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Eetela Sathyanarayana
Ph. D Research Scholar in Soil Science and Agricultural Chemistry at PJTSAU, Hyderabad, Telangana, India

SS Hadole
Assistant professor at College of Agriculture Akola, Maharashtra, India

Correspondence
Eetela Sathyanarayana
Ph. D Research Scholar in Soil Science and Agricultural Chemistry at PJTSAU, Hyderabad, Telangana, India

Effect of nutrient levels on nutrient uptake by seeds of ajwain (*Trachyspermum ammi* L. Sprague)

Eetela Sathyanarayana and SS Hadole

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 nutrient uptake by seeds 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 the uptake of major nutrients in ajwain crop.

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

1. Introduction
Spices play a very important role in the economy of our country as some of them are exported to earn foreign exchange. 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) [2]. 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, production is 0.22 lakh MT and productivity is 0.90 MT ha^{-1}. In Vidarbha region (Maharashtra) ajwain crop area is 2241 acres, production is 12089 q. and productivity is 2.40 q ha^{-1}. Ajwain seed analysis has revealed it to contain fibre (11.9%), carbohydrates (38.6%), tannins, glycosides, moisture (8.9%), protein (15.4%), fat (18.1%), saponins, flavone and mineral matter (7.1%) containing calcium, phosphorous, iron and nicotinic acid. The Ajwain fruits yields 2% to 4% brownish essential oil, with thymol as the major constituent (35% to 60%). The nonthymol fraction (thymine) contains para-cymene, γ-terpenine, α- and β-pinenes, dipentene, α-terpinene, and carvacrol.

1.2 Importance of study
A little attention has been paid by the research workers to develop proper agro techniques for successive cultivation of such an important crop. Among the several agro techniques, the proper supply of major nutrients like nitrogen, phosphorus and potassium are of greater importance. Nitrogen is an essential constituent of protein, chlorophyll and nitrogen is present in many compounds of physiological importance in crop metabolism such as nucleotides, phospholipids, alkaloids, enzymes, hormones and vitamins etc. Nitrogen promotes growth of leaves and stem. 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 and help in the enlargement of cell, develop resistant to diseases and fixation of phosphorus. Potassium plays a major role in transport of water and nutrients throughout the plant in xylem and improves drought tolerance to plants.

Applying of bio-fertilizers such as nitrogen fixing bacteria has led to a decrease in the use of chemical fertilizers and has provided high quality products free of harmful agrochemicals for human safety. Nitrogen fixing bacteria such as; *Azotobactor chroococcum* and *Azospirillum lipoferum*, were found have not only the ability to fix nitrogen but also ability to release phytohormones similar to gibberellic acid and indole acetic acid, which could stimulate plant growth, absorption of nutrients and photosynthesis (Ghilavizadeh *et al.*, 2012) [1].

The seeds of ajwain have been used for their flavour and spice in food industry. Also, the ajwain seeds contain 2 - 4.4% brown coloured oil known as ajwain oil. The main component of this oil is *thymol*, which is used as gastro intestinal ailments, lack of appetite and bronchial problems. It is used in pharmaceutical industry as a diuretic, anti-vomiting, analgesic, antiasthma, antispasmodic and a carminative. In southern parts of India, dry ajwain seeds are powdered and soaked in milk, which is then filtered and fed to babies. People in North India especially find it very effective in stomach pain, when taken in a large spoonful with a pinch of salt and a glass of water. It's very effective when swallowed with warm water.

Ajwain seed has been popular from ancient times for its use in folk medicines. The seeds contain an essential oil with 50% thymol, which is a strong germicide, antispasmodic and fungicide. Ajwain with its characteristic aromatic smell and pungent taste is widely used as a spice in curries. Its seeds are used in small quantities for flavouring numerous foods, as preservatives, in medicine and for the manufacture of essential oil in perfumery. Thymol isolated from the oil is a powerful antiseptic and an ingredient in a number of skin ointments/powders, deodorants, mouthwashes, toothpastes and gargles.

In Indian system of medicine, *ajwain* is administered as a stomach disorders, a paste of crushed fruits is applied externally for relieving colic pains, hot and dry fomentation of the fruits applied on chest for asthma. Therapeutic uses of ajwain fruits include, stomachic, carminative and expectorant, antiseptic and amoebiasis, antimicrobial seeds soaked in lemon juice with *Prunus amygdalus* (Badam) given in amenorrhoea it is also used as Antipyretic, febrifugal and in the treatment of typhoid fever.

1.3 Objectives of study

The present study entitled "Effect of nutrient levels on nutrient uptake by ajwain seeds" was conducted at experimental field of Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *rabi* season with the following objective.

1. To evaluate the effect of nutrient levels on nutrient uptake by seeds of ajwain.

1.4 Scope and limitations

Since, ajwain is a commercial spice crops not only its yield but also quality is important and both can be achieved only by maintaining soil fertility through proper nutrient management practices.

The level of nutrient supply at which the maximum yield of the plant is obtained reflects the optimum requirement of a particular plant species. Further, increase in nutrient supply does not affect the plant growth but reflects the luxury consumption without significantly contributing for either yield or quality. Plants require nitrogen, phosphorus and potassium in large quantities. The seasonal growth of plants and production of grains/fruits depletes the soil of its nutrient reserve resulting in reduction of native soil fertility. It is essential to replenish the soil for depleted nutrients regularly.

Very limited work of soil scientists on nutrient management and soil health studies in horticultural crops was available for review in Vidarbha region. Hence, promising research on nutrient levels on ajwain is major limitation in hand, however on the other hand this will open new doors of wide scope for soil scientists to check the performance of horticultural crops in semi-arid climate and restructuring of nutrient doses for optimum economic yields of crop with sustainable soil health.

1.5 Hypothesis

Being a cash crop, ajwain crop getting an importance amongst the farmers of the region 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.

2. Material and methods

2.1. Field Experiment

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 to draw conclusions.

2.2. Nutrient uptake

Based on the nutrient concentration in plants and dry matter accumulation, the uptake of nitrogen, phosphorus and potassium were worked out by using formula.

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Per cent nutrient concentration} \times \text{dry matter}}{100}$$

Statistical analysis

The data collected from the experimental field was analysed

statistically following the procedure as described by Panse and Sukhatme (1967) [3].

3. Result and discussion

3.1. Nutrient uptake by seed

a) Uptake of nitrogen

Significantly highest 36.67 kg ha^{-1} uptake of nitrogen was recorded by treatment T_5 (Table 1 and Fig. 1) followed by T_4 (34.28 kg ha^{-1}), T_3 (32.87 kg ha^{-1}) and T_2 (31.26 kg ha^{-1}) whereas, the lowest uptake of nitrogen was observed in the treatment T_1 (29.25 kg ha^{-1}).

b) Uptake of phosphorus

Significantly highest 3.93 kg ha^{-1} uptake of phosphorus was recorded by treatment T_5 (Table 1 and Fig. 1), it was at par with treatment T_4 (3.92 kg ha^{-1}) and T_3 (3.70 kg ha^{-1}), whereas, the lowest uptake of phosphorus was observed in the treatment T_1 (3.26 kg ha^{-1}).

c) Uptake of potassium

Significantly highest 33.81 kg ha^{-1} uptake of potassium was recorded by treatment T_5 (Table 1 and Fig. 1) followed by T_4 (31.39 kg ha^{-1}), T_3 (29.58 kg ha^{-1}) and T_2 (27.99 kg ha^{-1}), whereas, the lowest uptake of potassium was observed in the T_1 (Control) treatment (26.34 ha^{-1}).

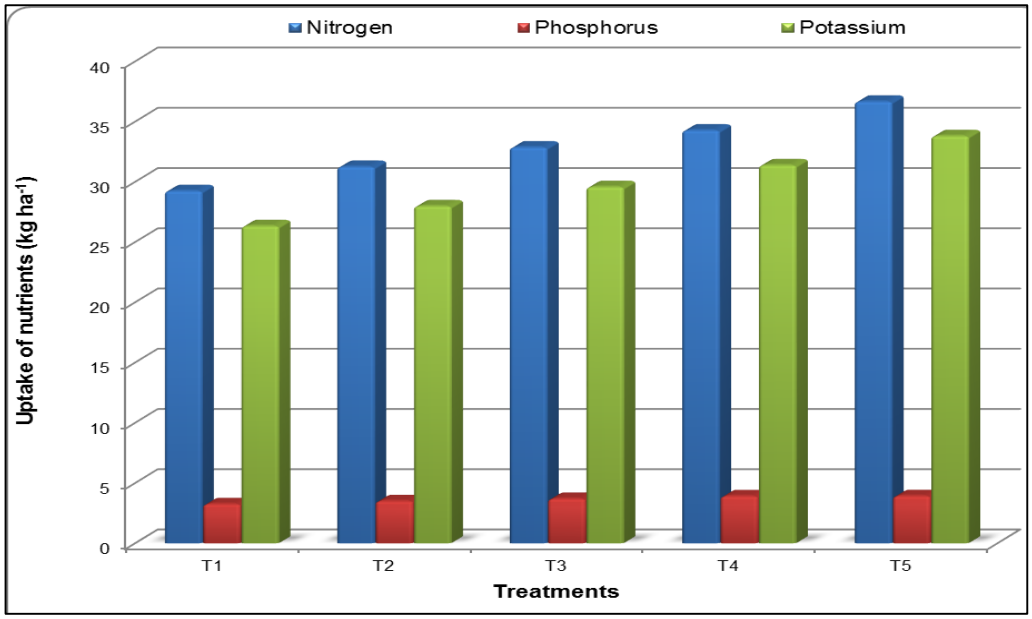

Fig 1: Major-nutrient uptake by seed under various nutrient levels

Seed yield of ajwain under various nutrient levels

Tr. No.	Treatments details	Seed yield (q ha^{-1})
T_1	Control	12.82
T_2	20:10:10 NPK kg ha^{-1}	13.32
T_3	40:20:20 NPK kg ha^{-1}	13.7
T_4	60:30:30 NPK kg ha^{-1}	14.08
T_5	80:40:40 NPK kg ha^{-1}	14.67
	SE (m)±	0.09
	CD at 5%	0.28

Table 1

Treatment No	Treatment details	Nutrient Uptake by ajwain seeds (kg ha^{-1})		
		N	P	K
T_1	Control	29.25	3.26	26.34
T_2	20:10:10 NPK kg ha^{-1}	31.26	3.51	27.99
T_3	40:20:20 NPK kg ha^{-1}	32.87	3.70	29.58
T_4	60:30:30 NPK kg ha^{-1}	34.28	3.92	31.39
T_5	80:40:40 NPK kg ha^{-1}	36.67	3.93	33.81

Conclusions

In the light of results summarized above, it observed that nitrogen application is of great advantage and the maximum uptake from the crop of ajwain can accrue only when N at the rate of 80 kg ha^{-1} is used. It is 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 80 kg nitrogen, 40 kg phosphorus and 40 kg potassium ha^{-1} should from the integral part of ajwain and package of practices for getting a good harvest of this crop under climatic conditions of Vidharbha region of Maharashtra.

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