increase early production in muskmelon. Other attributed advantages of these covers are improvements in plant uniformity and fruit quality, as well as the extension of the harvesting season.

### **Frost Protection**

Row covers give plants about 2-4 °C of frost protection in the spring and a bit more in the fall because the soil is warmer in fall. The plants remain protected from frost damage down to about -4 to -2 °C, depending on the fabric. The fabric can also be doubled, for additional protection when a frost is forecast.

### **Protection from Insect Pests and Diseases**

The role of row covers as an effective pest management tool has been increasing because they serve as a barrier against various insect pests, including aphids, cucumber beetles, whiteflies, thrips and the pathogens that these insects transmit, thus reducing disease spread. In addition to insect exclusion, it may also reduce insect damage and movement of pests that lay eggs near plants.

Row cover is a successful physical barrier against most pests if used correctly. Many common pests such as flea beetles, bean beetles and cucumber beetles overwinter in field edges and not in the soil. So, applying a layer of row cover to transplants immediately upon planting is generally successful in keeping these pests away. For the physical barrier to be most effective against pests, the row cover should be placed over the crop immediately upon seeding or transplanting.

For cucurbit crops, the cucumber beetle (*Diabrotica* and *Acalymma* sp.) is a common insect pest which not only feeds on plants but can carry a bacterium, *Erwinia tracheiphila*, in its gut and can transmit bacterial wilt causing severe yield loss. Row covers can decrease the incidence of bacterial wilt and increase yield.

Field trials at the experimental field of IARI Regional Station, Pune have shown that viral diseases in tomato and chilli can be managed by using row cover along with silver colour polythene mulch with minimal alternate spray of biopesticide and insecticide. The treatment was effective in decreasing disease incidence, increasing yield to one and a half times and reducing the number of sprays. Similarly in muskmelon, silver colour polythene mulch with floating row cover and two alternate sprays of Imidacloprid 0.01% and Agroneem 0.2% was found to be most effective in managing virus disease incidence and increasing the marketable yield to 2-3 folds.

### **Reduced Pesticide Use**

Use of row covers provides an alternative to pesticide application for managing insect feeding and disease transmission specially at the early stage of crop growth. Row covers act as a barrier to insect feeding and related disease transmission. Row covers used for production of horticultural crops such as melons and squash (cucurbits) have reduced insect feeding and disease in direct relation to their ability to exclude insects, thereby increasing fruit production potential.

In the field experiments undertaken at IARI Regional Station, Pune the use of row cover in tomato, chilli and muskmelon was effective in reducing the number of sprays of insecticides by 50 percent. A row cover system potentially increases feasibility for organic production as it shifts input costs from pesticide application to the row cover. A cover installed from seeding to pollination helps in exclusion of early season insect feeding and bacterial wilt.

### **Other Applications**

Row cover can also be utilized for direct-seeded crops such as corn to keep away pests like crows, pigeons and squirrels, as these pests make their way into the field and pluck out the sprouted seeds.

### **Disadvantages**

As row cover is lightweight, it rips easily, which means it can be used for only one season. Its weight also makes it nearly impossible to be managed by a single person if there is any wind when applying or reapplying it. Though the cover does an excellent job of protecting the plants, it also shields the seeds of weeds in the same area that it covers. If a section of the field is left covered for too long, weeds take over the majority of the bed space. If even a tiny opening remains while securing its edges, it can allow outside pests to wreak havoc on the covered plants. Care also needs to be taken that no insects are trapped inside the cover. Certain pests like cutworms, which tend to target the brassica family, and squash vine borers, which attack cucurbits, have larvae that overwinter in soil. If a susceptible crop is planted into soil in which these pests are already present, row cover will not be an effective method of keeping them from doing damage.