

Recent novel interventions for Hi-tech potato seed production under net house in north-western plains of India

Net houses are an integral part of Hi-tech potato seed production and provide excellent insect free environment for cultivating healthy plant material of early seed generations, both microplants and minitubers. It can also be used by farmers to multiply and maintain their own good quality seed, even in areas of high vector pressure. However, these are expensive investments, occupying productive land areas, and therefore require good management for deriving maximum benefits. Recent novel interventions developed by ICAR-Central Potato Research Institute offer scope for improving productivity of quality planting material planted under these insect free structures.

POTATO, in recent years, has emerged as a major staple and cash crop in India. Although India has emerged as the second largest potato producer in the world, seed productivity is low, with scarcity of quality potato seed looming large. This accounts for very high input cost in profitable potato cultivation, estimated to be approximately 40-50% of the total cost of production. Potato seed production has also evolved over the years, from its conventional form restricted to the low vector pressure regions of India, based on the seed plot technique and tuber indexing for just 8 viruses to the recent Hi-tech seed potato production which has been widely adapted all over the country. The Hi-tech potato seed production is based on micropropagation using tissue culture technique and further transplanting of this quality planting material under net house and aeroponics. These comprise the early seed generation and the tissue culture material is well tested for 27 different viruses. This system therefore not only yields high-quality potato seed material, but also has higher multiplication rates with lesser field exposure of just 5 years up to certified seed production as compared to the conventional seed production having 7 years of field exposure, and lesser stringent testing.

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potato seed production and provide excellent insect free environment for cultivating healthy plant material of early seed generations, both microplants and minitubers. It can also be used by farmers to multiply and maintain their own good quality seed, even in areas of high vector pressure. However, these are expensive investments, occupying productive land areas, and therefore require good management for deriving maximum benefits. The cultural practices for potato cultivation are already well known and lots of literature on the same is already available in the public domain. However, in recent years, certain new practices have been propounded to enhance the utility and productivity of the net house for potato seed production by the farmers. The present article discusses the recent novel interventions developed for potato seed production under net house.



High density planting of minitubers on flat beds
(10 cm × 10 cm)

High density planting under net house

Under standard net house plantings, minitubers or microplants are recommended for planting at 30 cm × 10-15 cm (row to row) × (plant to plant) spacing using ridge and furrow method. However, for early seed generation planted under net house, size is not the major criteria, rather it is somewhat more important to achieve higher number of propagules, giving due consideration

to the high cost of land covered under net house. High density planting on raised beds at 10 cm × 10 cm spacing promotes formation of larger number of tubers of comparatively smaller size, as compared to standard practices. It leads to increased seed productivity on unit area basis. Although higher number of planting propagules are used but simultaneously the benefit of increased sustainability and production of high-quality tubers under net house conditions is also harnessed.

Successive planting of minitubers or microplants

The North-western plains of India are the most important potato seed production area in India. They offer a potato growing period of approximately 200 days, however potato seed can only be grown in a limited period of about 90 days from October to December due to high insect vector pressure in the region both preceding and succeeding this seed growing period. These insect vectors namely whiteflies and aphids impose severe threat to potato seed all over the country, due to their role in virus spread, which degenerates the potato productivity over the years. Even in these regions, the potato seed can be successfully cultivated throughout the cropping season, under the insect-proof net houses. Since potato tubers can be harvested within 90 days, it becomes feasible to take two successive potato crops under the net house. This strategy implemented at an early seed generation would double its productivity and have profound effect on the overall potato seed production in the later generations. The strategy yielded comparatively higher net returns on per unit area basis as compared to the single crop taken under the net house. Successive cropping can be practiced for both minitubers as well as microplants.

Canopy management under net house

A high density planting is generally undertaken under net house cultivation to economize on space as compared to traditional crop in open fields. However, due to limited space, there is much overcrowding of branches, less circulation of air and poor light inside the canopy and related abiotic factors which indirectly affect productivity and are possibly a major cause for production of higher undersized tubers. This results in poor aeration, poor light penetration, significant decrease in photosynthesis, plant lodging, etc. The lower leaves of the crop turn yellow and fall on ground leading to lower photosynthetic rates and lesser tuberization. Further, compact canopy also harbours various pests and disease causing agents due to favourable micro-climate. Canopy management as practiced in several horticultural crops would be helpful to counter the aforesaid issue. The single or double net systems consisting of nylon net with 75 × 75 mm openings (for providing support) can be easily attached on angles fixed on the corners of the plot and can be pulled with hooks for canopy management and keeping potato crop in an upright position. The first net is established at 30 days after planting and the second one at 45 days after planting. Canopy netting practices have been reported to significantly reduce number of undersized tubers and improve overall tuber productivity, making it more economical.



Canopy management under net house using a nylon net

Rapid seed potato production by soilless method

Hi-tech seed system includes different rapid multiplication techniques like tissue culture, net house multiplication and aeroponics. The disease-free tested potato microplants are multiplied in tissue culture followed by its further multiplication in net house or aeroponics to produce Go minitubers. Aeroponics provides soil-free rapid multiplication technology for production of minitubers. This multiplication carried out under these conditions is free from all soil-borne pathogens and have much demand due to their disease free nature. However, it is not affordable and manageable by small and medium farmers who can opt for soilless cultivation for excluding all kinds of soil-borne infections. Soilless media like cocopeat can be successfully sterilized and used for transplanting microplants and deriving disease free minitubers. Multiple cropping under net house can also be practised more efficiently using soilless mediums. Here, mediums can even be sterilized in between the two crop cycles. Based on experience taking two crops from microplants and three crops from minitubers in a single season is suggested. This enables efficient utilisation of expensive net house space and to get premium prices for tubers produced without use of soil as media. This method may prove boon for seed production in areas which are unsuitable for seed production due to soil-borne diseases.

Recycling of < 3 g tubers under net house

Under the high density planting due to closer row-to-row and plant-to-plant spacing under net house conditions, there is a tendency of formation of higher proportion of undersized tubers (< 3 g). As compared to the seed sized tubers, these may be less prolific (shrinkage during storage) but are viable up to a certain limit when handled properly after harvesting. And these small sized minitubers are economically more adaptive as they provide more number of planting propagules per kg of planting material. So, one can recycle or multiply this material under net house instead of discarding this precious material. A proper management of these tubers during storage, withdrawal and chitting period, followed by proper planting can give very good germination and yield. These chitted tubers can be directly planted under



Seed farm of Dr Arora



Healthy seed crop under net house



Harvested minitubers

field conditions by placing the tubers on previously made ridges, to avoid their deep planting within a ridge, while using a planter during cultivation. Simultaneously, they can also be used for successive cropping under soilless/ soil conditions under net house, where better management, higher productivity and disease-free quality of these tubers can be ensured.

Multiplication of farmers' own seed

The net house space can be utilized by the farmers for the multiplication of their own quality seed. Good quality seed is an expensive input and deteriorates with field cultivation, also the seed replacement rate is quite low. This leads to the use of poor-quality infected seed by the farmers, which is generally kept as a part of the overall production and deteriorates further each year. Such a scenario is very common in regions of high potato production and high vector pressure like Gujarat, West Bengal, Eastern Uttar Pradesh, Assam, etc. However, net houses can provide ideal safe havens for healthy seed multiplication even in these high vector regions. Part of the certified quality seed may be planted under the net house for multiplication which will then act as a basic seeding unit for future supply of planting material. Depending on the seed requirement at the farm, the size of net house can be adjusted, with or without one cycle of field multiplication as the case may be.



Minitubers (< 3 g) harvested from net house

Further information sources and know how

ICAR-Central Potato Research Institute is the nodal agency for potato breeder seed in the country. The

institute has standardized methodologies for potato breeder seed using both conventional and Hi-tech potato seed production technologies like tuber indexing, tissue culture based micropropagation, net house multiplication, aeroponics based multiplication, photo autotrophic micropropagation, apical rooted cuttings, etc. for potato. Interested growers may contact the Division of Social Sciences, ICAR-Central Potato Research Institute, Shimla 171001, Himachal Pradesh for gaining more information on these technologies. Besides, regular training are organized by the institute for increasing awareness among the farmers about the new Hi-tech seed production technologies of the institute. ICAR-Central Potato Research Institute has developed the design of low cost net house structure, which can also be provided to the interested farmers for which they may contact the Agri Business Incubator of ICAR-Central Potato Research Institute. Some technical bulletins are available which may be further referenced by the farmers to gain knowledge about the Hi-tech production technologies and net house cultivation.

Government schemes for net house establishment

Financial assistance may be sought by growers for establishment of their own net house structures. The growers may contact National Horticulture Board (NHB) and National Horticulture Mission (NHM) which provide a subsidy of 50% of the project cost. The maximum ceiling for NHM is 36 lakhs, while NHB has a ceiling of 112 Lakhs per beneficiary/ farmer. Additionally 15-20% State Horticulture Departments promote the use of these protective structures providing subsidies to the tune of up to 65% of the project cost. Subsidies can also be availed for replacement of net after 3-5 years of use.

NHB includes polyhouse construction, drip and fogging system, bed preparation material and labour cost, planting material cost, basic infra-structure like packing hall, irrigation equipment room, labour quarters, etc.

NHM: The client can get 50% subsidy only on polyhouse construction and drip and fogging system according to the rates decided by particular State horticulture department. If the State government is having more funds then they can release subsidy for plants but it is not mandatory for them.

SUMMARY

Efficient management of net houses has a great scope of enhancing the productivity and increasing profits of the

Table 1. Economics of cultivation

Cost Heads/ others	Cost (₹)	Remarks
I. No. of mini tubers required @ 30 × 10 crop geometry and 10% space for doors, walkways etc (500m ²) 1500 tubers required (₹ 7)	10500	(subsidy can be availed on purchase of quality planting material)
II. Fixed cost (A) one time investment		
A Cost of construction of net house (₹)	250000	
III. Depreciation, interest and other misc. cost		
B Depreciation @ 1% per year (₹)	5000	
C Interest @ 10% pa (₹)	63500	Until 5 th year of construction
D Per year cost of repair/ net replacement (net change 4 years (₹))	2500	300 1.2 L
E Total fixed cost per year (₹) (B+C+D)	71000	
IV. Variable cost		
F Cost of purchase of mini tubers for planting @ ₹ 7 per minituber (₹)	10500	
G Labour cost @ 180 units per cycle @ 350/unit (₹)	16200	
H Fertilizer, chemicals, etc (₹)	5000	
I Total variable cost per year (F+G+H)	31700	
J Total cost of production ₹/year (Fixed Cost B (III E)+ Variable Cost IV I)	102700	
V. Production		
K Production no. of tubers/ square meter (mean over all considered varieties)	130	
L Total production (No. of tubers from 500 square meter net house) based on spacing	58500	
VI. Total sale price of produced tubers @ ₹ 7 per mini tuber (L x 5) (₹)	409500	
Profits (Total sale price (VI) - cost of production (IV J) (₹)	306800	
B:C ratio	2.99	

growers. The health status of the seed has a direct bearing on the field exposure, which highlights the critical role of insect proof net houses in potato seed production. Besides, it is also pertinent to mention the importance of proper lay out and maintenance of healthy growth conditions in the net house to reap the benefits. Soil solarization, green manuring, fertigation and insect control are crucial to get proficient growth of the plants under net house. Similarly, proper plant geometry, irrigation and other cultural

practices related to potato planting in the specific region need to be followed in a holistic manner.

For further interaction, please write to:

Ratna Preeti Kaur (Senior Scientist - Crop Improvement and Seed Technology Section), ICAR-CPRI (Regional Station), Jalandhar, Punjab 144 023. *Corresponding author email: kaur.rp@gmail.com

Movable screens in rose production

- Use movable screen, an important tool for rose cultivation.
- It can help growers manipulate environment conditions — lowers temperature, changes humidity and influences production numbers.
- The movable screens can be used year-round and in a variety of climates — from the Netherlands to India.