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Effect of Plant Growth Regulators on Growth, Yield and Quality of Coriander (*Coriandrum sativum* L.)

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ABSTRACT

An experiment entitled effect of plant growth regulators on growth, yield and quality of coriander was carried out during *rabi* season of 2016-17 at RVSKVV–College of Horticulture, Mandsaur, (M. P.) with 10 treatment combinations, comprising three plant growth regulators NAA, GA_3 and Cycocel at three level of concentrations with control. These treatments were replicated three times in Randomized Block Design and analyzed. Foliar application of 300 ppm Cycocel treatment to coriander crop recorded significantly highest fresh weight of plant, branches per plant, umbels per plant, umbellate per umbel, seeds per umbel, test weight, seed yield, biological yield and SPAD value of coriander. While, foliar application of 50 ppm GA_3 to coriander recorded significantly maximum plant height, essential oil and dry matter content of seed.

Keywords *Coriandrum sativum*. Cycocel, GA_3 NAA.

INTRODUCTION

Coriander (*Coriandrum sativum* L.) popularly known as “Dhania” is one of the oldest and most widely used seed spice crop by entire mankind of the world. India is the largest producer, consumer and exporter of spices in the world. In India, coriander is cultivated in about 622 thousand hectare with production of about 566.0 thousand MT, (Annonymous 2016). The average productivity of coriander in India is around 0.9 metric ton/ha. The major coriander growing states are Rajasthan, Madhya Pradesh, Andhra Pradesh, Gujarat, Bihar, Uttar Pradesh, coriander is cultivated in about 160.0 thousand hectare with annual production is about 75.0 thousand MT (Anonymous 2016). The major coriander growing districts in the Madhya Pradesh are Guna, Shivpuri, Mandsaur, Neemuch, Ratiam, Shajapur, Rajgarh and Vidisha. In agriculture, yield of any crop can increased by the judicious use of fertilizers, pesticides, irrigation and better management coupled with varietal and genetic improvement (Verma 2006). Similarly, the growth, yield and quality of coriander could be improved by the use of plant growth regulators, as their use has resulted in some outstanding achievements with respect to growth, yield and quality of several other crops. Among the various plant growth regulators,

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Table 1. Effect of PGRs on growth and quality of coriander.

Treatments	Plant height (cm)	Fresh weight of plant (g)	Branch/ plant	Days to 50% flowering	SPAD value	Essential oil content in seed (%)	Dry matter content in seed (%)
Control	108.3	30.08	5.17	93.3	37.67	0.33	80.14
NAA @ 25 ppm	109.5	35.14	5.70	86.3	40.27	0.34	84.72
NAA @ 50 ppm	112.3	37.37	5.80	84.7	41.06	0.43	85.78
NAA @ 75 ppm	118.9	42.98	6.27	82.7	42.25	0.47	88.01
GA_3 @ 10 ppm	114.4	36.17	5.77	85.7	41.33	0.44	85.96
GA_3 @ 25 ppm	115.3	39.74	5.87	84.0	41.51	0.45	86.24
GA_3 @ 50 ppm	122.7	46.34	6.77	79.3	45.08	0.51	90.80
Cycocel @ 100 ppm	105.5	34.49	6.30	91.0	37.95	0.33	82.57
Cycocel @ 200 ppm	104.3	36.87	6.37	89.7	38.43	0.35	84.44
Cycocel @ 300 ppm	103.1	47.15	7.20	89.3	46.38	0.46	85.63
SEm±	1.08	1.063	0.125	0.36	0.80	0.013	0.87
CD 5%	3.22	3.160	0.373	1.08	2.40	0.038	2.61

the use of gibberellic acid (GA_3), Cycocel (CCC) and α-naphthalene acetic acid (NAA) have been found to increase the economic yield of several leafy crops. The PGRs are applied on crop to increase yield and quality, there by meeting commercial demand and quality standards. Effectiveness of PGRs depends upon several factors, viz., concentration, method and time of application (Singh et al. 2012). Use of plant growth regulators may be one of the best possible way in affecting production and productivity as they provide an immediate impact on crop improvement and are less time consuming. Gibberellic acid is found to induce stem and internodes elongation, flowering and fruit setting and growth. Maphthalic Acetic Acid (NAA) is also known to induce higher physiological efficiency including photosynthetic ability of plants. Plant growth regulators leads also to better growth and yield without substantial increase in the cost of production. Therefore, standardizations of levels of growth regulators determine the growth, yield and quality of coriander (Haokip et al. 2016). Keeping all these in mind, an experiment was conducted to study the "Effect of plant growth regulators on growth, yield and quality of coriander (*Coriandrum sativum* L.) using cv NRCSS-ACr-1".

MATERIALS AND METHODS

The present experiment was conducted during September 2016 to March 2017 at the Research Farm, RVSKVV College of Horticulture, Mandsaur (MP) to assess the effect of plant growth regulators on growth, yield and quality of coriander (*Coriandrum sativum* L.). The soil of the experimental field was light black loamy in texture with low nitrogen (243.2 kg/ha), medium phosphorus (19.75 kg/ha), high potassium (448.0 kg/ha) and neutral in reaction (pH 6.5). The ten treatments tested were control, NAA 25 ppm, NAA 50 ppm, NAA 75 ppm, GA_3 10 mpp, GA_3 25 ppm, GA_3 50 ppm, Cycocel 100 ppm, Cycocel 200 ppm and Cycocel 300 ppm. These treatments were evaluated under Randomized Block Design with three replications. NRCSS ACr —1 variety of coriander was sown at 30 cm row to row spacing and at 10 cm plant to plant spacing, respectively. The treatments were applied at 25, 45 and 65 DAS with knapsack sprayer using 500 liters water per hectare. All the agronomic package of practices was adapted to grow a healthy crop. In each replication five plants randomly selected were marked for observation. Data was recorded for various growth, yield and quality parameters and statistically analyzed using the method of analysis of variance as descrived by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Plant height

Foliar application of plant growth regulators signifi-

Table 2. Effect of PGRs on yield attributes and yield of coriander.

Treatments	Umbel/ plant	Umbellet/ Umbel	Seed// Umbel	Test weight (g)	Seed yield (q/ha)	Biologi-cal yield (q/ha)	Harvest index (%)
Control	26.4	4.93	33.07	9.56	11.17	34.62	32.33
NAA @ 25 ppm	31.6	6.20	35.43	10.03	11.85	35.83	35.95
NAA @ 50 ppm	32.5	6.40	36.93	11.28	13.28	37.53	38.01
NAA @ 75 ppm	34.7	7.03	41.27	12.05	14.26	40.32	37.79
GA_3 @ 10 ppm	32.7	6.53	36.20	11.65	13.36	39.17	36.74
GA_3 @ 25 ppm	34.3	6.80	40.07	11.90	14.15	38.97	38.89
GA_3 @ 50 ppm	39.5	7.33	46.47	11.95	16.27	43.96	36.99
Cycocel @ 100 ppm	36.0	7.20	43.93	10.37	15.48	43.25	35.76
Cycocel @ 200 ppm	36.1	7.27	45.73	10.91	15.69	43.72	35.89
Cycocel @ 300 ppm	42.9	7.87	49.60	12.27	18.20	47.03	38.71
SEm±	1.11	0.15	0.92	0.29	0.63	0.98	1.32
CD 5%	3.31	0.46	2.75	0.88	1.89	2.92	NS

cantly influenced plant height of coriander. Application of GA_3 @ ppm registered significantly highest value of plant height (122.70 70 cm) followed by treatment NAA @ 75 ppm (118.9 cm) as compared to all other treatments tested. The increase in plant height seems to be due to enhanced cell division and cell enlargement. Promotion of protein synthesis by GA_3 application exogenously might have resulted in enhanced plant height. Similar results were reported by Meena et al. (2006), Panda et al. (2007), Verma and Sen (2008), Singh et al. (2012) in coriander.

Fresh weight of plant

Data presented in Table 1 revealed that foliar application of plant growth regulators significantly affected the fresh weight of plant recorded at harvest. Application of Cycocel @ 300 ppm recorded significantly highest fresh weight of plant (47.15 g/plant) of coriander which was significantly at par with fresh weight of plant observed under treatment GA_3 @ 50 ppm (46.34 g/plant) as compared to all other treatments tested. The significant improvement in fresh weight of plant seems to be due to enhanced cell division and cell enlargement. Similar results were reported by Meena et al. (2006), Panda et al. (2007), Verma and Sen (2008), Singh et al. (2012) in coriander.

Branches per plant

Application of Cycocel 300 ppm gave significantly higher number of branches per plant followed by GA_3 @ 50 ppm treatments as compared to all other treatments tested. The increase in number of primary branches could be due to suppression of apical dominance by the application of growth retardant Cycocel which diverts the polar transport of auxin towards the basal buds there by leads to increased branching. Similar findings were reported by Meena et al. (2006), Panda et al. (2007), Singh et al. (2012), Haokip et al. (2016) and Yugandhar et al. (2016) in coriander.

Days to 50% flowering

Foliar application of plant growth regulators significantly influence days to 50 percent flowering of coriander. Significant maximum days to 50% flowering of coriander were recorded under control treatment (93 days) followed by treatment of Cycocel @ 100 ppm which registered 91 days to 50% flowering as compared to all other treatments tested. The earliest 50 percent flowering was recorded in GA_3 @ 50 ppm, while most delayed 50 percent flowering was recorded with control. Early flowering may be due to increase in the endogenous gibberellins level in the plant, as gibberellins are well known for inducing early budding and flowering in several crop plants. Similar results were reported by Meena et al. (2006), Panda et al. (2007), Verma and Sen (2008), Singh et al. (2012) in coriander.

Umbels per plant

Data presented in Table 2 revealed that application of plant growth regulators significantly affect the umbels per plant recorded at harvest. Significant higher number of umbels per plant (42.9) was recorded in treatment Cycocel 300 ppm followed by GA_3 @ 50 ppm treatment. The increase in number of umbels plant^{-1} could be attributed due to the increase in the number of both primary and secondary branches plant^{-1} with the application of Cycocel 300 ppm. The above results were in conformity with the finding of Meena et al. (2006), Kumar and Sundareswarm (2011), Singh et al. (2012), Haokip et al. (2016), Yugandhar et al. (2016) in coriander.

Umbellets per Umbel

Data presented in Table 2 revealed that application of plant growth regulators significantly affect the umbellets per umbel recorded at harvest. Significant higher number of umbellets per umbel (7.87) was recorded in treatment Cycocel 300 ppm followed by GA_3 @ 50 ppm treatment. The increase in number of umbellets per umbel by Cycocel might be due to accumulation of metabolites which get translocated towards the reproductive sinks and these in turn resulted in stimulation of umbellets. Similar findings were reported by Meena et al. (2006), Panda et al. (2007), Singh et al. (2012), Haokip et al. (2016), and Yugandhar et al. (2016) in coriander.

Seeds per Umbel

Data presented in Table 2 revealed that application of plant growth regulators significantly affect the seeds per umbel recorded at harvest. Significant higher number of seeds per umbel (49.6) was recorded in treatment Cycocel 300 ppm followed by GA_3 @ 50 ppm (46.47) treatment. Similar findings were reported by Meena et al. (2006), Panda et al. (2007), Singh et al. (2012), Haokip et al. (2016), and Yugandhar et al. (201^) in coriander.

Test weight

Foliar application of plant growth regulators were significantly increased test weight (g) of coriander. The foliar application of Cycocel 300 ppm recorded the significant maximum test weight (12.27 g) which was statistically at par with treatments GA_3 @ 10 to 50 ppm and NAA @ 75 ppm treatments. The increase in test weight by Cycocel might be due to accumulation of metabolites which get translocated towards the reproductive sinks and these in turn resulted in bolder seeds. Similar results were assessed by Panda et al. (2007) and Singh et al. (2012) in coriander.

Seed yield

Foliar application of plant growth regulators were significantly increased all the yield and yield attributes such as number of umbels plant^{-1}, number of umbellets umbel^{-1}, number of seeds umbel^{-1}, test weight (g) and seed yield (q ha^{-1}). The foliar application of Cycocel 300 ppm recorded the significant maximum seed yield (18.20 q ha^{-1}), while the lowest seed yield was recorded with the control (11.17 q ha^{-1}). Treatment of GA_3 @ 50 ppm to coriander also achieved second highest seed yield (16.27 q ha^{-1}) of coriander which was statistically at par with seed yield of treatment of Cycocel @ 100 and 200 ppm. This increase in seed yield was due to increased in yield attributes such as number of umbels plant^{-1}, number of umbellets umbel^{-1}, number of seeds umbel^{-1} and increase in growth parameters like number of branches plant^{-1}. The above results were in close conformity with the findings of Panda et al. (2007), Kumar and Sundareswaran (2011), Singh et al. (2012), Haokip et al. (2016) and Yugandhar et al. (2016) in coriander.

Biological yield

The foliar application of Cycocel 300 ppm recorded the significant maximum biological yield (47.03 q ha^{-1}), while the lowest biological yield was recorded with the control (34.62 q ha^{-1}). Treatment of GA_3 @ 50 ppm to coriander also achieved second highest biological yield (43.96 q ha^{-1}) of coriander which was statistically at par with biological yield of treatment of Cycocel @ 100 and 200 ppm. This increase in biological yield was due to increased in growth attributes such as plant height and branches per plant. Similar results were assessed by Meena et al. (2006), Kumar et al. (2007), Kumar and Sundareswaran (2011), Singh et al. (2012), Haokip et al. (2016) and Yugandhar et al. (2016) in coriander.

Quality parameters

The maximum SPAD value, essential oil content in seed and dry matter content in seed was recorded in GA_3 @ 50 ppm, while it was lowest with the control. The increment in SPAD value essential oil content in seed and dry matter content in seed may be due to the positive effect of GA_3 50 ppm improved overall growth and metabolism and also the better translocation of carbohydrates and utilization by the plant for good growth. These findings are in close conformity with the findings of Verma and Sen (2008), Singh et al. (2012), Kuri et al. (2015), Yugandhar et al. (2016) and Haokip et al. (2016) in coriander.

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