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Vegetable Production under Protective Structures

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Background

Urban and peri-urban vegetable production (UPVP) systems offer farmers enhanced market opportunities with better economic returns. UPVP systems significantly contribute to urban food supplies, especially of vegetables. The impact of UPVP systems is limited by a number of factors including insect pests and disease problems. Insects are developing resistance to many of the most widely used pesticides in UPVP, prompting many farmers to grow vegetables under protective structures which block the entry of pest and prevent crop infestations.

Protective structures

There are two types of protective structures: permanent and temporary. AVRDC – The World Vegetable Center has designed suitable nethouse and plastic house structures and appropriate maintenance procedures that emphasize preventing entry of all damaging insects, thereby reducing the need to use pesticides.

Permanent nethouses

Permanent nethouses, if carefully constructed and properly maintained, can last for at least five years. The most widely used structure is 2 m high made of galvanized iron tubing covered with nylon net (Talekar et al., 2003). Coarser net (16- to 32-mesh size) is used for larger sized insects, such as lepidopteran moths, whereas finer net (50- or 60-mesh size) is used to exclude smaller insects, such as thrips, whiteflies, and aphids (Talekar et al., 2003; Harmanto, 2006; Shahak et al., 2008; Palada and Wu, 2009). Coarser nets allow a free airflow with minimum build-up of temperature inside. The nethouse is usually constructed to cover an area of 500 m^2. It has been demonstrated that 15 cycles of various leafy vegetables could be produced free of any pesticide use without losing yield or quality over a two-year period. In addition to leafy vegetables, tomato, eggplant, cabbage, cauliflower, broccoli, yard-long bean, and bitter gourd can also be grown successfully in nethouses (Talekar et al., 2003). In northern parts of India, such as Punjab, AVRDC introduced adaptations to the original design, especially in the shape of the nethouse. A net-room with a double door entry point was provided at the front side, using poly-grip assembly to fix the net, and with the net stitching parallel to the hoops, which makes the nethouses more durable under the climatic conditions of the region.

Improved nethouse as designed for the climatic conditions in Punjab. – S. Sain

Long-lasting, sturdy plastic house. – R. Srinivasan

Plastic houses

These are permanent structures lasting for about four to five years, which utilize transparent but sturdy rainproof plastics used mainly for longer duration fruit vegetables such as tomato, sweet pepper, and cucumber. These plastic houses not only protect the crop from rain, but also keep the insect pests away, thus allowing profitable tomato production during the hot-wet season.

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The usual dimension of the plastic houses is 25m × 6.5m. Each house has a semicircular top covered with clear plastic treated with an ultraviolet (UV) light protectant. In the center of the semicircular top, a 30 cm portion along the entire length is left free of the plastic cover, but closed with nylon net. This facilitates ventilation and reduces the buildup of heat inside. The ventilation facility is made rainproof by erecting a transparent plastic shade over the top. The side walls are covered with nylon netting. At the front side, a 60-mesh netting double door is installed (AVRDC, 2007).

There are two types of a temporary plastic house, which is used for a single growing season: a single-bed type with an arched roof and a double-bed type with an A-shaped roof covered with UV-protectant polyethylene film. The width is 2.4m for the single-bed shelter and 4.8m for the double-bed shelter. The height at the center of both types is 2.4 m (Palada et al., 2003). The sides are covered with nylon netting to exclude insect pests and prevent rain from blowing in. The growth and yield of cucumber, sweet pepper, and small-headed cabbage were significantly improved when grown under rain shelters during the hot-wet season in Vietnam. In addition, these structures significantly reduced the incidence of fungal and viral diseases (Hanh, 2003).

Low net tunnels

Growers who cannot afford the high initial construction costs of nethouses or plastic houses can grow vegetables under temporary net tunnels. The net tunnels are constructed with U-shaped iron or aluminum bars, which are covered with nylon netting over each bed (Talekar et al., 2003). Leafy vegetables such as *Brassica rapa* var *chinensis*, *B. oleracea* var. *alboglabra*, *B. rapa* var. *parachinensis*, and *B. juncea* grown under tunnels were less damaged by heavy rain and insect pests. This resulted in a reduced number of insecticide applications, better produce quality, and higher marketable yield. *Amaranthus* yield has tripled under net tunnels in Vietnam. Insect populations on cauliflower under net tunnels were greatly reduced, by 80% in Cambodia; marketable yields were 1.5 to 2.0 times greater under net tunnels than in the open field (Palada and Ali, 2007). Growing head cabbage under net tunnels in the Solomon Islands reduced insect incidence by 38-72%, and resulted in significantly higher economic returns (Neave et al., 2011).

Low-cost, temporary net tunnels. – R. Srinivasan

Conclusion

Vegetable production under protective structures reduces yield losses from insect pests, diseases, and heavy rains, and results in higher productivity and returns per unit area. Protective structures enable growers to produce vegetables successfully during the off-season, which enhances the availability of fresh produce at times when vegetables are usually in short supply. Because vegetable prices are higher during the off-season, growers also enjoy higher returns per unit area.

Further reading

AVRDC. 2007. Report 2004. Publication Number 07-691. AVRDC –The World Vegetable Center Shanhua, Taiwan. 158 pp.

Hanh, N.T. 2003. Crop diversification under shelter during wet season. In: L.T. Thuy, V.T. Tinh, D.H. Hoa, N.T.Hanh, N.K. Chien, V.T. Hien, and N.D. Hung (eds.). Off-season and tomato and year-round vegetable production under shelter in Hanoi. Research Institute for Fruits and Vegetables, Hanoi, Vietnam. pp. 34-38.

Harmanto, T. H. J. 2006. Evaluation of net greenhouses for tomato production in the tropics. Hannover University, PhD Dissertation. http://deposit.ddb.de/cgi-in/dokserv?idn=979810124&dok_var=d1&dok_ext=pdf&filename=979810124.pdf

Neave, S.M., Kelly, G., and Furlong, M.J. 2011. Field evaluation of insect exclusion netting for the management of pests on cabbage (*Brassica oleracea* var. *capitata*) in the Solomon Islands. In: Abstracts from the Sixth International Workshop on Management of the Diamondback Moth and Other Crucifer Insect Pests, 21-25 March 2011, Kasetsart Unversity, Nakhon Pathom, Thailand. Publication No. 11-746. AVRDC – The World Vegetable Center, Taiwan. 101 pp.

Palada, M.C. and Wu, D.L. 2009. Grafting sweet peppers for production in the hot-wet season. International Cooperator's Guide, AVRDC Publication Number: 09-722-e. http://203.64.245.61/fulltext_pdf/FLYER/f0002.pdf

Palada, M.C. and Ali, M. 2007. Evaluation of technologies for improving year-round production of safe vegetables in peri-urban agriculture of Southeast Asia. *Acta Horticulturae,* 762: 271-281.

Palada, M.C., Roan, Y.C., and Black, L.L. 2003. Rain shelters for tomato production in the hot-wet season. International Cooperator's Guide, AVRDC Publication Number: 03-552. http://www.avrdc.org/LC/tomato/shelter.pdf

Shahak, Y., Ratner, K., Zur, N., Offir, Y., Matan, E., Yehezkel, H., Messika,Y., Posalski, I., and Ben-Yakir, D. 2008. Photoselective netting: an emerging approach in protected agriculture. *Acta Horticulturae,* 807: 79-84.

Talekar, N.S., Su, F.C., and Lin, M.Y. 2003. How to produce safer leafy vegetables in nethouses and net tunnels. Asian Vegetable Research and Development Center, Shanhua, Tainan, Taiwan. 18 pp. http://www.avrdc.org/LC/cabbage/nethouse.pdf

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