Crop Layout & Planting Methods

David Wildung and Pat Johnson, University of Minnesota

The layout and planting methods used in high tunnels are more critical than in the field because the smaller area of the high tunnel is so much more intensely managed. The plants are spaced more closely and maintained more highly than in the field. The expectations for higher productivity are greater. Adapting layout and planting methods to accommodate these differences is important to success. At the same time, the principles of high tunnel layout are similar to those used in the field.

Figure 1. Multiple crops in one high tunnel

Tunnel layout really begins when a crop is removed in the fall. All old plant debris should be removed from the tunnel. Old plants can harbor insects and disease and should be removed and discarded. All trellis posts, wire, string, plant clasps, and hooks should be removed and discarded or, alternatively, should be sterilized with disinfectant if they will be used again. If ground-cover plastic and trickle irrigation tube were used, they too should be pulled up and discarded. Before the ground freezes in the fall, the area in the high tunnel should be worked up and any desired organic matter should be added. Finally, soil tests should be taken so that the nutrient status can be monitored and corrected, if necessary, early the following spring.

Pre-irrigation is the next step in the layout process. In the spring of 2004, it was surprising how dry the soil inside the high tunnel had become over the winter. Because the covering plastic was left on our high tunnels, the soil received no water from snowmelt, rain, or irrigation since the previous fall. The soil needed a heavy irrigation to bring it up to field capacity. This was done as soon as the soil had thawed and would absorb irrigation water. Sprinklers were used, but solid set irrigation is another good alternative.

Once the soil is at field capacity, it can be worked again to incorporate organic matter. At that time, all necessary solid fertilizer and lime should be added to the soil. One thing to remember when working with high tunnels is that they will warm up much more quickly than field plots. Even in northern Minnesota, some operations can be done in the high tunnels in late March. This would be unheard of in the field!

After the soil preparation process is completed, row spacing should be determined. The row spacing used depends on the management of the crop, the crop grown, and the width of the tunnel. Small seeded vegetables, like carrots, beets, or radishes, don’t need much room and can be grown in multiple rows to use space more efficiently. Larger seeded vegetables, such as snap beans or sugar snap peas, may need to be trellised. These crops can be planted in double rows with a trellis wire in between for the plants to climb on. The row spacing for transplanted warm-season crops, like tomatoes, cucumbers or peppers, depends on several factors. These include whether or not trellising will be done, how much trellising and pruning will be done, and whether determinate or indeterminate cultivars will
be grown. Certainly, tomatoes can be grown in traditional ground beds with no pruning or trellising, and several high tunnel growers in Minnesota have been successful with this system. If a ground bed system is chosen, ample spacing between rows is necessary to allow ease of work and movement. Because of favorable growing conditions, growth and row closure will occur faster in a high tunnel than in the field; therefore, high tunnel row spacing should be at least as great as, and perhaps greater than, traditional field row spacing. If intense management with trellising and pruning is planned, the row spacing can be closer. For example, 4.0 to 4.5 feet between trellised tomato, cucumber or pepper rows has been found to be enough space for good production. At NCROC, pruning and trellising have been used extensively. The high tunnels are 21 feet wide with five rows spaced 4.2 feet apart. This spacing was most efficient in terms of the area used, while still providing sufficient room for crop growth, maintenance, and harvest.

![Figure 2. Measuring planting bed](image1)

![Figure 3. Smoothing planting surface](image2)

With the row spacing determined, the next decisions are whether or not to use raised beds and whether or not the beds should be covered. The soil can be left as it was tilled with no beds formed or it can be formed into raised beds with or without plastic. The decisions to use beds or plastic are often personal preference.

![Figure 4. Direct seeded crop with trickle irrigation](image3)

At NCROC, neither beds nor plastic for direct seeded vegetables were used. Not creating beds for these crops was done because the water distribution and growth patterns were more uniform when using multiple rows and trickle irrigation without beds. Water from trickle irrigation tubing on raised beds had a tendency to run off the sides of the beds making the wetting pattern less uniform with multiple rows. In addition, with multiple rows root growth and development were more uniform without the rounded shape of the beds.

Plastic was not used with direct-seeded crops because most are cool-season crops and are used as filler crops before the main crop is planted. With warm-season transplants, raised beds, trickle irrigation, and black plastic were used. For these long-season crops, the raised
beds and trickle irrigation provided more uniform water and fertilizer distribution, leading to better root growth. The black plastic helped hold in moisture, warmed the soil, and enhanced weed control in and around the growing plant. While other systems certainly can be used, the results from this approach in our tunnels have worked well.

The height and width of the beds are another important consideration. Beds do not have to be more than two to three inches high and no more than 14 to 18 inches wide at the base. Larger beds can interfere with water distribution or with foot traffic while working inside the tunnel. Placement of the irrigation tubing in the beds is important for uniform water distribution. In 2003, we laid the trickle tube in the middle, on the top of the bed. In some cases, the tubing moved slightly. When the water distribution pattern was checked in the fall, we found that the water pattern was not always in the center of the bed. During the 2004 season, this was corrected by creating a shallow furrow less than one-inch square down the center of the bed. The trickle tube was laid in the furrow. This furrow was easy to make and stabilized the placement of the trickle tube, allowing for more uniform water distribution.

Once the trickle tube is laid, the plastic can be tightly stretched across the bed and the edges buried. For beds of this size, three-foot wide plastic is adequate to cover the beds. These operations can all be done as soon as the ground is workable and all necessary soil preparation has been done. Then the beds can be left until planting time.
Plant placement is the next aspect of tunnel layout that affects both plant development and crop management. Transplants used in high tunnels should be large, vigorous, actively growing, and of top quality. When planted, the transplants should be very slightly offset from the trickle tube but as close as possible to it. This will enable the developing root system to receive the maximum amount of water. Alternating the plants on either side of the trickle tube, planting one on one side and the next one on the other side of the tube, allows the best use of space.

![Figure 8. Graphic showing alternate plant spacing](image)

The spacing within the row can vary with the crop. Plants also need to be placed so that workers can move easily in and out of the high tunnel to maintain the crop and to harvest it once it is ripe. Outside rows of the tunnel usually can be planted from gable end to gable end; however, a minimum of two feet of space should remain unplanted at the gable ends of inside rows, especially in front of the doors. This allows room for the more vigorous plant growth in the tunnel and permits easier movement in, out and around the tunnel.

![Figure 9. Transplants in plastic](image)