Effect of nitrogen and plant growth regulators on nutrient concentration and uptake of ajwain (*Trachyspermum ammi* L. sprague)

Abstract

A field experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner in Jaipur district of Rajasthan during *rabi* season of 2016-17 on loamy sand soil. The experiment consisted of four levels of nitrogen (0, 30, 60 and 90 kg/ha) and five PGRs (control, NAA @ 50 ppm at 40 DAS, NAA @ 50 ppm at 40 and 60 DAS, thiourea @ 500 ppm at 40 DAS and thiourea @ 500 ppm at 40 and 60 DAS). The total 20 treatment combinations were tested in factorial randomized block design with three replications. The results showed that application of nitrogen up to 30 kg/ha significantly increased nitrogen concentration in seed and straw over control. However, total N uptake was significantly increased with application of 60 N kg/ha over lower levels but remained at par with 90 kg/ha. Application of PGRs significantly increased nitrogen concentration in seed and straw and total N uptake of ajwain over control.

***Key words*:** Ajwain, Nitrogen and PGRs

Introduction

The ajwain (*Trachyspermum ammi* L., 2n =18) belonging to the family Apiaceae (Umbelliferae) is an important seed spice. The ajwain is Indigenous to India and Egypt (Sayre, 2001). Ajwain is a cross-pollinated, aromatic and annual herbaceous plant. The flowers are protandrous and cross-pollination occurs through insects. The seed contain 3 to 4% volatile oil depending on the genotype or botanical type. Besides volatile oil, the seeds contain about 8.9% moisture, 15.4% protein, 18.1% fat, 38.6% carbohydrate, 11.9% crude fiber and 7.1% minerals. The important minerals are calcium, phosphorus, iron, sodium and potassium While major vitamins found are thiamine, riboflavin, nicotinic acid and carotene (Pruthi, 2001). In India, during the year 2015-16, area under the ajwain crop is 24010 ha and production is 17180 tonnes. India is the largest producer and exporter of the ajwain seed in the world. India exports ajwain to around 46 countries and the major importing countries are Pakistan, Saudi Arabia, USA, UAE, Malaysia, Nepal, Canada and UK. In Rajasthan it is cultivated in the districts of Chittorgarh, Udaipur, Rajsamand, Bhilwara, Kota and Jhalawar covering an area of 11058 ha with production and productivity of 4672 tonnes and 401 kg/ha, respectively (Anonymous, 2015-16b). Application of naphthalene acetic acid (NAA) is known to induce higher physiological efficiency including photosynthetic ability of plants. It has also been shown to enhance growth and yield of several vegetables and agricultural crops without substantial increase in the cost of production (Sarada *et al.,* 2008). Foliar spray

of thiourea have been reported not only to improve growth and development of plants, but also the dry matter partitioning for increased grain yield (Arora, 2004).

Materials and methods

A field experiment was conducted under loamy sand soil during *kharif* season of 2016 at Agronomy farm, S.K.N. College of Agriculture, Jobner, Jaipur Rajasthan (26° 05' N, 75° 20' E, 427 m above mean sea level). The soil of the experimental field was loamy sand with slightly alkaline in reaction pH 8.2. It was moderately fertile, being low in organic carbon (0.14%), low in available nitrogen (130.0 kg/ha), medium in available phosphorus (18.9kg/ha) and potassium (175.6 kg/ha). The experiment consisted of four levels of nitrogen (0, 30, 60 and 90 kg/ha) and five PGRs (control, NAA @ 50 ppm at 40 DAS, NAA @ 50 ppm at 40 and 60 DAS, thiourea @ 500 ppm at 40 DAS and thiourea @ 500 ppm at 40 and 60 DAS) in factorial randomized block design with three replications. A uniform dose of 40 kg P_2O_5 was applied through single super phosphate as basal and drilled about 5-7 cm deep through hand plough at the time of sowing. Nitrogen was applied through urea. One third nitrogen was applied at sowing as basal and remaining in two equal splits at 30 and 75 DAS as per treatments. The different weather parameters were recorded during crop growing period in the years. The maximum and minimum temperature recorded during *Rabi* season were in the rage of 20.4 to 43.4° C and 2.8 to 25.1° C in 2016-17.The total rainfall received during *Rabi* season was 24.8 mm in 2016-17. The crop was harvested at physiological maturity stage on 09 May, 2017.

Results and discussion

Effect of nitrogen

Nitrogen fertilization in crop resulted significant increase in nitrogen concentration in seed and straw (Table 1). Application of nitrogen upto 30 kg/ha improved the nitrogen concentration in seed and straw by 14.7 and 43.9 per cent and thus proved significantly superior over control. Further increase in nitrogen level increased the nitrogen content in seed and straw significantly with non-significant difference. However, total uptake of nitrogen by crop registered profound increase due to increasing levels of nitrogen fertilization. Application of nitrogen upto 60 kg/ha resulted in the total N uptake of 62.58 kg N/ha that was significantly higher over lower levels but remained at par with 90 kg N/ha. The magnitude of increase in total uptake was 14.8 and 67.6 per cent over 30 kg/ha and control with the application of 60 kg N/ha, respectively. The positive influence of nitrogen fertilization on nitrogen concentration of the crop appears to be due to improved nutritional environment in root zone as well as in plant system. The adequate supply of nitrogen in early crop season resulted in greater availability of nutrients of nitrogen in the crop root zone. The higher availability of nutrients coupled with accelerated metabolic activities at the cellular level probably might have increased the nutrient uptake and accumulation in various parts of the plant. Increased bio-mass production of the crop at harvest in terms of seed and straw yield together with higher nutrient concentration might have led to significant improvement in uptake of nitrogen by crop due to nitrogen fertilization These findings corroborate the

results of Naruka *et al.* (2012) in ajwain and Patel *et al.* (2013) in coriander. Application of 60 kg N/ha was found significantly superior over 30 kg N/ha and control giving 10.8 and 28.3 per cent higher seed yield, respectively. Further increase in level of nitrogen to 90 kg/ha could not improve the seed yield of ajwain significantly over 60 kg N/ha (Table 2). Results of the present investigation corroborate the results of Muvel *et al.* (2015) in ajwain.

Plant growth regulators

A perusal of data (Table 1) further indicated that application of PGRs significantly increased nitrogen concentration in seed and straw of ajwain over control, however all PGRs remained at par to each other. The per cent increase with thiourea @ 500 ppm spray at 40 and 60 DAS, NAA @ 50 ppm spray at 40 and 60 DAS, thiourea @ 500 ppm spray at 40 DAS and NAA @ 50 ppm spray at 40 DAS were 21.9, 20.7, 17.1 and 13.9 in seed and 29.7, 28.4, 25.7 and 23.0 in straw over control, respectively. A examination of data further indicated that application of PGRs significantly increased total uptake of nitrogen over control, significantly higher total uptake of nitrogen (64.28 kg/ha) was obtained with application of thiourea @ 500 ppm spray twice at 40 and 60 DAS, which was significantly higher to the tune of 15.6, 20.0 and 61.4 per cent over thiourea @ 500 ppm spray at 40 DAS, NAA @ 50 ppm spray at 40 DAS and control, respectively, however, it remained at par with application of NAA @ 50 ppm spray at 40 and 60 DAS. Thiourea application might have helped in improvement of metabolic processes of plants and better growth and development owing to greater absorption of nutrients from rhizosphere, it might be due to metabolic role of SH-group in root physiology and biochemistry. Thiourea creates better microbial population in soil which are responsible to mobilize essential nutrients. The similar results were also reported by Balai (2005) and Meena (2011) in coriander and Bochalia *et al*. (2011) in fenugreek. Application of PGRs significantly increased seed yield of ajwain over control (Table 2). Significantly higher seed yield (1112 kg/ha) of ajwain was obtained with application of thiourea @ 500 ppm spray at 40 and 60 DAS, which was significantly higher to the tune of 12.0, 14.0 and 31.4 per cent over thiourea @ 500 ppm spray at 40 DAS, NAA @ 50 ppm spray at 40 DAS and control, respectively, however, it remained at par with application of NAA @ 50 ppm spray at 40 and 60 DAS. These results corroborate the findings of Bairwa and Kaushik (2010) and Gour *et al*. (2010) in fenugreek.

Conclusion

Based on results of one year experimentation, it may be concluded that Application of nitrogen upto 30 kg/ha significantly increase the nitrogen concentration in seed and straw over control. Application of PGRs significantly increased nitrogen concentration in seed, straw and total N uptake over control.

References

Anonymous, 2015-16b. Vital Agriculture Statistics. Directorate of Agriculture, *Pant Krishi Bhawan,* Jaipur (Rajasthan).

Arora, D. 2004. Effect of thiourea and zinc on growth, yield and quality of barley (*Hordeum vulgare* L.). Ph.D. (Ag.) *Thesis*, Rajasthan Agricultural University, Bikaner.

Bairwa, R.C. and Kaushik, M.K. 2007. Effect of fertility levels and growth regulators on yield and yield attributes of fenugreek (*Trigonella foenum-graecum* L.) varieties. *Research on Crops* **8**(2): 355-360.

Balai, L.R. 2005. Effect of thiourea on growth and productivity of coriander (*Coriandrum sativum* L.) varieties under normal and late sown conditions. Ph.D. (Ag.) *Thesis*, Rajasthan Agricultural University, Bikaner.

Bochalia, G.C., Tiwari, R.C., Ram, B., Kantwa, S.R. and Choudhari, A.C. 2011. Response of fenugreek (*Trigonella foenum-graecum* L.) genotypes to planting geometry, agro-chemicals and sulphur levels. *Indian Journal of Agronomy* **56**(3): 273-279.

Gour, K., Patel, B.S. and Mehta, R.S. 2010. Growth, yield and profitability of fenugreek (*Trigonella foenum-graecum* L.) as influenced by varying levels of growth regulators and vermin-wash. *Journal of Spices and Aromatic Crops* **19**(1&2): 65-67.

Meena, S.K. 2011. Effect of Plant Growth Regulators and Sulphur on Productivity of Coriander (*Coriandrum sativum* L.). M.Sc. (Ag.) *Thesis*, Swami Keshwanand Rajasthan Agricultural University, Bikaner.

Muvel, R., Naruka, I.S., Chundawat, R.S., Shaktawat, R.P.S., Rathore, S.S. and Verma, R. 2015. Production, productivity and quality of ajwain (*Trachyspermum ammi* L. Sprague) as affected by plant geometry and fertilizer levels *International Journal Seed Spices* **5**(2): 32-37.

Naruka, I.S., Singh, P.P., Megha Barde and S.S. Rathore 2012. Effect of spacing and nitrogen level on growth, yield and quality of ajwain (*Trachyspermum ammi* L. Sprague). *International Journal Seed Spices* **2**(1): 12-17.

Patel, C.B., Amin, A.U., and Patel, A.L. 2013. Effect of varying levels of nitrogen and sulphur on growth and yield of coriander (*Coriandrum sativum* L.). *The Bioscan* **8**(4): 1285-1289.

Pruthi, J.S. 2001. Minor spices and condiments, Crop management and post-harvest technology. Published by publication and Information Division, ICAR, Krishi Anusandhan Bhavan, Pusa, New Delhi-110012, pp. 124-133.

Sarada, C., Girdhar, K. and Reddy, T.V. 2008. Effect of bio-regulators and their time of application on growth and yield of coriander (*Coriandrum sativum L.*). *Journal of Spices and Aromatic Crops* **17**(2): 183-186.

Sayre, J.K. 2001. Ancient herbs and modern herbs. Bottlebrush Press, San Carlos, California, USA, pp 14.

Table : 1 Effect of nitrogen and plant growth regulators on nitrogen concentration in seed, straw and total N uptake

Treatment	N concentration (%)		Total N uptake (kg/ha)
	Seed	Straw	
Nitrogen level (kg/ha)			
0	2.51	0.66	37.34
30	2.88	0.95	54.49
60	3.05	0.97	62.58
90	3.08	1.01	66.06
SEm±	0.07	0.02	1.44
CD (P=0.05)	0.20	0.06	4.12
Plant growth regulators			
Control	2.51	0.74	39.83
NAA @ 50 ppm spray at 40 DAS	2.86	0.91	53.55
NAA @ 50 ppm spray at 40 and 60 DAS	3.03	0.95	62.33
Thiourea @ 500 ppm spray at 40 DAS	2.94	0.93	55.58
Thiourea @ 500 ppm spray at 40 and 60 DAS	3.06	0.96	64.28
SEm±	0.08	0.02	1.61
CD (P=0.05)	0.22	0.07	4.60

Table : 2 Effect of nitrogen and plant growth regulators on seed yield of ajwain

Treatment	Seed Yield (kg/ha)
Nitrogen level (kg/ha)	
0	842
30	975
60	1081
90	1111
SEm±	25
CD (P=0.05)	70
Plant growth regulators	
Control	846
NAA @ 50 ppm spray at 40 DAS	975
NAA @ 50 ppm spray at 40 and 60 DAS	1084

Thiourea @ 500 ppm spray at 40 DAS	992
Thiourea @ 500 ppm spray at 40 and 60 DAS	1112
SEm±	27
CD (P=0.05)	79