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# Incremental Cost Benefit Ratio (ICBR) of Poly House and Open Field Conditions in Cabbage (*Brassica oleracea* var. capitata) after Chemical Intervention

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

This study evaluates the Incremental Cost Benefit Ratio (ICBR) between Poly house and Open field conditions in cabbage cultivation chemical intervention. The research aimed to compare the economic feasibility of adopting poly house technology over traditional open field methods, considering costs and benefits associated with chemical inputs. A comparative cost analysis was conducted to assess production expenses like costs for insecticidal treatments and labor charges. Yield data from both environments were collected to determine output differences and subsequent economic returns. Results indicate that Incremental cost benefit ratio of cabbage heads yields to the cost of treatments in poly house and open field presented as there was a significant superior difference in ICBR ratio of poly house with 1: 0.946 as compared to open field with 1: 0.639 of cabbage heads. The economic analysis revealed that the higher yields and quality achieved in poly house conditions due to less dissipation and undisturbed environmental factors on insecticide applied. Resulting in a favorable incremental Cost benefit ratio compared to open field cultivation.

*Keywords: Chemical intervention; cabbage heads; ICBR; open field; poly house.*

## 1. INTRODUCTION

"Cabbage can be consumed raw in salads, cooked in curries and preserved in pickles. India produced 9.60 million tonnes of cabbage in 2020-21 from 4.12 lakh ha of land, at an average of 23.27 MT per ha. States that produce the most cabbage include West Bengal, Uttar Pradesh, Orissa, Bihar, Assam, Maharashtra, and Karnataka. Cabbage is grown in 820 ha in Telangana, producing 27,780 tonnes per ha with a productivity of 33.71 tonnes per ha" (Indiastat.com, 2020-21). Abhijith et al. [1] reported that "the main pest is the diamondback moth *Plutella xylostella* (Linnaeus), which has a destructive potential ranging between 14 and 84 per cent. Although other lepidopteran pests like the cabbage butterfly, *Pieris brassicae* (Linnaeus), the cabbage semilooper, *Trichoplusia ni* (Hubner), the tobacco caterpillar, *Spodoptera litura* (Fabricius), the cabbage head borer, *Hellula undalis* (Fabricius) and the cabbage leaf webber, *Crocidolomia binotalis* (Zeller) cause extensive damage and some sucking pests like the cabbage aphid, *Brevicornye brassicae* (Linnaeus), green peach aphid, *Myzus persicae* (Green) and painted bug, *Bagrada cruciferum* (Burmeister) have also been recorded to cause significant harm. Poly house horticulture is quickly gaining relevance for its sustainability and higher returns per unit space" [2]. "As a result, every year more space is added for protected farming. Protected agriculture can be a useful supplement and alternative to the traditional open field production technique in order to boost productivity, quality and output" [3]. Tolfenpyrad, an insecticide from the pyrazole class, was created in Japan and received its initial approval in 2002. It works by preventing complex I from functioning in the mitochondria's respiratory electron-transfer chain. Hemipteran, coleopteran, dipteran, lepidopteran, thysanopteran and acarine pests are all commonly controlled using it.

## 2. MATERIALS AND METHODS

The trials of poly house cultivation and open field studies was carried out during *rabi*, 2022-23 at Horticultural Poly house, College of Agriculture, Rajendranagar. The experimental site is situated at an altitude of 542.3 m above mean sea level with 17.3850° N latitude and 78.4867°E longitude and it falls under semi-arid tropical climate. Cabbage seedlings of var. INDU SEMINIS were raised in a nursery at the Horticultural Garden, College of Agriculture, Rajendranagar. The nursery trays were filled with vermicompost and Farm Yard Manure (FYM). The seeds were sown in nursery trays on 12.10.2022. The trays were watered once in two days. Fertilizer (19:19:19) @ 2g/litre, was applied at every 10 days. Germination was observed within 5-6 days of sowing. The cabbage seedlings were transplanted into the beds at a spacing of 45 cm x 30 cm in 200 sq. m on 10th and 11th Nov, 2022 in both poly house and open field [2]. For polyhouse and open field cultivation insecticidal sprayings were taken up once the insect pests crossed ETL during the crop growth stage. Tolfenpyrad 15 EC @ 150 g *a.i.* $ha^{-1}$ and cyantraniliprole 10.26 OD @ 60 g *a.i.* $ha^{-1}$ were sprayed in rotation at 10 days interval.

### 2.1 Observations Recorded

#### 2.1.1 Incremental cost benefit ratio (ICBR)

Economics of insecticidal treatments was calculated, considering the cost of insecticides

and application costs during the study. The data of total yield of cabbage heads and its prevalent market price was used to work out the benefit derived from each treatment. Various parameters used for working out the incremental benefit cost ratio are given below.

**A) Gross monetary benefits**

It was obtained by multiplying the additional yield over control with prevailing minimum local market price of commodity (*i.e.* cabbage heads).

**B) Cost of treatments**

It was obtained by summing up all the cost of different insecticidal treatments including labour charges and Sprayer rent.

**C) Net monetary return**

This was calculated by subtracting total cost of treatment (B) from the monetary benefit (A) i.e. A-B. (D) Cost benefit ratio It was calculated by dividing the net monetary return (C) by total cost *i.e.* C/B.

## 3. RESULTS AND DISCUSSION

The Incremental cost benefit ratio of cabbage head yields to the cost of treatments. The poly house and open field results presented in the (Table 1) illustrated that there was a significant superior difference in ICBR ratio of poly house with 1: 0.946 as compared to open field with 1: 0.639 of cabbage heads (Fig. 1). This indicates that for every unit of cost invested in treatments, the poly house method generated a higher return in cabbage head yield relative to its costs, suggesting greater economic efficiency.

The higher ICBR observed in the poly house treatment can be attributed to several factors inherent in poly house cultivation. Poly house environments offer controlled conditions that can optimize crop growth, minimize pest infestations, and provide protection from adverse weather conditions. These advantages often lead to increased yields and better produce, which directly contribute to higher economic returns per unit area. In contrast, open field cultivation is subject to natural variations in weather, pests, and diseases, which can negatively impact yield and quality. Despite lower initial investment costs associated with open field farming, the potential for higher yield and profitability is limited compared to poly house farming under optimal conditions. These findings are consistent with Kumar et al. [4] reported that poly house-grown tomatoes yielded higher returns than those cultivated in open fields in their study of Haryana farmers. Similarily, Kaur. S [5] was found that cucumbers grown under poly house structures provided better returns than those grown in open fields and Kaur and Kaur et al. [6] observed that farmers growing capsicum in poly houses achieved better yields and returns than those using open field methods. Rani [7], observed that the adoption of improved practices can increase yield and reduce technology gaps [8,9].

**Table 1. Incremental cost benefit ratio in poly house and open field cabbage yields**

| Treatments | | Poly house | Open field |
|---|---|---|---|
| **Quantity of Tolfenpyrad insecticide required per 0.02 ha (6 Sprays)** | | 45 ml @1.5 ml per litre. | 45 ml @1.5 ml per litre. |
| **Quantity of cyantraniliprole insecticide required per 0.02 ha (5 Sprays)** | | 15 ml @ 0.6 ml per litre. | 15 ml @ 0.6 ml per litre. |
| **Cost of treatments** | **Tolfenpyrad 15 EC per 100 ml @ Rs.460** | Rs. 207 per 45 ml | Rs. 207 per 45 ml |
| | **Cyantraniliprole 10.26 OD per 50 ml @ Rs.620** | Rs. 186 per 15 ml | Rs. 186 per 15 ml |
| | **Labour charges with spraying equipments for 6 Sprays** | Rs. 700 | Rs. 700 |
| **Total costs Rs/ 0.02 ha (A)** | | 1093 | 1093 |
| **Total Yield (kgs / 0.02 ha)** | | 76 | 64 |
| **Total yield in Rs/0.02 ha (B)** | | 2128 @ Rs. 28/kg | 1792@Rs.28/kg |
| **Net returns in Rs /0.02 ha (B-A)** | | 1035 | 699 |
| **ICBR (C/A)** | | 0.946 | 0.639 |
| **Rank** | | 1 | 2 |

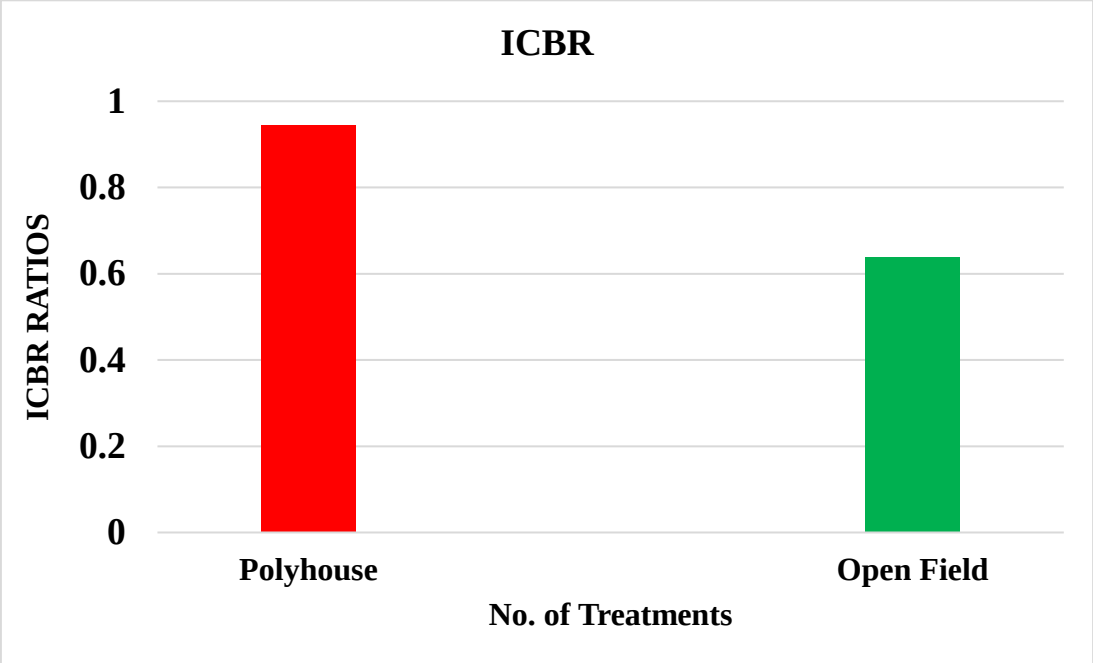


**Fig. 1. Incremental cost benefit ratio in polyhouse and open field *rabi*, 2022-23**

## 4. CONCLUSION

In conclusion, the study supports the adoption of poly house technology as a viable strategy to enhance economic returns in cabbage head production. Future research could further explore specific agronomic practices and technological innovations within poly house farming to optimize yield and economic efficiency further.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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