IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
Research Paper **© 2012 IJFANS. All Rights Reserved** UGC CARE Listed (Group -I) Journal Volume 11, Iss 13, 2022

OFF-SEASON VEGETABLE CULTIVATION UNDER PROTECTED STRUCTURES

[1]Vinay Joseph Silas, [2]Atul Yadav, [3]KK Mishra
Faculty of Agricultural Sciences & Allied Industries, Rama University, Mandhana, Kanpur, U.P

ABSTRACT

The research was carried in the Polyhouse constructed at the Horticluture farm at Rama University 2021-2022 & 2022-2023 .The demand for fresh vegetable prevails round the year but supply is restricted to cultivation season. The performance of the different vegetable crops is highly influenced by changes in climatic vagaries like fluctuation in temperature, light, humidity, wind velocity etc. that adversely affect the growth, physiological process, flowering, fruit setting and finally yield and economic return. The unpleasant climate drastically reduced the total production or even result in total crop failure. To increase the availability of the fresh vegetables beyond normal season, promotion of off-season cultivation is the need of the hour. Summer crop of winter season vegetables under open field condition is not possible as scorching sunand higher day and night temperature adversely affects the vegetative growth, prompted flower and fruit drop. Again cultivation of summer crop during winter months in open field suffers from low temperature, cold waves and freezing injury. By adopting proper protection technologies and providing favourable environment, the crops can be raised during off season. With the introduction of shade net which partially control the temperature and light and creates a favourable environment for crop growth that enables raise the crop under intense summer months with desirable yield and quality. Again poly house maintained higher temperature and light intensity compared to outside during winter months which favours the growth and yield of summer season vegetables. The full paper discussed the different aspects of off-season vegetable cultivation to make the production system economically viable and remunerative.

Key words: Off-season vegetable cultivation, agro shade net, poly house, temperature and light.

INTRODUCTION

Vegetable crops are cheaper source of natural protective nutrients namely carbohydrates (cassava, sweet potato, potato, colocasia), protein (peas, beans, drum stick, agathi flower, fenugreek leaves), fat (taro leaves, drum stick leaves), minerals (palak, amaranth, fenugreek, coriander) and vitamins (carrot, beet, cabbage, tomato, chilli). They are good source of essential amino acids that are lacking in cereals and pulses. Crops like amaranthus, okra, ridge gourd and sponge gourd are valuable source of roughages in the form of dietary fiber and neutralizes the acid formed during the digestion of protein and fatty foods.

Research Paper © 2012 IJFANS. All Rights Reserved

Coloured vegetables like orange carrot, purple cabbage/cauliflower, red tomato and watermelon are rich source of antioxidants and possessed anti-cancerous properties.

India is the second largest producer of vegetable crops in the world just after China. The present production of vegetables, 138.00 million tonnes (NHB-2011) is to be raised to 250 million tonnes by 2024-2025 [16]. There are different ways and means to achieve this target, e.g., bringing additional area under vegetable crops, using hybrid seeds, use of improved agro-techniques. Another potential approach is perfection and promotion of protected cultivation of vegetables [25, 26]. Protected cultivation is defined as cropping techniques wherein the micro climate surrounding the plant body is controlled partially/fully, as per the requirementof the plant species grown, during their period of growth [18]. It is a method where plants are getting protected from adverse conditions like rains, freezing temperature, hailstorm, sun burn, insect and disease pest etc. The main purpose of protected cultivation is to create a favourable environment for the sustained growth of crop so as to realize its maximum potential even in adverse climatic conditions. Protected cultivation offers several advantages like production risk is comparatively less than open field condition, 10-12 times higher yield than that of outdoor cultivation, proper nourishment of the crop, opportunity for year round production of high-value vegetable crops, disease free quality planting material production, efficient utilization of land and resources. This economic return can increase manifolds if high value vegetables are selected for cultivation under protected conditions, like poly houses, net houses, poly tunnels, rain shelter etc. The productivity of off-season vegetables can be increased many fold through protected cultivation technologies by growing the crops throughout the year. Singh and Sirohi [25] reported that protected cultivation of vegetables offers distinct advantages of quality, productivity and favourable market price to the vegetable growers. Proper selection of crops and adoption of appropriate protected structures will lead to better productivity and profit maximization. The system will also help to create employment for the local youths particularly farm women.

Utilization of Protected Structures for off-Season Vegetable Production
Growing of summer vegetables in winter months

Use of Poly house

The demand for fresh summer vegetable like okra, bitter gourd, bottle gourd, cucumber etc. increased many fold during winter months for increasing diversity in diet. Open field cultivation of summer vegetables during winter months will not be possible due to temperature fluctuations. The summer vegetables can be successfully cultivated in the poly house as the temperature inside poly house remain higher compared to outside environment. Again the adverse effect of cold wind can be overcome during crop cultivation. Poly house are the structures made of

Research Paper © 2012 IJFANS. All Rights Reserved

polyethylene. The size of structure can differ from small shacks to big-size buildings as per the need of the grower. In present condition, poly house cultivation of off-season vegetables is emerging as a specialized production technology to overcome abiotic stresses for year round production. Poly house gives the optimum environmental facilities to the crops. It can be utilized for organic cultivation of high value vegetables. Poly house also protect the crop from the attack of pest and diseases. Apart from crop cultivation, raising of seedlings of different summer season vegetable can also be practised for advancing the crop period and for better remuneration. Several researchers have observed that poly house cultivation can offer several benefits to small farmers which can help in doubling their farm income. Singh et al., [27] reported that low- cost, naturally ventilated poly houses were the most suitable and economical for year-round cultivation of cucumber in the northern plains of India. Isaac [15] observed that coriander plants establishes and grows well with higher biomass production in naturally ventilated poly house. Sweet pepper can be successfully grown under zero energy naturally ventilated poly house condition and produced higher returns [3].With the development of parthenocarpic hybrids in brinjal, now it is possible to grow brinjal under the protected conditions [16]. Dixit [8] studied the performance of leafy vegetables under protected environment and open field condition. Protected structure offers an opportunity for extended period of leafy vegetable cultivation under frost free and comparatively higher night temperature conditions.

Table No 1: Performance of tomato varieties under Low cost poly house

Varieties	**Poly house yield (q/ha)**	**Open field yield (q/ha)**	**Varieties**	**Poly house yield (q/ha)**	**Open field yield (q/ha)**
BT-117-5-3-1	372.00	165.00	Selection-2	203.00	73.83
KT-10	283.60	127.40	Selection-1	208.98	88.03
BT-10	214.00	118.65	KT-15	210.60	59.65
Arka Alok	270.00	62.90	H-24	203.17	60.75
BT-12	312.40	99.00	Arka Abha	173.50	80.33

(Source: Singh, [26])

ISSN PRINT 2319 1775 Online 2320 7876
Research Paper © 2012 IJFANS. All Rights Reserved UGC CARE Listed (Group -I) Journal Volume 11, Iss 13, 2022

Table No 2: Suitable vegetable varieties for year round cultivation under low cost poly house

Crops	Varieties	Season
I-Year		
Tomato	Naveen, Karnataka	May- Aug
French bean	Kentucky Wonder, Contender	Sept- Nov
Cauliflower	White Marble, Indam	Dec- Feb
Coriander	CO-1, Mehak	May- April
Green manure	Sesbania spp.	May
II-Year		
Tomato	Naveen, Karnataka	June- Sept
French bean	Kentucky Wonder, Contender	Oct- Dec
Chilli	KA-2, Arka Lohit	Jan- April
Cowpea	Arka Suman	May- June
Other crops		
Okra	Arka Anamika	May- June
Palak	All Green, Pusa Jyoti	June- July

[Source: Phookan and Saikia, [20]

Table No 3: Economics of crop cultivation under poly house

Sl No.	Crop	Month of planting	Area under crop (m^2)	Yield (kg)	Productivity (ton/ ha)
Crops in terrace					
1.	Capsicum	May	32.31	26	8.05
2.	Tomato	April	32.31	24	7.43
3.	Brinjal	May	35.0	38	10.86
4.	French Bean	June(1st week)	19.38	12	6.19
5.	Cabbage	July	62.70	63	10.05
6.	Cauliflower	August	32.31	22	6.81
7.	Pea	December	32.31	23	7.12
8.	French Bean	January	35.0	25	7.14
9.	Tomato	March	62.70	35	5.58
Crops on riser					
10.	Bitter Gourd	June	10.16	9.2	9.06
11.	Bottle	June	20.23	35	17.30

Research Paper © 2012 IJFANS. All Rights Reserved

	Gourd				
12.	Cucumber	July	10.16	12	11.81
13.	Bitter Gourd	November	10.16	4.6	4.53
14	Cucumber	February	30.31	26	8.58

[Source: Anonymous, [1]

Low tunnel/ Row cover

Cultivation of crops like tomato, summer squash, melons, capsicum are very difficult in open field during winter month under north Indian condition due to prevalence of cold wind. In such situation these crops are grown in low tunnels/ row cover. The structure protects the crop from wind damage. It also helps to retain the heat. Crop inside the row cover matures early and produce reasonable yield having higher market price. Row cover can increase the fruit yield up to the extent of 25% in many cucurbits namely summer quash, cucumbers, melons etc respond over open field condition during adverse climatic condition [13]. Earlier production and yield increment in cool season crops like spinach and leaf lettuce under row covers was reported by Dickerson, [7].

Table No 4: Performance of vegetable crops under low cost polyhouse

S. No.	Crop	Transplanting time	Harvesting time	Crop advancement	Expected cost benefit ratio
1.	Summer squash	First week of December	First week of February	60 days	1:3 to 1:4
2.	Muskmelon	hird week of January tofirst week of February	Second week of April to Last weekof April	30-40 days	1:2.5 to 1:3.5
3.	Bottle gourd	hird week of January tofirst week of February	Second week of April to Last week of April	30-40 days	1:2.5 to 1:3.5
4.	Bitter gourd	hird week of January tofirst week of February	Second week of April to Last week of april	30-40 days	1:3 to 1:4
5.	Water Melon	hird week of January tofirst week of February	Second week of April to Last week of April	30-40 days	1:2 to 1:2.5
6.	Cucumber	Third week of January	First week of	30 days	1:3 to 1:4

		to first week of February	February		

(Source: Singh et al., [28])

Growing winter vegetables in summer months Use of Shade net

Supply of winter vegetables like cabbage, cauliflower, carrot radish, turnip etc become restricted during summer months. The price of these vegetables remain very high due to restricted production and long distance transportation. Cultivation of winter vegetables like cabbage, cauliflower, carrot radish, turnip etc during summer month is possible through adoption of agro shade net house cultivation. A Shade house is a structure enclosed by shade nets or any other woven material to allow required sunlight, moisture and air to pass through the gaps. It creates an appropriate micro climate conducive to the plant growth. A shade house structure composed of two basic components i.e. frame and cladding material. The shade house frame provides support for cladding material and designed to protect against wind, rain and crop load. The life span of shade house can be up to 5 years depending on the climatic condition and the structural material utilized. Shade nets are available in wide range of shade percentages viz. 25%, 30%, 35%, 50%, 60%, 75% and 90%.The partial shade and ventilation reduce the temperature inside the structure and provide favourable environment for crop production. The structures also protect the crop against pest attack and natural weather disturbances. The structures can also be utilized for raising seedlings of different winter vegetable for early season open field cultivation. Negi et al., [19] reported that under higher altitude shade net can help to increase yield of many vegetables. They found that the percentage of yield increase was maximum for pea (286%) followed by capsicum (70%) and tomato (58.66%). Similarly, under low altitudes situation the maximum fruit yield was found for brinjal (169.33%) followed by capsicum (136%). Apart from yield quality of fruit can be enhanced under shade net condition. Cheema et al., 2004 observed that cultivation of off-season vegetable crops under shade net can produce higher yield, advance the maturity and reduce the incidence of insect pest attack. Singh and Asrey [29] also reported that cultivation of tomato in a greenhouse would help obtain high productivity and better return. Study on performance of cucumber inside the shade net house revealed that fruit yield and quality was better compared to the crop grown in open condition and nearly 3½ times higher fruit yield of cucumber was recorded under shade net house [9, 10]. Zoran et al., [31] also stated that fruit yield of cucumber can be increased by 113 to 131% under shade net condition over the open field cultivation.

Research Paper © 2012 IJFANS. All Rights Reserved

Table No 5: Performance of vegetable crops inside agro shade net

Tomato						Capsicum	
Net house	Fruit weight (g)	Yield kg/pt	TSS (0 Brix)	Vit.C (mg/100g)	Acidity (%)	Fruit weight (g)	Yield Kg/pt
NH-1	54.0	3.62	5.8	32.76	0.78	45.7	2.7
NH-2	57.9	3.83	6.3	34.02	0.78	57.4	2.5
NH-3	48.8	3.97	6.1	34.74	0.92	77.6	2.6
NH-4	45.6	3.71	7.0	36.18	1.03	62.5	2.7
Open field	42.0	2.17	5.6	32.72	0.72	35.8	1.3

Challenges in off-season vegetable production under protected structures

Farmers are facing a lot of challenges during cultivation of vegetable crops inside protected structures. High initial cost for establishment of structures like poly-house, shade net, rain shelter etc discourage for wider adaptation. Again non-availability of various construction materials like GI pipes, polyethylene sheet etc are not generally available in local market and need to be imported at high costs including freight and custom duty. Sometimes for installation, monitoring and supervision, skilled workers are required which are not easily available in the village areas. The package of practices of different vegetable crops for round the year cultivation have not been standardised, hence the recommendation of one region may not work for other region. Lack of awareness among farmers about the potentials of protected vegetable production hampering the large scale cultivation. Very limited research work have been initiated on protected vegetable farming of different commercial crops.

CONCLUSION

The growing population and rapid industrialization and urbanization is gradually decreasing the cultivated land. The demand of fresh vegetable under shrinking land area forces the policy maker to think beyond open field cultivation. For maximum utilization of available land and to enhance the productivity as well as to minimize the use of harmful pesticides, protected structures offers immense scope for the farming community of India. To fulfil the dream of doubling farmers income, adoption of protected structure for year round cultivation of the different vegetable crop is the need of the hour. Effort should be made to minimise the initial investment of establishment of protected structures. Promotion of low cost protected structures with natural ventilation should be encouraged. The market should be linked with the availability of crop in the protected structure for maximum monitary return. Government support as well as intervention of NGOs for financial help and arrangement for skill development

programme on protected cultivation will help to increase the area under protected cultivation. Supply of improved package of practices for protected cultivation through leaflets, farmers training will help to create more awareness about the protected cultivation among the farmers.

REFERENCES

1. Anonymous. https://www.quickcrop.co.uk/blog/polytunnel-gardening/
2. Anonymous, (2003). Annual Report of AICRP on Plastics in Agriculture, Umiam Centre. ICAR Research Complex for NEH Region, Umiam, Meghalaya.
3. Chandra P, Sirohi P S, Behera T K and Singh A K (2000) Cultivating vegetable in polyhouse.
Indian Hort.**45** (3): 17–32.
4. Cheema D S, Kaur P and Kaur S (2004) Off-season cultivation under net house conditions. Acta Hort. **659**: 177-81.
5. Chowdhury B R, Fagaria M S and Dhaka R S (2002) A Textbook on Production Technology of Vegetable. Pub. By Kalyani Publishers, Delhi.
6. Dalrymple D G (1973)A global Review of Green House Food Production, USDA report. **89**.
7. Dickerson G W (2014) Row Cover Vegetable Production Techniques www.cahe.nmsu.edu
8. Dixit A (2007) Performance of leafy vegetables under protected environment and open field condition. Asian J. Hort.**2** (1): 197- 200.
9. Ganesan M and Subashini H D (1999) Study on biometric characteristics of tomato grown in poly greenhouse and open field conditions. JRD Tata Eco technology Centre, M.S. Swaminathan Research Foundation, Chennai (TN) India.
10. Gonzage Z C, Capuno O B, Loreto M B and Rogers G S (2009)Lowcost- Protected Cultivation: Enhancing Year- Round production of High Value Vegetables in the Philippines.At http://www.protectedcropping.com/_files/pdfs/Working%20paper%2019%20Agronomy%20Final. pdf, accessed 13 March 2013.
11. Hasan M and Singh B (2013) Protected Cultivation Technology for Growing High Value Horticultural Crops. At <www.caftextension.org.in/CAFT2012Lectures/18.pdf>
12. Hassan M and Singh B (2012) Protected Cultivation Technology for Growing High Value Vegetable Crops. At www.drysrhu.edu.in/YSRHUNewsApril12.pdf
13. Helbacka and Joan, 2002 (March) Row Covers for Vegetable Gardens, Washington State University, King County Cooperative Extension Service, Fact Sheet No. 19.
14. Indian Horticulture Database 2011 - National Horticulture Board. At nhb.gov.in/area- pro/database-2011.

IJFANS International Journal of Food And Nutritional Sciences
Official Publication of International Association of Food and Nutrition Scientists

Research Paper **© 2012 IJFANS. All Rights Reserved**

15. Isaac S R (2015) Performance Evaluation of Leafy Vegetables in Naturally Ventilated Polyhouses. IJRSAS **1**(3): 1-4.
16. Kumar N and Singh G (2015) Protected Cultivation of Parthenocarpic Brinjal (Solanum melongena
L.). IJAIR **4** (1): 2319-1473.
17. Manual of Vegetable production in Botswana-2006, Department of Agriculture Research Private Bag 0033. Gaborone, Botswana.
18. Mccollum J P, Swider J M and Ware G W (1992) Producing vegetable crops. International book distributing company, Lucknow.
19. Negi V S, Maikhuri R K and Pharswan D S (2013) Protected cultivation as an option of livelihood in mountain region of central Himalaya, India. The International Journal of Sustainable Development and World Ecology. **20** (5).
20. Phookan D B and Saikia S (2003) Vegetable production under naturally ventilated plastic house cum rain shelter. PlasticultureInervantion for Agriculture Development in North Eastern Region, Edt. by K.K. Satapathy and Ashwani Kumar. 127-141.
21. Prasad S and Kumar U (2001) Principles of Horticulture. Pub. By Agro bios (India), Jodhpur.
22. Rai N and Yadav D S (2005) Advances in vegetable production. Research Book Centre, New Delhi.
23. Ranjan A, Kumar A, Prakash S and Pal A K (2019) Effect of Low Poly Tunnel and Planting time on Growth Parameters and Yield of Muskmelon Int. **J**. Curr. Microbiol. App. Sci. **8** (1): 2735-2739.
24. Roychowdhury N and Misra H P (2001) Text book on floriculture and landscaping. N. K. Gossian& Co. (Pvt.) Ltd., Kolkata.
25. Singh B and Sirohi N P S (2008) Protected cultivation of vegetables in India: problems and future prospects. Acta Hort.**710**: 339-342.
26. Singh B (2001) Compedium of lecture in National Training course on Vegetable Production Technology, IIVR, Varanasi.20-27.
27. Singh B, Kumar M and Sirohi N P S (2007) Protected Cultivation of Cucurbits under Low-Cost Protected Structures: A Sustainable Technology for Peri-Urban Areas of Northern India. Acta Hort.**731**:267-272.
28. Singh N, Diwedi S K and Paljor E (1999) Ladakh Mein Sabjion Kei SanrakshitKheti. Regional Research Laboratory of DRDO, Leh. Pub. By D.R.D.O. 56 A.P.O.
29. Singh R and Asrey R (2005) Performance of tomato and sweet pepper under unheated greenhouse. Haryana **J**. Hort. Sci, **34** (1-2): 174-175.
30. Takashi Masaki (1987) Vegetable Cultivation under the Plastic Rain Shelter Japan AgriculturalResearch Quarterly. **20** (3).
31. Zoran I, Milenkovicl L, Durovka M and Kapoulas N (2011) The effect of colour shade net on thegreen house climate and paper yield. Original Scientific Paper, **410**(4): 201 – 210.