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Production potential and economics of different vegetable crop sequences under protected cultivation

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Abstract

In a three year experiment in ultraviolet plastic film covered low cost polyhouse (less than rupees 60 per square meter) at a Research Farm of Himachal Pradesh Krishi Vishvavidyalaya, Palampur, capsicum-cabbage-green onion gave the highest net return and benefit:cost ratio followed by cucumber- tomato- cauliflower compared with open field cultivation.

Key words: Greenhouse, vegetables, cropping sequence, benefit cost ratio, polyhouse.

Introduction

Use of plastic covered green house for commercial vegetable crop production to achieve maximum net returns is very common in many Western countries (Chandra, 1985). In India vegetable crop production would have to increase to 20 tonnes/ ha by 2010 A.D. compared with 9.0 tonnes/ ha at present (Anonymous 2000). It is a challenge to the technology, processes and resources of agricultural production to produce vegetables several times more to meet the needs of fast increasing population. Green house technology is relevant to such a challenge. Green house technology has been in use for more than fifty countries all over the world. China is believed to have adopted plastic green house concept to a greater extent. Application of green house technology for crop production in India is a recent phenomenon. The total greenhouse area in India was about 5 hectares in 1983 which has increased to about 500 hectares in 2000 (Samuel, 2001). High capital investment is one of the serious constraints in its wide adaptability.

Looking into the benefits of cultivation inside greenhouse/ polyhouse, efforts have been made to develop technology which is cost effective and economically viable for higher production. In North India, vegetables can not be produced round the year in open fields due to abrupt climatic conditions. APA (Application of Plastics in Agriculture) has recently made a breakthrough in developing low cost polyhouses, which was made with locally available materials and UV stabilized film as a cladding materials. This structure is less energy intensive, suitable to climate and cost effective (cost is less than Rs. 70 per square meter) which enables the small and marginal farmers to grow off- season vegetables which can fetch high prices in the market. Taking these points into consideration, efforts have been made to use low cost polyhouse round the year for different crop combination to make it cost effective and within the reach of small farmers who want to take up off- season production as agribusiness.

Material and Methods

The experiment was conducted during 2000-2001 to 2002-2003 on a silty clay-loam soil of Palampur ($32^0.5^0$ N, $76^0.32^0$ E,1290 m above mean sea level). The soil having 0.75% organic carbon was medium in available nitrogen (240.5 kg N/ha), low in phosphorus (8.9 kg P/ha) and medium in potassium (257.4 kg K/ha), with acidic reaction (pH 5.7).

An arc type greenhouse structure of bamboo frame of size 15m X 5 m facing East-West was used. The structure was covered with ultraviolet-stabilized polyethylene sheet of 200 micron thickness. The gate and ventilator on opposite side were kept open during day time to facilitate ventilation. The detail of the cost of bamboo green house under different heads is given in Table 1. No additional environmental control measures were used except routine irrigation. The air temperature, relative humidity, evaporation and solar radiation were measured throughout the growth period of the crop. The experiment comprised of six cropping sequences *viz.* brinjal (April-June)- frenchbean (July-September)-cauliflower (September-November), capsicum (April-August) -cabbage (September-

November) - green onion (December-March), tomato (April-June) - cucumber (July-August)- cauliflower (September-November), cucumber (April-June) - frenchbean (June-August) - frenchbean (September-December), tomato (April-August) - cabbage (September-November) - spinach (November-March) and tomato (April-August) - cauliflower (September-November) - cauliflower (November-March). All these cropping sequences were replicated thrice in randomized block design.

Table 1. Cost of bamboo greenhouse

Sr. No.	Item	Amount (Rupees)
1.	Foundation Pipe	400
2.	Cement concrete	400
3.	End frame	380
4.	Hoops	150
5.	Ridge line	180
6.	Supports	30
7.	Glazing sheet	4000
8.	Miscellaneous	1200
	Total	6740

All these crops were grown in rows laid along the length of the greenhouse and a passage of 0.5m was kept along the control line. The same crops were also grown outside the greenhouse, keeping all the parameters constant. Nursery of these crops was raised inside the polyhouse. Recommended package of practices were followed for raising the crops.

Results and Discussion

The sequence of capsicum-cabbage-green onion and cucumber-tomato-cauliflower gave the maximum production of 18.30 and 15.17 q/100m^2/year in greenhouse compared with only 6.32 and 6.01 quintals/100m^2/year in field (Table 2). This shows an increase of 2.7 times in greenhouse cultivation. The higher production inside the greenhouse may be due to favourable environmental conditions during the entire growing season of the crop (Table 3). Nimje *et al.* (1991) and Pathania *et al.* (2005) have also observed similar observations. Benefit:cost ratio also showed similar trend (Table 4). Capsicum-cabbage-green onion cropping sequence recorded highest benefit: cost ratio of 5.46 followed by cucumber-tomato-cauliflower (2.98) and brinjal-cauliflower-frenchbean (2.95) inside the green house.

It was thus concluded that with the use of ultraviolet-stabilized plastic film covered greenhouse under partially controlled environment through irrigation and opening and closing of gates, the farmers of North-West Himalayas can grow vegetables round the year. For raising the yield level further and making the system economically more sound and energy efficient, better control of environment through the use of suitable equipments may be necessary.

Table 2. Productivity (q/100 m^2) crops under cropping sequences in greenhouse compared with field conditions

Cropping sequence	Greenhouse			Field		
C_1	Brinjal (4.88)	Frenchbean (1.95)	Cauliflower (4.98)	Brinjal (1.85)	Frenchbean (0.81)	Cauliflower (2.15)
C_2	Capsicum (3.41)	Cabbage (5.05)	Green onion (9.84)	Capsicum (1.36)	Cabbage (1.84)	Green onion (3.12)
C_3	Tomato (3.27)	Cauliflower (4.45)	Cauliflower (3.83)	Tomato (1.05)	Cauliflower (0.94)	Cauliflower (1.18)
C_4	Cucumber (5.97)	Frenchbean (2.12)	Frenchbean (1.68)	Cucumber (2.54)	Frenchbean (0.68)	Frenchbean (0.61)
C_5	Cucumber (5.76)	Tomato (5.89)	Cauliflower (3.52)	Cucumber (2.47)	Tomato (2.54)	Cauliflower (1.00)
C_6	Tomato (3.44)	Cabbage (4.44)	Spinach (5.36)	Tomato (1.54)	Cabbage (1.76)	Spinach (2.17)

Table 3. Environment parameters inside and outside greenhouse (mean of three years)

Weather parameters	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Air temperature (°C)												
						Greenhouse						
Maximum	28.2	29.7	35.2	39.4	44.1	42.0	40.1	42.2	39.1	37.3	33.1	31.2
Minimum	5.0	9.2	10.8	11.6	15.3	18.4	19.6	20.8	19.7	12.6	8.3	6.2
						Field						
Maximum	15.4	16.0	21.6	26.0	28.4	27.1	25.4	27.9	26.3	24.1	4.4	19.0
Minimum	4.5	7.8	8.9	10.0	13.8	16.7	17.9	18.9	19.0	11.1	7.5	5.1
Solar radiation (Lux)												
Greenhouse	387	314	443	560	544	485	463	355	510	527	491	327
Field	574	458	611	825	808	1005	672	658	658	709	771	690
Relative humidity (%)												
Green house	67.5	56.2	50.4	48.3	35.1	60.3	75.6	70.1	69.2	60.4	62.3	61.4
Field	60.3	56.2	50.4	48.3	35.1	60.3	75.6	70.1	69.2	60.4	62.3	61.6

Table 4. Benefit : cost ratio of cropping sequences in green house compared with field condition (Rs/100m²/year)

Cropping sequences	Greenhouse			Field		
	Cost of cultivation	Net return	Benefit: cost ratio	Cost of cultivation	Net return	Benefit : cost ratio
Brinjal-Frenchbean-cauliflower	3086	9114	2.95	1862	3110	1.67
Capsicum-cabbage-green onion	3402	18571	5.46	2075	5549	2.67
Tomato-cauliflower-cauliflower	3683	7867	2.14	2524	646	0.25
Cucumber-frenchbean-frenchbean	3033	7497	2.47	1905	2183	1.14
Cucumber-tomato-cauliflower	3809	11361	2.98	2597	3413	1.31
Tomato-cabbage-spinach	3471	9769	2.81	2087	3383	1.62

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