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Research Paper

Influence of gibberellic acid (GA_3) on growth, physiological and yield parameters in Ajwain (*Trachyspermum ammi* L.)

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Abstract: A pot experiment of the effect of GA_3 conduct on *Trachyspermum ammi* L (Ajwain) cv- R.A.19-80 during the rabi season of 2014-2015. The different concentration of GA_3 (15 ppm, 25 ppm, 35 ppm, 50 ppm, 60 ppm, 70 ppm, 80 ppm and 100 ppm) sprayed on the crops to study the growth behaviour, yield attributes and physiological characteristic of Ajwain with three replications. Spray given is two times at 25 and 60 DAS. The highest plant height, plant fresh weight, plant dry weight, relative water content, number of umbels, 1000 seed weight and seed yield was recorded by the treatment of GA_3 @ 100 ppm. The foliar application of GA_3 significantly increased vegetative growth, yield and physiology of Ajwain compared with control. Based on the result, It can be concluded that foliar application GA_3 @100 ppm had significantly on plant growth flowering and yield potential.

Keywords: Gibberellic acid (GA_3), growth, yield, physiology, Ajwain.

INTRODUCTION

Trachyspermum ammi L. (Ajwain) belongs to family Apiaceae. Its centre of origin is Egypt and India and also cultivated in arid and semiarid regions of world like Iran, Pakistan and Afghanistan. It is widely distributed in northern part of India in the states like Rajasthan, Gujarat, Uttar Pradesh, Punjab, Madhya Pradesh, Tamil Nadu and Andhra Pradesh. Ajwain is erect, glabrous or minutely pubescent branched annual herb which grows up to 75-80cm in height. Stem is striate, leaves are distant, and 2-3 innately divided, segments linear. Flowers are white in colour. The seeds are small and yellowish brown in colour **(**Rohamare, *et al.* 2013). Ajwain is also known by other names in literature as owa, omum, Bishop's weed, carom, or Ethiopian cumin. Ajwain is an aromatic seed spices, and it is generally used as a digestive stimulant or to treat liver disorders. A number of medicinal and therapeutic properties have been ascribed to various parts of this plant. Ajwain seed essential oil contains about 40-50% thymol which is a strong germicide, anti-spasmodic

and fungicide. Composition of the Ajwain seeds consist moisture 8.9 percent, protein 15.4 percent, fat 18.1 per cent, minerals 7.1 percent, fibre 11.9 percent, carbohydrates 38.6 percent, calcium 1.42 percent, phosphorus 0.30 percent, and iron 14.6 percent respectively (Dashora, *et al*. 2006). It is reported that the ripening seeds of ajwan contain 2-4% essential oil which is rich in mono terpenes like thymol and it is mainly used as an antiseptic agent as well as drug component in medicine (Gupta, 2002). Thymol is an important alkaloid of Ajwain and is used as an ingredient of deodorants, mouthwashes, toothpastes and many pharmaceutical preparations. Other extracted essential oils containing a liquid hydrocarbon, 1-methyl-4-isopropylbenzol is isomeric with oil of turpentine are used in the food and pharmaceutical industries due to their therapeutic, antimicrobial and antioxidant activities (Zachariah, *et al*. 2008). Ajwain is highly esteemed as a remedial agent for flatulence, flatulent colic, atonic dyspepsia, diarrhoea - in short, as a digestive aid and also as an antiseptic (Bentely and Trimen 1999). The fruits of this plant can be use as an antispasmodic, antiflatulent, anti-rheumatic, diuretic and antimicrobial (Malhotra and Vashishta 2005). Ajwain is an aromatic seed spices, and it is generally used as a digestive stimulant or to treat liver disorders. Thymol, which is the major phenolic compound in ajowan, has been reported to be a germicide, antispasmodic, and antifungal agent (Naglakshmi and Shankaracharya 2000). Plant growth hormone has a promising possiblities for crop improvement in future therefore the plant growth regulators (magic chemicals) are considered as a new generation agro-chemicals after fertilizers, pesticides and herbicides are known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates thereby helping better fruit set. Gibberellic acid (GA_3) stimulate vegetative growth and are involved in the initiation of cell division in the cambium. These plant growth regulators cause osmotic uptake of water which maintain a swelling force against the softening of cell wall **(**Arora, *et al*. 1985). Gibberellic acid (GA_3) is the first highly active and commercially available gibberellin to be purified from a culture medium of *Gibberella fujikuroi* (Sponsel, 1990). Gibberellins (GA_3) are a class of endogenous plant growth substances actively involved in the control of a number of key developmental processes including stem elongation, as well as flower and fruit development (Huttly and Phillips 1995). Plants subjected to exogenous application of GA_3 have been found to exhibit increased activities of carbonic anhydrase, nitrate reductase (Khan 1996). Thus in present investigation an attempt has been made to study the effect of foliar spray of different concentrations of gibberellic acid (GA_3) on growth, yield and physiology in Ajwain.

MATERIAL AND METHODS

A pot experiment for the effect of GA3 have been conducted on Ajwain cv (R. A. 19-80) during the rabi season of 2014-2015.The different concentration of GA3 (15, 25, 35, 50, 60, 70, 80 and 100 ppm) sprayed on the crop to study growth behaviour and yield attributes of Ajwain with R.B.D. and three replications. Sprays have been given in one time at 25 and 60 days after sowing. Parameter observed.

RESULT AND DISCUSSION

The statistical analysis in the Table 1 showed significant result at growth regulator GA_3 foliar spray.

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Table 1. Influence of gibberellic acid (GA_3) on plant height (cm.) at different stages in *Trachyspermum ammi* L.

Treatments		Plant Height (cm)		
		30DAS	60DAS	90DAS
T_1	Control	10.16	26.76	82.20
T_2	GA_3 (15 ppm)	10.40	30.50	83.60
T_3	GA_3 (25 ppm)	10.90	28.40	85.13
T_4	GA_3 (35 ppm)	11.20	35.13	87.73
T_5	GA_3 (50 ppm)	10.50	33.26	90.63
T_6	GA_3 (60 ppm)	11.40	37.80	87.53
T_7	GA_3 (70 ppm)	10.80	36.30	86.53
T_8	GA_3 (80 ppm)	11.60	38.53	94.10
T_9	GA_3 (100 ppm)	12.10	42.26	98.66
	F-test	NS	S	S
	S.Ed(±)	2.701	2.160	3.060
	CD(5%)	5.575	4.459	6.317

Table 2. Influence of gibberellicacid (GA_3)on no. of primary branches, no. of secondary branches, plant fresh weight (g), plant dry weight (g) in *Trachyspermum ammi* L.

	Treatments	No. of primary branches At harvest stage	No. of secondary branches At harvest stage	Plant fresh weight (g) At harvest stage	Plant dry weight (g) At harvest stage
T_1	Control	13.66	35.66	78.50	16.13
T_2	GA_3 (15 ppm)	13.33	34.66	82.60	17.33
T_3	GA_3 (25 ppm)	14.00	38.33	79.53	17.10
T_4	GA_3 (35 ppm)	13.00	34.33	83.20	18.16
T_5	GA_3 (50 ppm)	14.33	36.66	85.83	18.56
T_6	GA_3 (60 ppm)	15.00	43.66	81.50	18.23
T_7	GA_3 (70 ppm)	14.66	40.33	90.80	17.16
T_8	GA_3 (80 ppm)	15.66	45.66	95.55	19.13
T_9	GA_3 (100 ppm)	16.33	50.66	91.90	18.33
	F-test	S	S	S	S
	S.Ed(±)	0.828	1.036	1.062	0.577
	CD(5%)	1.708	2.138	2.193	1.192

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Table 3. Influence of gibberellic acid (GA_3) on no. of umbellates per plant, no. of seed per umbellate, seed yield (g), 1000 seed weight (g) in *Trachyspermum ammi* L.

	Treatments	No. of umbellates per plant	No. of seed per umbellate	Seed yield (g)	1000 seed weight (g)
T_1	Control	162.3	26.00	4.58	1.08
T_2	GA_3 (15 ppm)	165.33	27.33	4.99	1.10
T_3	GA_3 (25 ppm)	163.66	25.33	4.75	1.14
T_4	GA_3 (35 ppm)	167.66	29.66	5.55	1.13
T_5	GA_3 (50 ppm)	172.66	29.33	6.06	1.22
T_6	GA_3 (60 ppm)	171.33	29.33	6.04	1.20
T_7	GA_3 (70 ppm)	175.33	30.33	6.77	1.28
T_8	GA_3 (80 ppm)	173.33	28.33	5.99	1.24
T_9	GA_3 (100 ppm)	180.33	32.66	7.47	1.31
	F-test	S	S	S	S
	S.Ed(±)	1.339	1.087	0.276	0.016
	CD(5%)	2.764	2.244	0.571	0.034

Table 4. Influence of gibberellic acid (GA_3) on total chlorophyll content (mg/g fr. wt.), carotenoid content (mg/g fr. wt.), total protein content (mg/g), relative water content (%) in *Trachyspermum ammi* L.

	Treatments	Total chlorophyll content (mg/g fr. wt.)	Carotenoid content (mg/g fr. wt.)	Total protein content (mg/g)	Relative water content (%)
T_1	Control	1.28	1.35	3.27	50.46
T_2	GA_3 (15 ppm)	1.10	1.54	3.29	54.70
T_3	GA_3 (25 ppm)	1.38	1.45	3.37	57.23
T_4	GA_3 (35 ppm)	1.48	1.52	3.39	55.45
T_5	GA_3 (50 ppm)	1.61	1.41	3.40	60.80
T_6	GA_3 (60 ppm)	1.57	1.59	3.43	62.77
T_7	GA_3 (70 ppm)	1.91	1.69	3.57	66.15
T_8	GA_3 (80 ppm)	1.67	1.64	3.50	64.59
T_9	GA_3 (100 ppm)	2.16	1.82	3.64	68.22
	F-test	S	S	S	S
	S.Ed(±)	0.174	0.023	0.034	1.633
	CD(5%)	0.359	0.048	0.071	3.370

The plant height at 30 DAS differed significantly due to different treatments. Significantly maximum plant height (12.10 cm) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (11.60 cm) found in T_8 (Foliar application of GA_3 @80 ppm) and minimum was recorded (10.16 cm) in T_1 (control). At 60 DAS maximum plant height (42.26 cm) found in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (38.53cm) found in T_8 (Foliar application of GA_3 @ 80 ppm) and minimum was recorded

(26.76 cm) in T_1 (control). At 90 DAS maximum plant height (98.66 cm) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (94.10 cm) found in T_8 (Foliar application of GA_3 @ 80 ppm) and minimum was recorded (82.20 cm) in T_1 (control). Application of GA_3 @50 ppm was found (Moniruzzaman, *et al.,* 2014) to increase in plant height (76.72 cm), stem diameter (1.45 cm). It is also even found effective (Roy and Nasiruddin, 2011) in increase plant height (39.4) and stem fresh weight (46.30 g) in cabbage. The number of primary branches at harvest stages differed significantly due to different treatments. Significantly maximum number of primary branches (16.33) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (15.66) found in T_8 (Foliar application of GA_3 @80 ppm) and minimum was recorded (13.00) in T_4 (Foliar application of GA_3 @35 ppm). Application of GA_3 @ 100 ppm was found (Haq, *et al.,* 2013) to increase in number of primary branches (5.19). Further it is also found effective (Abbas, 2011) number of branches (30.67) in carrot. The number of secondary branches at harvest stages differed significantly due to different treatments. Significantly maximum number of secondary branches (50.66) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (45.66) found in T_8 (Foliar application of GA_3 @80 ppm) and minimum was recorded (34.33) in T_4 (Foliar application of GA_3 @35 ppm). Application of GA_3 @ 100 ppm was found (Pariari, *et al.,* 2012) to increase in number of secondary branches/plant (10.59). It is also even found effective (Prasad, *et al.,* 2013) increase number of branches/plant (10.59) in tomato. The plant fresh weight at harvest stage differed significantly due to different treatments. Significantly maximum plant fresh weight (95.55 g/plant) was recorded in T_8 (Foliar application of GA_3 @ 80 ppm) followed by (91.90 g/plant) found in T_9 (Foliar application of GA_3 @100 ppm) and minimum was recorded (78.50 g/plant) in T_1 (Control). Application of GA_3 @ 50 ppm was found (Tsiakaras, *et al.,* 2014) inplant fresh weight (932.0 g) in lettuce (*Lactuca sativa* L.). Further increase it is also found effective (Ghodrat and Rousta, 2012) in increase shoot fresh weight (1.6 mg) in maize. The plant dry weight at harvest stage differed significantly due to different treatments. Significantly maximum plant fresh weight (19.13 g/plant) was recorded in T_8 (Foliar application of GA_3 @ 80 ppm) followed by (18.33 g/plant) found in T_9 (Foliar application of GA_3 @100 ppm) and minimum was recorded (16.13 g/plant) in T_1 (control). Application of GA_3 @ 50 ppm was found (Netam and Sharma, 2014) in plant dry weight was observed of GA_3 @ 50 ppm in brinjal (*Solanum melongena* L.). Further increase it is also found effective (Haq, *et al.* 2013) in increase plant dry weight (9.36 g/plant) in black cumin. The number of umbellates per plant differed significantly due to different treatments. Significantly maximum number of umbellates per plant (180.66) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (175.33) found in T_7 (Foliar application of GA_3 @70 ppm) and minimum was recorded (162.33) in T_1 (Control). Application of GA_3 @ 50 ppm was found (Kumar, *et al.,* 2014) to increase number of flowers (38.26) in tomato. It is also even found effective (Hasanuzzaman, *et al.,* 2015) increase flowers per plant (56.42) in tomato. The number of seed per umbellate differed significantly due to different treatments. Significantly maximum number of seed per umbellate (32.66) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (30.33) found in T_7 (Foliar application of GA_3 @70 ppm) and minimum was recorded (26.00) in T_1 (Control). Application of GA_3 @ 75 ppm was found (Yugandhar, *et al.,* 2014) to increase in seed

per umbellates (33.00) in coriander. It is also even found effective (Emongor and Ndambole, 2011) increase seed number/ pod-1(8.5) in cowpea. The seed yield (g/plant) differed significantly due to different treatments. Significantly maximum seed yield (7.63 g/plant) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (6.77 g/plant) found in T_7 (Foliar application of GA_3 @70 ppm) and minimum was recorded (4.58 g/plant) in T_1 (Control). Application of GA_3 @ 90 ppm was found (Mazed, *et al.,* 2015) in Yield (13.51kg./ plot) in cabbage. Further increase it is also found effective (Shahid, *et al.* 2013) in seed yield in okra. The 1000 seed yield (g) differed significantly due to different treatments. Significantly maximum 1000 seed yield (1.31 g) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (1.28 g) found in T_7 (Foliar application of GA_3 @70 ppm) and minimum was recorded (1.08 g) in T_1 (Control). Application of GA_3 was found (Emongor and Ndambole., 2011) to increase in 1000 seed weight (21.40 g) in Lentil. It is also even found effective (Bakhsh, *et al*., 2011) increase 1000 seed weight (21.40 g) in paddy. The total chlorophyll content at 60 DAS differed significantly due to different treatments. Significantly maximum total chlorophyll (2.16 mg/g fresh weight) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (1.91 mg/g fresh weight) found in T_7 (Foliar application of GA_3 @70 ppm) and minimum was recorded (1.28 mg/g fresh weight) in T_1 (Control). Application of GA_3 @ 100mg$L^{-1}$was found (Rohamare, *et al.,* 2013) in chlorophyll and essential oil content in Ajwain. Further increase it is also found effective (Rashad and Hussien, 2014) in chlorophyll content (2.62 mg/g) in plants. The caraotenoid content at 60 DAS differed significantly due to different treatments. Significantly maximum caraotenoid (1.82 mg/g fresh weight) content was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (1.69 mg/g fresh weight) found in T_7 (Foliar application of GA_3 @70 ppm) and minimum was recorded (1.35 mg/g fresh weight) in T_1 (Control). Application of GA_3 was found (Khavari *et al.,* 2013) to increased total chlorophylls, carotenoids, soluble proteins and insoluble sugars contents in tomato. It is also even found effective Sattigeri, *et al.,* (2014) increase chlorophyll content and carotenoid content in tomato. The total protein content differed significantly due to different treatments. Significantly maximum protein content (2.16 mg/g fresh weight) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (1.91 mg/g fresh weight) found in T_7 (Foliar application of GA_3 @70 ppm) and minimum was recorded (1.28 mg/g fresh weight) in T_1 (Control). Application of GA_3 @ 50-75 ppm was found (Rahman, *et al.,* 2015) increased biochemical parameters (chlorophyll, soluble protein and nitrate reductase activity). Further increase it is also found effective (Kavina, *et al.,* 2011) in protein content (10.01 %) in Mentha (*Mentha piperita* L.). The relative water content differed significantly due to different treatments. Significantly maximum relative water content (68.22%) was recorded in T_9 (Foliar application of GA_3 @ 100 ppm) followed by (66.15%) found in T_7 (Foliar application of GA_3 @70 ppm) and minimum was recorded (50.46%) in T_1 (Control). Application of GA_3 was found (Mahdavi and Rahimi, 2013) higher leaf RWC allows the plant to maintain turgidity and this would exhibit relatively less reduction in biomass and yield. It is also even found effective (Amal, *et al.,* 2014) increase relative water content (72.00 %) in barley.

Conclusion: On the basis of single trial experiment, treatment T_9 (GA_3 @ 100 ppm) showed significantly improved vegetative

growth, yield and quality of *Trachyspermum ammi* L..

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