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Cultivation of Coriander (*Coriandrum sativum* L.): A Review Article

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ABSTRACT

Coriandrum sativum L is an important seed and herb spice crop of Asia, used in several culinary purposes and also for treatment of several diseases. It is cultivated for its herb and also for seeds. In India, Rajasthan, Gujarat, Karnataka and Andrapradesh are the major state producing coriander. There is a need to standardize the production technology which may help to improve the herb yield, seed yield and quality so as to extend the farmers a hand of reliability so that they can get high net returns per unit area. The present review is focused on production practices of Coriandrum sativum L.

Key words: *Coriandrum sativum, Coriander, Apiaceae, Production.*

INTRODUCTION

Coriander (*Coriandrum sativum* L.) is an important seed spice crop mainly grown in rabi season and belongs to family Apiaceae. India is the largest producer of coriander. It is prominently cultivated in Rajasthan, Andhra pradesh, Gujrat and Madhya pradesh with scattered pockets in Tamil Nadu, Odisha, Karnataka, Haryana, Uttar Pradesh and Bihar. Rajasthan occupies the premiere position in production and acreage and contributes about 40 percent to the total production of coriander in India. The tender leaves, stem and fruits of coriander have a pleasant aromatic flavour and thus is indispensable food adjunction in Indian cookery. The seeds are also used as condiment. The medicinal properties of coriander are many used in Indian Ayurvedic and Unani medicinal preparation. The aromatic odour in coriander is due to the presence of essential oil, which has been reported to range from 0.1 to 1.0 per cent in dry seed of varieties of different origin. Coriander oil is the value added product used in flavoring food, pharmaceuticals and perfumery.

In India, Rajasthan, Gujarat, Karnataka, Andra Pradesh and Tamil Nadu are the major state producing coriander. There is a need to standardize the production technology which may help to improve the yield, quality so as to extend the farmers a hand of reliability so that they can get high net returns per unit area.

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The present review is focused on production practices of *Coriandrum sativum* L. so as to promote the production of the crop in non-traditional areas. In this regard the studies on different aspects of *Coriandrum sativum* L are reviewed and presented under different headings.

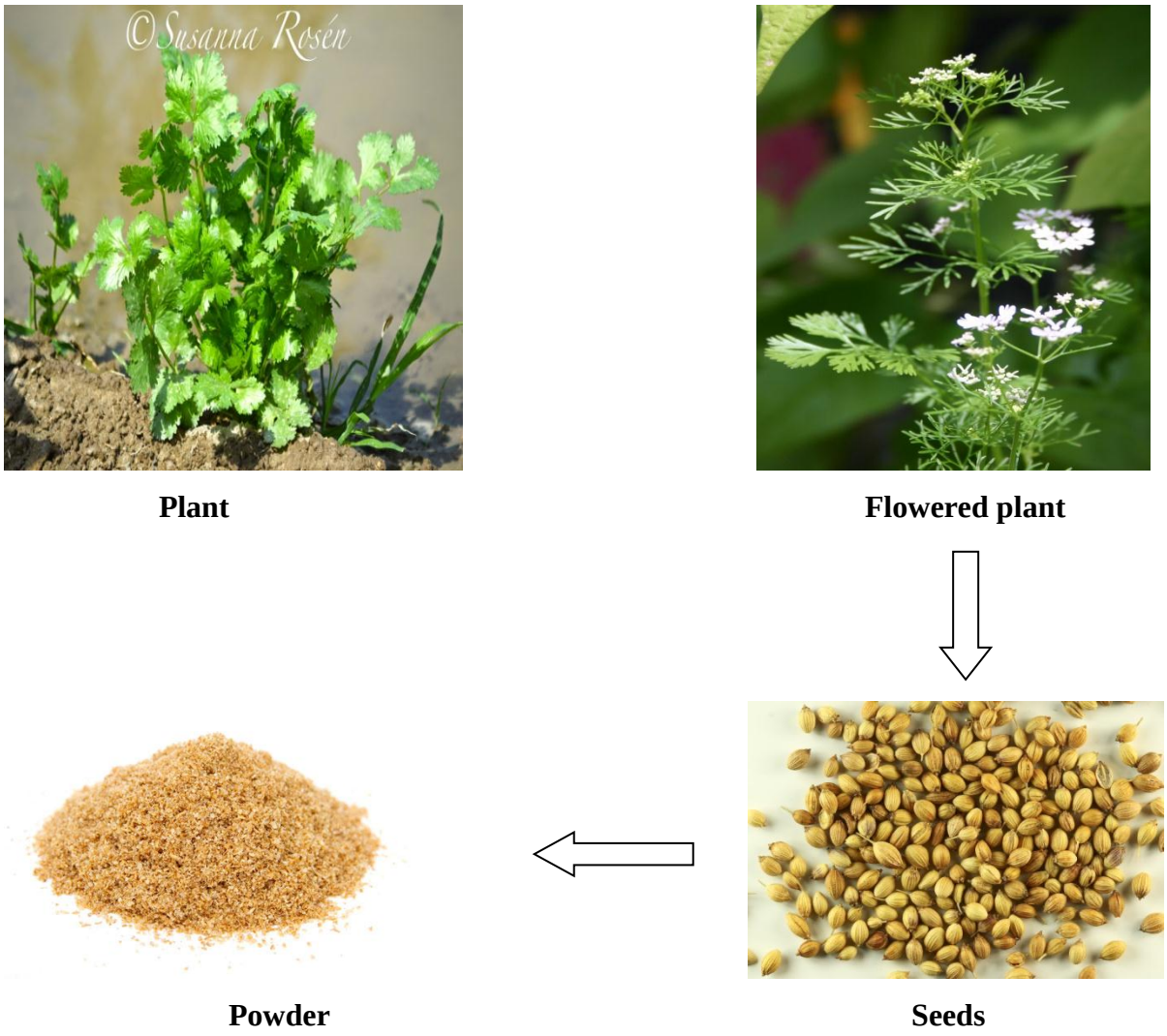

Fig. 1: Plant and plant parts of Coriander

Genotypic evaluation studies

Moniruzzaman *et al*[7]., evaluated fourteen genotypes of coriander (*Coriandrum sativum* L.). The genotype CS005 took the minimum days for bolting (38.00), while CS003 took the maximum (60.00 days) which developed 50% most early flowers (134.3 days) and the tallest plant (116.10 cm). The maximum number of primary and secondary branches were obtained from CS004 (8.70/plant) and CS001 (15.41/plant), respectively. Umbels/plant ranged from 12.70 (CS010) to 33.37 (CS003), while umbellates/ umbel ranged from 4.75 (CS003) to 6.67 (CS010). The maximum number of seeds were obtained from CS011 (35.63/umbel and 684.3/plant) and the lowest per umbel from CS005 (15.00) and per plant from CS010 (163.3). The highest fruit set was obtained from CS011 (48.20%) followed by that of CS007 (46.30%). The genotype CS002 had the maximum 1000-seed weight (12.00 g) and CS004 the minimum (1.65 g). The genotypes CS011 and CS007 gave the highest seed yield per plant (5.79 and 5.57g) as well as

per hectare (1.34 and 1.05 t). The highest germination of seed was recorded in CS003 (84.4%) and the lowest in CS004 (67.96%). The genotypes CS004, CS005, CS010, CS013, and CS014 were attacked with stem gall disease.

Malik and Tehlan[6] evaluated thirteen coriander cultivars/accessions for various growth parameters, seed yield and essential oil content during 2009-2010 to 2011-2012. The significant differences were obtained for all the parameters. Plant height ranged from 96.7 to 121.6, number of branches 6.1 to 10.3, umbels per plant 51.4 to 65.9, umbellate per umbel 3.8 to 6.0 and seeds per umbel 27.6 to 36.1 in DH-233. On the basis of mean seed yield of three years (2009-10 to 2011-2012), the maximum seed yield was recorded as 2104 kg/ha in DH-233 followed by DH -220(2053 kg/ha) showing an increase of 19.68 & 16.78 % higher seed yield over Hisar Anand (check), respectively. Although no significant differences in essential content were observed between the cultivars, DH-220 produced the highest essential oil content (0.39%).

Arif[1] evaluated seventy one genotypes of coriander with respect to growth and yield traits, the yield data emphasized the fact that the genotype DCC 37 (37.71 kg/ha), DCC 49 (31.64 kg/ha) and DCC 51(31.53 kg/ha) recorded maximum seed yield followed by DCC 8 (31.51 kg/ha), DCC 58 (29.44 kg/ha), DCC 59 (31.59 g / plant) and DCC 44 (31.20 g / plant) these genotypes can be used successfully for further breeding programmes.

Sowing dates

Ghobadi and Ghobadi[3] studied on the sowing date and density are two important factors in produce of coriander. A field experiment was conducted with treatments: sowing time (5 May, 20 May, 4 June and 19 June 2009) and plant density (10, 30, 50 and 70 plants m-2). The experimental plots were laid out in a factorial according to a RCBD with three replications. Results showed that the effect of sowing dates and densities were significant on grain yield and yield components, but interaction effects between sowing time and density were non-significant for all of traits in this trial. At sowing times 5 May, 20 May, 4 June and 19 June, grain yield obtained 736.9, 837.8, 1003.1 and 1299.6 kg ha-1, respectively. At 10, 30, 50 and 70 plants m-2, grain yield were 794.9, 1031.0, 1092.3 and 959.3 kg ha-1, respectively. In this experiment, sowing at 19 June and 50 and 30 plants m-2had the most grain yield.

Sharangi and Roychowdhary[13] studided the effect of different sowing dates on the phenology of the coriander. Six sowing dates were studied 5th November, 12th November, 19th November, 26th November, 3rd December and 10th December. The results showed that delay in sowing from November 5 to December 10 plant height, number of primary branches per palnt, days to 50 % germination, days to flower initation, days to 59 % flowering and days to 50 % maturity significantly. The 5th November exhibited significant improvement in yield attributes namely number of umbels per palnt (25.58), umbellets per umbel (6.85), seeds per umbel (30.55), test weight (12.61 g), seed weight per plant (6.85 g) and seed yield (1098.33 kg/ha).

Moosavi[8] (2012) studied the sowing date at three levels of March 30, April 14 and April 29. The sub-plot was plant density at three levels of 20, 40 and 60 plants m^2.The results showed that with the delay in sowing from March 30 to April 29, umbel number per m^2, fruit number per umbel, 1000-fruits weight, fruit and biological yield significantly decreased 42.5, 48.4, 20.5, 76.4 and 74.7%, respectively. Also, means comparison indicated that the increase in density from 20 to 60 plants/m^2 led to the increase in umbel number per m^2, 1000-fruits weight, fruit and biological yield by 158.8, 4.7, 87.6 and 95.7%, respectively. Finally, it is recommended to use sowing date of March 30 with the density of 60 plants/m^2 for the cultivation of coriander in because of having the highest fruit yield.

Inorganic nutrition

Tripathi *et al*[17]., studied on the rrigation at 20, 40 and 60 days after sowing (DAS) maintained higher umblets/plant, umbel/plant, 1,000-seed weight, production efficiency, nutrient use and N, P, K and S uptake. Maximum seed yield

(1.96 tonne/ha), biomass production (4.66 tonnes/ha), net returns (Rs.86,815/ha) and B:C ratio (8.19) were also recorded under 3 irrigations, which resulted in 38.31% and 3.93% increase in seed yield over 2 (20 and 40 DAS) and 4 (20, 40, 60 and 80 DAS) irrigation respectively. The application of 100% recommended dose of fertilizer (RDF) (60:17.6:16.6:30 kg N: P: K: S/ha) registered significantly higher yield attributes, water use efficiency, production efficiency, N: P: K and S uptake and 20.65% and 12.04% increased in seed yield over 50% and 75% RDF respectively. The interaction effect of irrigation and fertility levels on seed yield was also found significant and positive. The maximum yield (2.09 tonne/ha) was recorded with the combined application of 3 irrigations and 100% RDF followed by three irrigation and 125% RDF (2.02 tonne/ha).

Patel *et al*[11]., evaluated sixteen treatment combinations consisting of four levels each of nitrogen (20, 40, 60 and 80 kg N/ha) and sulphur (0, 10,20 and 30 kg S/ha) replicated four times. Among the levels of nitrogen @ 80 kg/ ha showed its producing highestseed yield (1203 kg/ha) and straw yield (1596 kg/ha). The highest performance is attributed to significanti mprovement in growth and yields parameters *viz.,* plant height, number of branches/ plant, number of umbels /plant, number of umbellate /umbel, number of seeds /umbellate, Test weight (g) and seed weight /plant (g).Similarly application of nitrogen @ 80 kg /ha recorded highest quality parameters (protein content, volatile oilcontent and total oil yield) and uptake of nitrogen and sulphur . Among the levels of sulphur @ 30 kg /harecorded significantly higher seed yield (1184 kg/ ha) and straw yield (1577 kg/ ha). Sulphur application @ 30kg/ ha significant improvement in growth and yield parameters *viz.,* number of branches plant-1, number ofumbels /plant, test weight (g) and seed weight/ plant (g). Application of sulphur @ 30 kg/ ha also showed positiveeffect on protein, volatile oil content and total oil yield as well as uptake of nitrogen and sulphur.

Mostafa *et al*[9]., studied the effects of different quantities of phosphorous on yield and yield components of Coriander (*Coriandrum sativum* L.). Phosphorous treatments were consisting: 0, 10, 15 and 20 mg/kg pot soil from triple super phosphate fertilizer. In each pot were sowed 6 seeds in 2-3 cm depth and after seedling growth, was kept one healthy and vigorous plant. Results showed that application of phosphorous significantly increased all evaluated traits compared to control treatment.

Ibadullah *et al*[5]., studied the response of seed yield of corriander to phosphorus. Maximum numbers of umbels plant-1 (47.00) and 1000 seed weight (10.32 g) were obtained with 45 kg P/ha at 45 cm row spacing. Whereas, the maximum days to first umbel maturity (30.0) and days to last umbel maturity (25.33) were recorded in control treatments. However, maximum seed yield (1360.0 kg/ha) was obtained when 45 kg P/ha .

Organic nutrition

Munnu Singh[10] studied the influence of vermicompost and chemical fertilizers (NPK and sulphur) on growth, seed and oil yield and oil quality of coriander (Coriandrum sativum). The results of the study showed that application of vermicompost (7.5 t ha-1) + 25% recommended NPK (25: 12.5: 12.5 kg ha-1) produced maximum biomass (28.2 q ha-1), seed (10.82 q ha-1) and oil yield (6.53 kg ha-1) of coriander which was at par with other treatments except full organic manure and control which indicated that 75% NPK requirement can be supplemented through vermicompost without loss of yield. The oil content and quality were not influenced by the treatments tested.

Singh[15] studied the combination of bio-fertilizer *Azospirrilum* + inorganic Nitrogen + FYM gave better performance as compared to alone application of bio-fertilizer *Azospirrilum*, organic FYM, inorganic nitrogen and other combinations. The combination treatment as soil application of inorganic Nitrogen (100%) of RDF + Azospirrilum @ 15kg ha-1 + FYM @ 5 t ha-1 (T1) gave the maximum plant height (144.62

cm), number of branches per plant (8.28), number of umbels per plant (72.03), number of umbellets per umbel (6.76), number of grains per umbel (54.64) and yield per plot (1.05 kg/4.8m2) or yield per hectare (2.18t ha-1) and increased the yield 71.65 percent over control followed by combination treatment (T2) as soil application of inorganic Nitrogen (75%) of RDF + *Azospirrilum* @ 15kg ha-1 + FYM @ 5 t ha-1 i.e. Plant height (141.59 cm), number of branches per plant (8.12), number of umbels per plant (65.35), number of umbellets per umbel (6.26), number of grains per umbel (45.72) and yield per plot (0.95 kg/4.8m2) or per hectare (1.98t ha-1) and increase the yield 55.90 per cent over control. Regarding income of the experiment, the maximum net profit Rs. 31,600 ha-1 and benefit : cost (Rs.1.94) were calculated in treatment (T1) as soil application of inorganic Nitrogen (100%) of RDF + Azospirrilum @ 15 kg ha-1 + FYM @ 5t ha-1.

Rahimi[12]., studied the influence of nitrogen and biofertilizer on the growth, yield, and essential oil content. Treatments were control (T1), biofertilizer (Azotobacter + Azospirillum) (T2), biofertilizer + 37.5 kg N (T3), and 75 kg N without inoculation (T4). Application of T4 and T3 significantly increased plant height, number of branches/plant, total dry weights, fruit yield, essential oil (EO) percentage, EO yield/plant, content of linalool in EO and linalool yield compared with control. The highest values were always obtained by T3 for all traits, followed by T4, but there were no significant differences in most cases. The lowest values were obtained in the control.

Growth regulators

Singh *et al*[16]., studied the effect of plant growth regulators on growth and yield of coriander (*Coriandrum sativum* L.) cv. NRCSS ACr-1. The seven treatments included control (water spray), three concentrations of NAA (25, 50 and 75 ppm) and three concentrations of GA_3 (10, 25 and 50 ppm). Among different PGRs applied, spray of 50 ppm of GA_3 resulted in significant maximum plant height, fresh weight of leaves, dry weight of leaves, number of branches, number of umbels per plant, umbellates per umbel, seeds per umbel, biological yield, seed yield, harvest index and test weight of coriander followed by spray of 75 ppm NAA. The maximum cost: benefit ratio (1:4.33) was also found with 50 ppm GA_3.

Shivran and Jat[14] studied the effects of NAA @ 50 ppm and Triacontanol (@ 0.5 ml and 1.0 ml/ litre) with three levels of spray *viz.*, one (40 DAS), two (40 and 60 DAS) and three (40, 60 and 80 DAS) along with one absolute control. The NAA @ 50 ppm recorded maximum plant height (79.7cm), number of branches/plant (6.56), umbels/plant (22.27), seeds/umbel (34.64) and biological yield (3.07 t/ha) which were on par with Triacontanol @ 1.0 and 0.5 ml/lt. The highest umbellets/umbel (6.55), test weight (10.75 g), seed yield (1.47 t/ha), net returns (Rs. 21,804/ha) and benefit : cost ratio (1.45) were recorded with NAA @ 50 ppm which were comparable with Triacontanol @ 1.0 ml/lt, but significantly superior to Triacontanol @ 0.5 ml/lt and water spray. With regard to number of sprays, significantly maximum plant height, number of branches/plant, umbels/plant, seeds/umbel, seed yield (1.42 t/ha), net returns (Rs. 20,210/ha) and benefit : cost ratio (1.33) were recorded with three sprays at 40, 60 and 80 DAS closely followed by two sprays at 40 and 60 DAS over single spray at 40 DAS.

Balai and Keshwa[2] studied the effect of thiourea on yield and economics of coriander varieties under normal and late sown conditions. The crop sown at normal sowing time (last week of October) produced significantly higher growth attributes, yield attributes, seed and straw yield and net returns of coriander as compared to late sown. Variety RCr-435 gave significantly higher seed and straw yield and net returns over variety RCr-41. The highest seed yield (14.2 q/ ha), straw yield and net returns (Rs 29,519 /ha) obtained observed under two foliar sprays of 1000 ppm thiourea at vegetative and flowering stages was significantly higher over one foliar spray of 500 ppm at vegetative stage, seed soaking with 500 and 1000 ppm thiourea and water sprayed control.

Economics

Godara *et al*[4]., conducted experiment with eight treatments (absolute control and varying proportion of organic and inorganic sources of nutrients viz., 100 % recommended dose of inorganic fertilizers (60:45:0), 100 % RDF through farm yard manure, 100 % RDF through poultry manure, 100 % RDF through vermicompost, 50 % RDF through fertilizers + 50 % RDF through farm yard manure, 50 % RDF through fertilizers + 50 % RDF through poultry manure and 50 % RDF through fertilizers + 50 % RDF through vermicompost) in completely randomized block design with three replications. Results revealed that, RDF through fertilizers and combinations of different organic and inorganic sources produced significantly higher grain yield over absolute control. Recommended dose of nutrients (100%) applied through fertilizers exhibited highest vegetative growth and yield attributes with maximum yield (1024 kg ha-1), net returns (Rs. 59556 ha-1) and benefit cost ratio (3.66), closely followed by 50 % RDF through fertilizers + 50 % RDF through vermicompost.

Tripathi *et al*[18]., studied the application of 50% RDF+FYM @ 5 t ha-^{1} + PSB @ 2.5 kg ha-^{1} recorded maximum plant height (125.48 cm), number of primary and secondary branches per plant (15.20 and 34.20) days to 50% flowering (82.58), number of umbels per plant (54.18), umbellate per umbel (5.84), grains per umbellate (5.79), days to maturity (140.25), test weight (13.8g), seed yield (16.8 q ha-1) net return (Rs 37280 ha-^{1} and B:C ratio (4.38). Thus integration of inorganic fertilizer with organic source improved the physicochemical and biological conditions of the soils and finally helped in increasing the yield attributes and yield of coriander.

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