Int.J.Curr.Microbiol.App.Sci (2019) *8*(9): 693-698

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 09 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.809.083

Effect of Cutting and Intra Row Spacing on Yield and Phenotypical Attributes of Coriander (*Coriandrum sativum* L.)

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Keywords

Cutting, Intra row spacing, Leaf & seed yield, Coriander

Article Info

Accepted:
15 August 2019
Available Online:
10 September 2019

A B S T R A C T

Effect of cutting and intra row spacing on leaf and seed yield of coriander (*Coriandrum sativum* L) was carried out in cv. Solan Selection at Dr. YSPUHF, Solan (HP) during *Rabi* 2015. The treatments comprised of three cutting and five intra row spacing. Coriander sown at closer spacing 30 × 2.5 cm and left for seed production after two cuttings (60 & 75 DAS) gave the highest leaf yield i.e. 55.53 q ha^{-1} along with seed yield of 17.44 q ha^{-1} with the maximum B : C ratio (3.39 : 1), whereas, sowing at spacing 30 × 7.5 cm and taking seed crop after one cutting (60 DAS) gave the highest seed yield i.e. 19.98 q ha^{-1} along with leaf yield of 13.28 q ha^{-1} with B : C ratio (2.28 : 1).

Introduction

Coriander (*Coriandrum sativum* L, 2n=22) belongs to the family Apiaceae is an annual herb, mainly cultivated for its fruits as well as for the tender green leaves. Its name has been derived from Greek word "Koris" meaning bad bug because of unpleasant, fetid bug like odour of the green unripened fruits. It is also mentioned in Sanskrit literature and the Bible. It is also recorded that it was the one of the first herbs grown in America by colonizers having been introduced into Massachusedds before 1670 BC (Tiwari and Agarwal, 2014).

It is native of South Europe and Mediterranean region. Globally it is cultivated in India, Malaysia, UAE, Singapore, United Kingdom, South Africa and Indonesia. In India, Rajasthan occupies more area and production among the states followed by Madhya Pradesh, Gujarat, Assam, Andhra Pradesh, Karnataka, Odisha, Tamil Nadu, Uttar Pradesh, Bihar, Chhattisgarh, Haryana, West Bengal, Maharashtra, Himachal Pradesh and Punjab (Tiwari and Agarwal, 2014). In India it is grown in about 447000 hectare with an annual production of 314000 tonnes and productivity 7.02 quintals per hectare in the year 2013-14. In Himachal Pradesh area under coriander is 140 hectare with annual

production of 50 tonnes (Saxena, 2015). Around 14.5 million tonnes coriander seed was exported in the year 2013-14 with net returns of 37185.65 lakhs US $ (Anonymous, 2016).

The entire plant of coriander is used as appetizer in preparing fresh chutneys and sauces, and leaves are used for flavouring curries and soup. The fruits are extensively used as condiment preparation of curry powder, pickling spices, seasoning and flavouring of bakery products. These are considered to have carminative, diuretic, tonic, stomachic, antibilious, refrigerant and aprodisiac properties. It contains antioxidants, which can prevent the spoilage of food seasoned with this spice. It is a tropical crop and can be grown throughout the year except very hot season i.e. March-May for leaf purpose, but for higher grain yield it has to be grown in specific season. A dry and cold weather free from frost especially during flowering and fruit setting stage, favours good grain production.

Materials and Methods

On farm trial conducted on "Studies on effect of cutting and intra row spacing on leaf and seed yield of coriander (*Coriandrum sativum* L.) was carried out at Dr. YSPUHF, Nauni, Solan (HP) during *Rabi* 2015-16 i.e. from October, 2015 to April, 2016. The climate is generally characterized as sub-humid, sub-temperate with cool winters. Generally, May and June are the hottest months and December and January are the coldest ones. The soil structure of the experimental farm is gravelly loam to gravelly clay loam with pH, EC and OC values ranging from 6.85-7.09, 0.60-0.80 dSm^{-1} and 0.80-0.92 %, respectively. Coriander cultivar 'Solan-Selection', a variety with tender leaves and good aroma was used for the present study. The experiment was laid out in a RCBD (Factorial) comprising of 15 treatment combinations of different cutting and intra row spacing (Table 1) with three replications of each treatment. Coriander seeds were directly sown in the field in the month of October, 2015, in a plot of size 1.8 × 1.5 m (2.7 m^2 area) accommodating 60, 30, 20, 15 and 12 plants per row at spacing of 30 × 2.5 cm, 30 × 5.0 cm, 30 × 7.5 cm, 30 × 10.0 cm and 30 × 12.5 cm, respectively.

Results and Discussion

The results revealed that two cuttings (C_2) resulted in significantly more leaf yield per hectare (30.88 q) than one cutting (C_1). However, spacing S_1 recorded higher leaf yield per hectare (41.39 q) compare to other spacing's. Whereas highest leaf yield per hectare (55.53 q) recorded in treatment combination of $C_2 \times S_1$. The obvious reason for more leaf yield at two cuttings (C_2) may be attributed to better vegetative growth of the crop after one cutting (C_1). The results are in line with the findings of Cuba and Debnath (2013) & Datta *et al.,* (2008). Whereas, Nandal *et al.,* (2007) also reported the higher leaf yield in fenugreek with spacing of (20 × 10 cm) and two cutting. One cutting (C_1) resulted in significantly higher seed yield per hectare (17.18 q) and Spacing S_3 gave the significantly maximum seed yield per hectare (17.93 q). The interaction between $C_1 \times S_3$ gave the highest seed yield per hectare (19.98 q). The results were in line with the findings of Moniruzzaman and Rahman (2015) and Cuba and Debnath (2013) who reported that the highest seed yield was noted with one cutting. Whereas, Sharma *et al.,* (2016) who reported that the medium spacing gave higher seed yield than wider spacing. Maheriya *et al.,* (2015) also reported higher seed yield with one cutting and medium spacing. Highest plant height (102.95 cm) was recorded with no cutting (C_0). Widest spacing S_5 gave highest plant height (102.55 cm). The interaction between $C_0 \times S_5$ gave the highest plant height (105.55 cm). The results were in line with those of Tehlan and Thakral (2008) who

reported that the increasing number of leaf cuttings from one to two drastically reduced the plant height. Whereas, Sharma *et al.,* (2016), Vasmate *et al.,* (2008) and Okut and Yidirim (2005) who observed that the plant height of coriander was increased with wider spacing. Maximum number of primary branches per plant (5.00) was observed with one cutting (C_1). The significantly maximum number of primary branches per plant (5.52) was recorded with the spacing S_5. The interaction between C_1 × S_5 gave the maximum number of primary branches per plant (6.66). This result corroborated the findings of Maheriya *et al.,* (2015) who reported that one cutting at 45 DAS recorded significantly highest number of branches per plant. Similar results were also reported by Tehlan and Thakral (2008). Whereas, Tuncturk (2011), Vasmate *et al.,* (2008) and Pawar *et al.,* (2007) who stated that the number of primary branches significantly increased with increasing row spacing. Maheriya *et al.,* (2015) also reported that one cutting at 45 days after sowing at a spacing of 45 cm recorded significantly highest number of branches per plant. The significantly maximum number of secondary branches per plant (13.00) was observed with one cutting (C_1).

The significantly maximum number of secondary branches per plant (13.52) were recorded with the spacing S_5. The interaction between C_1 × S_5 gave the maximum number of secondary branches per plant (15.66). Maheriya *et al.,* (2015) who stated that one cutting at 45 DAS recorded significantly highest number of branches per plant. The results were in line with the observations by Tuncturk (2011) and Vasmate *et al.,* (2008) who stated that the number of secondary branches significantly increased with increasing row spacing. Maheriya *et al.,* (2015) also reported that one cutting at 45 days after sowing at a spacing of 45 cm recorded significantly highest number of branches per plant.

From the present investigation, it can be concluded that the coriander cv. Solan Selection, sown at closer spacing 30 × 2.5 cm and left for seed production after two cuttings (60 and 75 DAS) gave the highest leaf yield i.e. 55.53 q/ha along with seed yield of 17.44 q/ha with the maximum B : C ratio (3.39 : 1), whereas, sowing at spacing 30 × 7.5 cm and taking seed crop after one cutting (60 DAS) gave the highest seed yield ie 19.98 q/ha along with leaf yield of 13.28 q/ha with B : C ratio (2.28 : 1). Therefore, when green leaf yield is the primary objective, the crop should be sown at closer spacing of 30 × 2.5 cm and left for seed production after two cuttings (60 and 75 DAS) for getting maximum financial benefits, whereas, in case of seed yield being the primary objective, sowing at spacing 30 × 7.5 cm and taking seed crop after one cutting (60 DAS) is beneficial under mid hill conditions of Himachal Pradesh.

Table.1 Details of cutting (C) and intra row spacing (S) treatments undertaken during the study

C: Cutting	S: Spacing
	S_1: 30 × 2.5 cm
C_0: No cutting	**S_2:** 30 × 5.0 cm
C_1: One cutting (60 DAS)	**S_3:** 30 × 7.5 cm
C_2: Two cuttings (60 & 75 DAS)	**S_4:** 30 × 10.0 cm
	S_5: 30 × 12.5 cm

Table.2-Effect of cutting and intra row spacing on yield and morphological traits of coriander

Treatments	Leaf yield/ha (q)	Seed yield/ha (q)	Plant Height (Cm)	No. of Primary Branches	No. of Secondary Branches
Cutting (S)					
C_0 :No cutting	-	15.82	102.95	2.71	8.89
C_1:One cutting at 60 DAS)	15.27	17.18	98.97	5.00	13.00
C_2:Two cuttings (60 & 75	30.88	15.21	95.97	4.37	11.57
$CD_{(0.05)}$	0.60	0.84	0.74	0.26	0.23
CV	52.36	6.28	3.53	29.40	18.72
Intra row Spacing (S)					
S_1: 30 × 2.5 cm	41.39	16.52	95.37	2.29	9.00
S_2: 30 × 5.0 cm	28.94	17.05	97.77	3.48	10.00
S_3: 30 × 7.5 cm	18.32	17.93	99.70	4.11	11.14
S_4: 30 × 10.0 cm	14.41	15.72	101.11	4.74	12.11
S_5: 30 × 12.5 cm	12.30	13.15	102.55	5.52	13.52
$CD_{(0.05)}$	0.94	1.08	0.96	0.34	0.29
CV	47.85	11.33	2.84	30.51	15.84
Treatment combinations					
C_0 S_1	-	14.82	100.44	1.66	7.33
C_0 S_2	-	17.86	102.00	2.22	8.00
C_0 S_3	-	17.41	102.77	2.33	8.89
C_0 S_4	-	15.63	104.00	3.33	9.22
C_0 S_5	-	13.39	105.55	4.00	11.00
C_1 S_1	27.25	17.28	95.11	2.66	10.44
C_1 S_2	17.13	18.05	97.44	4.33	11.44
C_1 S_3	13.28	19.98	99.11	5.44	12.89
C_1 S_4	09.91	16.79	100.77	5.89	14.55
C_1 S_5	08.77	13.82	102.44	6.66	15.66
C_2 S_1	55.53	17.44	90.55	2.55	9.22
C_2 S_2	40.76	15.25	93.88	3.89	10.55
C_2 S_3	23.36	16.40	97.22	4.55	11.66
C_2 S_4	18.90	14.73	98.55	5.00	12.55
C_2 S_5	15.83	12.24	99.66	5.89	13.89
$CD_{(0.05)}$	1.33	1.87	1.66	0.59	0.51
CV	58.45	12.80	4.04	38.39	21.80

Table.4.4 Economics of different cutting and intra row spacing treatments in coriander

Treatments	Leaf yield per hectare (q)	Seed yield per hectare (q)	Income from leaf @ Rs 3000/q (Rs ha^{-1})	Income from seed @ Rs 10000/q (Rs ha^{-1})	Gross income (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
$C_0 \times S_1$	0	14.82	0	1 48 200.00	1 48 200.00	68 260.08	79 939.92	1.17
$C_0 \times S_2$	0	17.86	0	1 78 600.00	1 78 600.00	68 260.08	1 10 339.92	1.62
$C_0 \times S_3$	0	17.41	0	1 74 100.00	1 74 100.00	68 260.08	1 05 839.92	1.55
$C_0 \times S_4$	0	15.63	0	1 56 300.00	1 56 300.00	68 260.08	88 039.92	1.29
$C_0 \times S_5$	0	13.39	0	1 33 900.00	1 33 900.00	68 260.08	65 639.92	0.96
$C_1 \times S_1$	27.25	17.28	81 750.00	1 72 800.00	2 54 550.00	72 952.08	1 81 597.92	2.49
$C_1 \times S_2$	17.13	18.05	51 390.00	1 80 500.00	2 31 890.00	72 952.08	1 58 937.92	2.18
$C_1 \times S_3$	13.28	19.98	39 840.00	1 99 800.00	2 39 640.00	72 952.08	1 66 687.92	2.28
$C_1 \times S_4$	9.91	16.79	29 730.00	1 67 900.00	1 97 630.00	72 952.08	1 24 677.92	1.71
$C_1 \times S_5$	8.77	13.82	26 310.00	1 38 200.00	1 64 510.00	72 952.08	91 557.92	1.26
$C_2 \times S_1$	55.53	17.44	1 66 590.00	1 74 400.00	3 40 990.00	77 644.08	2 63 345.92	3.39
$C_2 \times S_2$	40.76	15.25	1 22 280.00	1 52 500.00	2 74 780.00	77 644.08	1 97 135.92	2.54
$C_2 \times S_3$	23.36	16.40	70 080.00	1 64 000.00	2 34 080.00	77 644.08	1 56 435.92	2.01
$C_2 \times S_4$	18.90	14.73	56 700.00	1 47 300.00	2 04 000.00	77 644.08	1 26 355.92	1.63
$C_2 \times S_5$	15.83	12.24	47 490.00	1 22 400.00	1 69 890.00	77 644.08	92 245.92	1.19

Acknowledgments

The authors deeply acknowledge Dr. Happy Dev Sharma (Principal Scientist) & Dr. Vipin Sharma (Assistant Professor) from Dr. YS Parmar UHF, Solan (HP) who had supported in this research work.

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How to cite this article:

Pradip Balaso Bhapkar, H Dev Sharma, Sudhaker Negi, Diksha Pundir, Vipin Sharma, Monika Kapil and Sridhar Reddy. 2019. Effect of Cutting and Intra Row Spacing on Yield and Phenotypical Attributes of Coriander (*Coriandrum sativum* L.). *Int.J.Curr.Microbiol.App.Sci.* 8(09): 693-698. doi: https://doi.org/10.20546/ijcmas.2019.809.083