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Impact of micronutrients application on growth and yield attributes of fennel (*Foeniculum vulgare* Mill.)

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Abstract

A field experiment was conducted to find out the effect of micronutrients application on growth and yield parameters of fennel (*Foeniculum vulgare* Mill.) at ICAR-National Research Centre on Seed Spices, Tabiji, Ajmer, (Rajasthan) during rabi season of 2014-15. The results revealed significant differences in growth, yield and yield attributing characters of fennel. At 45 DAS highest plant height (10.5cm) was observed in seed priming with manganese 500 ppm. Whereas, at 90DAS it was maximum (86.2 cm) in the treatment of foliar application of $FeSO_4$ 0.5%, while at harvest soil application of iron 10 kg per hectare recorded highest plant height (227.7 cm) as well as number of primary branches (11.7), secondary branches (19.8), total dry matter accumulation per hectare (13.39 t) and seed yield per hectare (23.8 q). From the present study it may be concluded that f deficiency of iron in soil makes iron fertilization more responsive than other micro-nutrient application in fennel.

Key words: Fennel, micronutrients, growth, yield, seed priming, foliar spray

Introduction

For the optimal growth and development of plants, balanced application of nutrients is highly essential. If any element is lacking in the soil or not adequately balanced with other nutrients, growth suppression or even complete inhibition may result (Mengel *et al., 2001*). In recent days excessive use of non micro nutrient fertilizers and less or no use of organic manure is leading to micronutrients disorder in crop plants particularly in arid and semi arid regions of India, where, soils are poor structured and low in native nutrient status. Apart from this, method of nutrient application also affect nutrient use efficiency in crop plants. Fennel is one of the important seed spices grown in semi arid regions of Rajasthan and Gujarat, that is mainly used in culinary and pharmaceutical preprations. Fennel is a long duration crop with huge biomass thus, removes higher amount of nutrients from the soil. The soils of semi arid regions are low in micro-nutrients such as iron and zinc. Poor soil structure, salinity and non use of micro-nutrient fertilizers are mainly responsible for deficiency of these elements. Apart from these, methods of application of micro-nutrients are very important to achieve effective utilization of applied nutrients when there is existence of factors such as salinity and poor nutrient availability. There are mainly three methods of micro-nutrient application in crops like viz. soil, foliar and seed treatment (Jhonson *et al.*, 2005). Each method of application may affect the crop growth differently. Keeping these things in view, an experiment was conducted on micro-nutrient management in fennel with the objective to find the response of fennel in terms of growth and yield to applied micro-nutrients and method of application.

Material and methods

The present study was carried out at ICAR-National Research Centre on Seed Spices, Tabiji, Ajmer during Rabi 2014-15. The soil of the experimental field was sandy loam having 4.32 mg kg^{-1} DTPA extractable iron, 8.77 mg kg^{-1} DTPA extractable manganese, 0.78 mg kg^{-1} DTPA extractable copper, 0.96 mg kg^{-1} DTPA extractable zinc and 0.43 mg kg^{-1} hot water extractable boron. The study was carried out with three methods of nutrients application such as soil application, foliar

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spray and seed priming. The soil application treatments includes T_1- control, T_2-Fe 10 kg ha^{-1}, T_3-Mn 10kg ha^{-1}, T_4-Cu 5 kg ha^{-1}, T_5-Zn 5 kg ha^{-1} and T_6-boron 2.5 kg ha^{-1} through Ferrous Sulphate ($FeSo_4.7H_2O$), Manganese Sulphate ($MgSO_4.H_2O$), Copper sulphate ($CuSO_4$ $.5H_2O$), Zinc Sulphate ($ZnSO_4.7H_2O$) and Borax Powder (Di-Sodium tetra borate) ($Na_2B_4O_7.10H_2O$) respectively. All the micro-nutrient fertilizers were applied to soil by incorporating in soil just before sowing. In foliar spray treatments the micro-nutrients such as T_7 - water spray, T_8- $FeSO_4$ 0.5 %, T_9-$MnSO_4$ 0.5 %, T_{10}-$CuSO_4$ 0.5 %, T_{11}- $ZnSO_4$ 0.5 % and T_{12}-Borax 0.25 % were sprayed at 45 and 90 DAS by mixing with sticker at the rate of one ml per litre of spray solution. Spraying was carried out using 5.0 litre capacity hand sprayer. In seed treatments T_{13}-Water soaking, T_{14}- Iron 500ppm, T_{15}- Manganese 500ppm, T_{16}- Copper 500ppm, T_{17}- Zinc 500ppm and T_{18}- Boron 250ppm solutions were prepared and seeds were soaked for 12 hours, surface washed by water to remove surface nutrients and shade dried for 24 hours to bring the seed moisture to its original status. These treated seeds were used for sowing in the field. The recommended dose of major nutrients for the fennel crop was applied (90:50:30 kg N: P_2O_5: K_2O ha^{-1}), where, 50 percent of nitrogen applied was basal dose and remaining nitrogen was applied in two equal splits at 30DAS and 60DAS. Experiment was laid in RBD and the plot size was 3.5 m x 3m (10.5 m^2) with three replications. Fennel crop was sown at row distance of 50 cm and 30 cm between plants using 12 kg seed per hectare. The observations on vegetative growth like plant height, No. of branches, biomass accumulation, yield parameters such as umbells per plant, umbellets per umbel and seeds per umbellate, seed yield and test weight were recorded. The data thus recorded was (statistically) analyzed to find out the influence of micro-nutrients on growth and yield of fennel.

Results and discussion

Influence of micro-nutrient application on growth characters in fennel was found significant. Seed priming with 500ppm manganese (T_{15}) recorded significantly highest plant height (10.5cm) at 45 DAS and foliar application of $FeSO_4$ 0.5 percent (T_8) recorded the maximum plant height (86.2 cm) at 90 DAS. Whereas, at harvest (195 DAS), the highest plant height (227.7 cm) was recorded in the treatment T_2 involving the soil application of iron 10 kg per hectare. In case of dry biomass accumulation, seed priming with manganese 500ppm (T_{15}) recorded highest dry biomass accumulation (0.373 t ha^{-1}) at 45 DAS. Whereas, at 90 DAS and at the time of harvest maximum dry biomass accumulation (2.22 t ha^{-1} and 13.39 t ha^{-1} respectively) was found in the treatment of iron 10 kg $hectare^{-1}$ (T_2). Soil application of iron 10 kg $hectare^{-1}$ (T_2) recorded highest number of primary (11.7) and secondary branches (19.8) $plant^{-1}$. Least number of primary (6.5) and secondary branches $plant^{-1}$ (10.0) was observed in (seed priming with boron 250ppm) soil application of boron 2.5 kg $hectare^{-1}$ (T_6), respectively. These observations are similar as reported by Sinta *et al.*, (2014) in coriander. Less number of branches in (treatment) boron seed priming may be due to its toxic effect on germination and growth. Maximum number of umbels per plant (28.1) were observed in T_2 (soil application iron 10kg ha^{-1}). Whereas, number of umbelletes $umbel^{-1}$, seeds $umbellate^{-1}$ and test weight of seeds were not influenced by any micronutrient application. The highest seed yield $hectare^{-1}$ (23.8q ha^{-1}) was obtained in Soil application of iron 10 kg $hectare^{-1}$ (T_2) while the least seed yield $hectare^{-1}$ (15.0 q ha^{-1}) was recorded in T_{18} (seed priming boron 250 ppm). In case of foliar spray treatment zinc sulphate 0.5 % recorded higher yield (21.7q ha^{-1}) and was at par with soil application of iron. These findings revealed that foliar application of zinc is more efficient than soil application as reported by Kalidasu *et al.* (2008) and Lal *et al.*, (2014) in coriander. The positive influence of micronutrients application on fennel crop growth may be due to the improved ability of the crop to absorb nutrients to photosynthesize and better sink source relationship. Increase in yield may be attributed to increased plant height, maximum number of primary and secondary branches, and maximum number of umbels and umbellets, which were positively affected by the application of iron to soil for correcting its deficiency in soil. Increase in seed weight might be due to

Table 1. Effect of micronutrients on plant height, biomass yield and number of branches in fennel

Treatments	Plant height (cm)			Biomass accumulation (t ha^{-1})			Primary branches plant^{-1}	Secondary branches plant^{-1}
	45 DAS	90 DAS	At harvest	45 DAS	90 DAS	At harvest		
T_1:Soil Control (No soil application)	8.1	75.9	189.9	0.23	1.51	10.30	7.7	12.7
T_2: Soil application Fe 10kg ha^{-1}	8.6	85.7	227.7	0.30	2.22	13.39	11.7	19.8
T_3: Soil application Mn 10kg ha^{-1}	8.8	77.7	212.3	0.27	1.95	12.46	11.0	19.2
T_4: Soil application Cu 5kg ha^{-1}	8.7	70.0	206.7	0.26	1.54	12.03	9.7	11.7
T_5: Soil application Zn 5kg ha^{-1}	8.8	74.6	213.3	0.24	1.76	11.16	8.7	12.0
T_6: Soil application B 2.5kg ha^{-1}	7.3	71.5	199.7	0.24	1.54	10.87	6.5	11.6
T_7: Foliar Water spray	8.8	75.2	192.8	0.27	1.47	10.23	7.8	16.1
T_8: Foliar application $FeSO_4$ 0.5 %	8.6	86.2	209.3	0.21	1.89	12.90	9.4	14.1
T_9: Foliar application $MnSO_4$ 0.5%	8.9	75.0	216.3	0.27	1.79	12.17	8.6	13.8
T_{10}: Foliar application $CuSO_4$ 0.5%	8.2	69.2	205.4	0.17	1.61	11.66	9.0	13.1
T_{11}: Foliar application $ZnSO_4$ 0.5%	8.8	72.2	209.7	0.22	1.97	12.48	9.6	17.9
T_{12}: Foliar application Borax 0.25%	8.8	64.2	200.3	0.24	1.75	10.09	8.4	11.3
T_{13}: Seed priming water	8.0	63.8	185.0	0.30	1.53	10.16	8.9	13.4
T_{14}: Seed priming Fe 500ppm	9.1	70.5	204.5	0.33	1.85	12.84	10.2	16.0
T_{15}: Seed priming Mn500ppm	10.5	74.6	212.3	0.37	1.94	12.37	9.5	14.2
T_{16}: Seed priming Cu 500ppm	8.7	73.4	199.5	0.28	1.65	10.76	9.8	14.1
T_{17}: Seed priming Zn 500ppm	8.7	67.6	208.7	0.27	1.60	10.15	10.1	14.5
T_{18}: Seed priming B 250ppm	7.8	63.2	198.4	0.20	1.49	10.02	8.3	10.0
F test	*	*	*	*	*	*	*	*
S. Em ±	0.04	4.38	7.28	0.035	0.109	0.803	0.88	1.71
CD at 5%	1.15	12.66	21.02	0.101	0.315	2.319	2.55	4.62

Table 2. Effect of micronutrients on yield and yield attributing characters in fennel

Treatments	No. of umbels plant^{-1}	No. of umbelletesumbel^{-1}	Seeds umbellete^{-1}	Test weight (g)	Seed yield (q ha^{-1})
T_1:Soil Control (No soil application)	17.7	41.8	7.7	7.0	15.5
T_2: Soil application Fe 10kg ha^{-1}	28.1	42.8	11.7	7.5	23.8
T_3: Soil application Mn 10kg ha^{-1}	25.5	42.6	11.0	8.1	21.2
T_4: Soil application Cu 5kg ha^{-1}	19.6	40.8	9.7	8.0	19.4
T_5: Soil application Zn 5kg ha^{-1}	19.3	42.5	8.7	7.6	17.2
T_6: Soil application B 2.5kg ha^{-1}	13.5	34.2	6.5	7.5	16.5
T_7: Foliar Water spray	19.6	35.0	7.8	7.9	18.5
T_8: Foliar application $FeSO_4$ 0.5 %	25.1	45.8	9.4	7.9	20.9
T_9: Foliar application $MnSO_4$ 0.5%	22.3	32.1	8.6	6.8	18.8
T_{10}: Foliar application $CuSO_4$ 0.5%	21.1	32.9	9.0	8.0	17.8
T_{11}: Foliar application $ZnSO_4$ 0.5%	23.3	26.9	9.6	7.0	21.7
T_{12}: Foliar application Borax 0.25%	17.9	45.6	8.4	7.2	16.6
T_{13}: Seed priming water	20.0	44.2	8.9	7.2	15.4
T_{14}: Seed priming Fe 500ppm	24.5	42.4	10.2	6.9	20.8
T_{15}: Seed priming Mn500ppm	22.1	35.5	9.5	8.3	21.9
T_{16}: Seed priming Cu 500ppm	21.1	32.0	9.8	6.7	15.3
T_{17}: Seed priming Zn 500ppm	21.7	37.1	10.1	7.3	16.4
T_{18}: Seed priming B 250ppm	15.9	30.4	8.3	7.0	15.0
F test	*	NS	*	NS	*
S. Em ±	2.17	5.05	0.88	0.47	1.93
CD at 5%	6.27	-	2.55	-	5.58

better mineral utilization of plants accompanied with enhancement by photosynthesis, other metabolic activities and greater diversion of food material to seeds (Naga *et al*., 2013).

Based on the results of the study it may be concluded that soil application of iron 10 kg h^{-1} is best considering the growth and yield. This treatment was *at par* with soil application of manganese 10kg h^{-1}, seed priming manganese 500ppm, foliar application of $ZnSO_4$ 0.5 % and foliar application of $FeSO_4$ 0.5 % with regard to growth and seed yield. Existence of deficiency of iron in experimental soil makes the iron fertilization to respond significantly than other micro-nutrient elements. Hence, soil application of iron and manganese and foliar application of zinc 0.5 % is beneficial in achieving higher yield and also in correcting the deficiency of micro-nutrients in fennel crop.

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Marketing cost and price spread of coriander in Kota district of Rajasthan

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Abstract

This study is based on the data collected from 50 coriander-producers in Rajasthan in 2012-13. The coriander producers were using two marketing channels for the disposal of coriander. Channel-I comprised of farmer, village trader, wholesaler-cum-commission agent and retailer while Channel-II was having farmer, wholesaler-cum-commission agent (Mandi) and retailer. The total marketing cost in Channel-I and II was estimated to be ₹1616.04 and ₹1513.69 per quintal, respectively. The marketing cost has been found to be higher in Channel-I due to involvement of more number of middlemen as compared to Channel-II. The producer's share in the consumer's price was estimated to be 63.59 and 68.46 per cent in Channel-I and II, respectively. It has been advised to take measures to increase market information access of farmers and they should be motivated to market their produce collectively to reduce the cost on transportation.

Key words: Coriander, marketing channel, price spread, Rajasthan

Introduction

India is the foremost country in the production, consumption and export of spices, hence popularly known as Land of spices. About 59.51 lakh metric tonnes spices were produced from 32.12 lakh hectares land in India during 2011-2012 (Anonymous, 2012b).The seed spices are mainly cultivated in Rajasthan and Gujarat. Rajasthan and Gujarat states are called as “Seed Spice Bowl of India”, accounting 80 percent of the total seed spice production. Coriander (*Coriandrum sativum* L.) is one of the most important spice crops in the world. India produces about 80 per cent of its world production. In India, it was grown on an area of 5.57 lakh hectares with a production of 5.33 lakh metric tonnes in year 2011-12. The major coriander growing states in the country are Rajasthan (62 %), Madhya Pradesh (17%) remaining 21% is produced by states like Andhra Pradesh, Assam, Tamil Nadu, Odisha and Gujarat. Rajasthan ranks first in area and production among the coriander growing states in the country. The area under coriander in the state was 2.68 lakh hectares and production was 3.29 lakh Metric tonnes in 2011-12.The main coriander growing districts of Rajasthan are Baran, Kota, Jhalawar, Bundi and Chittorgar (Anonymous, 2012a).

An efficient marketing channel ensures remunerative prices to the producers for their commodities and delivers maximum satisfaction to the end consumers for their purchase. This motivates the producers to increase the production and productivity on the one hand and can generate additional income and employment to their farm family on the other. An efficient marketing system is an important means for raising the income level of the farmers. The good marketing facilities, efficient marketing channels and marketing machinery ensure remunerative prices for the produce in the market. There are need to carry out micro level studies on these aspects in different geographical areas under the varying marketing environments. As such there is need to evaluate the marketing system and estimate costs, margins and price spread in marketing of coriander through different channels in major coriander producing areas. The involvement of large number of marketing intermediaries pushes the marketing cost and producers get lower shares in consumer's rupee (Agarwal, 1998 and Verma *et al.*, 2013). In the back

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drop, the present study was carried out to examine producers share in consumer's rupee, marketing cost and margins, marketing channels involved in marketing of coriander. In this view, an analytical study of marketing channels of coriander was done to know the problems associated with marketing of coriander and preferences of producers towards different marketing channels.

Material and methods

The study was conducted in Kota district which was selected on the basis of the highest area under coriander in the state of Rajasthan. Sangod Tehsil was selected because this Teshil holds highest area of coriander crop. The study was based on primary data collected from farmers, village traders, wholesaler-cum-commission agents and retailers. The coriander growers were categorized into five standard categories, namely, marginal (<1ha), small (1-2ha), semi-medium (2-4 ha), medium (4-10 ha) and large (>10 ha) based on their crop acreage of coriander. A random sample of 50 farmers were taken from three randomly selected villages in the Tehsils. To make the sampling design self weighing, the number of farmers selected from each category was in proportion to their number in that category. The category wise number of marginal, small, semi- medium and medium farmers was 11, 16, 14 and 9, respectively from Sangod teshil. Kota local market (mandi) of the coriander producing area was also selected.

The data were collected with the help of pre-tested interview schedules for the agricultural year 2012-13. Primary data regarding various aspect of marketing such as marketing channels, marketing costs, and margins in marketing of coriander were collected through survey with farmers, village traders, wholesaler-cum-commission agent and retailers by actual spot observations. Simple tabular analysis was done for analysis of data collected to draw the inference in accordance with the objectives.

Total Cost of Marketing

The total cost incurred on marketing of particular crop by the farmers and the intermediaries involved in the process of marketing was calculated as:

$$C = C_F + C_{m1} + C_{m2} + C_{m3} \ldots\ldots\ldots + C_{mn}$$

Where,

C = Total cost of marketing

C_F = Cost borne by the producer-farmer in marketing of particular crop; and

C_{mi} = Cost incurred by the i^{th} middlemen in the process of marketing

Absolute Margin

The absolute and percentage margins of middlemen involved in the process of marketing were calculated as:

Absolute margin of i^{th} middlemen = $P_{Ri} - (P_{pi} + C_{mi})$

Percentage margin of i^{th} middlemen

$$= \frac{P_{ri} - (P_{pi} + C_{mi})}{P_{Ri}} \times 100$$

Where,

P_{Ri} = Sale price of the i^{th} middlemen

P_{Pi} = Purchase price of the i^{th} middlemen; and

C_{mi} = Marketing cost incurred by i^{th} middlemen

Price Spread

The price spread refers to the difference between the price paid by the ultimate consumer and the price received by the producer i.e., seller, it includes cost of performing various marketing functions and margins of different agencies involved in marketing.

Producer's Share

It represents the percentage share of producer in the price paid by the consumer.

$$P_s = \frac{P_f}{P_c} \times 100$$

Where,

P_s = Producer's share in consumer's rupee

P_f = Price of the produce received by the farmer; and

P_c = Price of the produce paid by the ultimate consumer

Results and discussion

Marketing Channels

Two marketing channels were identified in coriander marketing in the study area.

Channel –I: Producer → village trader → wholesaler cum commission agent →retailer → consumer.

Channel –II: Producer→ wholesaler cum commission agent →retailer →consumer.

Among these channels, 70 per cent quantity of coriander moved through channel- II and 30 per cent quantity was moved through channel-I (Singh and Singh, 1999)

Costs incurred in sale of coriander at village sale (channel -I)

(Producer village trader wholesaler-cum-commission agent retailerconsumer)

In this channel, farmers sold their coriander produce to the village traders who in turn sold it to the wholesalers through commission agents and finally, wholesalers sold it to the retailer. Table 1 show that this channel was adopted by 30 per cent of selected farmers in selling of coriander in the study area. Among the different size groups of farmers, this channel was adopted by 72.73 per cent marginal farmer, 31.25 per cent small farmer, 14.28 per cent semi-medium farmer and none of them. In this channel, coriander moved from producer farmers to village traders and then to wholesalers through commission agents and finally to retailer (Table 2). It is obvious from the table that the total marketing costs were ₹ 1616.04 per quintal when producer farmers sold coriander through channel-I. Out of this ₹ 62.93 (3.89 per cent), ₹ 169.05 (10.46 per cent), ₹ 771.11 (47.72 per cent) and ₹ 612.95 (37.93 per cent) were incurred by the producer farmers, village traders, wholesalers and retailer, respectively. In this channel the wholesalers had borne highest amount due to the payment of the value added tax (₹252.39),commission charges(₹126.19) and mandi fee (₹100.95). These findings are in consonance with Verma *et al*. (2013).

Costs incurred in sale of coriander at mandi sale (Channel- II)

(Producer wholesaler-cum-commission agent retailer consumer)

This channel was the most common marketing channel adopted by farmers in selected areas under study. In this channel, producer and farmers sold coriander through the commission agents to the wholesalers of the mandi. Finally, these wholesalers stored coriander for sale to the retailer at some later date. Table 1 depicted that 70 per cent of total selected farmers marketed their coriander produce through this channel. Among the different size groups of farmer's 27.22 per cent marginal, 68.75 per cent small, 85.72 per cent semi-medium, 100 per cent medium and none of the large farmers. It was the most common method of sale for coriander in the study area. In this channel, the producer farmers took the produce to the Krishi

Table 1. Distributions of farmers adopting different marketing channels at Kota

S. No	Name of marketing channel	Size Groups					Total
		Marginal	Small	Semi medium	Medium	Large	
1	Producer →Village Trader→ Wholesaler Cum Commission agent → Retailer → Consumer	8 (72.73)	5 (31.25)	2 (14.28)	NA	NA	15 (30)
2	Producer → Wholesaler Cum Commission agent→ Retailer → Consumer	3 (27.27)	11 (68.75)	12 (85.72)	9 (100)	NA	35 (70)
	Total	11 (100)	16 (100)	14 (100)	9 (100)	NA	50 (100)

Table 2. Marketing costs of coriander at village sale (channel- I) in Kota district of Rajasthan during 2012-13 (₹/qtls)

Particulars	Charges paid by					Total marketing cost
	Producer	Village Trader	Commission agent cum Wholesaler	Retailer	Consumer	
Transportation	10.23 (16.26)	74.85 (44.28)	46.18 (6.07)	38.45 (6.27)	-	169.71(10.57)
VAT		-	252.39 (33.15)		-	252.39 (15.62)
Commission Charges			126.19 (16.58)		-	126.19 (7.81)
Mandi Fee			100.95 (13.26)		-	100.95 (6.25)
Loading Charges	6.5 (10.33)	5.5 (3.25)	5.5 (0.72)	5.5 (0.90)	-	23 (1.42)
Unloading charges	3.75 (5.96)	3.75 (2.22)	3.75 (0.49)	3.75 (0.61)	-	15 (0.93)
Weighing charges	3.5 (5.56)	2.5 (1.48)	2.5 (0.33)	2.5 (0.41)	-	11 (0.68)
Grading			30 (3.94)		-	30 (1.86)
Cost of gunny bags*	15 (23.84)	5 (2.96)	60 (7.88)		-	80 (4.95)
Value of Quantity losses	12.59 (20.01)	45 (26.62)	84 (11.09)	46.30 (7.55)	-	188.34 (11.65)
Cleaning			5 (0.66)		-	5 (0.31)
Processing				480 (78.31)		480 (29.70)
Miscellaneous charges**	11.36 (18.05)	32.45 (19.20)	54.20 (7.12)	36.45 (5.95)	-	134.66 (8.32)
Total Cost	62.93 (100)	169.05 (100)	771.11 (100)	612.95 (100)	-	1616.04 (100)

Upaj Mandi and sold it to the wholesalers through commission agents. The wholesalers sold it to the retailer. The marketing cost incurred in movement of the produce through this channel is presented in table 3.

On average marketing costs were turned out to be 1513.69 per quintal in channel-II. Out of this, Rs 129.63, 771.11 and 612.95 were incurred by the producer farmer and the wholesaler cum-commission agent and retailer, respectively which accounted for 8.62, 51.28 and 40.76 per cent of the total costs of marketing of coriander, respectively. The processing (480), transportation charges (142.41), value added tax (252.39), commission charges(₹126.19), mandi fee (100.95), value of quantity lost(₹152.75), miscellaneous

Table 3. Marketing costs of coriander at mandi sale (channel-I) in Kota district of Rajasthan during 2012-13 (₹/qtls)

Particulars	Charges paid by					Total marketing cost
	Producer	Village Trader	Commission agent cum Wholesaler	Retailer	Consumer	
Transportation	10.23 (16.26)	74.85 (44.28)	46.18 (6.07)	38.45 (6.27)	-	169.71(10.57)
VAT		-	252.39 (33.15)		-	252.39 (15.62)
Commission Charges			126.19 (16.58)		-	126.19 (7.81)
Mandi Fee			100.95 (13.26)		-	100.95 (6.25)
Loading Charges	6.5 (10.33)	5.5 (3.25)	5.5 (0.72)	5.5 (0.90)	-	23 (1.42)
Unloading charges	3.75 (5.96)	3.75 (2.22)	3.75 (0.49)	3.75 (0.61)	-	15 (0.93)
Weighing charges	3.5 (5.56)	2.5 (1.48)	2.5 (0.33)	2.5 (0.41)	-	11 (0.68)
Grading			30 (3.94)		-	30 (1.86)
Cost of gunny bags*	15 (23.84)	5 (2.96)	60 (7.88)		-	80 (4.95)
Value of Quantity losses	12.59 (20.01)	45 (26.62)	84 (11.09)	46.30 (7.55)	-	188.34 (11.65)
Cleaning			5 (0.66)		-	5 (0.31)
Processing				480 (78.31)		480 (29.70)
Miscellaneous charges**	11.36 (18.05)	32.45 (19.20)	54.20 (7.12)	36.45 (5.95)	-	134.66 (8.32)
Total Cost	62.93 (100)	169.05 (100)	771.11 (100)	612.95 (100)	-	1616.04 (100)

* Figures in parentheses are the percentages of respective column totals.

* Farmers purchased gunny bags @ ` 80/bag and sold it to wholesaler cum commission agent @ ` 60/bag i.e., cost of gunny bag borne by the farmer was ` 20/bag.

** Miscellaneous charges include cost of jute thread, food, tea and mobile charges

charges(₹108.75) and cost of gunny bag(₹80.00) were the main items of cost for marketing of coriander which, together accounted for 95.98 per cent of the total costs of marketing. These cost items individually accounted for 31.92, 9.47, 19.78, 8.39, 6.71, 10.16, 7.23 and 5.32 per cent, respectively. These findings are agreeable with Kumar *et al.,* (2011).

Price spread

Price-spread in marketing of coriander at village sale (channel-I)

(Producer village trader wholesaler-cum-commission agent retailer consumer)

The price spread in marketing of coriander by the producer farmer at village level to the village trader and then to the wholesaler-cum-commission agent and retailer are presented in Table 4. The producer's net share in consumers rupee in the sale of coriander through the channel-I was ₹ 5740.42 (63.59 per cent). In this channel the village traders purchased coriander from the producer-farmers at their own shop on an average price of ₹ 5803.35 per quintal. The village traders took it to the Krishi Upaj Mandi, Kota and sold to the wholesaler through the commission agents at on average price of ₹ 6309.63 per quintal. In this channel of sale the producer farmers and the village traders incurred an average ₹ 62.93 and ₹ 169.05 per quintal towards marketing costs, respectively. The village traders got a net margin of ₹ 337.23 per quintal. This accounted for 3.74 per cent of the consumer's price. The wholesalers purchased coriander at an average price of ₹ 6309.63 per quintal and sold it to the retailer at ₹ 7669.97 per quintals. The margin of wholesalers retained was ₹ 588.23 per quintal of coriander. The retailer purchased coriander at an average price of ₹ 7669.97 per quintal and sold it to the consumer at ₹ 9027.52 per quintals. The margin of retailer in this process was ₹ 745.60 per quintal of coriander. Among the three market functionaries involved in channel-I retailers received the highest margin due to sale of coriander at high prices to the consumers in small quantity. Similar results have been reported by Verma *et al.* (2013). The total marketing costs incurred by various intermediaries constituted 17.89 per cent of the consumer's price. The price spread in this channel was ₹ 3287.10 (36.41). The small producer farmers preferred to sell coriander in village to the village traders because of their poor economic condition as well as small quantity of produce available with them.

Table 4. Price spread in marketing of coriander in channel-I at Kota district of Rajasthan: 2012-13

S. No.	Particulars	₹ /quintal	Share in consumer's rupee (in percent)
1.	Producer's net share	5740.42	63.59
2.	Costs incurred by		
	(a) Producer	62.93	0.70
	(b) Village trader	169.05	1.87
	(c)Wholesaler-cum-commission agent	771.11	8.54
	(d) Retailer	612.95	6.78
	Total costs	1616.04	17.89
3.	Margins earned by		
	(a) Village trader	337.23	3.74
	(b) Wholesaler-cum-commission agent	588.23	6.52
	(c) Retailer	745.60	8.26
	Total margins	1671.06	18.52
4.	Consumers price	9027.52	100.00
5.	Price spread	3287.10	

Table 5. Price spread in marketing of coriander in channel-II in Kota district of Rajasthan: 2012-13

S. No.	Particulars	₹ /quintal	Share in consumers rupee (in percent)
1.	Producer's net share	6180.00	68.46
2.	Costs incurred by		
	(a) Producer	129.63	1.44
	(b)Wholesaler-cum-commission agent	771.11	8.54
	(c) Retailer	612.95	6.78
	Total costs	1513.69	16.78
3.	Margins earned by		
	(a) Wholesaler-cum-commission agent	588.23	6.52
	(b) Retailer	745.60	8.26
	Total margins	1333.83	14.78
4.	Consumers price	9027.52	100.00
5.	Price spread	2847.52	

Price-spread in marketing of coriander at mandi sale (Channel-II)

(Producer wholesaler-cum-commission agent retailer consumer)

The price spread in marketing of coriander in channel-II is presented in Table 5. In this channel, producer-farmers directly sold the produce in the mandis to the wholesalers through commission agents. The producer's net share in consumers price on the sale of coriander through the channel-II was ₹ 6180.00 (68.46 %). The producer farmer has incurred on an average ₹ 129.63 per quintal of coriander before selling it to the wholesaler at an average price of ₹ 6309.63 per quintal. In this channel, the producer- farmer and the wholesaler-cum-commission agent has incurred on an average ₹ 129.63 and ₹ 771.11 per quintal respectively, in the disposal of coriander. The wholesaler-cum-commission agent received a net margin of ₹ 588.23 per quintal. This accounted for 6.52 per cent of the consumer's price. The retailer purchased coriander at an average price of ₹ 7659.12 per quintal and sold it to the consumers at ₹ 9027.52 per quintals. The margin of retailer in this process was estimated to be ₹ 745.60 quintal^{-1} of coriander. These resluts were in line with Verma *et al*. (2013). Among the two market functionaries present in channel-II retailers retained the highest margin due to sale of coriander to the consumers in small quantities. The total marketing costs incurred by various intermediaries constituted 16.78 per cent of the consumer's price. The price spread in absolute terms in channel-II was estimated to be ₹ 2847.52 (31.54%).

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Conclusions

The net price received by the producers was relatively higher in the channels in which the produce is directly sold to the regulated markets as they receive competitive price therein. The producer used different channels for the disposal of coriander keeping in mind price elasticity of demand by doing so they were acting as rational economic agents. The farmer's should be educated to sell their produce in the regulated markets which fetch higher returns as compared to village level marketing.

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