

Optimization of leaf cutting and plant growth regulator treatments for enhancing seed quality parameters in coriander (*Coriandrum sativum* L.)

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Abstract

An experiment was carried out at Chaudhary Charan Singh Haryana Agricultural University, Hisar throughout the 2023–2024 and 2024–2025 rabi seasons, to optimize the leaf cutting and plant growth regulators (PGRs) spray on seed quality parameters of coriander (*Coriandrum sativum* L.). The treatments consisted of control (no cutting) and two leaf cutting levels (one cutting and two cuttings) and nine PGR treatments including benzyl adenine at 10 and 20 ppm, GA₃ at 50 ppm, salicylic acid at 50 and 100 ppm, jasmonic acid at 50 and 100 ppm, NAA at 75 ppm and water spray as control. Seed quality parameters were significantly influenced by cutting and PGR application. Recommended package of practices recorded superior test weight, germination percentage, seedling length, seedling dry weight and seed vigour indices compared to one and two cuttings. Among PGRs, benzyl adenine at 20 ppm resulted in the greatest improvement in all seed quality attributes like test weight, standard germination, seedling length, seedling vigour indices I and II followed by benzyl adenine 10 ppm and GA₃ at 50 ppm. The combination of no cutting and benzyl adenine at 20 ppm proved most effective for producing vigorous and high-quality seed in coriander.

Keywords: Coriander, plant growth regulators, cutting, germination, seed, benzyl adenine, quality

Introduction

Coriander (*Coriandrum sativum* L.) popularly known as “Dhania” is one of the oldest seed spices used by the mankind (Hnamte *et al.*, 2013). Coriander is cultivated for its aromatic seeds, splitting into two mericarps upon maturity. It is highly grown in the arid and semi-arid region of India in Rajasthan and Gujarat and on low scale in Punjab, Uttar

Pradesh, Madhya Pradesh, Haryana (Lal *et al.*, 2019). In India, coriander is grown in an area of 638.62 thousand hectares with a production of 627.01 thousand metric tonnes and productivity of 1.39 metric tonnes per hectare (Indiastat, 2024a). In Haryana state, the crop is grown an area of 0.65 thousand hectares with a production of 1.30 thousand metric tonnes and a productivity of 2.00 metric tonnes per hectare (Indiastat, 2024b).

Seed is a vital component, and high-quality seed is essential for agricultural output. The availability of healthy and vigorous seed at planting time is critical for meeting agricultural output targets because good quality seed acts as a catalyst for realizing the potential of other inputs (Andrabi *et al.*, 2019a). Both leaf cutting and growth regulator plays a major role in growth or yield of coriander crop. Due to the coriander plant's ability to regenerate, taking two or three cuttings is possible. Plant growth regulators are essential to the plant's growth and development, which greatly influences the plant's production (Sahu *et al.*, 2022). It is environmentally or toxicologically safe and has strong effect on vegetative and reproductive yield of the coriander crop which enhances productivity and food safety (Kaur *et al.*, 2018). Different crops have been shown to grow and yield more when PGRs are applied exogenously (Saxena *et al.*, 2014a). The seed yield of coriander crop obtained was 24.72% higher with the use of growth regulator treatments than the control which directly indicated that seed yield was increased due to the impact on crop morphological and growth parameters (Shivran & Jat, 2013b).

Quality seed is the most important input for realising potential productivity because it ensures good germination, rapid emergence and vigorous growth of the plant stand, resulting in a good crop yield that contributes approximately 15-20% to various crops productivity (Chauhan *et al.*, 2016). This study examines coriander seed quality metrics based on leaf cutting levels and treatments with plant growth regulators.

Material and methods

The present study was conducted during rabi seasons of 2023-2024 and 2024-25 at Research Field of Vegetable Science and seed quality parameters in Lab of the Department of SST, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. Sowing of DH 228 seed was completed on 5th November and 7th

November of 2023-24 and 2024-25, respectively, during Rabi season in split plot design with three replications. To ensure an optimum plant population, 30×20 cm spacing (row to row and plant to plant) was maintained as per recommended by package of practices. Plant growth regulators used were salicylic acid @ 50 and 100 ppm, jasmonic acid @ 50 and 100 ppm, benzyl adenine @10 and 20 ppm, GA3 @50 ppm, NAA @ 75 ppm and control (water spray) used for foliar spray with three leaf cutting treatments (No cutting, one cutting and two cuttings). One cutting was performed after 40 days after sowing (DAS), two cuttings at 40 and 60 DAS. Two foliar sprays of PGRs were taken up at 45 and 60 days after sowing (DAS), following the respective cutting treatments. In order to successfully raise a healthy crop, all agronomic procedures were completed on schedule time in accordance with the university's recommended package practices (*Phal, Phool, Sabji Utpadan Evam Parirakshan-Package of Practices*, 2024). Crop was harvested after it reached to full maturity and dried in shade for 3 to 4 days. Seed samples were dried and then taken to laboratory for testing several seed quality parameters. The data was statistically analyzed using Panse & Sukhatme's (1967) recommended methodology at a 5% level of significance ($p = 0.05$). The following seed quality characteristics were examined for the experiment:

Test weight (g): One thousand seed weight was determined from three replications according to ISTA (1999).

Standard germination percentage: Fifty seeds per replication were placed in germination papers at $20 \pm 1^\circ\text{C}$ and 90–95% RH. Normal seedlings were counted on the 5th and 21st day as per ISTA (1999), and germination percentage was calculated.

Seedling length (cm): The seedling length was measured from tip of shoot to root tip and the mean length was calculated and expressed as seedling length in centimeters. The seedlings

shoot lengths were measured after the final count (21st day) in standard germination test.

Seedling dry weight (mg): Seedling dry weight was determined by oven-drying ten healthy seedlings at $80 \pm 1^\circ\text{C}$ for 24 h after the final germination count (21 days), and the mean dry weight was recorded.

Seed Vigour Index-I: Seed vigour index-I (length) was computed according to Abdul Baki & Anderson (1973).

Seed vigour index-I (length) = Germination (%) $\times$ Seedling length (cm).

Seed Vigour Index-II: Seedling vigour index-II (mass) was computed according to Abdul Baki & Anderson (1973).

Seedling vigour index-II: (Mass) = Germination (%) $\times$ Seedling dry weight (mg)

Results and discussion

Test weight (g)

During 2023–24, the no-cutting treatment recorded the highest test weight (11.98 g), followed by one cutting (10.61 g), whereas two cuttings recorded the lowest value (9.26 g) (Table 1). Among the PGRs, benzyl adenine at 20 ppm recorded the highest test weight (11.44 g), which was statistically at par with benzyl adenine at 10 ppm (11.31 g) and GA₃ at 50 ppm (11.13 g). The control treatment recorded the lowest test weight (9.86 g). A similar trend was observed during 2024–25, with the highest test weight under no cutting (12.58 g) and benzyl adenine at 20 ppm (12.22 g), while two cuttings (10.52 g) and the control (11.07 g) recorded the lowest values. Overall, no cutting and benzyl adenine at 20 ppm consistently produced the highest test weight across both years, although the latter remained statistically at par with benzyl adenine at 10 ppm and GA₃ at 50 ppm.

The study of the data indicated that the interaction between leaf cutting and PGRs application assessed non-significant for test

weight for both years in the coriander crop. These results are consistent with those of Gill *et al.*, (2001) and Singh *et al.*, (2021) who found that cutting practices significantly reduced seed quality parameters, including test weight. The lower test weight observed in the two cuttings treatments can be attributed to decreased photosynthetic reserves and poor nutrient translocation to seeds. Similarly, Rana *et al.*, (2015) and Singh *et al.*, (2017) found that no cutting resulted in higher test weight because of continuous vegetative growth and optimal nutrient distribution. Plant growth regulators (PGRs) significantly improved seed quality with benzyl adenine at 20 ppm resulting in the highest test weight. Shivran *et al.*, (2016), Parmar *et al.*, (2018), Sahu *et al.*, (2022), Dubey *et al.*, (2024) and Nair *et al.*, (2024) discovered that BA increased seed density and quality significantly.

Standard germination (%)

The no-cutting treatment recorded the highest standard germination (91.59%), followed by one cutting (87.44%), while two cuttings recorded the lowest germination (84.96%) in 2023–24 (Table 2). Among the PGRs, benzyl adenine at 20 ppm recorded the highest germination (92.33%), which was statistically at par with benzyl adenine at 10 ppm (91.44%). The control (water spray) recorded the lowest germination (83.89%). A similar trend was observed during 2024–25, with the highest germination under no cutting (92.37%) and benzyl adenine at 20 ppm (93.44%), which remained statistically at par with benzyl adenine at 10 ppm (93.56%). The lowest germination was recorded under two cuttings (87.78%) and the control (84.67%). Overall, no cutting and benzyl adenine at 20 ppm consistently recorded the highest standard germination across both years, whereas two cuttings and the control produced the lowest values.

These findings are related to with Nandal *et al.*, (2010), Singh *et al.*, (2021), Rana *et al.*, (2015) and Tehlan & Thakral (2008) who emphasised

Table 1. Influence of leaf cuttings and different plant growth regulators application on test weight (g) of coriander

Cutting PGR	2023-24				2024-25				Overall Mean
	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	
Salicylic acid @ 50 ppm	11.83	9.88	8.86	10.19	12.30	11.64	9.95	11.30	10.75
Salicylic acid @ 100 ppm	11.95	10.03	9.12	10.37	12.42	11.70	10.09	11.40	10.89
Jasmonic acid @ 50 ppm	12.08	10.64	9.53	10.75	12.75	11.82	10.85	11.80	11.28
Jasmonic acid @ 100 ppm	11.99	10.32	9.29	10.53	12.59	11.74	10.32	11.55	11.04
Benzyl adenine @ 10 ppm	12.25	11.74	9.95	11.31	12.96	12.02	11.40	12.13	11.72
Benzyl adenine @ 20 ppm	12.28	11.86	10.17	11.44	13.05	12.08	11.52	12.22	11.83
GA ₃ @ 50 ppm	12.16	11.53	9.69	11.13	12.80	11.95	10.94	11.90	11.52
NAA @ 75 ppm	11.70	9.76	8.54	10.00	12.24	11.52	9.90	11.22	10.61
Control (water spray)	11.61	9.77	8.22	9.86	12.08	11.40	9.72	11.07	10.47
Mean	11.98	10.61	9.26		12.58	11.76	10.52		
Overall mean	No cutting				One cutting				
	12.28				11.18				
	2023-24				2024-25				
	SE(m)		CD at 5%		SE(m)		CD at 5%		
Cutting	0.04		0.17		0.06		0.22		
PGR	0.15		0.42		0.11		0.32		
Cutting × PGR	0.13		-		0.16		-		

the importance of maintaining foliage in ensuring optimal nutrient allocation to seed development and thus improving germination rates. The application of benzyl adenine at 20 ppm resulted in the highest germination percentage. This is attributed to BA's role in promoting cell division, protein synthesis, and hormonal balance all of which are necessary for germination. BA also stimulates enzymes that mobilise energy during germination (Dubey *et al.*, 2024, Nazmy, (2020), Shivran & Jat, 2013 and Ahmed, (2007).

Seedling length (cm)

During 2023–24, the no-cutting treatment recorded the highest seedling length (22.73 cm), followed by one cutting (20.93 cm), while two cuttings produced the shortest seedlings (19.56 cm) (Table 3). Among the PGRs, benzyl adenine at 20 ppm recorded the maximum seedling length (22.88 cm), which was statistically at par with benzyl adenine at 10 ppm (22.63 cm). The control (water spray) recorded the minimum seedling length (19.12 cm). A similar trend was observed during 2024–25, with the

Table 2. Influence of leaf cuttings and different plant growth regulators application on standard germination (%) of coriander

Cutting PGR	2023-24				2024-25				Overall Mean
	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	
Salicylic acid @ 50 ppm	90.67	84.33	81.33	85.44	90.33	88.33	86.33	88.33	86.89
Salicylic acid @ 100 ppm	91.67	85.00	82.67	86.44	92.00	89.33	87.67	89.67	88.06
Jasmonic acid @ 50 ppm	92.33	88.00	86.33	88.89	92.67	91.33	89.33	91.11	90.00
Jasmonic acid @ 100 ppm	92.00	86.67	85.33	88.00	93.00	90.00	88.67	90.56	89.28
Benzyl adenine @ 10 ppm	93.67	92.00	88.67	91.44	94.67	94.33	91.67	93.56	92.50
Benzyl adenine @ 20 ppm	94.33	93.33	89.33	92.33	94.67	95.00	90.67	93.44	92.89
GA ₃ @ 50 ppm	93.00	90.00	88.33	90.44	95.00	92.67	90.33	92.67	91.56
NAA @ 75 ppm	89.33	84.00	82.00	85.11	89.67	84.67	83.33	85.89	85.50
Control (water spray)	87.33	83.67	80.67	83.89	89.33	82.67	82.00	84.67	84.28
Mean	91.59	87.44	84.96		92.37	89.82	87.78		
Overall mean	No cutting 91.98				One cutting 88.63		Two cuttings 86.37		
	2023-24				2024-25				
Factors	SE(m)		CD at 5%		SE(m)		CD at 5%		
Cutting	0.33		1.35		0.16		0.64		
PGR	0.51		1.44		0.59		1.67		
Cutting × PGR	1.00		-		0.48		-		

highest seedling length under no cutting (23.59 cm) and benzyl adenine at 20 ppm (23.56 cm), which remained statistically at par with benzyl adenine at 10 ppm (23.25 cm) and GA₃ at 50 ppm (22.34 cm). The lowest seedling length was recorded under two cuttings (20.38 cm) and the control (20.01 cm). Overall, no cutting and benzyl adenine at 20 ppm consistently produced the maximum seedling length across both years. The interaction between cutting practices and PGR application was significant, with the combination of no cutting and benzyl adenine at 20 ppm recording the highest seedling length (23.57 and 24.70 cm during

2023–24 and 2024–25, respectively), which was statistically at par with no cutting combined with benzyl adenine at 10 ppm, GA₃ at 50 ppm, and jasmonic acid at 50 and 100 ppm in both years. The minimum seedling length was recorded under two cuttings combined with the control treatment (17.27 and 18.46 cm during 2023–24 and 2024–25, respectively).

The treatments also had a significant effect on seedling length, with no cutting resulting in the longest seedlings followed by one cutting. Because the retained foliage contributed to consistent photosynthesis and the seedlings

Table 3. Influence of leaf cuttings and different plant growth regulators application on seedling length (cm) of coriander

Cutting PGR	2023-24				2024-25				Overall Mean
	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	No cut- ting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	
Salicylic acid @ 50 ppm	22.27	20.13	17.87	20.09	23.17	20.21	19.46	20.95	20.52
Salicylic acid @ 100 ppm	22.93	20.07	19.20	20.73	23.22	19.78	19.81	20.94	20.84
Jasmonic acid @ 50 ppm	23.37	21.53	19.90	21.60	23.72	21.65	20.75	22.04	21.82
Jasmonic acid @ 100 ppm	22.53	20.61	19.87	21.00	23.69	20.75	19.87	21.44	21.22
Benzyl adenine @ 10 ppm	23.51	22.60	21.76	22.63	24.32	22.92	22.59	23.25	22.94
Benzyl adenine @ 20 ppm	23.57	22.94	22.13	22.88	24.70	22.56	23.43	23.56	23.22
GA ₃ @ 50 ppm	23.43	21.87	20.17	21.82	24.25	21.87	20.91	22.34	22.08
NAA @ 75 ppm	21.80	19.67	17.84	19.77	22.70	19.57	19.15	20.47	20.12
Control (water spray)	21.13	18.97	17.27	19.12	22.55	19.02	18.46	20.01	19.57
Mean	22.73	20.93	19.56		23.59	20.81	20.38		
Overall mean	No cutting 23.16				One cutting 20.87				Two cuttings 19.97
	2023-24				2024-25				
Factors	SE(m)		CD at 5%		SE(m)		CD at 5%		
Cutting	0.06		0.25		0.10		0.40		
PGR	0.21		0.59		0.15		0.42		
Cutting × PGR	0.19		1.04		0.29		0.77		

had enough energy to grow. Leaves synthesise nutrients and hormones required for elongation (Gill *et al.*, 2001, Kumar *et al.*, 2017). Among treatments, BA at 20 ppm and BA at 10 ppm were at par, and resulted in maximum seedling length. BA promotes cell elongation and division which directly contributes to seedling growth (Ahmed, (2007), Shivran *et al.*, 2016, Yugandhar *et al.*, 2014 and Sahu *et al.*, 2022). It also regulates cytokinin levels, which promotes cell proliferation.

Seedling dry weight (mg)

The table assessed that the no-cutting treatment recorded the highest seedling dry weight (3.26

mg), followed by one cutting (2.94 mg), while two cuttings recorded the lowest value (2.76 mg) during 2023–24 (Table 4). Among the PGRs, benzyl adenine at 20 ppm recorded the maximum seedling dry weight (3.31 mg), which was statistically at par with benzyl adenine at 10 ppm (3.25 mg) and GA₃ at 50 ppm (3.15 mg). The control (water spray) recorded the lowest seedling dry weight (2.64 mg). A similar trend was observed during 2024–25, with the highest seedling dry weight under no cutting (3.03 mg) and benzyl adenine at 20 ppm (3.20 mg), which remained statistically at par with benzyl adenine at 10 ppm (3.14 mg) and GA₃ at 50 ppm (3.05 mg). The lowest values were recorded

under two cuttings (2.72 mg) and the control (2.52 mg). Overall, no cutting and benzyl adenine at 20 ppm consistently produced the highest seedling dry weight across both years, whereas two cuttings and the control recorded the lowest values. The interaction between cutting practices and PGR application was not significant for seedling dry weight.

These findings are consistent with Kumar & Singh (2007) and Tehlan & Thakral (2008) who found that retaining foliage promotes biomass accumulation. Similarly, Nandal *et al.*, (2010) noted that no cutting treatments allow for the accumulation of energy reserves which

directly improves seedling dry weight. PGRs applications increased seedling dry weight even more with benzyl adenine at 20 ppm. This is consistent with result of Dubey *et al.*, (2024), Sahu *et al.*, (2022) and Aminifard *et al.*, (2020) which found that BA promotes biomass accumulation. Furthermore, Hirpara *et al.*, (2015) and Vaja *et al.*, (2017) reported that GA3 significantly increases seedling dry weight by enhancing nutrient uptake and utilization.

Seed vigour index I

The no-cutting treatment recorded the highest seed vigour index-I (2083), followed by one cutting (1835), while two cuttings recorded the

Table 4. Influence of leaf cuttings and different plant growth regulators application on seedling dry weight (mg) of coriander

Cutting PGR	2023-24				2024-25				Overall Mean
	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	
Salicylic acid @ 50 ppm	3.21	2.77	2.60	2.86	2.76	2.62	2.61	2.67	2.77
Salicylic acid @ 100 ppm	3.29	2.87	2.66	2.94	2.94	2.70	2.70	2.78	2.86
Jasmonic acid @ 50 ppm	3.33	3.01	2.76	3.04	3.19	2.81	2.77	2.92	2.98
Jasmonic acid @ 100 ppm	3.24	2.90	2.72	2.96	3.12	2.74	2.72	2.86	2.91
Benzyl adenine @ 10 ppm	3.45	3.26	3.03	3.25	3.39	3.12	2.90	3.14	3.20
Benzyl adenine @ 20 ppm	3.57	3.28	3.08	3.31	3.43	3.21	2.97	3.20	3.26
GA ₃ @ 50 ppm	3.40	3.13	2.92	3.15	3.22	3.09	2.83	3.05	3.10
NAA @ 75 ppm	2.95	2.73	2.56	2.75	2.65	2.56	2.53	2.58	2.67
Control (water spray)	2.87	2.54	2.51	2.64	2.57	2.50	2.48	2.52	2.58
Mean	3.26	2.94	2.76		3.03	2.82	2.72		
Overall mean	No cutting 3.14				One cutting 2.88				Two cuttings 2.74
	2023-24				2024-25				
Factors	SE(m)		CD at 5%		SE(m)		CD at 5%		
Cutting	0.03		0.12		0.03		0.13		
PGR	0.05		0.16		0.04		0.15		
Cutting × PGR	0.09		-		0.10		-		

lowest value (1667) during 2023-24 (Table 5). Among the PGRs, benzyl adenine at 20 ppm recorded the maximum seed vigour index-I (2114), which was statistically at par with benzyl adenine at 10 ppm (2071). The control (water spray) recorded the lowest vigour index-I (1609). A similar trend was observed during 2024-25, with the highest seed vigour index-I under no cutting (2193) and benzyl adenine at 20 ppm (2207), which remained statistically at par with benzyl adenine at 10 ppm (2199). The lowest values were recorded under two cuttings (1796) and the control (1731). Overall, no cutting and benzyl adenine at 20 ppm

consistently produced the highest seed vigour index-I across both years. The interaction between cutting practices and PGR application was significant, with the combination of no cutting and benzyl adenine at 20 ppm recording the highest seed vigour index-I (2223 and 2338 during 2023-24 and 2024-25, respectively), which was statistically at par with no cutting + benzyl adenine at 10 ppm (2203 and 2302) and no cutting + GA₃ at 50 ppm (2179 and 2296). The lowest seed vigour index-I was recorded under two cuttings combined with the control treatment (1393 and 1517 during 2023-24 and 2024-25, respectively).

Table 5. Influence of leaf cuttings and different plant growth regulators application on seedling vigour index I of coriander

Cutting PGR	2023-24				2024-25				Overall Mean
	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	
Salicylic acid @ 50 ppm	2019	1698	1454	1723	2093	1785	1679	1853	1788
Salicylic acid @ 100 ppm	2101	1706	1587	1798	2137	1767	1737	1880	1839
Jasmonic acid @ 50 ppm	2156	1895	1718	1923	2206	1977	1854	2013	1968
Jasmonic acid @ 100 ppm	2074	1786	1696	1852	2203	1868	1762	1944	1898
Benzyl adenine @ 10 ppm	2203	2079	1931	2071	2302	2285	2010	2199	2135
Benzyl adenine @ 20 ppm	2223	2141	1977	2114	2338	2151	2132	2207	2161
GA ₃ @ 50 ppm	2179	1967	1781	1976	2296	2026	1882	2068	2022
NAA @ 75 ppm	1947	1652	1462	1687	2057	1659	1589	1768	1728
Control (water spray)	1846	1587	1393	1609	2108	1567	1517	1731	1670
Mean	2083	1835	1667		2193	1898	1796		
Overall mean	No cutting 2138				One cutting 1854				Two cuttings 1729
	2023-24				2024-25				
Factors	SE(m)		CD at 5%		SE(m)		CD at 5%		
Cutting	20.53		82.76		9.46		38.12		
PGR	24.35		69.45		19.68		56.14		
Cutting × PGR	61.58		130.75		28.37		100.44		

No cutting maintains a consistent nutrient supply and carbohydrate reserves. Higher reserves lead to stronger and more vigorous seedlings (Tehlan & Thakral, 2008; Singh *et al.*, 2021 and Kumar *et al.*, 2017). Benzyl adenine at 20 ppm consistently yielded the highest vigour index by improving hormonal regulation and encouraging better seedling growth parameters like length and dry weight (Dubey *et al.*, 2024; Yugandhar *et al.*, 2014). BA's ability to stimulate metabolic processes directly contributes to increased vigour indices. Retaining foliage increases photosynthetic efficiency and nutrient allocation to seeds, which improves

seedling vigour (Gill *et al.*, 2001; Tehlan & Thakral, 2008). Two cuttings reduced vigour by reducing the carbohydrate reserves available for seedling growth.

Seed vigour index II

During 2023–24, the highest seed vigour index-II was recorded under no cutting (299), followed by one cutting (258), while two cuttings recorded the lowest value (235) (Table 6). Among the PGRs, benzyl adenine at 20 ppm recorded the maximum vigour index-II (306), which was statistically at par with benzyl adenine at 10 ppm (297). The control

Table 6. Influence of leaf cuttings and different plant growth regulators application on seedling vigour index II of coriander

Cutting	2023-24				2024-25				Overall Mean
	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	No cutting (C ₀)	One cutting (C ₁)	Two cuttings (C ₂)	Mean	
PGR									
Salicylic acid @ 50 ppm	291	234	212	245	250	232	226	236	241
Salicylic acid @ 100 ppm	302	244	220	255	271	241	236	249	252
Jasmonic acid @ 50 ppm	308	265	238	270	297	257	248	267	269
Jasmonic acid @ 100 ppm	299	251	233	261	290	247	241	259	260
Benzyl adenine @ 10 ppm	324	300	268	297	321	294	266	294	295
Benzyl adenine @ 20 ppm	336	306	275	306	325	306	271	300	303
GA ₃ @ 50 ppm	316	282	258	285	304	286	255	282	283
NAA @ 75 ppm	263	229	210	234	238	217	210	222	228
Control (water spray)	250	212	202	222	229	206	203	213	217
Mean	299	258	235		280	254	240		
Overall mean	No cutting 290				One cutting 256				
	2023-24				2024-25				
Factors	SE(m)		CD at 5%		SE(m)		CD at 5%		
Cutting	2.59		10.46		2.75		11.10		
PGR	3.43		9.79		3.93		11.20		
Cutting × PGR	7.78		-		8.26		-		

(water spray) recorded the lowest value (222). A similar trend was observed during 2024–25, with the highest vigour index-II under no cutting (280) and benzyl adenine at 20 ppm (300), which remained statistically at par with benzyl adenine at 10 ppm (294). The lowest values were recorded under two cuttings (240) and the control (213). Overall, no cutting and benzyl adenine at 20 ppm consistently produced the highest seed vigour index-II across both years, whereas two cuttings and the control recorded the lowest values. The interaction between cutting practices and PGR application was non-significant.

The seed vigour index II showed a similar pattern with the no cutting treatment yielding the most vigour followed by one and two cuttings. No cutting enhanced nutrient mobilization during seedling growth, resulting in improved seedling vigour. Similar findings have been reported by Singh *et al.*, (2017), Kumar *et al.*, (2017), and Tehlan and Thakral (2008). Among PGRs, benzyl adenine at 20 ppm was the most effective producing the greatest vigour (306 and 300). BA promotes efficient root and shoot development, which leads to higher vigour indices (Ahmed, (2007); Hirpara *et al.*, (2015); Dubey *et al.*, (2024) and Nazmy, (2020).

Conclusion

The results of this study showed that leaf cuttings and plant growth regulator spray had a favourable and substantial relationship with many seed quality parameters. Across both years, the no-cutting treatment consistently recorded superior performance in test weight (11.98–12.58 g), germination (91.59–92.37%), seedling length (22.73–23.59 cm), seedling dry weight (3.26–3.03 mg), SVI-I (2083–2193), and SVI-II (280–299), while two cuttings showed the lowest values for all parameters. Among PGR treatments, benzyl adenine at 20 ppm was most effective, recording higher test weight (11.44–12.22 g), germination (92.33–93.44%), seedling length (22.88–23.56 cm), seedling dry

weight (3.31–3.20 mg), SVI-I (2114–2207), and SVI-II (300–306), closely followed by BA at 10 ppm and GA₃ at 50 ppm. Interaction effects were significant only for seedling length and SVI-I, with maximum values under no cutting + BA 20 ppm and minimum under two cuttings + control.

References

- Abdul-Baki A A & Anderson J D 1973 Vigour determination in soybean seed by multiple criteria. *Crop Science*, 13: 630–633. <https://doi.org/10.2135/cropsci1973.0011183X001300060013x>
- Ahmed Shamsheer A M 2007 Effect of growth regulators and stages of fruit harvest on seed yield and quality in Paprika Chilli (*Capsicum annum* L.). Ph D Thesis, University of Agricultural Sciences, Dharwad.
- Aminifard M H, Jorkesh A, Fallahi H R & Moslemi F S 2020 Influences of benzyl adenine and salicylic acid on growth, yield, and biochemical characteristics of coriander (*Coriandrum sativum* L.). *South African Journal of Botany*, 132: 299–303. <https://doi.org/10.1016/j.sajb.2020.05.019>
- Andrabi M, Qureshi A & Singh J 2019a Role of quality seed in agricultural production and national economy. *Journal of Agricultural Science*, 12(3): 45–52.
- Chauhan S K, Sharma R & Singh B 2016 Importance of quality seed in enhancing crop productivity. *Indian Journal of Agricultural Research*, 50(2): 112–118.
- Dubey S, Nair R, Jain S, Sharma A, Thakur H, Koushale M & Ahirwar S 2024 Effect of foliar-applied plant growth regulators on coriander (*Coriandrum sativum* L.) to regulate growth and yield attributes. *Archives of Current Research International*, 24(9): 217–226. <https://doi.org/10.9734/acri/2024/v24i9886>
- Gill BS, Randhawa G S & Saini S S 2001 Effect of sowing dates and herb-cutting management on growth and yield of fenugreek (*Trigonella foenum-graecum*). *Indian Journal of Agronomy*, 46(2): 364–367.

- Hirpara A J, Vaddoria M A & Polara A M 2015 Seed quality as influenced by plant growth regulators in bitter gourd (*Momordica charantia* L.). *Journal of Pure and Applied Microbiology*, 9(4): 3115–3119.
- Hnamte V, Chatterjee R & Paul PK 2013 Coriander (*Coriandrum sativum* L.): A potential seed spice for income generation in Tripura. *International Journal of Agriculture, Environment & Biotechnology*, 6(4): 571–576.
- Indiastat 2024a Crop-wise area, average yield and production of major crops in India. Indiastat.com.
- Indiastat 2024b Crop-wise area, average yield and production of major crops in Haryana. Indiastat.com.
- ISTA 1999 International rules for seed testing. *Seed Science and Technology*, 23: 1-334.
- Kaur H, Singh G, Sharma 2018 Plant growth regulators in sustainable agriculture: A review. *Journal of Pharmacognosy and Phytochemistry*, 7(3): 2969–2974.
- Kumar A & Singh R 2007 Response of fenugreek (*Trigonella foenum graecum*) to different phosphorus and cutting management practices. *The Indian Journal of Agricultural Sciences*, 77(3): 154–157. <https://epubs.icar.org.in/index.php/IJAgS/article/view/3221>
- Kumar R, Singh M K, Kumar M, Kumar V & Tripathi S K 2017. Effect of nitrogen, phosphorus, and cutting management on flowering and yield of green leaves of fenugreek (*Trigonella foenum-graecum* L.). *Annals of Horticulture*, 9(2): 220–224. <http://dx.doi.org/10.5958/0976-4623.2016.00044.X>
- Lal G, Meena R S & Singh D 2019 Coriander cultivation in arid and semi-arid regions of India. *Indian Journal of Agricultural Sciences*, 89(5): 789–794.
- Nair R, Sharma A, Dubey S, Thakur H, Ahirwar S & Koushale M 2024 Influence of plant growth regulators on growth, seed yield and economics of coriander (*Coriandrum sativum* L.) Cv. Jawahar Dhaniya-10. *Journal of Scientific Research and Reports*, 30(10): 854-862.
- Nandal J K, Dahiya M S, Gupta V, Bamel J & Telhan S K 2010 Response of spacing, phosphorus level, and cutting of leaves on growth and yield of coriander. *Indian Journal of Horticulture*, 67(4): 271–275.
- Nazmy A 2020 Effect of benzyl adenine, indole acetic acid and gibberellic acid on vegetative growth, chemical constituents and volatile oil attributes of sweet basil plants. *Egyptian Journal of Horticulture*, 47(1): 41-56.
- Panase VG & Sukhatme PV 1967 *Statistical Methods for Agricultural Workers*, ICAR Publication, New Delhi (4th Ed.), pp. 218-220.
- Phal, Phool, Sabji Utpadan Evam Parirakshan-Package of Practices 2024 Directorate of Extension Education, CCS Haryana Agricultural University, Hisar, Haryana.
- Rana S C, Pandita V K & Sirohi S 2015 Influence of spacing and number of leaf cuttings on seed yield in fenugreek. *Legume Research – An International Journal*, 38(6): 858–860. <http://10.0.73.117/lr.v38i6.6737>
- Sahu P K, Singh D P & Pandey S K 2022 Role of plant growth regulators in crop productivity: A review. *International Journal of Current Microbiology and Applied Sciences*, 11(1): 123- 134.
- Saxena S N, Kakani R K & Sharma Y K 2014a Plant growth regulators in agriculture: Commercial applications. *Advances in Plant Physiology*, 15: 89–102.
- Shivran A C & Jat N L 2013a Effect of bioregulators and their time of application on growth and yield of cumin. *Annals of Plant and Soil Research*, 15(1):5–8.
- Shivran A C & Jat N L 2013b Effect of growth regulators on seed yield of coriander. *Annals of Agricultural Research*, 34(2): 156–160.
- Shivran A C & Jat N L 2016 Influence of bioregulators and their time of application on growth, yield and economics of coriander (*Coriandrum sativum*). *Annals of Agricultural Research*, 34(4):
- Singh D K, Gupta H O, Kumar L & Sharma S L 2021 Studies on effect of cutting and intra row spacing on leaf and seed yield of fenugreek

- (*Trigonella foenum-graecum* L.). Journal of Agriculture and Ecology, 12: 74–79.
- Singh P, Mor V, Khan M & Kumar S 2017a Effect of foliage cuttings on seed yield and quality of coriander (*Coriandrum sativum* L.). Advances in Research, 10(4): 1–9.
- Singh R, Kumar V & Meena B S 2017b Impact of foliage cuttings on seed yield and quality of coriander. Journal of Spices and Aromatic Crops, 26(1): 34–39.
- Tehlan SK & Thakral KK 2008 Effect of different levels of nitrogen and leaf cutting on leaf and seed yield of coriander (*Coriandrum sativum* L.). Journal of Spices and Aromatic crops, 17(2):
- Vaja A D, Patel J B, Daki R N & Chauhan S A 2017. Effect of nitrogen and plant growth regulators on seed yield per plant and seed quality parameters in brinjal (*Solanum melongena* L.). Journal of Applied and Natural Science, 9(4): 2338–2343.
- Yugandhar V, Reddy P S S, Sivaram G T, & Reddy D S 2014 Effect of growth regulators on growth, seed yield and quality of coriander (*Coriandrum sativum* L.) v. Sudha. Plant Archives, 14(2): 1083–1086.