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METHODS FOR GROWING OUT OF SEASON VEGETABLES: EXTENSION OF HORTICULTURAL SEASONS IN MEGHALAYA (IN NORTH-EAST OF INDIA)

1. Introduction

Meghalaya is a state in North-East India. The name means "*the abode of clouds*". With the elevation ranges between 150 m to 1961 m and an average annual rainfall as high as 1200 cm in some areas, Meghalaya is the wettest place on earth. The maximum temperature in this region rarely goes beyond 28 °C (82 °F), whereas sub-zero winter temperatures are common.

Meghalaya has a vast potential for the development of horticulture sector. The climate and ecological conditions are most congenial for the cultivation of varieties of horticultural crops ranging from different types of fruits (strawberry, citrus species, pineapple, banana, papaya, guava, plum, pear and peach and jack-fruit), spices (turmeric, ginger, chilli, black-pepper, and bay-leaf), flowers, mushrooms, medicinal plants, wide variety of vegetables (cucumber, pumpkins, bitter gourd, beans, brinjal, cabbage, cauliflower, tomato, peas, radish, carrot, beet, and tuber plants (Potato, Sweet Potato, Yam, Colocasia and Tapioca). Meghalaya is well known for its organic horticultural fruits and vegetables.

2. Why extension of horticultural seasons?

- The winter horticulture meets several problems related to the coldest that prevented some agricultural practices and in consequence, during this season, there is lack of vegetables food and staples food.
- Availability of vegetables and fruits all the year (Food all year long and healthy diet): some production methods of vegetables and fruits such as hydroponic, greenhouse, cloches and tunnels and kitchen garden (described below) can help to improve the winter horticulture production and are adaptable in each season.
- Horticultural crops can be cultivated in a small plots of mixed crops, rather than large fields of single crop.
- In horticultural cultivation, variety of crops ranging from fruits to vegetables can be cultivated simultaneously in a single plot of land.
- Horticulture in Meghalaya is heading for a drastic transformation as most of the horticultural crops have advantage over the traditional crops in generating rural employment, enhancing rural income and have high potentiality to tap national and international markets.
- A chance to make some money: the extension of horticultural season can take advantage of opportunities when prices are high. In fact with pronounced seasons, supplies are low at the start of the harvest season, so prices are high. Prices are at their lowest when the crop reaches maturity in the main production areas. At the end of the season prices normally increase again as supply diminishes. Prices are generally highest during the off-season, when only a small percentage of farmers are able to grow the crop. Farmers who are located in areas where early or late-season crop production is possible (for example, hill or mountain areas) or who can use production methods, such as plastic tunnels or greenhouses, kitchen garden, hydroponic that bring forward the harvesting date, are best placed to take advantage of high early or late-season prices. Similarly, production under irrigation can supply crops in the off-season when prices are normally the highest. High prices have a

large effect on farmers' profits. In the short term a farmer's response to high prices will be to try to increase the quantity of produce marketed. When prices fall consumers increase their purchases. They buy less when prices rise.

3. Methods for growing out of season vegetables

3.1. Garden cloches and garden tunnels

A polytunnel (also known as a polyhouse, hoop greenhouse or hoophouse, or high tunnel) is a tunnel made of polyethylene, usually semi-circular, square or elongated in shape. The interior heats up because incoming solar radiation from the sun warms plants, soil, and other things inside the building faster than heat can escape the structure.

These days they come in three main varieties for the home grower, fleece, ideal for frost protection, extra warmth or bringing on crops earlier in the season, polythene, very common with larger growers, they provide pest protection, light and excellent growing environments.



However Net Tunnels are probably the most widely known and used of all garden tunnels. The netting allows light and moisture to filter through, while at the same time protecting from the ultraviolet sun rays (too much sun) and most pests (slugs, snails, rodents and insects). Too much sunlight causes vegetables to wilt and need more water and even sun burn, a net tunnel solves this and shades the crop.

Net Tunnels these days come in a variety of forms, from rigid fixed netting over a series of poles which often have to be self-assembled or more popular now, the accordingly folding variety. With an accordion net tunnel the netting is sown into a series of steel hoops, these are spaced a few feet apart and allow the gardener to stretch out the net over their line of vegetables.

The advantage of the according garden tunnels is that they can be very easily stored, they fold up into just a few inches of their length and also the tunnel length can be flexible, it's easy to adjust the length of the net - this allows flexible row lengths.

Innovations with garden tunnels also come in two forms:

- Drawstrings at the ends, these allow gardeners to close off the end of the tunnel should they wish to, this provides much greater pest protection as the tunnel ends are vulnerable.
- Joining Tunnel Cloches - a common length of a net tunnel is 3 meters, but if you have a longer row of vegetables you should be able to join the tunnels seamlessly to stretch the extra distance.

Choosing a Tunnel Cloche: choose a product that suits you is a bit harder, too cheap and tacky and allow you to do the job properly, durable product that is going to last years, rather than a single season, you should also look for the flexibility in design, do the ends close, can you join them together, is a portable net tunnel that can be adjusted for length any time you need it to.

Growing techniques practices

- Prepare the ground near home or near a source of clean water a month before sowing or planting to give the soil time to settle and put near home or near a source of clean water.
- Two weeks before sowing or planting, mark a central row with a string line, leave this in position, and cover the row with the cloches to warm up the soil. Secure the end panels.
- Remove the cloches at sowing time, the purpose of leaving the string line is to Centre the row where the developing plants will get most headroom.
- Sow small seeds about 6mm deeper than in the open ground because the surface dries out during the warming-up period. Do not water until the seeds germinate enough moisture will filter up from the soil beneath the seeds to begin with. However, water immediately after setting out young plants.
- After sowing or planting, scatter slug pellets and replace the cloches in exactly the same position as when the ground was being warmed. Subsequent cultivation is the same as for plants growing in the open. Although the surface may look dry, a few centimeters down it will have the same moisture content as the uncovered soil alongside and water will reach the plants' roots by capillary action.
- If spring days are unusually warm, open up some continuous cloches or slide back the polythene of a tunnel cloche to allow air to circulate. Replace or close the cloches an hour before sunset.
- If late spring frosts are forecast, cover the cloches over tender crops with four or five sheets of newspaper in the evening and remove them in the morning.
- A week before moving cloches from one row to another, harden off the plants that are about to be left in the open. Leave off some cloches or slide back the polythene during the day and replace them in the evening.
- When using cloches to cover strawberries, they serve a dual purpose it will be unnecessary to net the plants against bird attacks and, if put in position in late autumn, will provide an earlier crop than in the open garden.
- In each case, mixing three wheelbarrow of soil out of one wheelbarrow of organic manure or compost.



3.2.Kitchen garden

Kitchen garden is a garden in which vegetables, fruits, and herbs are grown for household consumption. There are a lot of kinds of kitchen garden and there are installed near or around habitations.

Advantages

- Raising of seedlings in the nursery
- Produce vegetables and fruit all year long
- Different vegetables can be planted on the same garden kitchen
- High quality and uniformity in plant growth with good vigour.
- Provide quick take off with little or no transplanting shock.

- Easy maintenance for horticultural practices
- Easy to handle, grade and shift or for transportation.
- Better water drainage and aeration.

Growing techniques practices

The soil preparation for a garden kitchen consist of making a field of variable forms such as Rhombus, rectangle, square or circle. The appropriate technique is the one which conserve long time water and fertilizer. This technique consists of superposition of these forms mentioned as the figure below in circle form shows it. First of all, the preparation of each form is preceded by a pre-cleaning of the ground. The land must be rid of his old vegetation. This is followed by grubbing and removal of stones, pebbles and all objects that can be a barrier to vegetables and then collect the soil and superimpose it around the poles installed in the ground.

The circles, rhombus, rectangle or square superimposed are separated of 40 cm and 30 cm of high for each circle. However the diameter or diagonal of the form can vary, it depends on the availability of soil, fertilizer (organic or mineral) and the destination of vegetables (if the vegetables are for market or for self-consumption). Mix three wheelbarrows of soil against one wheelbarrow of manure or compost very well decomposed. On the same form of garden kitchen, it is possible to plant different vegetables. But, the vegetable of high growing vegetation begins on the layer down and second to enable each vegetable to get sufficient light. Example for 5 layers on the same garden kitchen: Eggplant, pepper, cabbage, onions, carrots. Regular watering, control of weeds, disease and pests. If it rains a lot then watering once a week may be enough. Gardeners should touch the soil to judge if the plants need watering. Direct sowing or indirect sowing of this technique is possible.



Direct seeding is to deposit the seed where the plant will definitely until the end of its cycle. It is practiced for some large-seeded fruit vegetables and most tuberous vegetables, roots. Example: Fruit vegetables: green beans, cucumber, okra etc. Root vegetables: carrot, radish etc. After emergence, it is necessary to clarify the planting and watering.

The indirect sowing involves the growth of plants in the nursery which is where plants spend the first weeks of life. It is used for multiplication or reproduction of plants. Some species require very neat germination conditions. It must be installed as close as possible to a water source and must make to it the maximum care (control of the quality of seeds, light shade, shelter against strong winds, disease and weeds control etc.)

Vegetables rotation

Rotation is the sequence of different crops on the same form. To make a good rotation, must successively grow vegetables whose nutrient requirements, deep roots, pests and diseases are different. Examples of succession: Lettuce; green beans; carrot, tomato, radish, cucumber, bean; amaranth.

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