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Potential of Poly-house Technology for Vegetable Cultivation in the Punjab, India

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ABSTRACT

The study entitled "Potential of polyhouse technology for vegetable cultivation in Punjab" was done in the six districts having maximum number of poly-houses. From each selected district 10 adopter and 10 non-adopters were randomly selected thus making a total of 120 respondents. Potential of polyhouse technology was measured in terms of types of crops grown, most suitable crop & promising varieties under polyhouse cultivation, comparative advantage over open cultivation, extension and technological gaps in adoption of the technology. It was observed that cucumber (Rank1), capsicum and tomato were the most suitable crops grown under polyhouses. King Star RZ (cucumber), Inspiration (capsicum), LS524 (Tomato) etc. were the most preferred crop varieties grown under polyhouse structures. It was also observed these crops were giving significantly better yield and market prices as compared to open field conditions. The extension gaps for polyhouse grown vegetables were ranging from 20-30 q/acre and technology gaps were ranging between 35-55 q/acre emphasized that there was dire need for capacity building of farmers.

***Key words**: Polyhouse; Potential; Extension gaps; Technological gaps.*

India holds 2nd rank in vegetable production after China. The vegetable crops in India occupies about 10.35 million hectare cultivated area. The annual production of vegetables is 191.77 million metric tonnes (*Anonymous, 2019*). In the state of Punjab, vegetable occupy 2.73 lakh hectare area with production of 55.59 lakh metric tonnes (*Anonymous, 2019*). In India per capita per day availability of vegetables is very low i.e. 180g, significantly less than that recommended (300 g) by FAO (*Nair and Barche 2014*). These factors are contributing to higher demand and lesser supply of fresh vegetables which cannot be fulfilled through open field cultivation. The best possible solution to this seems to be the vertical expansion through increased productivity and cropping intensity by using protected structures with controlled environmental conditions i.e. polyhouse cultivation of vegetables (*Paroda, 2013* and *Gowda, 2009*). This technology is 3-5 times more useful in improving the productivity of vegetable qualitatively as well as quantitatively than the open environment (*Reddy, 2016*). There are various types of protected structures such as Natural ventilated poly-house, Walk in tunnel and Anti-insect net shade house. All these structures are beneficial for off-season cultivation of vegetable crops and also protect the crop from insect-pests and diseases (*Ghanghas et al 2018*). The major crops grown under poly-house are tomato, cucumber and capsicum. Some other crops such as cabbage, cauliflower, brinjal, green leafy vegetables and pea can also be grown successfully under these structures (*Sabir and Singh 2013*). The area under protected cultivation in India was about 25000 ha during 2004-05 *(Sabir & Singh, 2013*) which further rised up to 1,50,000 ha in year 2014-15 (20% of which was under polyhouse) (*Punera et al 2017*). The state that consistently expanded the area under protected cultivation for the period of

2007-12 were Andhra Pradesh, Gujarat, Maharashtra, Haryana, Punjab, Tamil Nadu and West Bengal (*Nair and Barche 2014*). This might be due to provision of subsides on installation of protected structures under some schemes initiated by the Centre and State Governments. In India Government subsidies available under National Horticulture Mission (NHM) through which Haryana is providing 65 per cent, Punjab 50 per cent and Himachal 80-85 percent subsidy for the installation of polyhouses as well as 70 per cent subsidy for replacement of polysheet after at least 3-5 years of polyhouse construction or damage due to natural calamities. In the Punjab state, many poly-houses have been established by the farmers under National Horticulture Mission (NHM), Rashtriya Krishi Vikas Yojana (RKVY), Punjab State Farmers Commission and at their own level also (*Anonymous, 2015*). Despite all these government supports the adoption of this technology is very costlier affair as on an average for the installation of poly-house in an acre, investment of Rs. 37.40 lakhs is required (*Kaur and Ranguwal, 2021*). Therefore, it was pertinent to know the potential of this technology in the state so that it might help the policy planners to revise their policies accordingly and might help the new entrepreneurs for better decision making regarding the adoption of this technology.

METHODOLOGY

District wise inventory of poly-house farmers of Punjab state was obtained from the Department of Horticulture, Punjab. Based on the list, six districts having maximum number of poly-houses i.e. Ludhiana (148), Hoshiarpur (88), Patiala (63), Bathinda (57), Sangrur (49) and Jalandhar (36) were selected. From each selected district, 10 polyhouse technology adopters and 10 non-adopters (open field vegetable growers) were selected randomly. Initially, a total of 120 vegetable growers (60 adopters and 60 non-adopters of the technology) were selected as respondents for the investigation. However, at the time of data collection it was found that out 60 selected adopters 18 had discontinued polyhouse cultivation of vegetables. Thus, in the present investigation only 42 adopters who were continuing this technology retained in the final sample. To know the potential of polyhouse technology, primary data was collected through personal interview of the respondents by visiting the study area. The data related to most suitable crop to be grown under polyhouse technology, most promising varieties used, comparative advantage over open field cultivation in terms of yield obtained, extension and technological yield gaps, price fetched, comparison in terms of economic feasibility of the investment incurred on production of vegetables under these structures were collected from the farmers through a pre-structured interview schedule. The primary data were analyzed through the various statistical tools such as frequency, percentage, ranking, standard deviation and t-test.

RESULTS AND DISCUSSION

Types of vegetable crops grown under polyhouse structures : The perusal of data given in Table 1 show that majority of the poly-house respondents (50.0%) were growing cucumber followed by 30.9 per cent were growing capsicum, 9.5 per cent were growing tomato and very small fraction of the respondents were growing cucumber-capsicum, tomato-capsicum and tomato-cucumber together under these structures. In case of non-adopters, it can be seen that about 38 per cent of the respondents were growing tomato followed by 28.3 per cent were growing cucumber, 23.3 per cent were growing capsicum and very small fraction of respondents were taking cucumber-capsicum, tomato-capsicum and tomato-cucumber together in open field conditions. From the rank wise suitability, it can be concluded that cucumber was the most suitable crop (1st rank) under polyhouse conditions followed by tomato and capsicum. Whereas

Table 1. Distribution of sampled farmers according to crops grown

Crops	Adopters (n=42)		Non-adopters (n=60)	
	No. (%)	Rank	No. (%)	Rank
Cucumber	21 (50.0)	I	17 (28.3)	II
Capsicum	13 (30.9)	II	14 (23.3)	III
Tomato	4 (9.5)	III	23 (38.3)	I
Cucumber+ Capsicum	2 (4.8)	IV	1 (1.7)	VI
Tomato+ capsicum	1 (2.4)	VI	4 (6.7)	IV
Tomato+ cucumber	1 (2.4)	V	1 (1.7)	V

in case of open field cultivation, tomato crop got the first rank followed by cucumber and capsicum. These findings are in line with *Kaur and Ranguwal, (2021)* who found cucumber as the most suitable crop under polyhouse structures whereas in contrast with *Sharma et al (2013)* who found capsicum was most suitable crop under poly-house.

Varietal preference : The findings given in Table 2 depict rank wise preference of different vegetable varieties used by the farmers for polyhouse cultivation as compared to the open field cultivation. It can be seen in the table that under polyhouse conditions *King Star Rz* was the most preferred variety used by the farmers for cucumber followed by *Kian, Insight*, *infinity* and *Rizwan sunpool*. However, in case of open field conditions Rizwan sunpool variety was the most commonly grown cucumber variety followed by *Namdhari kheera*, *Kian, King Star RZ* and *Infinity*.

Table 2. Suitability Ranks of different vegetable varieties under polyhouse and open field conditions

Crops/ varieties	Suitability Ranking	
	In polyhouse conditions (n=42)	In open field conditions (n=60)
Cucumber		
Kian	II	III
King Star RZ	I	IV
Insight	III	V
Infinity	IV	Not grown
Rizwan Sunpool	V	I
Namdhari kheera	Not preferred	II
Capsicum		
Inspiration	I	IV
Indira	II	I
Bachata	III	Not grown
Starlet king	V	III
Hungtington	Not preferred	II
Bomby & Orobelle	IV	Not preferred
Tomato		
LS524	I	IV
Naveen	II	V
Nunhems	Not preferred	I
Heemsona	III	Not grown
Abhilash	Not preferred	III
S-575	Not preferred	II
Selvia	IV	Not grown

These findings can be supported with the findings of *Sharma et al (2013)* who observed that in Himachal Pradesh *Kian* and *Malini* were the most preferred cucumber varieties under protected cultivation structures. In case of capsicum crop *Inspiration* was the most preferred variety under polyhouse cultivation followed by *Indira, Bachata, Bomy* & *Orobelle* (coloured capsicum varieties) and *Starlet King*. Similarly, in open field conditions *Indira* was the most commonly grown capsicum variety followed by *Hungtington*, *Starlet king* and *Inspiration. Sharma et al (2013)* also observed that as a green capsicum, *Indira* and as coloured capsicum *Bomby* and *Orobelle* were found to be the most predominant varieties among HP farmers. In case of tomato under polyhouse cultivation *LS 524* was found to be the most predominant variety grown by the polyhouse farmers followed by *Naveen, Heemsona* and *Selvia* where as in open cultivation *Nunhems*, *S-575*, *Abhilash, LS 524* and *Naveen* were the tomato varieties preferred by the farmers. *Sharma et al (2013)* also observed that among HP farmers *7711*, *Yash* and *Heemsona* were the most predominant tomato varieties under protected cultivation.

Potential of polyhouse technology was also measured in terms yield advantage obtained by growing crops under polyhouse structures as compared open field cultivation. It is evident from the data given in Table 3 that all the three major crops grown under polyhouse structures i.e. cucumber (109.2%), capsicum (74.0 %) and Tomato (44.5%) were giving significantly better yield to the farmers as compared to open field cultivation.

Table 3. Comparative advantage in terms of yield of vegetable crops grown under polyhouse over open field cultivation

Crop	Yield (q/acre)		Yield (%)	t-value
	Adopters	Non-adopters		
Cucumber ($n_{adopter}$= 21; $n_{non\text{-}adopters}$=17)	346.7±68.5	165.7±42.2	109.2	10.1*
Capsicum ($n_{adopter}$= 13; $n_{non\text{-}adopters}$=14)	248.5±85.8	142.8±21.6	74.0	4.1*
Tomato ($n_{adopter}$= 4; $n_{non\text{-}adopters}$=23)	362.3±51.2	250.7±47.5	44.5	6.4*

*Significant at 5 per cent

Table 4. Comparison of costs of cultivation and returns of major crops grown under polyhouse and open field conditions

Parameter	Cucumber			Capsicum			Tomato		
	Adopters 7 (n=21)	Non-adopters (n=17)	t value	Adopters (n=13)	Non-adopters (n=14)	t value	Adopters (n=4)	Non-adopters (n=23)	t value
Sale price (Rs./Kg)	22.5 ±8.03	13.0 ±5.25	4.5*	30.0 ±11.5	16.5 ±7.25	3.4*	21.36 ±8.15	14.5 ±5.76	2.8*
Cost of production (Rs./acre)	275580 ±35600	125766 ±15600	17.1*	315890 ±37400	105800 ±22400	16.5*	320475 ±42500	115580±22600	18.7*
Gross Return (Rs./acre)	779985 ±15670	215475 ±47520	54.0*	745500 ±76380	228900 ±34560	21.2*	773937±86520	353850±64200	16.3*
Net Return (Rs./ acre)	504985 ±23600	90475 ±34525	46.7*	430566 ±55290	123900 ±27370	17.1*	453937±62300	238850±44650	11.8*
B:C Ratio	2.84	1.72		2.37	2.18		2.42	1.91	
Rank	I			III			II		

Rank=Most profitable crop under polyhouse structures; * Significant at 5 per cent level;

Comparison of Costs of cultivation and returns of major vegetable crops grown under polyhouse and open field conditions : As for as the marketing of cucumber production was concerned it be clearly seen in Table 4 that polyhouse grown cucumber were fetching significantly better market price (Rs. 22-23/Kg) as compared to open field condition (Rs. 13/ Kg) due to off season cultivation of this vegetable under protected structures. The cost of production of cucumber was significantly higher in polyhouse conditions as compared to open field conditions but it can be seen in the table that Gross returns as well as net returns were significantly better in case of polyhouse cultivation of cucumber as compared to the open field cultivation. The BC ratio was found to 2.84 in polyhouse cultivation of cucumber as compared to the open field cultivation i.e., 1.72. As for as marketing of capsicum was concerned polyhouse grown capsicum was also most fetching double rates due to its off-season cultivation as compared to open field conditions. The cost of production in case of capsicum grown under polyhouse structures was found to three times more than the open field conditions but these expenses were compensated by the significantly better returns from capsicum grown under polyhouse structures than grown under open field conditions. For the polyhouse grown capsicum crop the benefit cost ratio was found to be 2.37 while in case of open field conditions it was found to be 2.18. The polyhouse respondents were also getting better tomato prices in the market, better market returns although their cost of production was three times more than the tomato crop grown under open field conditions. The BC ratio was found to be 2.42 in case of tomato crop grown under polyhouse conditions as compared to the crop grown under open field conditions (1.91). Cucumber crop grown under polyhouse structures was giving better returns to the farmers as compared to open field cultivation. Similarly, *Kaur and Ranguwal (2021)* in their study found that the farmers growing capsicum under poly-house structures were getting better yield and returns than the farmers growing this crop under open field conditions. On the basis of benefit cost ratio polyhouse grown crops were ranked to find out the most profitable crop under polyhouse conditions. Thus, it can be concluded that cucumber was the most profitable

Table 5. Extension and technology gaps in adoption of polyhouse technology

Parameter	Cucumber	Capsicum	Tomato
Extension yield gap (q/ acre) Range (Av.)	12.5- 42.6 (24.5)	18.5 -46.5 (32.5)	15.7 – 27.8 (21.75)
Technology yield gap Range (Av. q/ acre)	35.8-42.5 (38.5)	45.5-62.4 (54.6)	31.8-62.5 (48.6)

crop under protected structures followed by tomato and capsicum seems to be III[rd] most profitable crop.

Extension and technology gaps in adoption of polyhouse technology : To check the possibility of enhancing the yield/ profit from polyhouse technology extension and technology gaps were also worked out. Table 5 reveals that the extension gaps for polyhouse grown vegetables ranging from 20-30 q/acre emphasizes that there is need for capacity building of farmers through various extension programmes for adoption of improved agricultural technologies to enhance further yield and profit. The technology gaps were found to be ranging between 35-55 q/acre might be attributed to dissimilarity in soil fertility, cultivation practices, selection crop varieties and technical know how about the technology. *Rani (2020)* found that adoption of improved practices can enhance yield and thus can minimize technology gap.

CONCLUSION

It can be concluded from the above findings that cucumber, capsicum and tomato were the most suitable crop grown under polyhouses. Although cost of production in the crop cultivation under polyhouse conditions was higher than open field conditions for the three major crops such as cucumber, capsicum and tomato, however at the same time the gross returns as well as net returns were significantly better under polyhouse cultivation. The extension gaps as well as technological gaps emphasizes that there was need for capacity building of farmers through various extension programmes for adoption of improved agricultural technologies to enhance further yield and profit.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

Anonymous (2015). Subsidy Assistance. Retrieved from https://www.pioneeragritech.com/on 8 October 2021.

Anonymous (2019). Area and production under horticulture crops in India. Retri. from http://nhb.gov.in/ on 4 February 2020.

Ghanghas, B.S.; Malik, J.S. and Yadav, V.P.S. (2018). Sustainable vegetables and flowers production technology (Poly-house): Problems and prospects in Haryana. *Indian Res. J. Ext. Edu.,* **18**:12-16.

Gowda, S.M.V. (2009). Hi-tech floriculture in Karnataka, occasional paper-49, the national bank for agriculture and rural development department of economic analysis and research, Karnataka Orion Press, Fort, Mumbai, pp1-95.

Kaur, P. and Ranguwal, S.(2021). Constraints in adoption of protected cultivation technology in Punjab. *Int.J.Eco.Env. Sci.,* **3**:273-79.

Nair, R. and Barche, S. (2014). Protected Cultivation of vegetables- Present status and future prospects in India. *India J. App. Res.,* **4**:245-47.

Paroda, R.S. (2013). Strategies for protected cultivation. Inaugral address delivered at the first national seminar on Advances in protected cultivation, at NASC complex, Pusa campus, New Delhi.

Punera, B.; Pal, S.; Jha, G.K. and Kumar, P. (2017). Economics and institutional aspects of protected cultivation of carnation in Himachal Preadesh. *Agri.Eco. Res. Rev.,* **30**: 73-80.

Rani, A. J. (2020). Technological gaps in major vegetable crops and suggestions to sustain the vegetable production. *Agric Update,* **15**:45-49.

Reddy, P.P. (2016). Sustainable crop protection under protected cultivation, Springer, Pp 1-11.

Sabir, N. and Singh, B. (2013) Protected cultivation of vegetables in global arena: A review. *Indian J. Agri. Sci.,* **83**:123-35.

Sharma, K.D.; Pathania, M.S.; Bala, B. and Gupta, M, (2013) Developing technologies for protected cultivation in Himachal Pradesh.

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