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Effect of Nutrient Levels on Growth and Yield of Ajwain (Trachyspermum ammi L. Sprague) Eetela Sathyanarayana

Abstract

An experiment was conducted during Rabi season of 2014-15 at Chilli and Vegetable Research Unit of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS), to find out effect of nutrient levels on growth and yield of ajwain. The treatment consisted of five levels of nitrogen (0, 20, 40, 60 and 80 kg ha^{-1}), five levels of phosphorus (0, 10, 20, 30 and 40 kg ha^{-1} in form of P_2O_5) and five levels of potassium (0, 10, 20, 30 and 40 kg ha^{-1}). Results indicated that increasing application of N, P and K increased plant height, stem diameter, number of branches per plant, number of umbels per plant, Plant spread, seed yield and dry matter yield. Highest seed yield (14.67 q ha^{-1}) and dry matter yield (5851.83 kg ha^{-1}) were obtained with application of 80 kg N + 40 kg P_2O_5 and 40 kg K_2O ha^{-1}.

Keywords: Ajwain, Trachyspermum ammi, Nitrogen, Phosphorus, Potassium, Growth, Yield.

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Fill Some Details

Introduction

Ajwain (*Trachyspermum ammi* L.) belonging to the Apiaceae family is a grassy, annual plant with a white flower and small, brownish seeds. Ajwain or *Bishop's weed* is an annual herbaceous plant, the seeds of which are used for flavouring foods and preservatives. The essential oil from seeds is used in perfumery, essence and medicinal preparations (Nath *et al*., 2008). Ajwain is widely grown in arid and semi-arid regions where soils contain high level of salt. Ajwain is a profusely branched annual herb, 60-90 cm tall, straight stem with inflorescence and compound umbel with 16 umbellates, each containing up to 16 flowers. Ajwain commonly grows medicinal plants in Iran, India, Egypt and Europe. In India, it is cultivated in Madhya Pradesh, Uttar Pradesh, Gujarat, Rajasthan, Maharashtra, Bihar and West Bengal. In India, area under the ajwain crop is 0.25 lakh ha., annual production is 0.22 lakh MT. and productivity is 0.90 MT/ha. In Vidarbha region (Maharashtra) ajwain crop is grown on area of 2241 hectares with annual production of 7089 tonnes and productivity is 1.37 t/ha.

Ajwain seed is considered as hot medicine and is used for relief of pain in human digestive track and as an anti-blot (Mirheidar, 1993). Ajwain seeds are reported to be useful in flatulence, colic, diarrhoea and spasmodic affections of bowels. It owes its characteristic odour and taste due to presence of an essential oil (2-4%). Ajwain oil is principal source of thymol. Its characteristic aromatic smell and pungent taste is widely used as a spice in curries. It employed either alone or in mixture with other spices and condiments. More important use of ajwain is medicinal and it is a household remedy for indigestion. It is much valued for its antispasmodic, stimulant, tonic and aromatic carminative properties. Ajwain oil is also used in medicine as an antiseptic and aromatic carminative. Dethymolised oil or thymol is used for industrial purpose.

Hypothesis

Being a cash crop, ajwain crop getting an importance amongst the farmers of the Vidarbha region of Maharashtra as against the traditional crop, farmers are therefore in want of diversification of cropping pattern through the seed species crop like ajwain, coriander, fennel and cumin, etc.

The development of agricultural activities is relatively healthy in the areas of high fertile soil. The fertility of the soil is largely influenced by the physiography, climate and agricultural activities. But with increasing population pressure, low fertile areas are also utilized for agriculture and to get maximum production. Over exploitation of productive land creates

serious problem of lowering the fertility status of soil and it leads to deterioration of soil. The deficiency of nutrients directly affects on the growth of crops and crop response become poor. Hence, it is necessary to assess the fertility status of soil with the consideration of available nutrients and to recommend the specific nutrients for the proper management of soil. Adequate supply of N promotes higher photosynthetic activity and vigorous vegetative growth and as a result, the plants turn into dark green colour. (Balasubramaniyam and Palaniappan 2005,). Phosphorus, being the constituent of nucleic acid, phospholipids, is also very essential for proper development of crops. It imparts hardness to shoot, improves grain quality, regulates photosynthesis, governs physicochemical processes, help in the enlargement of cell and develop resistant to diseases. Potassium plays a major role in transport of water and nutrients throughout the plant in xylem and improves drought tolerance to plants.

Keeping all these in mind, an experiment was conducted to study the effect of nutrient levels on growth, yield and quality of ajwain.

Materials and Methods

The experiment was laid out during Rabi season 2014-15 at the Chilli and Vegetable Research unit of Dr. P.D.K.V., Akola (Maharashtra). The experimental site has semi-arid with erratic climatic conditions (maximum temperature goes up to 43.9^0C in summer and 22^0C during winters). The mean annual rainfall of the area is 591.3 mm. The experimental soil was typichaplusterts, pH (8.29), EC (0.56 dSm^{-1}), soil organic carbon (5.0 g kg^{-1}), available N (220 kg ha^{-1}), available P (17.27 kg ha^{-1}) and has a relatively high available K (288.85 kg ha^{-1}). The five treatments were replicated four times in randomized block design. The treatments comprising of T_1 Control, T_2 20:10:10 NPK kg ha^{-1}, T_3 40:20:20 NPK kg ha^{-1}, T4 60:30:30 NPK kg ha^{-1} and T_5 80:40:40 NPK kg ha^{-1}. Half of the nitrogen was applied at the time of sowing and the remaining half of nitrogen was applied as topdressing 30 days after sowing. All the cultural and plant protection measures were adopted as and when required. Growth parameters were studied at 90 and 120 days after sowing. The data on growth and yield attributing parameters were recorded and pooled data were analysed statistically as described by Panse and Sukhatme (1967) to draw conclusions.

Results and Discussion

Plant Height (cm)

The height of the ajwain plants was measured at 90 and 120 DAS. Significant height differences were observed among the treatments and plant height was ranged from 52.75 cm to 63.47 cm for 90 days and 74.2 cm to 86 cm for 120 days (Table 1). The observations of growth habit of five ajwain treatments under study in semi-arid climate of Vidharbha region revealed that two treatments *viz.,* T_5 and T_4 (80:40:40 and 60:30:30 NPK kg ha^{-1} respectively) were tall in plant height and two treatments viz. control, 20:10:10 NPK kg ha^{-1} (T_2) were dwarf in height and rest of treatment 40:20:20 NPK kg ha^{-1} (T_3) was medium in height having plant height above 70 cm.

Significantly highest average plant height i.e. 86 cm was recorded by treatment T_5 followed T_4 (81.5 cm) and T_3 (77.25 cm). Nath *et al.* (2008) and Naruka *et al*. (2012) also observed similar height of ajwain plant with the application of highest N kg ha^{-1}. The lowest average plant height i.e. 74.2 cm was recorded by treatment T_1 which was control (Table 1).

Table - 1

Effect of Nutrient Levels on Growth Performance of Ajwain

Sr. No.	Treatment NPK (kg ha^{-1})	Plant height (cm)		Stem diameter (cm)		Number of branches		Plant spread (cm^3)		Number of Umbels Per Plant	
		90 days	120 days	90 days	120 days	90 days	120 days	90 days	120 days	90 days	120 days
1	Control	52.75	74.2	0.60	0.68	7.22	9.02	25.94	40.95	120.45	175.7
2	20:10:10	54.6	75.82	0.64	0.73	7.95	9.35	26.74	41.16	121.17	177.27
3	40:20:20	55.02	77.25	0.64	0.73	8.17	9.87	26.43	41.89	122.1	178.2
4	60:30:30	59.3	81.5	0.70	0.81	9.17	10.85	29.96	45.06	122.7	179.7
5	80:40:40	63.47	86.0	0.76	0.91	9.77	11.6	30.81	46.30	124.8	180.95
	SE (m)±	1.03	1.42	0.02	0.02	0.37	0.29.	0.77	0.65	0.27	0.32
	CD at 5%	3.17	4.39	0.07	0.06	1.13	0.88	2.39	2.0	0.84	0.98

Stem Diameter (cm)

The stem diameter of the ajwain plants were measured at 90 and 120 DAS. Significant differences were observed among the treatments and average stem diameter was ranges from 0.6 cm to 0.76 cm for 90 days and 0.68 cm to 0.91 cm for 120 days (Table 1). Similar results were also reported by Marks *et al.* (2005).

Significantly the highest average stem diameter i.e. 0.91 cm was recorded by treatment T_5 followed by T_4 (0.81 cm) and T_3 (0.73 cm). The lowest average stem diameter i.e. 0.69 cm was recorded by treatment T_1 (Table 1). Nath *et al.* (2008) also observed highest stem diameter of ajwain plant with the application of 60 kg N ha^{1}.

Number of branches per plant

The numbers of branches of ajwain plants were measured at 90 and 120 DAS. Significant differences were observed among the treatments and in an average branch per plant ranges from to 7.22 to 9.77 for 90 days and 9.02 to 11.6 for 120 days (Table 1). Similar results were also reported by Marks *et al.* (2005), Nath *et al*. (2008) and Naruka *et al*. (2012).

Amongst all treatments under study, significantly highest number of branches per plant were recorded by treatment T_5 (80:40:40 NPK kg ha^{-1})

and lowest branches were reported by treatment T_1 (Table 1).

Plant spread (cm^3)

The plant spread of ajwain plants were measured at 90 and 120 DAS. Significant differences were observed among the treatments and average plant spread of plant ranges from 25.94 cm^3 to 30.81 cm^3 for 90 days and 40.95 cm^3 to 46.30 cm^3 for 120 days (Table 1). Significant variation in plant spread of ajwain among treatment was also reported by Nath *et al.* (2008).

Amongst all treatments under study, significantly highest plant spread per plant was recorded by treatment T_5 (80:40:40 NPK kg ha^{-1}) which was at par with treatment T_4 and lowest plant spread was reported by T_1 treatment (Table 1).

Number of Umbels per Plant

The numbers of umbels per plants of ajwain were measured at 90 and 120 DAS. Significant differences were observed among the treatments and in an average number of umbels per plant ranges from 120.45 to 124.8 for 90 days and 175.7 to 180.95 for 120 days (Table 1). Similar results were also reported by Nath *et al.* (2008), Vahidipour *et al.* (2013) and Moussavi *et al*. (2011).

Amongst all treatments under study, significantly highest number of umbels per plant was recorded by treatment T_5 (80:40:40 NPK kg ha^{-1}) and lowest number of umbels was reported by T_1 treatment (Table 1).

Seed Yield

Yield of seed being the important economic characteristics need special consideration while evaluating the treatment effects. The yield of any crop generally based on two major components viz., yield per plant and plant population per unit area. Further, yield per plant is governed by several yield attributing characters such as number of umbels, number of seeds per umbel, weight of seed per umbel, number of seeds and weight of seeds per plant, thousand seed weight are of the great importance. It may be seen that, in general, with every increase in the level of nitrogen, phosphorus and potassium there was an appreciable improvement in all the attributes mentioned above. The result indicates that, highest seed yield (14.67 q ha^{-1}) was recorded by treatment T_5 i.e., 80:40:40 NPK kg ha^{-1} and lowest seed yield (12.82 q ha^{-1}) recorded by control treatment (Table 2). The similar findings were reported by Vahidipour *et al.* (2013), Naruka *et al*. (2012), and Moussavi *et al*. (2011) Marks *et al.* (2005) in ajwain and Singh *et al.* (1980), Verma and Solanki (1989), in coriander.

Table- 2

Effect of Nutrient Levels on Seed Yield of Ajwain

Sr. No.	Treatments	Seed yield (q ha^{-1})
1	Control NPK kg ha^{-1}	12.82
2	20:10:10 NPK kg ha^{-1}	13.32
3	40:20:20 NPK kg ha^{-1}	13.7
4	60:30:30 NPK kg ha^{-1}	14.08
5	80:40:40 NPK kg ha^{-1}	14.67
SE (m)±		0.09
CD at 5%		0.28

Dry Matter Production

Various treatments under evaluation showed significant differences in their dry matter production ranges from 5222.21 kg ha^{-1} to 5851.83 kg ha^{-1}. The variation in growth components of various treatments was due to environmental impact.

Data presented (Table 3) revealed that, significantly the maximum (5851.83 kg ha^{-1}) dry matter production was recorded by treatment T_5 (80:40:40 NPK kg ha^{-1}) followed by treatment T_4 (5481.47 kg ha^{-1}), treatment T_3 (5328.33 kg ha^{-1}) and treatment T_2 (5279.01 kg ha^{-1}), whereas, minimum (5222.21 kg ha^{-1}) dry matter production was recorded by T_1 treatment (Control).

Table- 3

Effect of Nutrient Levels on Dry Matter Production of Ajwain

Sr. No.	Treatments	Dry Matter (kg ha^{-1})
1	Control NPK kg ha^{-1}	5222.21
2	20:10:10 NPK kg ha^{-1}	5279.01
3	40:20:20 NPK kg ha^{-1}	5328.33
4	60:30:30 NPK kg ha^{-1}	5481.47
5	80:40:40 NPK kg ha^{-1}	5851.83
SE (m)±		49.56
CD at 5%		152.79

These results indicate that, nitrogen fertilizer has high importance for production of a desirable growing body for economic performance and due to better physiological activities within the plant. These plants have better establishment and higher economic performance than the same plants in the adjacent experimental plots. Nitrogen deficiency delays phenological development, vegetative and reproductive stages of plant and reduces leaf expansion rate and leaf area duration. Reduction in plant area reduces sunlight absorption, photosynthesis and biological function of the plant. Increasing biological yield of ajwain with nitrogen application is consistent to the results of Naruka *et al.* (2012). Results (Table 3) shows that consumption of different amounts of nitrogen reduces the effects of drought stress and improves biomass and straw weight.

Suggesstions

In the light of results summarized above, it was observed that, nitrogen application had great advantage and the maximum benefit from the crop of ajwain can accrue only when nitrogen was applied at the rate of 80 kg ha^{-1}. It was also quite clear that, application of phosphorus and potassium also very essential and to get good results, the crop needs to be fertilized at the rate of 40 kg P and 40 kg K ha^{-1}. Thus application of 80 kg nitrogen, 40 kg phosphorus and 40 kg potassium ha^{-1} should form the integral part of ajwain and package of practices for getting a good harvest of this crop, under climatic conditions of Akola (Vidharbha) region of Maharashtra.

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