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

Abstract

A field experiment was conducted during *rabi* season of 2016-17 entitled "Effect of nitrogen and plant growth regulators on nutrient concentration and uptake of ajwain (*Trachyspermum ammi* L. sprague)" at Agronomy farm, Sri Karan Narendra College of Agriculture, Jobner in Jaipur district of Rajasthan. The experiment comprising of total twenty treatment combinations consisting four levels of nitrogen (0, 30, 60, 90 kg ha^{-1}) and five levels of plant growth regulators (control, NAA 50 ppm at 40 day after sowing, NAA 50 ppm at 40 and 60 day after sowing, thiourea 500 ppm at 40 day after sowing, thiourea 500 ppm at 40 and 60 day after sowing) laid out in factorial randomized block design replicated thrice. The results showed that application of nitrogen up to 30 kg ha^{-1} significantly higher nitrogen concentration in grain and straw over control. However, total nitrogen uptake was significantly increased with application of 60 kg N ha^{-1} over lower levels, but remained at par with 90 kg N ha^{-1}. Foliar application of plant growth regulators significantly increased nitrogen concentration in grain, straw and total nitrogen uptake of ajwain over control.

***Key words*:** Ajwain, Nitrogen and Plant growth regulators

Introduction

Ajwain is a belonging to the family Apiaceae. Ajwain is a annual herbaceous, aromatic, cross-pollinated plant with a white flower. Ajwain is widely diffused and cultivated throughout the world, including Iran, Pakistan, Afghanistan, India, and Europe, yet it is native to Egypt Shojaaddin et al (2008). Ajwain is commonly used to treat a variety of ailments in people and animals. Depending on the genotype or botanical kind, the seed contains 3 to 4% volatile oil. Besides volatile oil, the grains contain about moisture (8.9 percent), carbohydrate (38.6 percent), protein (15.4 percent), fat (18.1percent), crude fiber (11.9 percent) and minerals (7.1 percent). Phosphorus, potassium, calcium, iron, and sodium are significant minerals, whereas thiamine, nicotinic acid, carotene, and riboflavin are vital vitamins (Pruthi , 2001).Thymol is used as an ingredient of deodorants, toothpastes, mouthwashes and many pharmaceutical preparations Malhotra and Vijay (2004). In India, during the year 2015-16, area under the ajwain crop was 24010 hectare and production was 17180 tonnes. India is the largest producer and exporter of the ajwain grain in the world. India exports ajwain to around 46 countries and the major importing countries are Pakistan, United States of America, Malaysia, Saudi Arabia, United Arab Emirates, Nepal, Canada and United Kingdom. In Rajasthan it is cultivated in the districts of

Chittorgarh, Bhilwara, Udaipur, Rajsamand, Kota, Jhalawar covering an area of 11267 ha with production and productivity of 7666 tonnes and 680 kg/ha, respectively Anonymous (2018-19).

Materials and methods

The experiment was conducted to study the effect of nitrogen and plant growth regulators on nutrient concentration and uptake of ajwain at Agronomy farm, Sri Karan Narendra College of Agriculture, Jobner, Jaipur Rajasthan during *rabi* season of 2016-17. The experimental soil was loamy sand with 8.2 pH and EC (1.25 ds/m), having low in organic carbon (0.14 percent), low available N (130.0 Kg ha^{-1}), medium in available P (18.9 Kg ha^{-1}), enough available K (175.6 kg ha^{-1}). The experiment consisted of 4 levels of nitrogen (0, 30, 60, 90 kg ha^{-1}) and 5 plant growth regulators (control, NAA 50 ppm at 40 day after sowing, NAA 50 ppm at 40 and 60 day after sowing, thiourea 500 ppm at 40 day after sowing, thiourea 500 ppm at 40 and 60 day after sowing) in factorial randomized block design with 3 replications. A uniform dose of 40 kilogram phosphorus 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 2 equal splits at 30 and 75 day after sowing 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 range 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 millimeter in 2016-17. The data were statistically analysed as per the procedure given by Panse and Sukhatme (1985). The crop was harvested at physiological maturity stage on 09 May, 2017.

Results and discussion

Effect of nitrogen

An examination of data table 1 revealed that application of nitrogen fertilization in crop resulted significant increase in nitrogen concentration in grain and straw of ajwain. Application of nitrogen up to 30 kg ha^{-1} increase the nitrogen concentration in grain and straw by 14.74 and 43.93 percent and thus proved significantly superior over control. The nitrogen concentration in grain and straw increased dramatically with a non-significant difference as the nitrogen level increased. However, increasing nitrogen fertilisation levels resulted in a significant increase in total nitrogen uptake by crops. Nitrogen application up to 60 kg ha-1 resulted in a total nitrogen intake of 62.58 kg N ha-1, which was significantly greater than the control and 30 kg N ha-1 but comparable to 90 kg N ha-1. The magnitude of increase in total uptake was 14.84 and 67.59 percent over 30 kg ha^{-1} and control with the application of nitrogen up to 60 kg ha^{-1}, respectively. The beneficial effect of nitrogen fertilisation on crop nitrogen content appears to be attributable to a better nutritional environment in both the root zone and the plant system. The availability of nitrogen nutrients in the crop root zone was increased due to an adequate supply of nitrogen early in the crop season. Boosted nutrient availability combined with enhanced metabolic processes at the cellular level may have increased nutrient uptake and accumulation in different sections of the plant. Increased crop biomass output during harvest in terms of seed and straw yield, as well as increased nutrient concentrations, may have resulted in a large increase in nitrogen uptake by the crop as

a result of nitrogen fertiliser. These results are in conformity with the findings of Patel *et al.* (2013) in coriander and Naruka *et al.* (2012) in ajwain. Application of nitrogen 60 kg ha^{-1} was found significantly higher over 30 kg N ha^{-1} and control giving 10.87 and 28.38 percent higher grain yield, respectively. Further increase in level of nitrogen to 90 kg ha^{-1} could not improve the grain yield of ajwain significantly over 60 kg N ha^{-1}. The similar results have also been reported by Muvel *et al.* (2015) in ajwain (Table 2).

Plant growth regulators

An investigation of data table 1 revealed that foliar application of plant growth regulators significantly increased nitrogen concentration in grain and straw of ajwain over control, however all plant growth regulators remained at par to each other. The percent increase with thiourea 500 ppm spray at 40 and 60 day after sowing, NAA 50 ppm spray at 40 and 60 day after sowing, thiourea 500 ppm spray at 40 day after sowing, NAA 50 ppm spray at 40 day after sowing were 21.91, 20.71, 17.13 and 13.94 percent in grain and 29.72, 28.37, 25.67, 22.97 percent in straw over control, respectively. A examination of data further indicated that foliar application of plant growth regulators significantly increased total uptake of nitrogen over control, significantly higher total uptake of nitrogen (64.28 kg/ha) was obtained with foliar application of thiourea 500 ppm spray twice at 40 and 60 day after sowing, which was significantly higher to the tune of 15.65, 20.03 and 61.38 percent over thiourea 500 ppm spray at 40 day after sowing, NAA 50 ppm spray at 40 day after sowing and control, respectively, however, it remained at par with application of NAA 50 ppm spray at 40 and 60 day after sowing. Boosted nutrient availability combined with enhanced metabolic processes at the cellular level may have increased nutrient uptake and accumulation in different sections of the plant. Increased crop biomass output during harvest in terms of seed and straw yield, as well as increased nutrient concentrations, may have resulted in a large increase in nitrogen uptake by the crop as a result of nitrogen fertiliser. The similar results were also reported by Balai (2005) and Meena (2011) in coriander and Bochalia *et al*. (2011) in fenugreek. Application of plant growth regulators significantly increased seed yield of ajwain over control table 2. Significantly higher grain yield (1112 kg ha^{-1}) of ajwain was obtained with application of thiourea 500 ppm spray at 40 and 60 day after sowing, which was significantly higher to the tune of 12.09, 14.05 and 31.44 percent over thiourea 500 ppm spray at 40 day after sowing, NAA 50 ppm spray at 40 day after sowing and control, respectively, however, it remained at par with application of NAA 50 ppm spray at 40 and 60 day after sowing. The result corroborate with the finding of Bairwa and Kaushik (2010) and Gour *et al*. (2010) in fenugreek.

Conclusion

Based on one years of investigation, it may be concluded that application of nitrogen up to 30 kg ha^{-1} significantly higher the nitrogen concentration in grain and straw over control. Foliar application of

plant growth regulators significantly increased nitrogen concentration in grain, straw and total nitrogen uptake over control.

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

Treatment	Nitrogen concentration (%)		Total nitrogen uptake (kg ha^{-1})
	Grain	Straw	
Nitrogen level (kg ha^{-1})			
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 day after sowing	2.86	0.91	53.55
NAA 50 ppm spray at 40 and 60 day after sowing	3.03	0.95	62.33
Thiourea 500 ppm spray at 40 day after sowing	2.94	0.93	55.58
Thiourea 500 ppm spray at 40 and 60 day after sowing	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 grain yield of ajwain

Treatment	Grain Yield (kg ha^{-1})
Nitrogen level (kg ha^{-1})	
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 day after sowing	975
NAA 50 ppm spray at 40 and 60 day after sowing	1084
Thiourea 500 ppm spray at 40 day after sowing	992
Thiourea 500 ppm spray at 40 and 60 day after sowing	1112
SEm±	27
CD (P=0.05)	79

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