Economics of Raising Seedling of Broccoli (*Brassica oleracea* L. var. Italica) in Protected Structure

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Abstract

The experiment was conducted during 2020–21 and 2021–22 at Green house complex, AICRP on Plastic Engineering in Agriculture Structure and Environment Management, Departmental of Renewable Energy Engineering, College of Agricultural Engineering and Technology, Junagadh, Gujarat, India to study the economics of vegetable seedling nursery for high valued broccoli crop for profitable entrepreneurship. Timely sowing and optimizing plant population significantly increase vegetable production. The availability and required seedling in time play a major role in vegetable cultivation. The seedlings of broccoli are transplanted in the *rabi* season, therefore, farmers have to prepare seedlings in the late monsoon. The germination percentage and survival of seedlings are reduced due to extreme weather condition like frosting, freezing, heat wave, high temperature and excess soil moisture in the open field. Therefore, present work was carried out on the economic feasibility of seedling raising of broccoli in a natural ventilated net-cum-poly house. The seeds of broccoli of Namdhari seeds of F1 were sown in a plug tray in the month of September of the year 2020 and 2021. Plug trays were filled with the mixture of cocopeat and vermicompost in an equal proportion of 1:1 (V/V). The germination was recorded at 94% and each seedling of broccoli was sold for ₹ 1.60. The Gross Return (GR), Net Return (NR), and benefit-cost ratio of the seedling raising of broccoli were recorded as ₹ 556.80 m^{-2}, ₹ 262.69 m^{-2} and 1.89, respectively.

1. Introduction

India is the famous for diversity of agro climatic zones (Ahmad et al., 2017). It has extreme temperate to extreme tropical region with sub-tropical region (Dash, 2016). The wide range of climatic zones suitable for all horticultural crops such as fruits, vegetables, spices, ornamental, medicinal and aromatics (Anonymous, 2018). India ranked for second in fruits and vegetables production followed by china. In 2020–21, It produced 102.76 mt of fruits and 196.27 mt of vegetables in 9.6 and 6.80 mha respectively (Anonymous, 2021). Gujarat contributes 8% and 7% of the total production of the fruits and vegetable respectively as per the National Horticulture statistics division, National Horticulture Board. India (Anonymous, 2018). Adoption of hybrid seeds and use improved high tech techniques in agriculture like micro irrigation, green house technology, soilless media and fertigation help to sustainable use of water resources add more area under vegetable cultivation (Gonnella and Renna, 2021, Baudoin et al., 2017). Healthy and disease free seedling is prime requirement for higher productions for fruits and vegetables (Pandiyaraj et al., 2017).

The seedling needs to produce in the late monsoon season for plantation of vegetable in *rabi* season. It is difficult to grow seedling in rainy season due to excess soil moisture and root zone temperature that reduce the survival rate in the open field. There is more chance of failure of seedlings owing to exposure to frosting, freezing, heat wave and high temperature in the open field (Sahu et al., 2020). The failure of seedling not only drains the cost of seeds but various inputs like fertilizer, insecticide, pesticides and time also. The crop yield reduced due delayed transplantation causes of failure of seedling. Therefore natural ventilated poly-cum-net house type structure is benefitted over the open cultivation. Plug trays, soil less media, water soluble nutrients, mechanization and automation in irrigation, seed priming and hardening technic applied in in seedling raising is possible only in protected structure (Mohanta et al., 2020).

Protected cultivation is economic empire-building processes through various businesses like seedling raising (Ashoka et al., 2019, Linganagouda and Mahajanashetti, 2016), off season

vegetable and fruits cultivation (Bala et al., 2011, Cheema et al., 2004, Murthy et al., 2009), ornamental (Slathia et al., 2018, Darras, 2020), exotic and horticultural plantation (Sagar, 2020). It also provides rural employment, social empowerment and respectability among the farmers (Hasan et al., 2018, Sabir and Singh, 2013). The maximum germination and lowest morality also observed while studied the effect of different shade house on quality seedling raising of high value vegetables by Quamruzzaman et al. (2021).

The establishment of plug tray nursery is huge initial investment and also need enough contingency to running the nursery throughout year. Sometimes famers are also lack in knowledge about to soilless media, fertigation, and other technic to manage the high tech nursery as entrepreneurship. Vegetable grower always needs healthy and good seedling but the change of their mind set to set up high-tech nursery is difficult. Plug tray nursery provides actual required quantity and disease free seedling which also forward steps towards the precision farming. The seedling of most vegetable like tomato, eggplant, chilli, capsicum, cauliflower, cabbage, broccoli, brussels sprout and lettuce could be prepared in plug tray nursery (Chauhan et al., 2021, Sahu et al., 2020). Keeping the above thing in view, the present research paper is carried out to study the economics of vegetable seedling nursery for high valued broccoli crop for profitable entrepreneurship.

2. Materials and Methods

2.1. Location

The experiment was conducted for two years during 2020–21 and 2021–22 at Green house complex, AICRP on Plastic Engineering in Agriculture Structure and Environment Management, Departmental of Renewable Energy Engineering, College of Agricultural Engineering and Technology, Junagadh, Gujarat, India located at 21.52°N latitude and 70.47°E longitude with an altitude of 107 m above mean sea level on the western side of the foothills of the mountain Girnar. The area is fall in South Saurashtra Agro climatic Zone of Gujarat State.

2.2. Climate

The study area is having typically subtropical and semi-arid climate, characterized by fairly cold and dry winter, hot and dry summer and warm and moderately humid during monsoon. Winter sets in the month of November and continues till the end of February. January is the coldest month of winter. Summer commences in the second fortnight of February and ends in the middle of June. April and May are the hottest months of summer. The average annual rainfall and evaporation is 950 mm and 2482 mm respectively.

2.3. Specification of Natural ventilated net-cum-poly house

GI pipe framed natural ventilated net-cum-poly house was covered with 200 µm thickness UVS plastic at the roof and 50% white shade net on four sides of the structure. The details of the structure are shown in the Table 1 The front view and photographic of the structure of natural ventilated net-cum-poly house was as shown in Figure 1. This type of structure

prevents failure of seedling during monsoon. It also prevents cold wave against cold and thunder during winter season. Satasiya et al. (2022) also reported that poly-cum-shadenet house significantly influence the morphological parameters of papaya seedling during winter season.

2.4. Preparation of soilless media

A dry cocopeat brick of 5 kg in a bag of 50 kg was purchased from the market. In proration of 5 kg brick of cocopeat was

Table 1: Specifications of natural ventilated greenhouse structure.

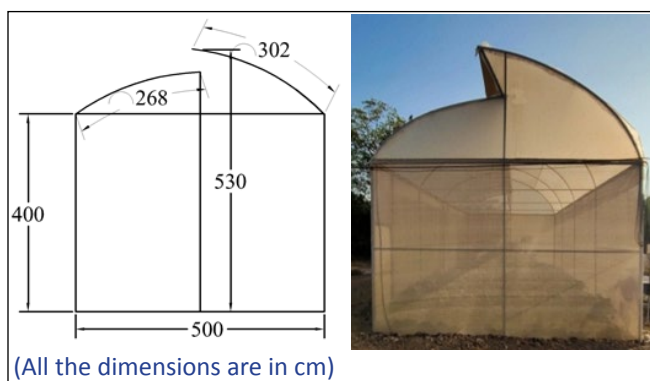| Sl. No.	Particular	Details
1.	Floor area	12.0 m×5.00 m
2.	Eave height	4.00 m
3.	Ridge height	5.30 m
4.	Orientation	East-West
5.	Cooling mechanism	Natural ventilation
6.	Structure covering	Roof: 200 µm thickness UVS plastic Side: 50% white net

(All the dimensions are in cm)

Figure 1: Natural ventilated net-cum-poly house

immersed into 25 L of water for sufficient expansion for 24 h. The calcium nitrate was dissolved @ 2.5 g L^{-1} to wash cocopeat (Nyawade and Parker, 2020). Thereafter, it was washed with clean water and collected over plain land. Vermicompost was collected from Cattle Breeding Farm, Junagadh Agricultural University, Junagadh. Cocopeat and vermicompost were mixed in ratio of 1:1 (v/v) proportion. This mixture was used to fill the plug tray. The complete processed of preparation of prepareation of seedling raising is depicted in Plate 1.

2.5. Raising of seedlings

The seeds of broccoli of Namdhari seeds (NS 50F1 hybrid) were sown in plug tray in the month of Third week of the September month in both the year. The irrigation water with 1.5 ml l^{-1} humic acid was sprayed after placing the seeds in plug tray for better germination. Uniform watering was done with nursery jug for every alternate day by manually. Water soluble fertilizer of 19:19:19 of N: P: K was sprayed with water @ 5 g 5 l^{-1} for healthy seedling at end of the every week. The healthy

Plate 1: Raising of seedling of broccoli

seedling is prime requirement for vegetable cultivation and failure of seedling creates uncertainty of vegetable cultivation. Plug tray nursery grown technique provides actual number of seedling and reduce chance of failure.

2.6. Economics

The economics of raising seedling of broccoli seeds includes the total cost and total return per unit area.

2.6.1. Total cost of cultivation

The total cost of cultivation was computed using the equation (1).

TCC=FCC+OCC-SSV……………………… (1)

Where,

TCC=Total Cost of Cultivation of broccoli (₹ m^{-2}),

FCC=Fixed Cost of Cultivation (₹ m^{-2}),

OCC=Operation Cost of Cultivation of broccoli (₹ m^{-2}),

SSV=Seasonal Salvage Value (₹ m^{-2})

2.6.2. Fixed Cost of Cultivation (FCC)

The fixed cost of structures included frame and covering materials. It was estimated considering the material quantity for 1 m^2 of naturally ventilated net-cum-poly house. The Rate of components with all taxes was considered as per market price of 2020–21. The fixed cost of frame and covering material were calculated considering the 25 and 5 years life respectively with system serving for 8 seasons per year. The each season was considered 45 days of total duration of seedling. The rate of interest was taken as 9%.

SFC=AFC/8 ………………………………. (2)

Where, AC=[$CRF_f(CI_f) + CRF_c(CI_c)$] ………………(3)

and

CRF=$(i(i+1)^n)/([(i+1)^n-1])$ ………………(4)

Where, SFC=Seasonal Fix Cost (₹ m^{-2})

AFC=Annual Fixed Cost (₹ m^{-2})

CI_s: Capital Investment of structure's frame

CI_c: Capital Cost of covering

n=Life of structure and covering material

i=Rate of interest

2.6.3. Operational Cost of Cultivation (OCC)

The Operational Cost of Cultivation (OCC) includes cost towards the common inputs like soilless media, Plug tray, seeds, fertilizer, common agronomic practices like soilless media preparation and irrigation.

2.6.4. Seasonal salvage value (SSV)

The Seasonal Salvage Value can be calculated as,

SSV=ASV/8 ………………………… (5)

Where, ASV=[$SSF_f(SV_f) + SSF_c(SV_c)$] ………………(6)

and SSF=$1/([(i+1)^n-1])$ ………………(7)

and SV_f=0.25 (CI_f)

SV_c=0.05 (CI_c)

Where, SSV=Seasonal Salvage Value, ₹ m^{-2}

ASV=Actual Salvage Value, ₹ m^{-2}

3. Results and Discussion

3.1. Fixed cost of cultivation (FCC)

The fixed cost of structures frame and covering materials was calculated ₹ 8.22, 15.62 m^{-2}. The season fixed cost was summed up ₹ 34.74 m^{-2}.

3.2. Operational cost of cultivation (OCC)

The Operational Cost of Cultivation (OCC) contains cost concerning the common inputs like soilless media, plug tray, seeds and fertilizers were ₹ 34.74, ₹ 118.52, ₹ 78.63, and ₹ 12.00 m^{-2} respectively. The common labour charge of agronomical practices for soilless media preparation and irrigation were 16.24 and 10.15 m^{-2} respectively.

3.3. Gross return (GR) and net return (NR)

The Gross Return (GR) in terms of ₹ m^{-2} was calculated from the income received from selling of broccoli seedling at the prevailing market price (₹ 1.60 $seedling^{-1}$). The net return (NR)was taken as the difference of Gross Revenue (GR) and Total Cost of Cultivation (TCC) of the broccoli Seedling. The Gross return (GR) and Net Return (NR) in terms of ₹ m^{-2} was calculated as ₹ 556.80 and ₹ 262.69 respectively.

3.4. Benefit cost ratio

The benefit cost ratio of broccoli seedling was worked out 1.89 by dividing the gross income with total cost of cultivation.

4. Conclusion

Seedling raising of vegetables is economic empire business for rural area which might attract more rural in agriculture and its allied business. The germination was recorded 94.00%. The season fixed and operational cost was calculated ₹ 34.74 and ₹ 278.28 m^{-2}. The total cost of cultivation was found ₹ 302.11 m^{-2}. The sales price of seedling was ₹ 1.60 seedling^{-1}. The gross return (GR) and net return (NR) in terms of ₹ m^{-2} were calculated ₹ 556.80 m^{-2} and ₹ 254.69 m^{-2} respectively. The benefit cost ratio was calculated 1.89.

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