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Protected Cultivation as an Emerging Agri-Entrepreneurship in Hilly Regions of India

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Hilly region states like Himachal Pradesh, Uttrakhand and Jammu & Kashmir are also called as natural greenhouses of the country. Scattered and small land holdings, difficult terrain, fluctuating and unpredictable weather, prevalence of low and variable seasonal and diurnal temperature during autumn, winter and spring seasons in North-western Himalayan region affect productivity and quality of the produce which consequently results in low profit margin of the hill farmers in open environment. Protected cultivation of high value crops has emerged as the single most important technology for ensuring nutritional security, high productivity, improved quality and lucrative returns in these regions of the country.

Introduction

India is the second largest producer of vegetable crops in the world. However, its vegetable production is much less than the requirement if balanced diet is provided to every individual. Himachal Pradesh produces approximately 1.5 million tonnes of vegetable from an area of about 80,400 ha. Among different ways to fulfil the requirement of vegetable in the country by use of improved agro-techniques and bringing additional area under vegetable crops using hybrid seeds, perfection and promotion of protected cultivation of vegetables also is a potential approach. In upper reaches of Himalayas, where the temperature is extremely low (-5 to -30^{0}C) during winter season and most of the region remain cut off from rest of the country during November to March due to very heavy snowfall, it is very difficult to grow vegetables in such cold desert climatic conditions. To overcome these types of climatic variability, greenhouse cultivation is emerging as the most efficient tool. Greenhouse vegetable production makes the use of recent advances in technology to control the environment for maximizing crop productivity per unit area and increasing the quality of vegetables produce. India has entered into the era of greenhouse vegetables cultivation more recently and the total area under protected vegetable production is not more than 10,000 hectares. India being a vast country with diverse and extreme agro-climatic conditions, the protected cultivation technology can be utilized for year round off-season production of high value, low volume vegetables, production of virus free quality seedlings, production of quality hybrid seeds and as well as for disease resistance breeding programmes.

Greenhouse

Green house is a framed structure covered with transparent or translucent material wherein the plant are grown under controlled or partially controlled environmental condition resulting in yields higher than that of under open conditions.

Principle of Greenhouse

Greenhouse is generally covered with transparent material such as polythene or glass. Major fraction of incoming solar radiation is absorbed by plants and earth objects. These objects in turn emit long wave thermal radiations for which cladding material has low transparency. Thus, long wave thermal radiations are trapped inside the polyhouse which raises the temperature inside. This is called greenhouse effect. Due to this rise in temperature inside polyhouses, growing offseason crops in cold climate becomes possible. During summer months, temperature is brought down to low by providing cooling device in polyhouses.

Need for Protected Cultivation:

- Increased production per unit area
- Better quality produce
- Early maturity
- Round the year cultivation
- Protection of valuable plant germplasm
- Controlled temperature, humidity and light as per requirement creates micro-climate for better plant performance
- Protection from biotic and abiotic stresses

Structure of Greenhouse

- Tunnel type (cold climate greenhouse)
- Quonset (semicircular/subtropical greenhouse)
- Gabble type (slopping roof)
- Tropical region greenhouse
- Ridges and furrows greenhouse
- Ground to ground greenhouse

Type of Greenhouse Based on Cost of Installation

Low Cost Polyhouse/Greenhouse

Polythene sheet of 700 gauge thickness is supported on bamboo ropes and nails. Temperature inside greenhouse is 6-10^{0}C higher than outside.

Medium Cost Greenhouse

It costs higher than low tech greenhouse. In quonset shaped polyhouses frame, Galvanised Iron (GI) pipes are used. Thickness of single layered Ultra Violet (UV) stabilized polythene is 800 gauges. Exhaust fan are thermostatically controlled. Frames and glazing materials have life span of 20 years and 2 years, respectively.

High Tech Greenhouse

Frame is made up of iron or aluminum. Designs are dome shaped or cone shaped. These are highly durable, 5-6 times costlier, growing medium used in these type of greenhouses are Peat, Perlite, Solarite, Vermiculite, Rock wool. In India coco fibres and rice husks are used as growing media as these materials are cheaper. Fertigation and pesticide sprays are done by fogging machine.

Miniature Forms of Greenhouses

Plastic Low Tunnels

Plastic low tunnels are miniature form of greenhouses to protect the plants from rains, winds, low temperature, frost and other vagaries of weather. The low tunnels are very simple structures requiring very limited skills to maintain and easy to constructs and offer multiple advantages. For construction of low tunnels, film of 100 micron would be sufficient.

Net Houses

Net houses are used for raising vegetable crops in high rainfall regions. Roof of the structure is covered with suitable cladding material. Sides are made of wire mesh of different gauges. Such structures are useful for north-eastern hilly region. Sweet pepper,

an economically potential vegetable is generally grown at high altitude (> 1000 ft.) but more recently its cultivation is gaining popularity in Northern Indian plains where its fruit size and productivity is very poor because of fluctuations in temperature and attack of insects-pests (fruit borer, aphid, mite and white fly) under open field conditions. Therefore there is a great scope for protected Sweet pepper cultivation. Likewise, offseason capsicum production under protected cultivation is also becoming popular in Indian plains.

Advantages of Green House Technology

- Protection from adverse climatic conditions
- Increased yield (4-5 times than traditional planting)
- Harvesting time can be adjusted
- Off-season crop production
- Disease free plants
- More profit due to continuous supply of produce throughout the year
- Water saving as use of drip/sprinkle system
- Barren and uncultivable land may be brought under use
- Gain of more foreign exchange due to export
- Useful technology for hybrid seed production
- Employment generation

Why Greenhouse for Vegetable Production

1. Vegetable production forcing for domestic consumption and export: During winters in Northern India region, the temperature and solar radiations are sub-optimal for growing offseason vegetables namely tomato, capsicum, brinjal, cucumber, okra and chilli, etc. In tomato, low temperature and low radiation cause puffiness and blotchy ripening. Hence during extreme conditions of winter season (October-February), these vegetables will be cultivated under polyhouse. In a medium cost greenhouse, 98.6-110.5 tonnes/ha yield of tomato and 87.2 tonnes/ha yield of capsicum can be obtained. Under prolonged winter the protected cultivation would be well suited. The high priced vegetables like asparagus, broccoli, leek, tomato, cucumber and capsicum are most important crops for winter season and off-season production around metropolis. It may be useful to grow these crops in plastic tunnels as they would be protected from cold and frost and manifest faster and better growth resulting in earlier flowering & fruiting compared to crops grown in the open.

2. Raising off season nurseries: The cost of hybrid seeds is very high. So, it is necessary that every seed must be germinated. For 100% germination, it requires the controlled conditions. The cucurbits are warm season crops. They are sown in last week of March to April when night temperature is around 18-20^{0}C. But in polyhouse their seedlings can be raised during December and January in polythene bags. By planting these seedlings during end of February and 1st week of March in the field, their yield could be taken in one and a half months in advance than the normal time of sowing. This technology fetches the bonus price due to marketing of produce in the off season. Similarly, the seedlings of tomato, chilli, capsicum, brinjal, cucumber, cabbage, cauliflower and broccoli can be grown under plastic cover protecting them against frost, severe cold and heavy rains. The environmental condition, particularly increase in temperature inside polyhouse hastens the germination and early growth of

warm season vegetable seedlings for raising early crops in spring summer. Vegetable nursery raising under protected conditions is becoming popular throughout the country especially in hilly regions. Management of vegetable nursery in protected structure is easier and early nursery can be raised. This practice also eliminates danger of destruction of nurseries by abiotic stresses.

3. Vegetable seed production: Seed production in vegetables is the limiting factor for cultivation of vegetables in India. Vegetables require specific temperature and other climatic conditions for flowering and fruit setting. To combat unfavourable micro climatic condition, the seed production of highly remunerative crops namely tomato, capsicum and cucumber can be done under protected environments. The maintenance and purity of different varieties/lines can be achieved by growing them under greenhouse without giving isolation distance particularly in cross-pollinated vegetables namely onion, cauliflower and cabbage. Hence, vegetable production for domestic consumption and export in low and medium cost greenhouse is a technical reality in India. Such production system has not only extended the growing season of vegetables and their availability but also encouraged conservation of different underutilized vegetables.

4. Hybrid seed production: In 21st century, protected vegetable production is likely to be commercial practice not only because of its potential but out of sheer necessity. In vegetable production hybrids seeds, transgenic, stress resistant varieties, micro propagated transplants, synthetic seeds are likely to replace conventional varieties. Protected environments will be helpful in production of hybrid seeds of cucumber and summer squash by using gynoecious lines. Gibberellic acid is used to maintain such lines followed by selfing. The desired pollen can be used for production of hybrid seed of cucumber. Similarly in summer squash use of Ethephon in inducing female flower at every node would help in the hybrid seed production by using desired pollen parent.

5. Maintenance and multiplication of self incompatible line for hybrid seed production: In case of cauliflower, there is problem of maintaining and multiplication of potential self-incompatible lines for the production of F_1 hybrid seed. Temporary elimination of the self-incompatibility with the use of CO_2 gas has solved this problem. For this purpose, the self-incompatible line is planted in a greenhouse and bees are allowed to pollinate the crop when it is bloom. Then keeping the greenhouse closed tightly, within 2-6 hours of pollination, it is treated with 2-5% CO_2 gas which allows successful fertilization by temporarily eliminating the self-incompatibility.

6. Polyhouse for plant propagation: Asparagus, sweet potato, pointed gourd and ivy gourd are sensitive to low temperature. The propagating materials of these vegetables can be well- maintained under polyhouse in winter season before planting their cuttings in early spring-summer season for higher profit.

Suggestions to Make Greenhouse Technology More Popular

- Reducing cost by using only local made materials.
- Use of indigenous technology knowledge for control of temperature and humidity inside low tech polyhouse.
- For poor and marginal farmers rate of subsidy may be increased.

- Increasing amount of loan and decreasing rate of interest.
- Creation of co-operatives by farmers to make best use of polyhouses jointly in arranging materials at cheaper rate.
- Making the technology simple by providing technical knowhow to farmers by university or department.
- Appropriate selection of site & location for polyhouse installation.

Conclusion

The protected cultivation of high value crops has become irreplaceable both from economic and environment points of view. It offers several advantages to grow high value crops with improved quality even under unfavourable and marginal environments. However, due to high training needs of the green house growers and some poor quality produce with pesticide residues has been a matter of great concern. These issues can easily be addressed by integrating various production and protection practices including location specific designing and construction of the polyhouses for efficient input use. Creating awareness among the greenhouse growers for judicious use of pesticides for safe production can be instrumental in providing quality products without polluting the environment.