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Research Paper

Effect of sowing time, varieties and plant growth regulators on growth, physiological indices and productivity of coriander (*Coriandrum sativum*)

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ABSTRACT

A field experiment was conducted during winter (*rabi*) seasons of 2011–12 and 2012–13 at Agronomy Farm, Jobner, Rajasthan, to study the response of coriander (*Coriandrum sativum* L.) varieties to plant-growth regulators under normal and late-sown conditions grown on irrigated loamy sand soil of semi-arid Eastern Plains Zone of Rajasthan. The experiment consisting of 2 sowing times (normal in the first week of November and late sown in the third week of November), 3 varieties ('RCr 41', 'RCr 435' and 'RCr 480') and 5 plant-growth regulators (PGR), i.e. control (water sprayed), triacontanol @ 1,000 ppm, brassinolide @ 1 ppm, thiourea @ 1,000 ppm and naphthalene acetic acid (NAA) @ 50 ppm at 40 and 70 days after sowing (DAS) making 30 treatment combinations, were replicated thrice in split a plot design, keeping dates of sowing and varieties in main-plots and PGR treatments in subplots. The crop sown at normal sowing time showed significantly higher values of the growth parameters and physiological indices and seed yield (1.48 t/ha), stover yield (2.20 t/ha) and net returns (₹32,810/ha) than the late-sown crop. Variety 'RCr 435', being at par with 'RCr 480', showed significantly higher growth and better physiological indices at all the growth stages. However, the highest seed (1.37 t/ha) and stover (2.03 t/ha) yields and net returns (₹28,478/ha) were obtained from 'RCr 480' coriander. Foliar spray of 1,000 ppm thiourea significantly increased the crop growth at all the stages/phases over other PGRs and remained at par with triacontanol. However, foliar spray of 1,000 ppm triacontanol significantly increased the seed (1.40 t/ha) and stover (2.12 t/ha) yields and net returns (₹30,020/ha) as compared to the other PGRs, while it was at par with brassinolide.

Key words **:** Coriander, PGRs, Physiological indices, Sowing time, Varieties, Yield

Coriander is one of the most important seed spice with respect to export and foreign exchange earnings in India (Peter *et al*., 2006). It is an established fact that a crop when sown at optimum time is able to exploit the environmental factors most favourably. In Rajasthan, temperature starts rising by February onwards coinciding with the time of late flowering and grain-filling stage, coupled with soil-moisture stress which lead to low productivity of coriander. It is largely assumed that the rise in temperature during terminal reproductive stage of coriander is the major cause of reduction in seed yield under late-sown conditions. A late-sown crop produces shrivelled grains as compared to early sowing leading to low yield. For the reasons, if the crop is not sown at normal sowing time, possibilities to enhance the productivity under late-sown conditions is to be explored. Use of some chemicals like triacontanol (a long-chain aliphatic alcohol-based plant-growth regulator) has been reported to induce physiological efficiencies including photosynthetic ability of plants which resulted in better growth and yield of agronomic crops without substantial increase in cost of production (Jain *et al.,* 1988). Thiourea is a sulphydral compound which contains one-SH group and has been known to bring marked biological activity in plants. Use of thiourea as plant-growth regulator may be helpful in this regard (Sahu and Solanki, 1991). Foliar spray of thiourea not only improves growth and development of plants, but also the

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dry-matter partitioning for increased grain yield. Brassinosteroids are a new group of plant hormones with growth-promoting activity (Mandava, 1988). Brassinosteroids improve the resistance in plant against environmental stresses such as water, salinity, low and high temperature stresses and it also enhances the crop productivity (Rao *et al.,* 2002). Application of naphthalic acitic acid (NAA) is known to induce higher physiological efficiency including photosynthetic ability of plants.

Coriander variety 'RCr 41' is an important variety of Rajasthan covering large area and is recommended for normal sowing time. However, the early growth of variety is very slow and the maturity generally coincides with high temperature. Similarly, varieties 'RCr 435' and 'RCr 480' is also covers a large area in the state. It has been reported that the productivity of these varieties has come to stagnate with prevailing management practices. Therefore, it was felt necessary to look for the use of PGRs to break the yield stagnation of these important varieties and its differential effect in term of yield and quality under normal and late-sown conditions. Hence present investigation was carried out to exploit genetic yield potential of the crop to the economic maxima with low-cost technology, time of sowing, varieties and application of plant-growth regulators.

MATERIALS AND METHODS

A field experiment was conducted during the winter (*rabi*) seasons of 2011–12 and 2012–13 at the Agronomy farm, Jobner, (27º05' N, 75° 28' E, 427 m above the mean sea-level). The soil of the experiment field was loamy sand (80.7% sand, 10.9% silt and 8.3% clay), alkaline in reaction (pH 8.2). The soil was low in organic carbon (0.17%), available nitrogen (128.7 kg/ha), medium in available phosphorus (14.6 kg/ha) and available potassium (148.6 kg/ha). The maximum and minimum temperature during the crop-growing season was 32.9 and 1.9ºC during 2011–12 and 34.2 and 0.5°C during 2012–13 respectively. The total rainfall received during the crop growing season of 2011–12 and 2012–13 was 3.0 and 34.2 mm respectively.

The experiment consisting of 2 sowing times (normal: in the first week of November and late: in the third week of November), 3 varieties ('RCr 41', 'RCr 435' and 'RCr 480') and 5 plant-growth regulators, i.e. control (water sprayed), triacontanol @ 1,000 ppm, brassinolide @ 1 ppm, thiourea @ 1,000 ppm and naphthalene acetic acid (NAA) @ 50 ppm at 40 and 70 days after sowing (DAS), making 30 treatment combinations, replicated thrice in a split-plot design, keeping dates of sowing and varieties in main-plots and PGR treatments in subplots. The seeds of coriander varieties seed were sown as per treatments under normal and late sowing in the first and third week of November in both the years. Two foliar sprays of triacontanol @ 1,000 ppm, brassinolide @ 1 ppm, thiourea @ 1,000 ppm and NAA @ 50 ppm were done at 40 and 70 DAS.

The coriander seeds were split into 2 halves and treated with bavistin @ 2 g/kg seed. The sowing was done, in rows at 30 cm apart, behind the hand plough with a seed rate of 12 kg/ha keeping 2–3 cm depth. A uniform dose of 60 kg N, 40 kg P_2O_5 and 20 kg K_2O /ha was applied in all plots. Entire quantity of P and K and half dose of N were applied at the time of sowing and the remaining nitrogen was applied in 2 equal splits–at third and fourth irrigations. All recommended practices were followed during crop-growing season. Eight irrigations were applied during crop-growing season in both the years. Coriander varieties were grown as per sowing time and harvested on 22 March and 20 March during 2012 and 2013 respectively. The physiological indices were calculated. The crop-growth rate (CGR), relative growth rate (RGR), leaf-area ratio (LAR), net assimilation rate (NAR) and leaf-area duration (LAD) were calculated using standard formula, (Radford, 1967).

RESULTS AND DISCUSSION

Effect of sowing times

The normal-sown crop recorded significantly higher plant height, branches/plant and dry-matter/plant at all the stages over the late sown one. The normal-sown crop increased the plant height by 5.5, 20.1, 17.3 and 23.1% at 30, 60, 90 DAS and at harvesting, 37.8 and 38.9% of branches/plant at 90 DAS and at harvesting and 23.3, 14.5, 37.9 and 27.7% of dry-matter at 30, 60, 90 DAS and at harvest, respectively, over late-sown crop (Table 1). The normal-sown crop also had significantly higher chlorophyll content of the leaves, ultimately leading to higher contribution of photosynthates to leaves (Table 4). The increase in crop duration as well as overall growth and vigour of the crop by normal sowing seems to be on account of exposure of plants to many favourable climatic conditions. While under late sowing, prevalence of low temperature at early stage and high temperature at terminal phase of the crop might have adversely (forced maturity) affected the growth of each developing structure. Hornok (1976) also observed that low temperature at the time of emergence caused slow germination of coriander. Balai and Keshwa (2010) also reported similar results in coriander crop due to dates of sowing.

The normal-sown crop recorded significantly higher mean leaf-area index (LAI), crop-growth rate (CGR), relative growth rate (RGR), leaf-area ratio (LAR), net assimilation rate (NAR) and leaf-area duration (LAD) (Tables 2 and 3) almost at all the stages/phases than late-sown crop.

However, late-sown crop showed significantly higher mean RGR at 90 DAS to harvest and NAR at 30–60 DAS as compared to normal-sown crop. The normal-sown crop represented an increase of 16.4, 55.3 and 37.4% of mean LAI at 30, 60 and 90 DAS; 23.2, 14.0, 42.0 and 11.8% of mean CGR at 0–30 DAS, 30–60 DAS, 60–90 DAS and 90 DAS to harvest; 9.9% of mean RGR at 60–90 DAS, 38.6 and 5.5% of mean LAR at 30–60 and 60–90 DAS; and 54.3 and 41.6% of mean LAD at 30–60 DAS and 60–90 DAS, respectively, over late-sown crop. It indicates that in normal-sown crop, the capability of the levels was more to produce dry weight as compared to late-sown crop. The improvement in these growth indices might have contributed to higher biomass at harvest when crop was sown at normal sowing date over late sowing. The normal-sown crop also showed significantly higher chlorophyll content of the leaves, ultimately leading to higher contribution of photosynthates to leaves. These results corroborate the finding of Meena *et al*. (2006).

Significantly higher seed and stover yields were observed under normal-sown crop and represented an increased 32.1 and 26.4% of seed and stover yields over late-sown crop (Table 4). This might be owing to favourable environmental conditions available to the crop during its initial growth, flowering and fruiting stages. The possible reason for low yield in delayed sowing might be due to insufficient time for vegetative growth as the plant entered the reproductive phase at a faster rate. The cumulative effect of higher values of yield attributes led to production of higher yield under normal-sown crop. It is an established fact that sink capacity largely governs crop productivity (Evans, 1975). It was because of the fact that optimum sowing time resulted in higher growth parameters, improved the yield-attributing characters and hence improved the seed and stover yield or in other words yield is a function of yield attributes. These results corroborate the findings of Meena *et al*. (2006), who noted higher yield under normal-sown crop.

Planting of coriander at normal-sown conditions resulted significantly higher net returns as compared to late-sown conditions (Table 4). The normal-sown crop fetched significantly higher net returns than late-sown crop. The higher seed yield obtained under this treatment and similar cost of cultivation as late-sown conditions resulted increased net returns under normal-sown crop. These results confirm the findings of Balai and Keshwa (2010).

Response of varieties

Variety 'RCr 435' being at par with 'RCr 480', produced significantly better plant growth parameters over 'RCr 41' and the increase of 19.5 and 22.1% branches/plant at 90 DAS and at harvesting; 18.4, 15.3, 17.7 and

Table 1. Effect of sowing time, varieties and plant-growth regulators on plant height, branches/plant and dry-matter accumulation of coriander (pooled data of 2 years)

Treatment	Plant height (cm)				Number of branches/plant		Dry-matter accumulation (g)/plant			
	30 DAS	60 DAS	90 DAS	At harvesting	90 DAS	At harvesting	30 DAS	60 DAS	90 DAS	At harvesting
Sowing time										
Normal	3.85	13.84	81.71	100.83	5.91	7.14	0.0553	1.018	7.89	11.90
Late	3.65	11.52	69.67	81.89	4.29	5.14	0.0449	0.889	5.73	9.32
SEm±	0.03	0.12	0.68	0.98	0.05	0.06	0.0005	0.009	0.08	0.11
CD (P=0.05)	0.09	0.35	2.01	2.88	0.15	0.17	0.0014	0.027	0.23	0.32
Varieties										
'RCr 41'	3.64	11.79	80.33	99.63	4.47	5.30	0.0451	0.873	6.16	9.69
'RCr 435'	3.83	13.29	74.45	88.67	5.34	6.47	0.0534	1.007	7.25	11.23
'RCr 480'	3.77	12.97	72.29	85.77	5.49	6.65	0.0518	0.981	7.02	10.92
SEm±	0.04	0.15	0.84	1.20	0.06	0.07	0.0006	0.011	0.10	0.13
CD (P=0.05)	0.11	0.43	2.46	3.52	0.18	0.21	0.0017	0.033	0.28	0.39
Plant growth regulators										
Control	3.72	11.33	67.04	79.19	3.92	4.77	0.0493	0.880	5.61	8.81
Triacontanol @ 1,000 ppm	3.72	13.31	79.61	96.38	5.68	6.81	0.0498	0.991	7.29	11.37
Brassinolide @ 1 ppm	3.77	12.51	74.67	89.36	5.01	6.02	0.0507	0.942	6.98	10.81
Thiourea @ 1,000 ppm	3.81	13.39	81.23	99.44	5.72	6.91	0.0510	1.009	7.33	11.47
NAA @ 50 ppm	3.72	12.88	75.92	92.44	5.16	6.20	0.0498	0.947	6.86	10.61
SEm±	0.04	0.14	0.82	1.17	0.07	0.07	0.0008	0.011	0.08	0.13
CD (P=0.05)	NS	0.41	2.29	3.29	0.19	0.20	NS	0.030	0.24	0.36

DAS, Days after sowing; NAA, naphthalic acitic acid; ppm, parts per million

15.9% dry-matter accumulation/plant at 30, 60, 90 DAS and at harvesting, respectively, over ‘RCr 41’ respectively (Table 1). However, at later stages, the plant height was significantly increased under variety ‘RCr 41’ by 12.4 and 16.2% over ‘RCr 480’ and 7.9 and 11.1% over ‘RCr 435’ at 90 DAS and at harvesting, respectively. The varieties ‘RCr 435’ and ‘RCr 480’ also showed significantly higher chlorophyll content of the leaves at 75 DAS (Table 4) due to genotypic characters of the variety. It is an established fact that growth, development and yield potential of crop/ variety is an outcome of genomic, environmental and agronomic interactions. Since these varieties were grown under identical agronomic management practices and environmental condition, the observed variation in overall growth of varieties seems to be due to their genetic milieu. The better growth of ‘RCr 435’ than the other varieties was also observed at Jobner (Balai and Keshwa, 2010).

Among these varieties, ‘RCr 435’, being at par with ‘RCr 480’, recorded significantly higher growth indices than ‘RCr 41’ (Tables 2 and 3). Variety ‘RCr 435’ represented an increase of 15.6, 33.8 and 19.4% of mean LAI at 30, 60 and 90 DAS; 18.1, 15.3, 18.0 and 13.0% of mean CGR at 0–30, 30–60, 60–90 DAS and 90 DAS harvest; 22.4% of mean LAR at 30–60 DAS, 33.4 and 23.8% at 30–60 and 60–90 DAS, respectively over ‘RCr 41’. These varieties could not bring any significant variation in mean RGR of coriander at all the growth phases and mean LAR at 60–90 days phase. However, variety ‘RCr 41’ recorded significantly higher mean NAR at 30–60 and 60–90 DAS over ‘RCr 435’ and ‘RCr 480’ and represented an increase of 10.1 and 9.8% at 30–60 DAS phase and 4.7 and 4.7% at 60–90 DAS, respectively, over ‘RCr 435’ and ‘RCr 480’. The significant increase in biomass production under varieties ‘RCr 435’ and ‘RCr 480’ could be ascribed to its higher branching potential, which might have facilitated larger canopy development thus, LAI. The improvement in these growth parameters might be owing to more interception and absorption of radiant energy, resulting in greater photosynthesis and finally dry-matter accumulation. Varieties ‘RCr 435’ and ‘RCr 480’ also had significantly higher chlorophyll content in the leaves at 75 DAS (Table 4) owing to genotypic character of the variety. These results confirm the findings of Balai (2005) in coriander.

It was observed that seed and stover yields were significantly higher with variety ‘RCr 480’ than ‘RCr 41’ and showed an increase of 14.2 and 8.0% of seed and stover yields but remained at par with ‘RCr 435’ (Table 4). Coriander yield formation is a complex process and governed by interaction between source (photosynthesis and avail-

Table 2. Effect of sowing time, varieties and plant-growth regulators on leaf-area index, crop-growth rate and relative growth rate of coriander (pooled data of 2 years)

Treatment	Leaf-area index			Crop-growth rate (g/m^2/day)				Relative-growth rate (mg/g/day)		
	30 DAS	60 DAS	90 DAS	0–30 DAS	30–60 DAS	60–90 DAS	90 DAS-harvesting	30–60 DAS	60–90 DAS	90 DAS-harvesting
Sowing time										
Normal	0.0263	1.449	3.93	0.0615	1.069	7.64	4.46	87.4	61.3	12.3
Late	0.0226	0.933	2.86	0.0499	0.938	5.38	3.99	89.6	55.8	14.6
SEm±	0.0003	0.014	0.03	0.0005	0.009	0.07	0.04	0.8	0.6	0.1
CD (P=0.05)	0.0009	0.040	0.09	0.0016	0.028	0.19	0.12	NS	1.7	0.4
Varieties										
‘RCr 41’	0.0224	0.985	3.04	0.0502	0.919	5.88	3.91	88.9	58.2	13.7
‘RCr 435’	0.0259	1.318	3.63	0.0593	1.060	6.94	4.42	88.2	58.8	13.3
‘RCr 480’	0.0251	1.270	3.53	0.0575	1.032	6.71	4.33	88.3	58.6	13.4
SEm±	0.0004	0.017	0.04	0.0007	0.012	0.08	0.05	1.0	0.7	0.2
CD (P=0.05)	0.0010	0.049	0.11	0.0019	0.034	0.24	0.14	NS	NS	NS
Plant growth regulators										
Control	0.0240	0.945	2.65	0.0548	0.922	5.25	3.56	86.6	55.2	13.7
Triacontanol @ 1,000 ppm	0.0242	1.329	3.77	0.0553	1.045	7.00	4.53	89.9	59.6	13.5
Brassinolide @ 1 ppm	0.0245	1.121	3.37	0.0563	0.990	6.71	4.25	87.8	59.8	13.3
Thiourea @ 1,000 ppm	0.0251	1.382	3.91	0.0567	1.064	7.02	4.60	89.7	59.2	13.6
NAA @ 50 ppm	0.0246	1.178	3.30	0.0553	0.996	6.56	4.17	88.5	59.1	13.3
SEm±	0.0004	0.020	0.05	0.0006	0.011	0.08	0.05	1.0	0.7	0.2
CD (P=0.05)	NS	0.058	0.15	NS	0.032	0.22	0.14	2.9	1.9	NS

DAS, Days after sowing; NAA, naphthalic acitic acid; ppm, parts per million

ability of assimilates in leaves etc.) and sink component (storage organs). Thus, as a consequence of marked improvement in both these regulative process as evident from higher accumulation of biomass and nutrients as well as yield components in varieties 'RCr 480' and 'RCr 435' led to significant increase in seed yield. Further, the seed yield of coriander is dependent on 2 most important components, namely umbels/plant and seeds/umbel. Thus, owing to more number of seeds by virtue of increased number of umbels/plant, seeds/umbel and test weight under 'RCr 480' and 'RCr 435' might have increased the seed yield over 'RCr 41'. The marked variation in various yield components and yield between these varieties 'RCr 480', 'RCr 435' and 'RCr 41' was also observed under multilocation trials conducted under AICRP on Spices (Balai and Keshwa, 2010; AICRPS, 2011). Variety 'RCr 480' gave significantly higher net returns than 'RCr 41' and 'RCr 435'. Despite the same cost of cultivation for these varieties, the higher seed yield recorded under variety 'RCr 480' has led to increased net returns as compared to 'RCr 435' and 'RCr 41'. These results also support by the findings of Balai and Keshwa (2010).

Effect of plant-growth regulators

Foliar application of PGRs significantly increased the growth parameters, viz. plant height, branches/plant, dry matter accumulation/plant and total chlorophyll content of leaves over the control (Table 1). Foliar spray of 1,000 ppm thiourea remained at par with 1,000 ppm triacontanol and significantly enhanced the plant height by 18.2, 7.0 and 4.0% at 60 DAS; 21.2, 8.8 and 7.0% at 90 DAS; and 25.6, 11.3 and 7.6% at harvest; branches/plant by 45.9, 14.2 and 10.8% at 90 DAS and 44.9, 14.8 and 11.5% at harvest; and dry-matter accumulation/plant by 14.6, 6.5 and 7.1% at 60 DAS, 30.7, 6.8 and 5.0% at 90 DAS and 30.2, 8.1 and 6.1% at harvest stages over the control, brassinolide and NAA respectively. While brassinolide significantly increased the plant height, branches/plant and dry-matter accumulation over the control and remained at par with NAA. All the PGRs significantly increased the total chlorophyll content in leaves at 75 DAS compared to control, but highest was recorded under thiourea 1,000 ppm. The favourable effect of thiourea on plant growth might be due to improved photosynthetic efficiency. The positive action of thiourea on growth could be ascribed due to one or a number of reasons. It might be due to the change in the metabolites present in the seedlings as a result of changed activity of hydrolytic enzymes and change in the oxidation mechanism, especially those concerned with electron transport (Poljakoff-Mayber *et al.,* 1958). These results also support the findings of Meena *et al*. (2014) in coriander.

Table 3. Effect of sowing time, varieties and plant growth regulators on leaf-area ratio, net assimilation rate and leaf-area duration of coriander (pooled data of 2 years)

Treatment	Leaf-area ratio (cm^2/g)		Net assimilation rate (g/m^2 leaf area /day)		Leaf-area duration (days)	
	30–60 DAS	60–90 DAS	30–60 DAS	60–90 DAS	30–60 DAS	60–90 DAS
Sowing time						
Normal	229.4	224.4	3.27	3.22	22.1	80.7
Late	165.5	212.6	4.12	3.24	14.3	57.0
SEm±	1.8	2.1	0.04	0.03	0.2	0.6
CD (P=0.05)	5.4	6.1	0.11	NS	0.5	1.9
Varieties						
'RCr 41'	173.3	215.8	3.93	3.33	15.1	60.3
'RCr 435'	212.1	221.9	3.57	3.18	20.2	74.7
'RCr 480'	207.1	217.9	3.58	3.18	19.4	71.5
SEm±	2.3	2.5	0.04	0.04	0.2	0.8
CD (P=0.05)	6.6	NS	0.13	0.11	0.6	2.3
Plant growth regulators						
Control	166.8	194.4	4.00	3.24	14.5	53.9
Triacontanol @ 1,000 ppm	216.1	230.1	3.52	3.13	20.3	76.4
Brassinolide @ 1 ppm	188.6	220.6	3.77	3.40	17.2	67.4
Thiourea @ 1,000 ppm	221.5	236.9	3.48	3.05	21.1	79.3
NAA @ 50 ppm	194.6	210.6	3.70	3.34	18.0	67.1
SEm±	2.3	2.5	0.04	0.04	0.2	0.8
CD (P=0.05)	6.4	7.0	0.12	0.11	0.6	2.2

DAS, Days after sowing; NAA, naphthalic acitic acid; ppm, parts per million

Growth indices of coriander were significantly influenced by application of plant-growth regulators (Tables 2 and 3). Foliar spray of 1,000 ppm thiourea, being at par with triacontanol, significantly increased mean LAI at 60 and 90 DAS, CGR at 30–60, 60–90 DAS and 90 DAS to harvest and mean LAR at 30–60 and 60–90 DAS as compared to control, NAA and brassinolide. However, foliar application of all PGRs significantly increased the mean RGR at 30–60 and 60–90 DAS compared to the control and remained at par with each other, and maximum mean RGR was recorded under thiourea. Water-sprayed control brought significant improvement in mean NAR as compared to all the PGR treatments at 30–60 DAS. Among the PGRs, foliar application of brassinolide, being at par with NAA, significantly increased the mean NAR at 30–60 DAS over triacontanol and thiourea. However, at 60–90 DAS foliar application of brassinolide, being at par with NAA, recorded significantly higher mean NAR over the control, triacontanol and thiourea. Foliar application of thiourea significantly increased LAD over the control, NAA, brassinolide and triacontanol at both the phases. The positive effect on mean LAI, LAD, CGR, LAR, RGR and NAR also provided a clue to such a possibility that thiourea might have resulted in creation of more photosynthetically active leaf area for longer period during vegetative and reproductive phases, resulting in more absorption and utilization of radiant energy which ultimately led in higher dry-matter accumulation, number of branches and plant height. These findings are in close conformity with the results of Balai (2005) in coriander.

Foliar application of PGRs significantly increased the seed and stover yields of coriander over the control. Foliar spray of triacontanol, being at par with brassinolide significantly increased the seed yield by 8.5, 9.4 and 21.7% and stover yield by 6.0, 12.2 and 19.8% over thiourea, NAA and control respectively. This might owing to the stimulatory effect of growth regulators which induce large number of reproductive sinks leading to greater activity of carboxylating enzymes (ribose 1, 5-di phosphate carboxylase), thus resulting in higher photosynthetic rates with greater translocation and accumulation of metabolites in sink (Nehara *et al*., 2006) and ultimately higher seed yield. The favourable hormonal balance maintained at cellular levels due to application of PGRs may also have greater photosynthetic efficiency and enzymatic activities through the production of endogenous auxins. The similar response with foliar spray of triacontanol was also reported by Nehara *et al*. (2006) in fenugreek and Sarada *et al*. (2008) in coriander. Foliar application of all the PGRs significantly increased the net returns over water spray (Table 4). Significantly higher net returns were recorded with foliar spray of 1,000 ppm triacontanol compared to the other PGRs. This treatment enhanced the net returns by Rs 9,000, 4,350, 4,360 and 3,735/ha over water-sprayed control, 50 ppm NAA, 1.0 ppm brassinolide and 1,000 ppm thiourea respectively. The cost of triacontanol was lower

Table 4. Effect of sowing time, varieties and plant-growth regulators on chlorophyll content, yields and net returns (pooled data of 2 years)

Treatment	Total chlorophyll content at 75 DAS (mg/g)	Yield (t/ha)		Net returns (₹/ha)
		Seed	Stover	
Sowing time				
Normal	2.46	1.48	2.20	32,810
Late	2.13	1.12	1.74	18,652
SEm±	0.03	0.02	0.02	317
CD (P=0.05)	0.08	0.04	0.07	933
Varieties				
'RCr 41'	2.16	1.20	1.88	21,597
'RCr 435'	2.40	1.34	2.03	27,118
'RCr 480'	2.32	1.37	2.03	28,478
SEm±	0.03	0.02	0.03	388
CD (P=0.05)	0.09	0.05	0.08	1,142
Plant growth regulators				
Control	2.09	1.15	1.77	21,020
Tricontanol @ 1,000 ppm	2.32	1.40	2.12	30,020
Brassinolide @ 1 ppm	2.34	1.38	2.06	25,660
Thiourea @ 1,000 ppm	2.40	1.29	2.00	26,285
NAA @ 50 ppm	2.30	1.28	1.89	25,670
SEm±	0.04	0.02	0.03	345
CD (P=0.05)	0.10	0.05	0.07	969

DAS, Days after sowing; NAA, naphthalic acitic acid; ppm, parts per million

in comparison to added outputs. Thus, the increased seed yield led to higher net returns. These results are in close conformity with the findings of Sarada *et al.* (2008).

It may be concluded that sowing of coriander variety 'RCr 480' in the first week of November with foliar application of 1,000 ppm triacontanol at 40 and 70 DAS gives higher yield and net returns in semi-arid eastern plain zone of Rajasthan.

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