

## Low Tunnel Farming: An Inexpensive Solution for Frost Protection and Increased Yields

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### Abstract

Low tunnels have been used for producing healthy and high value nurseries. Use of low tunnels has been effective in crops such as Tomato, Cucumber, Radish, Beans, Asparagus, Strawberries, Melon and Tobacco, etc. This technique prominently used in Israel, was introduced a few years back in some villages of Gurugram for growing winter crops. In neighbouring Nepal, farmers have produced both seasonal and unseasonal vegetables in such tunnels. In many places farmers are limited to grow seasonal vegetables, face shortage in numbers of vegetable processors and lack of cold storage infrastructure. On many occasions, farmers cannot get reasonable profit margins from their produce when the market is flooded with seasonal vegetables. Such challenges may be overcome by growing vegetables through the production technology of tunnel farming. It was reported that many cucurbits (squash, cucumber and melons) respond well under row covers with increased yield as much as 25%. Similarly strawberry, Chinese cabbage, snap bean, tomato etc. have also shown positive results with higher vegetative growth and quality yields under plastic protection.

**Keywords:** Off season vegetables, Low tunnel, Protected cultivation, Poly house, and Plastic tunnels

### Introduction

Growing vegetables is not only a great way to provide a healthy source of food and nutrition for families, but it can also be a profitable business for farmers. However, farmers often face challenges such as extreme heat, fog, and unpredictable weather conditions. To overcome these challenges, many farmers are turning to low tunnel farming as an affordable and effective solution. Low tunnels, also known as plastic tunnels, are small structures that

mimic the effects of a greenhouse. They are usually two to four feet tall and four to six feet wide at their widest point, making them a more compact version of high tunnels. They are ideal for windy locations, and it is advisable to use a length of less than 50 feet. These tunnels trap carbon dioxide, which strengthens the plant's photosynthesis and increases yield. They also protect crops from high winds, rain, frost, and snow. The low tunnel method is particularly useful during cold waves that can threaten vegetable production. It not only protects crops, but it also allows farmers to earn higher prices for their food by producing off-season. These structures are not only cost-effective, but they are also easy to assemble and dismantle. The main frame of a low tunnel is usually made of PVC tubing with a moon-shaped design. Instead of being attached to a building, the frame is covered with a plastic poly film sheet that is anchored in place. They can also be used in high altitude tunnels.

Low tunnels may be a low-cost, cost-effective investment choice for companies looking to get into poly tunnel manufacturing or expand their present capacity. It offers an alternative form of crop protection and season extension that may work even better than a high tunnel for some growers and in certain situations.

### **Plant and weather monitoring**

Many plants, particularly cucurbits, rely on pollination for growth and reproduction. However, the use of low tunnels can sometimes impede this process as insects, including bees, may have difficulty accessing the enclosed environment. This is due to the variations in temperature, relative humidity, and light that occur within the tunnels. Even when low tunnels are perforated, most insects prefer to stay outside. To prevent this, it is important to open low tunnels before the flowers bloom to ensure proper pollination and optimal fruit set.

For certain cucurbits, a delay of just two to three days in opening the low tunnels can result in a significant decrease in yield. High temperatures inside the low tunnels can also lead to tomato flower abortion. To prevent this, farmers can use weather monitoring tools to open the tunnels when temperatures become too high for certain crops. Even when the outside temperature is around 70°F, the temperature inside a transparent, perforated polyethylene low tunnel can easily exceed 100°F on hot and sunny days with little wind. Extreme temperatures, whether hot or cold, can harm the entire crop. Additionally, hot air can sometimes be funnelled upward within the tunnels, particularly when the beds are placed on a slope.

## Low Tunnels

A low tunnel is a type of agricultural structure that is used to cover the canopy of plants. It is typically made of thin, clear plastic, supported by wires or pipes, and has a height that is just sufficient to cover the plants. Low tunnels can significantly raise the air temperature around the plants on sunny days, by as much as 5-15 degrees Fahrenheit or more. However, the temperature increase during the night is minimal.

Another structure that can be used in conjunction with low tunnels is a high tunnel. It is similar to a greenhouse, and is covered with UV-stable plastic. When used with low tunnels, it has been observed that the night-time air temperature inside the high tunnel can be 3-5°F higher than the high tunnel's air temperature and 5-7°F higher than the outside air temperature. Low tunnel ventilation can be done either by lifting one or both sides or by removing the tunnel altogether, depending on the design.



**Atypical low tunnel structure**



**Low tunnels within a high tunnel being ventilated by lifting low tunnel**

## Construction

Low tunnels can either be used alone or combined with a high tunnel depending on the intended use. Below are instructions for two low tunnel types: pinned tunnel, and free floating. The pinned tunnel is designed to withstand wind and the free floating is designed to be used within a high tunnel and should not be used without a structure providing protection from the wind and UV light.

### Pinned Low Tunnel

To build a pinned low tunnel you will need a post pounder, bolt cutters, and measuring tape. Materials needed to construct a pinned low tunnel:

Material	Quantity
Smooth galvanized steel trellis wire (#10gauge)	100ft
1 milclear UV-stabilized plastic (6'wide)	100ft
Sand bags (grocery sack filled with sand)	12
T-posts to secure tunnel ends(5')	2
2' long wooden garden stakes (1x 2"size)	2
Fencing staples	2

Low Tunnels Canbe Used Over A Raised bed, Or Simply Over A Flat Row.

#### Procedure:

- Using bolt cutters, cut the 10 gauge smooth galvanized steel trellis wire in to 6' lengths. Pre-cut wire is also available, usually in bundles of 100. Five feet from each end of the row or raised bed, in sert a T-postal a 60°angle,the post will anchor the plastic.
- Startingapproximately5'infromtheT-post,layouta6'wirearchevery 10'andend5'fromthesecond T-post. Pushthewirearches8"to 12"into the soilat the base of each side of the bed. Pound a wooden support 6"to8" into the ground under each end arch to provide rigidity and to ensure it will stay parallel to the ground. Using a fencing staple, secure the wire to the top of the wooden support.
- Roll out plastic from one end to the other, leaving an extra 5' to tie off with at the end .Before cutting the plastic, tie the end to the T-post by wrapping the plastic around the post several times and then, using the bailing wine, tie the plastic to itself.
- Cut plastic, leaving at least 5' of plastic at the other end to tie off to the T-post. Pull theplastic tight across the wire arches making sure that the plastic should not twisted. Tiethe end to the T-post, pulling the plastic as tight as possible.
- Keeping tension on the plastic from one end to the other will help the tunnel withstand wind. Push additional wire arches into soil between the wire arches under

the plastic result in give very other wirearch being above the plastic.

- In areas prone to strong winds, the sides of the plastic need to be secured. On the windward side, bury the edge of the plastic with soil. This helps keep plastic in place during windy conditions.
- On the other side of the low tunnel, either cover with soil or place sand bags every 10'. Use extra bags to hold down the tunnel ends near the T-post and the first arch. Bags can be removed, and the plastic lifted on that side to allow for ventilation on sunny days. Both sides can be buried with soil if the plastic is perforated.

#### **Low tunnel with in a high tunnel:**

Low tunnels within a high tunnel add an additional increase of air temperature. During the night, air temperature under the low tunnel stays about 5<sup>0</sup>F warmer than outside air and 3<sup>0</sup>F warmer than the high tunnel. This additional temperature increase may be the difference between frost protection and frost damage.

Low tunnels have been evaluated on several crops; both when used with a high tunnel and when used in the open field and revealed that low tunnels in high tunnels impact the performance of strawberry, spinach, and beans. In most cases, the use of a low tunnel within a high tunnel improves yield, positively affects seedling performance, and may further extend the harvest season.

#### **Major advantages of low tunnel technique:**

- Used for raising healthy and early nursery.
- Maintains optimum temperature for plant growth.
- Enhances nutrients uptake by the plants.
- Increases photosynthetic activities of the plants.
- Used for cultivation during winter.
- Protection against wind, rain, frost & snow.

#### **Off-season cultivation**

Many vegetable growers aim to get higher prices for their off-season produce by sending it to market earlier in the season or by extending the growing season for certain crops. This is done in order to gain a competitive advantage in the marketplace. For example, crops like long melon, round melon, bottle gourd, bitter melon, muskmelon, and summer squash, if grown earlier in spring or early summer, can often fetch a higher price on the market.





**Important factors which are considered for off season cultivation are,**

- increased costs of using season, extender production systems,
- potential increase in sale prices of the crop if produced either earlier or later,
- suitability of the crop to season extender production systems

#### **Nursery raising for off-season cucurbits cultivation**

In order to get an early start on the growing season and to take advantage of high prices for off-season produce, cucurbits are often grown under low tunnels or row covers. Seedlings are typically started in a greenhouse using plastic trays with 1.5" cell size in a soil-less medium in December or January. When the seedlings are 28-32 days old and have reached the four-leaf stage, they are transplanted into the open field under low tunnels or row covers from mid-January to mid-February, when the night temperatures are very low in northern regions.

It is also possible to raise the nursery for these crops in polythene bags under simple, low-cost protected structures like walk-in tunnels or in locally available plastic trays in soil-less media, depending on the specific needs of the area. For example, crops like summer squash can be transplanted as early as December for complete off-season production, and they will be ready for harvest in the first week of February, fetching high prices in the market.

#### **Preparation of beds, fixing of hoops, transplanting of seedlings and covering of plastic**

In order to extend the growing season and obtain a marketing advantage for off-season produce, farmers will often use low tunnels. These structures are typically made of transparent, 30-micron, IR grade plastic and supported by flexible galvanized iron hoops placed at a distance of 1.5 m to 2.5 m. The plastic is typically placed on the beds or rows, with a width of 40-60 cm and a height of 40-60 cm above the level of the beds. The seedlings are transplanted under the row covers or low tunnels, usually in a single row on each bed at a distance of 50 cm on a drip irrigation system. The distance between the rows is 1.5 to 1.6 meters. Biodegradable plastic is also available for making low tunnels and mulching, which is an eco-friendly and sustainable technology for off-season vegetable production. The plastic can be vented or slitted during the growing season as the temperature increases within the tunnels during peak daytime. The plastic is usually covered in the afternoon after transplanting and can be completely removed from the plants in February or March

depending on the date of transplanting, growth of the crop, and the prevailing night temperature in the area.

### Conclusion

Low tunnels are structures that are used to protect plants from frost and other environmental factors. They are typically made of thin, clear plastic, and are supported by wires or pipes. The height of the low tunnel is just enough to cover the plant's canopy. They are an excellent solution for farmers looking to extend the growing season for certain vegetable crops and to obtain a marketing advantage for their off-season produce. Low tunnels can be used in conjunction with high tunnels, which are larger greenhouse-like structures covered with UV-stable plastic. In this case, the night time air temperature inside the low tunnel can be several degrees higher than the high tunnel air temperature and the outside air temperature. Low tunnels are also useful for protecting plants from high winds, rain, frost, and snow. They can be opened or ventilated as needed to allow for pollination and to maintain optimal temperature conditions for the crop. While low tunnels can increase production costs, they can also increase yields and profits if they are used effectively.

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