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Research Article

EFFECT OF PLASTIC LOW TUNNEL ON YIELD AND ECONOMICS OF SUMMER BOTTLE GOURD [*Lagenaria siceraria*(Mol.) STANDI] BY EARLY PRODUCTION OF SEEDLINGS

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Abstract: The experiment was conducted to find out the effect of plastic low tunnel on yield and economics of summer bottle gourd [*Lagenaria siceraria* (Mol.) Standl] by early production of seedlings during 2021 and 2022 at Alwar, Rajasthan. Seeds were sown in plug-trays on 15th January when minimum temperature and maximum temperature were 8°C and 21°C respectively under plastic low tunnel covered by transparent polythene sheet of 30micron thickness. Seedlings were shifted on 25th February when minimum temperature and maximum temperature were 15°C and 33°C, respectively. Seedlings produced under low plastic tunnel produced first picking earlier (30-35 days after transplanting) and higher yield 215 q/ha. with higher B:C ratio of 1:3.91 in comparison to farmer's practice (control) of direct sowing of seeds on 25th February to 05th March in open field when temperature was suitable for growth which produced first picking later (65-70 days after sowing) and lower yield of 186.5 q/ha. with B:C ratio of 1:3.42. There was 15.28 % increase in yield over farmer's practice. The technology gap in productivity of 35q/ha was computed. The technology index value of 14 was recorded. The results indicated that the gap existed in the potential yield and demonstration yield is due to soil fertility and weather conditions. By conducting on farm testing of proven technology of earlier seedlings production in off-season in plastic low tunnel yield potential of bottle gourd can be increased. This will substantially increase income as well as the livelihood of farming community.

Keywords: *Off season, On-farm testing, Plug-trays, Plastic low tunnel, Polythene sheet, Bottle guard*

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Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl] is an important vegetable of cucurbitaceous family grown for its tender fruits in northern plain. It is grown during summer and rainy seasons. It is one of the excellent fruits that are required for good health and quality human life. Bottle gourd is mainly a warm season crop requires optimum temperature between 24° C-27°C having trailing habit. Fruit pulp is a good source of fiber free carbohydrates. Being a warm season crop it is grown successfully in tropical and subtropical areas in open as spring summer, summer and rainy season crop cultivation. India it's area and production were186000 hectare and 3052000 Metric tonnes respectively during 2018-19 [1]. India being a vast country with diverse and extreme agro-climatic conditions, the protected vegetable cultivation technology can be utilized for year-round. Off season production of high value low volume vegetable crops (parthenocarpic cucumber and capsicum *etc*.), are highly demanded in the market. Among the protected structure, plastic low tunnel is a cheap and better way for off-season seedlings production of bottle gourd during winter (January) when minimum temperature is about 8°C and transplanting in open field when temperature is suitable for plant growth. It generates changes in the environmental condition of light, temperature and relative humidity that may have effect on the productive and physiological responses of the plant [2]. Studies have shown that air temperature inside the tunnel is 3 to 20°C higher and soil temperature is 2-5°C higher than soil temperature recorded in open fields [3]. Low tunnel can warm the soil and protect the plants from hails, cold wind, and injury and advance the crop [4]. But the price of the produces has high premium value during their off-season availability by adopting the season forcing techniques like green house, poly house net house and low tunnel [5] but installation of these structures are costlier so unaffordable by the small and marginal farmers. Out of these techniques, low tunnel is found one of the best for non woody species, such as ornamental and vegetable.

Farmers are gradually adopting different protected structure to combat the climatic vagaries and emerging challenges in vegetable production. The low tunnel techniques can be used for raising seedlings by modifying the microclimate [6]. Generally, the tunnels are made in north to south direction to receive maximum sun light. Transparent plastic of 30-50 micron is commonly used for making low tunnels, which reflects infra-red radiation to keep the temperature inside the low tunnels higher than outside. These tunnel increases the inside temperature and entrapment of carbon dioxide, resulted more photosynthetic activity of crops hence early produce. They create a favourable microclimate around the crops by proving, frost and pest protection and reducing moisture loss [7]. In several part of country, especially in northern plains, temperature is hovering 4 to15°C during winter season. So warm season crops like bottle gourd, bitter gourd okra do not allow successful production in open field during winter season. Keeping all the above facts in view, the proposed study was planned with the objective to produce seedlings earlier in off-season under plastic low tunnel and transplanting them in open field under suitable temperature condition instead of direct sowing of seeds in open field under presence of suitable temperature that occurs late for germination and growth to get earliest flowering and fruiting in bottle gourd for fetching higher price in market. Another benefit of seedling's production under low tunnel is that in main field other crops like mustard or other vegetables may be taken and just after harvesting that crop shifting of seedlings in quick succession is possible to save time, space and other resources like water and nutrient. Today, some advanced farmers sows seed of cucurbits in channels in the month of January or earlier with drip irrigation system and covers the whole channels by transparent polythene sheets up to occurrence of suitable temperature in February. By using these methods, they get early production that fetches higher price in the market. But here cost of cultivation is more and more water are needed and field should not be occupied from rabi season crops like mustard *etc*.

Table-1 Yield, technology gap, extension gap and technology index

Variable	No. of trials	First picking	Yield (q/ha)	Increase over farmers' Practice (%)	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
T_1. Farmer's practice of direct sowing of seeds in open field from 25th February to 5th March	10	65-70 days after sowing	186.5	-	-	-	-
T_2. Sowing of seeds in plug-trays under low tunnel on 15th January and transplanting on 25th February	10	30-35 days after transplanting	215	15.28	28.5	35	14
Additional in T_2 treatments application			28.5				

Table-2 Economics (average of 2 years) of bottle gourd production under on-farm testing

Technology option	Yield q/ha)	Cost /ha (₹)	Gross return ₹/ha	Net return ₹/ha	Benefit : cost ratio
T_1. Farmer's practice of direct sowing of seeds in open field from 25th February to 5th March	186.5	65450	223800	158350	01:03.4
T_2 . Sowing of seeds in polythene plug-trays under low tunnel on 15 th January transplanting on 25th February	215	68100	266250	198150	01:03.9
Additional in T_2 treatment application	28.5	2650	42450	39800	* 15.02

Hence, crop from seedlings produced under low plastic tunnel is more economical to both direct sowing of seeds in open field and in channels in whole fields under low plastic tunnel.

Materials and Methods

An on-farm testing was conducted in Alwar district to see the effect of plastic low tunnel on yield and economics of summer bottle gourd by early production of seedlings in winter season during 2021 and 2022 at 10 farmer's fields. The experimental site was characterized by subtropical climate in which temperature ranges from 4°C to 28°C during winter. For some times may goes below 4°C in January. The soil was sandy loam in texture, medium in nitrogen, phosphorous and potash with saline reaction. Seeds of bottle gourd var. Mahima F1 were sown in plug-trays on 15th January during off-season when minimum temperature and maximum temperature were 8°C and 21°C, respectively. Plug-trays having 1.5inch cubic centimeter cell size are filled with artificial soilless media for raising healthy and vigorous seedlings containing mixture of cocopeat, perlite and vermiculite in the ratio of 3:1:1(V/V). Benefit of this nursery was better root development of transplants and reduction in the mortality in transplanting of seedling as compared to the traditional system of nursery raising. Cocopeat is a naturally growing media made from the husk of a coconut. compared to the soil, cocopeat retains much more water and releases it slowly to plant roots. It is considered to be eco-friendly and a sustainable material. It increases the porosity of the rooting media, which will help the roots to grow more effectively. Perlite is grey- white salicaceous material obtained after processing of crude ore which appears, after volcanic eruption. It holds 3-4 times more water to its weight. It is neutral in reaction with a pH of 6.0 to 8.0. It does not contain mineral nutrients. Vermiculite is a micaceous mineral. It is neutral in reaction with good buffering property and insoluble in water. It is able to absorb large quantities of water. It has good cation exchange capacity and thus can hold nutrients in reserve and releases it slowly and slowly. It contains enough magnesium and potassium for plants [8].

These trays after sowing of seeds placed in low tunnel made by pegging immature bamboo stick/hoops in soil to make them semi-circular shape keeping one meter spacing between two hoops. Width of low tunnel was kept 60 cm and with 50 cm height at center of semi-circular shape hoops/bamboo sticks and covered by transparent polythene sheet of 30 micron thickness. Seedlings were ready in about 40 days to shift from low tunnel to main field on 25th February under favourable climatic condition when minimum temperature and maximum temperature were 15° C and 33°C, respectively keeping the spacing of 2 m x 0.6 m. In farmer's practice (control) direct sowing of seeds was done on 25th February to 05th March in open field when temperature was suitable for germination and growth. All the necessary cultural practices were carried as per package of practices during the growth period of the crop.

The data on days to first picking ,cost of cultivation, production, productivity, total return and net return were collected in both treatments as per schedule . Average of cost of cultivation, yield and net returns were analyzed by formula.

Average = [F_1+ F_2+F_3.....Fn]/N

where, F_1 = Farmer

N = Number of farmers

Technology index was operationally defined as the technical feasibility obtained due to implementation of demonstration(on- farm testing) in fennel. To estimate the technology gap, extension gap and technology index, following formula have been used [9].

Technology gap = Pi (Potential yield) – Di (Demonstration yield)

Extension gap = Di (Demonstration Yield) – Fi (Farmers yield)

Technology index = [(Potential yield—Demonstration yield) / Potential yield] X 100

Results and Discussion

Performance of on-farm testing

The sowing of seeds in polythene plug-trays under low tunnel on 15th January and transplanting on 25th February gave first picking earlier 30-35 days after transplanting fetches higher price in market and produced fruits for longer period up to last June. This treatment recorded the higher yield (215 q/ha) than 186.5 q/ha yield obtained under farmer's practice of direct sowing of seeds in open field from 25th February to 5th March. The percentage increase in the yield (15.28) over farmer's practice was recorded [Table-1].

Early Seedlings production during off-season (winter) under plastic low tunnel and transplanting in main field exhibited significant influence on yield. This might be due that tunnel forces the early harvest of crop which can earn high market value in off season (March). During off-season germination was occurred and growth of seedlings was satisfactory under low tunnel because presence of conducive micro climate inside the tunnel , than outside. The impact of climate change is likely to have a great influence on the agriculture and eventually on the food security. Protected structures i.e., low tunnel can play important role to minimize the impact of temperature fluctuation over precipitation, fluctuating sun shine hour and infestation of disease and pest [10]. Such analyses are being made to support the regional policies for making agriculture sector resilient to climate change. The time of fruiting was related to early temperature condition which favour to low tunnel structure [11]. Musk melon crop grown under plastic cover flowered 24 days earlier than uncovered plants [12-14].

A study on row covers for vegetable gardens and re-ported that many cucurbits (squash, cucumber, and melons) respond well under row covers with increased yield of as much as 25% (5). Vegetative growth was greatest in plants in the tunnel where the thermal condition was best, early and total marketable yield were highest under the poly tunnel [15]. Singh (2020) [16] observed that bottle gourd cultivation under poly tunnel accounted for increment in fruit yield and induced precosity due to temperature during flowering stage and fruit set. Perusal of data presented in [Table-1] revealed that yield per hectare was significantly influenced by growing conditions. Thus, it is evident that performance of technology tested was found to be better than the farmers practice under the same environment conditions. The yield under on- farm testing and potential yield of crop was compared to estimate the yield gaps which were further categorized into technology index and technology gap.

The technology gap showed the difference between potential yields over demonstration (on- farm testing) yield of the technology. The potential yield of the variety is 250 q/ha. The Technology gap 35 q/ha was recorded. The on-farm testing was laid down under the supervision of Krishi Vigyan Kendra's specialists at the farmers' field, there exist a gap between the potential yield and demonstration yield. This may be due to the soil fertility and weather condition. Hence, location specific recommendations are necessary to bridge the gap.

Comparative high extension gap (28.5q/ha) indicates that there is need to educate the farmers and help them for optimizing the yield by adopting improved practices. More use of improved technologies by the farmers will subsequently change existing trend of extension gap. Technology index shows the feasibility of technology at farmers' field. The lower value of technology index, more is feasibility of particular technology. The result revealed that technology index value 14 [Table-1]. It means the technology is suitable for Alwar district of eastern Rajasthan.

Conclusion

The economic analysis of bottle gourd production revealed that the treatment T2 sowing of seeds in plug-trays under low tunnel on 15th January and transplanting on 25th February recorded higher gross return (₹2,66,250 /ha) and net return (₹1,98,000 /ha) with higher benefit: cost ratio (1:3.91) as compared to farmers practic. An additional cost of ₹ 2,650 / ha has increased additional net return ₹ 39,800 / ha with incremental benefit: cost ratio 15.02 suggesting higher profitability and economic viabilility of sowing of seeds in polythene plug-trays under low tunnel on 15th January transplanting on 25th February [Table-2]. Kumari, *et al*., (2021) [17] concluded that the total bottle gourd yield and net profit per unit area were above normal when grown under low tunnels as the produce reached the market early avoiding the market glut [18-20].

Application of research: Study of early production of seedlings in winter season to get early crop.

Research Category: Agriculture economics

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Study area / Sample Collection: Alwar

Cultivar / Variety / Breed name: Bottle Gourd [*Lagenaria siceraria* (Mol.) Standi]

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