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Effect of Phytohormones on Seed Germination and Seedling Growth of *Coriandrum sativum* L.

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Abstract: Coriander commonly known as Dhania or Chinese parsley is generally grown for its use in soups, salads, dressing vegetables, seasoning and chutney. Effect of two phytohormones viz. GA_3 and 2,4-D on seed germination, seedling growth and various physiological and biochemical parameters were studied. The hormones were applied individually in different concentrations (10, 50 and 100 μM concentrations). Both the hormones enhanced the germination percentage, seedling growth (root and shoot length), leaf area, chlorophyll and carotenoid content. The application of these hormones also decreased the germination time. Maximum germination, shoot length, leaf area and carotenoid content was observed in 100 μm concentration of GA_3. Root length, chl. a and chl. b was maximum in 50 μM of 2,4-D and 100 μm GA_3, respectively. The application of two hormones exhibited a marked increase on all the parameters studied as compared to the control.

Key words: Carotenoid, chlorophyll, dhania, growth hormones, leaf area

INTRODUCTION

Coriandrum sativum is an annual herb of the family Apiaceae and grown all over the world primarily for its seed and seed oil (Verma and Sen, 2008). This crop is native of the Mediterranean region and is normally grown in several countries of the world viz. Bangladesh, India, Russia, Central Europe and Morocco and also cultivated since human antiquity. This is an erect, sweet-smelling herb attains a height upto 50-100 cm in length with multiple branching. The stem is smooth and greenish in colour. The leaves are thin, compound, alternate and easily breakable. The flowers are white or pinkish and the inflorescence is umbel. The fruits are having longitudinal ridges (Dierchesen, 1996). The extract of coriander is highly beneficial in deficiencies of vitamin A, B and C. In the traditional system of medicine, seed extract of coriander is used as stimulative, carminative, antispasmodic, diuretic and antirheumatic (Khare, 2007). Plant Growth Regulators (PGRs) are widely used for modifying the growth and development of many agricultural crops. Phytohormones are the chemicals generally related with the enhancent of plant growth in minute quantity (Naeem *et al*., 2004). Gibberellins are the PGRs with stimulating effects as they increase shoot length due to accelerated cell division and enlargement of their unique effects on flowering behavior of majority of plants (Jaleel *et al*., 2009). Gibberellins increased seed germination percentage by attributing the fact that they increase the amino acid content in embryo and cause release of hydrolytic enzymes required for the digestion of endospermic starch (Chauhan *et al*., 2009; Chakraborti and Mukherji, 2003). Auxin is effect GA_3 biosynthesis and deactivation in plants pea, tobacco and barley (O'Neil and Ross, 2002; Ngo *et al*., 2002; Ozga *et al*., 2003). The 2,4-D is a synthetic auxin which improved growth attributes and fruit yield of tomato plant at very low concentrations (Anwar *et al*., 2010). Hence, in the present investigation an attempt has been make to see the effect of these plant growth substances on the germination and subsequently seedling growth of *Coriandrum sativum*.

MATERIALS AND METHODS

An experiment was conducted under laboratory conditions (temperature 30±2°C and humidity 60±2°C) in the Department of Botany, School of Life Sciences, Dr. B.R. Ambedkar University, Agra, during the month of February-March, 2012. The seeds of *Coriandrum sativum* were obtained from National Seeds Corporation, Sikandra, Agra.

The seeds were surface sterilized with 0.01% mercuric chloride solution to prevent the fungal contamination. Seed germination was recorded up to 20 days after the start of the experiment and Seeds were considered germinated when radicle emerged by about 2 mm in length (Mohammadi, 2009). After 15 days, germination

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Table 1: Effect of GA_3 and 2,4-D on seed germination, seedling growth, leaf area, chlorophyll and carotenoid content of *Coriandrum sativum*

Hormones	Conc.	Seed germination (%)	Root length (cm)	Shoot length (cm)	Leaf area (cm^2)	Chl a	Chl b	Total chlorophyll (Chl a and b) (mg g^{-1} FW)	Carotenoid (mg g^{-1} FW)
Control	-	40.00	1.66±0.06	6.06±0.23	3.15±0.02	0.91±0.260	0.25±0.017	1.16±0.277	0.55±0.017
GA_3	10 µM	68.00**	2.16±0.14^{ns}	8.43±0.26*	3.25±0.01**	1.47±0.034	0.30±0.002	1.77±0.036*	0.61±0.011*
	50 µM	81.33**	2.10±0.15^{ns}	9.30±0.20*	3.46±0.04**	1.07±0.277	0.46±0.001	1.53±0.278*	0.68±0.005*
	100 µM	87.13**	1.96±0.20^{ns}	9.76±0.87*	4.19±0.04**	0.97±0.236	0.33±0.028	1.30±0.246*	0.70±0.005*
2, 4-D	10 µM	61.12*	1.93±0.02^{ns}	6.83±0.87*	3.19±0.01*	1.53±0.017	0.38±0.028	1.91±0.045**	0.58±0.009^{ns}
	50 µM	67.00*	2.26±0.13^{ns}	6.46±0.29*	3.51±0.12*	1.56±0.023	0.62±0.023	2.18±0.046**	0.59±0.011^{ns}
	100 µM	68.14*	2.03±0.13^{ns}	6.90±0.05*	3.99±0.05*	1.16±0.335	0.48±0.005	1.64±0.034*	0.57±0.06^{ns}

Data represent average percentage values of 3 replicates, Values represent Mean±standard error, **Highly significant at 5% level of significance, *Significant at 5% level of significance, ns: Non significant at 5% level of significance

percentage was recorded after 24 days and root and shoot length (seedling growth) was measured with the help of a scale. Leaf area was determined by standard graph-paper methods. The leaves were outlined and the squares covered under outline of leaves were counted (Taghipour and Salehi, 2008). An average of 5 leaves was taken per treatment in triplicate. Arnon (1949) techniques was used to determine the amount of chl a and b by measuring the Optical Density (OD) on a Systronics UV Vis Double Beam spectrophotometer at 663 and 645 nm. The check reading was carried out at 652 nm. However, in case of carotenoid content optical density was measured at 440 nm.

Statistical analysis: The experiment was carried out in completely randomized design with three replications. For statistical analysis of data, windows 7 was used and graphs were plotted using microsoft excel. The root/shoot length and biomass were statistically analyzed by analysis of variance (ANOVA) (Steel and Torie, 1984) to determine the level of significance at $p<0.05\%$.

RESULTS AND DISCUSSION

The application of growth regulators GA_3 and 2,4-D improved germination and seedling growth in *Coriandrum sativum*, which is generally based on their concentration and the sensitivity of the organ concerned. Germination is a physiological process, which starts with the imbibition of water by dry seeds and the emergence of root and shoot system from it. Under control conditions, Coriander seeds exhibited only 40% germination. But when the seeds were treated with GA_3 and 2,4-D, germination percentage increased significantly. All the three concentrations of the growth regulators increased the germination percentage. Maximum germination was observed in 100 µM concentration of GA_3 87.13% (Table 1). Similar increase in germination percentage by the application of PGRs have been observed by different workers working on different plants (Chauhan *et al*., 2009; Vamil *et al*., 2010; Rawat and Vashistha, 2011). Both root as well as shoot length increased by the application of growth regulators GA_3 and 2,4-D. Maximum root length was observed at 50 µM 2,4-D and maximum shoot length was observed at 100 µM GA_3. An increase in shoot length by GA_3 have also been observed by Chaudhry and Khan (2000) working on *Cicer arietinum* L., (Vamil *et al*., 2010), while working on *Bambusa arundinacea*. Leaf area also increased significantly by the application of two growth regulators GA_3 and 2,4-D. Plants grown order control conditions exhibited 3.15 cm^2 leaf area. The application of 10 µM GA_3 and 2,4-D increased 3.25 and 3.19 cm^2 leaf area, 50 µM GA_3 and 2,4-D increased 3.46 and 3.51 cm^2, while 100 µM GA_3 and 2,4-D increased 4.19 and 3.99 cm^2 leaf area (Table 1). Similar increase in leaf area by the application of growth regulators have been observed by Sritharan *et al*. (2005) and Vamil *et al*. (2010). Table 1 clearly show the effect of two growth regulators on chlorophyll and carotenoid content of *Coriandrum sativum*. Both chlorophyll and carotenoid content showed a marked increased over control by the application of PGRs. Maximum total chlorophyll content (2.18 mg g^{-1} FW) was observed at 50 µM 2,4-D. Under control condition carotenoid content observed was 0.55 mg g^{-1} FW (Table 1). The application of two growth regulators (GA3 and 2,4-D) exhibited a marked increase in carotenoid content over control. Maximum carotenoid content was observed at 100 µM GA_3. Similarly increase in chlorophyll and carotenoid content by the application of growth regulators have been observed by various workers (Sritharan *et al*., 2005; Vamil *et al*., 2010, 2011; Khandaker *et al*., 2012).

CONCLUSION

In the present investigation, it was observed that the application of two growth regulators (GA_3 and 2,4-D) at different concentrations (10, 50 and 100 µM) enhanced the seed-germination, seedling growth, leaf area, cholorophyll and carotenoid content significantly as compared to the control. As the soil of this region is endowed with high salinity and germination of coriander is a very serious problem. Therefore, the present study will be helpful to farmers of this regions and hormonal treatment may be beneficial for cultivation of this important spice crop.

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