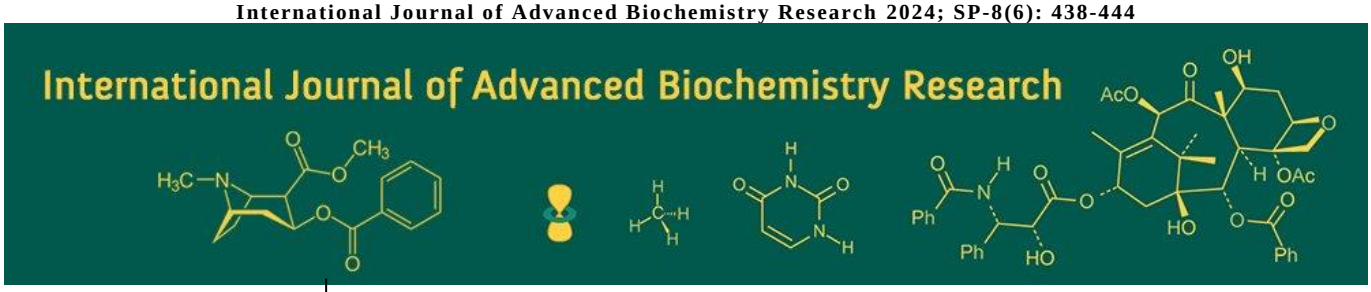

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(6): 438-444
www.biochemjournal.com
Received: 15-03-2024
Accepted: 18-04-2024

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An economic analysis of marketing and price spread of biopesticides in Chhattisgarh

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DOI: https://doi.org/10.33545/26174693.2024.v8.i6Sf.1332

Abstract
Four major producers as respondents and 350 farmers for fulfil constraints questionnaire were selected from three districts namely, Bilaspur, Raigarh and Raipur respectively. The secondary data of biopesticides production in Chhattisgarh was recorded from various publications of the government to accomplish the objective of study area. The primary data on different aspects to achieve the remaining objectives of study were personally recorded from the respondents.

From this study it was found that if all the cost of biopesticide is reduced per kg then 50-70 rupees per kg income can be earned. Profit from the production of biopesticide can range from Rs 15 lakh to crores rupees per year. The price spread in marketing of biopesticide is 50-60 rupees per kg which depends on the type of marketing channel. On the basis of analysis of breakeven point of production unit, it was found that if the annual total expenditure of a plant is Rs 26,08,200 then there will be no profit or loss in the production of 15,525 kg of biopesticides to get profit more than 15,525 kg. that will be produced it means that its breakeven point will be 15,525 kg. of which the price of one unit will be Rs 168.

The result of study revealed that main objective of this study is to reduce the harmful effects of the use of chemical pesticides on the environment due to traditional farming method. Instead of using chemical pesticides, we can improve the environment by removing their harmful effects by using biopesticides. This study provides information on the establishment of biopesticide production unit in Chhattisgarh, information on production cost of biopesticide production, information on return (income) and profit from production of biopesticides, information and suggestions on marketing of biopesticides in Chhattisgarh along with production of biopesticides and this study gives details of the problems faced in production and marketing and gives the measures to avoid them.

Keywords: Biopesticides, wholesaler, producer, retailer, price spread, biochemical, marketing channel, skilled labour, marketing margin, packaging materials

1. Introduction

First sampled state Bio-Control Laboratory Chorbhatti (a unit of BTC college of agriculture and research station Bilaspur CG), short for biologi*cal* control laboratory, is a facility dedicated to studying and implementing biological control methods for managing pests, diseases, and invasive species. This laboratory typically focus on production, marketing as well as research and developing strategies that involve the use of natural enemies, such as predators, parasites, and pathogens, to regulate populations of pest in agriculture Key activities and functions of a bio control lab include. Second sampled producer bio control laboratory unit (a unit of college of agriculture Raipur), short for biological control laboratory, typically focuses on the study, development, and implementation of biological control methods to manage pests, diseases, or invasive species in agriculture, forestry, public health, or natural ecosystems. Third sampled established in 2011, Bharat Biocon Pvt Ltd is one of the enterprises of the state readily indulged in manufacturing a wide variety of Organic Fertilizers, Bio Insecticides, etc. The products offer is made-up in close exactness with the pre-set principles of supremacy using top-notch material and sophisticated techniques. Also, these offered products are credited to customers for superiority and rugged. Establishing a biopesticide production plant involves several steps and considerations. Fourth sampled producer R K Bio Crop Care Raipur the plant located in Rawabhata Raipur and involves in biopesticides production and marketing.

Biopesticides produced like trichoderma, metarhizium, bacillus thuringiensis, Beauveria bassiana and pseudomonas. Biopesticides production plant involves several steps and considerations. Quality Control Implement rigorous quality control measures to ensure the consistency, purity, and efficacy of biopesticide products. This may include testing for microbial contamination, potency, stability, and environmental safety. Distribution and marketing develop a distribution network to reach target market effectively. Invest in marketing and promotional activities to raise awareness of biopesticide products and differentiate them from conventional pesticides. Environmental considerations Implement environmentally sustainable practices in production process, such as waste management, energy efficiency, and pollution prevention. Training and safety provide training to staff on proper production techniques, safety protocols, and regulatory compliance requirements. Continuous Improvement continuously monitors and improves production process, product quality, and customer satisfaction to stay competitive in the market.

2. Major advantages of Bio-control agents

- Bio-control agents are preferred over chemical pesticides for the following reasons:
- No harmful residues;
- Target specific and safe to beneficial organisms like pollinators, predators, parasites etc.;
- Growth of natural enemies of pests is not affected, thus reducing the pesticide application;
- Environment friendly;
- Cost effective;

3. Materials and Methods

3.1 Selection of Producers

Four producers were selected from selected districts. Out of four producer, two producers from Raipur district, one producer from Raigarh district and one farmer from Bilaspur district. A list of selected producer with their location is shown below:

Table 1: District-wise list of selected respondents as producers

S. No.	District Name	Producers	Location
1.	Bilaspur	State Bio Control Laboratory. (SBCL)	Chorbhatti Bilaspur
2.	Raigarh	Bharat Biocon Private Limited. (BB Pvt.ltd.)	Raigarh
3.	Raipur	Bio Control Laboratory. (BCL)	College of agriculture campus, IGKV, Raipur (C.G.)
4.	Raipur	R K Bio Crop Care Raipur. (RKBCC)	Rawanbhata Raipur

3.2 Collection of Data

1. Sampling Procedure: Suitable statistical tools will be taken for sampling procedure.

The primary data were used which was collected from sample of 4 producer respondents and survey from 350 farmers. The data was collected using personal interview method and prepared questionnaire schedule from sampled producers.

2. Collection of Data

1. **Primary data:** Primary data will be collected from selected production unit. Data will be collected through personal interview method with the help of questionnaires.
2. **Secondary Data:** The secondary data will be collected through different authentic agencies.

3.3 Analytical tools

3.3.1 Marketing pattern

Disposal pattern, price received of produce, quantity transported and different cost incurred during marketing of biopesticides are estimated by simple calculation.

The total expenditure incurred by retailers is estimated as follows:

$$C = Cf + Cmi + Cm2 + Cm3 + \text{---------}n$$

Where,

C = Total cost of marketing (Rs./kg).

Cf = Cost incurred by grower (Rs./ kg).

Cm = Expenditure incurred by ith type of intermediaries in the process of buying and selling (Rs. / kg).

Per kg gross margin at each successive level of marketing is worked out by taking the difference of sale price and purchase price. The following formula is used to work out the per kg gross margin of the retailer.

$$Mg = Si - Pi$$

Where,

Mg = Gross margin.

Si = Sale value of produce for ith intermediaries.

Pi = Purchase value of i^{th} intermediaries,

i = Types of intermediaries.

The net margin of ith type of market agencies are calculated as under

$$Nmi = PRi - (Ppi + Cmi)$$

Where,

PRi = Per kg price received of produce by i^{th} type intermediaries.

Ppi = Per kg purchase price by i^{th} type intermediaries.

Cmi = Per kg marketing cost incurred by i^{th} type intermediaries.

Nmi = Net margin of i^{th} type market intermediaries.

4. Results and Discussion

4.1 Marketing channel

Marketing channel is the way through which the commodity flows from producer to farmer. Producers prefer different marketing channels. Marketing channels followed by biopesticide producers in study area are as follows,

Channel-I: Producer –Local wholesaler – Retailer – Farmer

Channel-II: Producer – Distant wholesaler - Retailer – Farmer

Channel-III: Producer –Farmer producer organisation (FPO) – Member farmer.

Channel-IV: Producer –Govt. Organisation (KVK) –farmer (for demonstration).
The sample producer sold their produce through the Channel I, II, III and IV

4.2 Marketing cost and marketing margins

The marketing cost can vary widely depending on factors like the industry, target audience, marketing channels, and campaign objectives. It could include expenses for advertising, and social media management. Marketing cost expenses by producer, Retailers and other middlemen of marketing channels.

4.2.1 Marketing expenses incurred by Producer

The producer was responsible for paying the marketing expenses for biopesticide item-by-item per kg or ltr, as given in Table 2. The producer paid the most, at Rs.11.83 per kg in Channel III, followed by Rs. 11.16/kg in Channel II and channel IV and the least amount, Rs. 10.53, in Channel I. Packing requires a lot of labour and other things thus it made up the largest portion of Channel III's costs at Rs. 4.90, followed by commission fees at Rs. 1.90 which is comparatively higher than Channel I. The producer had to take the produce to the market by themselves thus transporting cost was incurred by them. The transportation cost in Channel II was highest among the three channels at Rs. 1.90. The loading of crates or boxes in trucks and unloading them in markets required much money. These expenses incurred were 1-2 Rs. Per kg/Ltr.

Table 2: Marketing cost incurred by Producer (Rs. /kg)

S.N.	Particulars	Channel-I	Channel-II	Channel –III	Channel –IV
1.	Loading charges	1.02 (9.69)	1.30 (11.65)	1.36 (11.50)	1.40 (12.54)
2.	Unloading charges	0.89 (8.45)	0.95 (8.51)	0.97 (8.20)	1.10 (9.86)
3.	Transportation charges	1.62 (15.38)	1.90 (17.03)	1.70 (14.37)	1.56 (13.98)
4.	Packing	4.80 (45.58)	4.56 (40.86)	4.90 (41.42)	4.80 (43.01)
5.	Commission charges	1.20 (11.40)	1.45 (12.99)	1.90 (16.06)	1.30 (11.65)
6.	License Charges	1.00 (9.50)	1.00 (8.96)	1.00 (8.45)	1.00 (8.96)
	Total cost incurred by producer	10.53 (100)	11.16 (100)	11.83 (100)	11.16 (100)

4.2.2. Marketing expenses incurred by Wholesaler

The wholesalers marketing expenses in Channel I and Channel II for biopesticides was worked out and shown in Table 3. The outcome showed that in the channel-II total cost was Rs.7.56 in Channel II, the storage charge had the highest 31.03 percent. The cost of storage was Rs. 2.25 succeeded by Rs. 2.0 for channel IV. Highest labour charges Rs. 2.10 for labour required in channel IV for all activities like shifting crates from place to place and Rs. 2.10 for transporting crates or boxes of biopesticide to the destined places or markets.

Table 3: Marketing cost incurred by Wholesaler (Rs./kg)

S.N.	Particulars	Channel-I	Channel-II	Channel-III	Channel-IV
1.	Labour charges	1.70 (24.29)	2.56 (33.86)	1.50 (20.69)	2.10 (28.00)
2.	License charges	1.0 (14.29)	1.0 (13.23)	1.0 (13.79)	1.0 (13.33)
3.	Transportation charge	2.10 (30.00)	1.90 (25.13)	2.0 (27.59)	1.90 (25.33)
4.	Advertising charges	0.50 (7.14)	0.40 (5.29)	0.50 (6.90)	0.50 (6.66)
5.	Storage charges	1.70 (24.29)	1.70 (22.49)	2.25 (31.03)	2.0 (26.67)
	Total cost incurred by Wholesaler	7.00 (100)	7.56 (100)	7.25 (100)	7.50 (100)

4.2.3 Marketing expenses incurred by Retailer

The retailer's marketing expenses are listed in Table 4. shows that the total cost of marketing for channel I was Rs. 7.46, channel II was Rs. 7.68, for channel III was Rs. 7.60 and for channel IV was Rs. 7.40 the least Rs. 7.40 Out of the summed up costs incurred by the Retailer, for Channel IV, the highest cost of labour was Rs. 1.5 in channel III and the highest storage charges were Rs. 2.63. The transportation charges requisite were Rs. 2.00 and other channels Rs.2.10.

Table 4: Marketing cost incurred by Retailer (Rs. /kg, ltr)

S.N.	Particulars	Channel-I	Channel-II	Channel-III	Channel-IV
1	Labour charges	1.20 (16.80)	1.35 (17.57)	1.5 (19.73)	1.20 (16.21)
2	Transport charges	2.10 (28.15)	2.10 (27.34)	2.0 (26.31)	2.10 (28.37)
3	Storage charges	2.60 (34.85)	2.63 (34.24)	2.50 (32.89)	2.50 (33.78)
4	License charges	0.56 (7.50)	0.60 (7.81)	0.50 (6.57)	0.60 (8.10)
5	Advertising charges	1.0 (13.40)	1.0 (13.02)	1.10 (14.47)	1.0 (13.51)
	Total cost incurred by Retailer	7.46	7.68	7.60	7.40

4.3. Marketing margin and price spread of biopesticides

The different marketing agencies are involved during the marketing process of different marketing channels of biopesticides, it is therefore to understand their share's involved in between price paid by farmer's rupee and price received by producers, the same is estimated by the difference between price paid by consumer and price received by producers is price spread and the share that goes to the different functionaries/agencies in the market is marketing margin. Total marketing cost in channel-I was Rs. 24.98 in which expenses incurred by producer were Rs. 10.53, expenses incurred by wholesaler were 7.00, expenses incurred by retailer Rs. 7.46. The total marketing cost was given in table no 5 through the channel I, channel II, channel III and channel IV.

Table 5: Price spread in different channels of biopesticides production (Rs. /kg, ltr)

S.N.	Particulars	Channel-I	Channel-II	Channel-III	Channel-IV
1.	Expenses incurred by producer	10.53	11.16	11.83	11.16
2.	Expenses incurred by Wholesaler	7.00	7.56	7.25	7.5
3.	Expenses incurred by Retailer	7.46	7.68	7.60	7.40
4.	Marketing cost	24.98	26.09	26.68	26.06

4.3.1 Net price received by producer

Net price received by producer in all marketing channel given in table no. 6. In channel I average net price received by producer from trichoderma Rs. 157.47, from metarhizium Rs. 129.47, from *Pseudomonas* Rs. 157.47, from Bt. Rs. 124.47, from *Bacillus subtilis* Rs. 131.47, from *Beauveria bassiana* Rs. 134.47, from *Verticillium* sp. Rs. 157.47.

Table 6: Product wise Net price received by producer (producers share in farmer Rupee) Rs./kg

No.	Product Name	Channel-I	Channel-II	Channel-III	Channel -IV
1.	Trichoderma	157.47	156.84	120.17	122.84
2.	Metarhizium	129.47	128.84	116.17	120.84
3.	*Pseudomonas fluorescens*	157.47	156.84	123.17	126.84
4.	*Bacillus thuringiensis* (Bt)	124.47	123.84	125.17	128.84
5.	*Bacillus subtilis*	131.47	130.84	119.17	123.84
6.	*Beauveria bassiana*	134.47	133.84	118.17	118.84
7.	*Verticillium sp.*	157.47	134.47	117.17	118.17

4.3.2 Price paid by Wholesaler

Price paid by wholesaler in all marketing channel is given in table no. 7. In channel I average price paid by wholesaler for trichoderma Rs. 168, for metarhizium Rs. 140, for *Pseudomonas* Rs. 168, for Bt. Rs. 135, for *Bacillus subtilis* Rs. 142, for *Beauveria bassiana* Rs. 145 and for *Verticillium* sp. Rs. 168.

Table 7: Product wise price paid by wholesaler

No.	Product Name	Channel-I	Channel-II	Channel-III	Channel -IV
1.	Trichoderma	168	168	132	134
2.	Metarhizium	140	140	128	132
3.	*Pseudomonas fluorescens*	168	168	135	138
4.	*Bacillus thuringiensis* (Bt)	135	135	137	140
5.	*Bacillus subtilis*	142	142	131	135
6.	*Beauveria bassiana*	145	145	130	130
7.	*Verticillium sp.*	168	145	129	130

4.3.3 Margin of wholesaler

Margin of wholesaler is given in table no 8 In channel I margin of wholesaler for trichoderma Rs. 12, for metarhizium Rs. 13, for *Pseudomonas* Rs. 12, for Bt. Rs. 12, for *Bacillus subtilis* Rs. 11, for *Beauveria bassiana* Rs. 12 and for *Verticillium* sp. Rs. 11.

Table 8: Margin of wholesaler

No.	Product Name	Channel-I	Channel-II	Channel-III	Channel -IV
1.	Trichoderma	12	12	13	13
2.	Metarhizium	13	12	12	13
3.	*Pseudomonas fluorescens*	12	13	13	13
4.	*Bacillus thuringiensis* (Bt)	12	14	13	14
5.	*Bacillus subtilis*	11	12	13	13
6.	*Beauveria bassiana*	12	12	13	13
7.	*Verticillium sp.*	11	12	12	13

4.3.4 Price paid by Retailer

Price paid by retailer is given in the table no. 9. In channel I price paid by retailer for trichoderma Rs. 187, for metarhizium Rs. 160, for *Pseudomonas* Rs. 187, for Bt. Rs. 154, for *Bacillus subtilis* Rs. 160, for *Beauveria bassiana* Rs. 164 and for *Verticillium* sp. Rs. 186.

Table 9: Price paid by Retailer

No.	Product Name	Channel-I	Channel-II	Channel-III	Channel –IV
1.	Trichoderma	187	187.56	152.25	154.5
2.	Metarhizium	160	159.56	147.25	152.5
3.	*Pseudomonas fluorescens*	187	188.56	155.25	158.5
4.	*Bacillus thuringiensis* (Bt)	154	156.56	157.25	161.5
5.	*Bacillus subtilis*	160	161.56	151.25	155.5
6.	*Beauveria bassiana*	164	164.56	150.25	150.5
7.	*Verticillium sp.*	186	164	148.25	150.25

4.3.5 Margin of Retailer

Margin of retailer is given in table no. 10. In channel I margin of retailer for trichoderma Rs. 20, for metarhizium Rs. 22, for *Pseudomonas* Rs. 25, for Bt. Rs. 22, for *Bacillus subtilis* Rs. 23, for *Beauveria bassiana* Rs. 21 and for *Verticillium* sp. Rs. 22.

Table 10: Margin of Retailer

No.	Product Name	Channel-I	Channel-II	Channel-III	Channel-IV
1.	Trichoderma	20	21	22	26
2.	Metarhizium	22	22	23	25
3.	*Pseudomonas fluorescens*	25	22	25	25
4.	*Bacillus thuringiensis* (Bt)	22	23	24	26
5.	*Bacillus subtilis*	23	22	23	25
6.	*Beauveria bassiana*	21	21	23	25
7.	*Verticillium sp.*	22	21	22	23

4.3.6 Price paid by farmer

Price paid by retailer is given in the table no. 11. In channel I price paid by farmer for trichoderma Rs. 214.46, for metarhizium Rs. 189.46, for *Pseudomonas* Rs. 219.46, for Bt. Rs. 183.46, for *Bacillus subtilis* Rs. 190.46, for *Beauveria bassiana* Rs. 192.46 and for *Verticillium* sp. Rs. 215.46.

Table 11: Price paid by Farmer

No.	Product Name	Channel-I	Channel-II	Channel-III	Channel –IV
1.	Trichoderma	214.46	216.24	181.85	187.90
2.	Metarhizium	189.46	189.24	177.85	184.90
3.	*Pseudomonas fluorescens*	219.46	218.24	180.85	190.90
4.	*Bacillus thuringiensis* (Bt)	183.46	187.24	188.85	194.90
5.	*Bacillus subtilis*	190.46	191.24	181.85	187.90
6.	*Beauveria bassiana*	192.46	193.24	180.85	182.90
7.	*Verticillium sp.*	215.46	192.46	177.85	180.85

4.3.7 Price spread

Price spread is given in table no. 12. In channel I margin of retailer for trichoderma Rs. 56.99, for metarhizium Rs. 59.99, for *Pseudomonas* Rs. 61.99, for Bt. Rs. 58.99, for *Bacillus subtilis* Rs. 58.99, for *Beauveria bassiana* Rs. 57.99 and for *Verticillium* sp. Rs. 58.99.

Table 12: Price spread

No.	Product Name	Channel-I	Channel-II	Channel-III	Channel –IV
1.	Trichoderma	56.99	59.40	61.68	65.06
2.	Metarhizium	59.99	60.40	61.68	64.06
3.	*Pseudomonas fluorescens*	61.99	61.40	57.68	64.06
4.	*Bacillus thuringiensis* (Bt)	58.99	63.40	63.68	66.06
5.	*Bacillus subtilis*	58.99	60.40	62.68	64.06
6.	*Beauveria bassiana*	57.99	59.40	62.68	64.06
7.	*Verticillium sp.*	58.99	57.99	60.68	62.68

4.3.8 Producer share

Price share is given in table no. 13. In channel I margin of retailer for trichoderma Rs. 73.43, for metarhizium Rs. 68.34, for *Pseudomonas* Rs. 71.75, for Bt. Rs. 67.85, for *Bacillus subtilis* Rs. 69.03, for *Beauveria bassiana* Rs. 69.87 and for *Verticillium* sp. Rs. 73.09.

Table 13: Producer share

No.	Product Name	Channel-I	Channel-II	Channel-III	Channel –IV
1.	Trichoderma	73.43	72.53	66.08	65.38
2.	Metarhizium	68.34	68.08	65.32	65.35
3.	*Pseudomonas fluorescens*	71.75	71.87	68.11	66.44
4.	*Bacillus thuringiensis* (Bt)	67.85	66.14	66.28	66.11
5.	*Bacillus subtilis*	69.03	68.42	65.53	65.91
6.	*Beauveria bassiana*	69.87	69.26	65.34	64.98
7.	*Verticillium sp.*	73.09	69.87	65.88	65.34

5. Conclusion

The different marketing agencies are involved during the marketing process of different marketing channels of biopesticides, it is therefore to understand their share's involved in between price paid by farmer's rupee and price received by producers, the same is estimated by the difference between price paid by consumer and price received by producers is price spread and the share that goes to the different functionaries/agencies in the market is marketing margin. Total marketing cost in channel-I was Rs. 24.98 in which expenses incurred by producer were Rs. 10.53, expenses incurred by wholesaler were 7.00, expenses incurred by retailer Rs. 7.46.

Net price received by producer in all marketing channel given in table no. 13. In channel I average net price received by producer from trichoderma Rs. 157.47, from

metarhizium Rs. 129.47, from *Pseudomonas* Rs. 157.47, from Bt. Rs. 124.47, from *Bacillus subtilis* Rs. 131.47, from *Beauveria bassiana* Rs. 134.47, from *Verticillium* sp. Rs. 157.47.

Price paid by wholesaler in all marketing channel. In channel I average price paid by wholesaler for trichoderma Rs. 168, for metarhizium Rs. 140, for *Pseudomonas* Rs. 168, for Bt. Rs. 135, for *Bacillus subtilis* Rs. 142, for *Beauveria bassiana* Rs. 145 and for *Verticillium* sp. Rs. 168. Margin of wholesaler in channel I margin of wholesaler for trichoderma Rs. 12, for metarhizium Rs. 13, for *Pseudomonas* Rs. 12, for Bt. Rs. 12, for *Bacillus subtilis* Rs. 11, for *Beauveria bassiana* Rs. 12 and for *Verticillium* sp. Rs. 11. Price paid by retailer in channel I price paid by retailer for trichoderma Rs. 187, for metarhizium Rs. 160, for *Pseudomonas* Rs. 187, for Bt. Rs. 154, for *Bacillus subtilis* Rs. 160, for *Beauveria bassiana* Rs. 164 and for *Verticillium* sp. Rs. 186. Margin of retailer in channel I margin of retailer for trichoderma Rs. 20, for metarhizium Rs. 22, for *Pseudomonas* Rs. 25, for Bt. Rs. 22, for *Bacillus subtilis* Rs. 23, for *Beauveria bassiana* Rs. 21 and for *Verticillium* sp. Rs. 22. Price paid by retailer in channel I price paid by farmer for trichoderma Rs. 214.46, for metarhizium Rs. 189.46, for *Pseudomonas* Rs. 219.46, for Bt. Rs. 183.46, for *Bacillus subtilis* Rs. 190.46, for *Beauveria bassiana* Rs. 192.46 and for *Verticillium* sp. Rs. 215.46.

Price spread is given in table no. 13. In channel I margin of retailer for trichoderma Rs. 56.99, for metarhizium Rs. 59.99, for *Pseudomonas* Rs. 61.99, for Bt. Rs. 58.99, for *Bacillus subtilis* Rs. 58.99, for *Beauveria bassiana* Rs. 57.99 and for *Verticillium* sp. Rs. 58.99.Price share is given in channel I margin of retailer for trichoderma Rs. 73.43, for metarhizium Rs. 68.34, for *Pseudomonas* Rs. 71.75, for Bt. Rs. 67.85, for *Bacillus subtilis* Rs. 69.03, for *Beauveria bassiana* Rs. 69.87 and for *Verticillium* sp. Rs. 73.09. The information received from study area respondents, biopesticides have very little effect on agricultural pests as compared to chemical pesticides, due to which they have no interest in using biopesticides and encourage the application of chemical pesticides. Also it has been discovered from the information received that biopesticides have less effect on agricultural pests but there is supply of poor quality biopesticides in the market and similarly all the problems have come to light in this study, by removing which the use of biopesticides can be promoted and this will prove to be a help in improving the environment.

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