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National Academy of Agricultural Science (NAAS) Rating : 3.03

Effect of Nutrient Levels on Fertility Status of Soil and Quality of Ajwain (*Trachyspermum ammi* L. Sprague)

Eetela Sathyanarayana, S. S. Hadole, G. S. Laharia and S. M. Ghawade

ABSTRACT: *In order to study the effect of nutrient levels on fertility status of soil and quality of ajwain, an experiment was carried out during Rabi season of 2014-15 at Chilli and Vegetable Research Unit of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, (MS). The experiment was conducted based on design randomized complete blocks with five treatment and four replications. 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}). The essential oil was extracted by Clevenger type apparatus method. Results indicated that increasing application of N, P and K increased fertility status of soil (available nutrients* viz., *N, P and K after harvest of ajwain crop) and highest essential oil yield (44.70 L ha^{-1}) was obtained from T_5 treatment, which was 80 kg N + 40 kg P_2O_5 and 40 kg K_2O ha^{-1}.*

Key words: *Ajwain, Trachyspermum ammi, Nitrogen, Phosphorus, Potassium, Fertility, Essential oil.*

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., production is 0.22 lakh MT. and productivity is 0.90 MT/ha. In Vidarbha region (Maharashtra) ajwain crop area is 2241 acres, production is 12089 q. and productivity is 2.40 q/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. Adequate supply of N promotes higher photosynthetic activity and vigorous vegetative growth and as a result, the plants turn into dark green colour. A high N supply favours the conversion of carbohydrate into protein which, in turn, promotes the formation of protoplasm. Protoplasm, being highly hydrated, is conducive for the succulent plant growth (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.

MATERIAL AND METHODS

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^{0}C in summer and 22^{0}C 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.

Table 1
Initial status of experimental soil

Sr. No.	*Soil properties*	*Value*
1	pH (1:2.5)	8.29
2	EC (dSm^{-1})	0.56
3	Organic carbon (g kg^{-1})	5.0
4	Available N (kg ha^{-1})	220
5	Available P (kg ha^{-1})	17.27
6	Available K (kg ha^{-1})	288.85

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. The data on fertility status of soil and quality of ajwain attributing parameters were recorded and pooled data were analysed statistically to draw conclusions.

Essential oil Extraction

In order to determine the essential oil content (%), a sample of 100 g of ajwain seeds from the each treatment were crushed in electric grinder and were mixed with 500 ml distilled water and then were subjected to hydro-distillation for 3 hour using a Clevenger type apparatus. The essential oil content was measured after dehydrating of water by anhydrous sodium sulphate and stored in glass bottle which is expressed in percentage (%).

Statistical analysis

The data collected from the experimental field was analysed statistically following the procedure as described by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Fertility status of Soil

Available nitrogen

Data pertaining to nutrient status of soil after harvest of ajwain recorded significant influence on available nitrogen content in soil. However, it varies from 217 kg ha^{-1} to 246.5 kg ha^{-1}. The highest available nitrogen content in soil was observed in the treatment T_5 i.e. 246.5 kg ha^{-1}, whereas, lowest available nitrogen 217 kg ha^{-1} in soil was recorded in the plot under T_1 treatment (Table 1). Significant improvement in the available nitrogen content of soil after harvest of the crop may be due to the fact that used of different doses of fertilizers.

Available phosphorus

The data regarding available phosphorus content in soil after harvest of ajwain crop was significant and presented in table 1 revealed that available P content in the plots ranges from 16.52 to 19.04 kg ha^{-1} under various ajwain treatments.The highest 19.04 kg ha^{-1} content of available phosphorus in soil was observed in the plot under treatment T_5. The lowest available P i.e. 16.52 kg ha^{-1} was noticed in the T_1 (Control) treatment.

Table 2
Effect of nutrient levels on available nutrient status in soil after harvest of ajwain

S.No.	*Treatments*	*Available nutrients (kg ha^{-1})*		
		N	*P*	*K*
1	Control	217.0	16.52	275.5
2	20:10:10 NPK kg ha^{-1}	225.7	17.57	282.1
3	40:20:20 NPK kg ha^{-1}	234.0	18.07	287.52
4	60:30:30 NPK kg ha^{-1}	240.5	18.58	292.47
5	80:40:40 NPK kg ha^{-1}	246.5	19.04	299.25
SE (m)±		0.64	0.12	1.45
CD at 5%		1.98	0.38	4.48

Available potassium

Significant difference existed among the treatments with respect to available potassium status in soil and ranged from 275.5 to 299.2 kg ha^{-1} (Table 1).

Significantly highest available potassium was observed in the treatment T_5 (299.25 kg ha^{-1}). The lowest available potassium in soil was recorded by T_1 (Control) treatment (275.5 kg ha^{-1}).

Fertility status of the soil under various treatments presented in Table 1 showed the with respect to available nitrogen, phosphorus and potassium in the soil influenced significantly under the treatment of cultivation. However, the fact is that there was overall

increase in the fertility status of soil, due to different doses of fertilizers.

Quality performance

Essential oil percentage and yield

Quality was judged in the present investigation in terms of essential oil yield in seed. The essential oil content in the form of volatile oil was taken into consideration in this investigation, while evaluating treatment effects on quality.

Table 3
Effect of nutrient levels on essential oil percent of ajwain

Sr. No.	*Treatments*	*Essential oil (%)*
1	Control	2.82
2	20:10:10 NPK kg ha^{-1}	2.78
3	40:20:20 NPK kg ha^{-1}	2.75
4	60:30:30 NPK kg ha^{-1}	2.96
5	80:40:40 NPK kg ha^{-1}	3.05
SE (m)±	0.08	
CD at 5%		0.25

The effect of various nutrient levels on essential oil percentage of ajwain was not significant. Mean comparison of data showed the highest essential oil percentage with average of 3.08 percent was recorded from treatment T_5 (Table 2) and the lowest with average of 2.82 percent was recorded from the T_1 (Control) treatment. The difference between T_5 and T_1 was not statistically significant. The highest essential oil yield 44.70 L ha^{-1} (Table 3) was recorded from the treatment T_5 but it was at par with treatment T_4. The lowest essential oil yield (34.55 L ha^{-1}) was recorded from the T_1 (Control) treatment.

Table 4
Effect of nutrient levels on essential oil yield of ajwain

Sr. No.	*Treatments*	*Essential oil yield (L ha^{-1})*
1	Control	34.55
2	20:10:10 NPK kg ha^{-1}	36.88
3	40:20:20 NPK kg ha^{-1}	37.97
4	60:30:30 NPK kg ha^{-1}	42.49
5	80:40:40 NPK kg ha^{-1}	44.70
SE (m)±		1.24
CD at 5%		3.81

Essential oil percentage showed no significant difference between treatments, but the essential oil yield increased significantly with increasing nitrogen application. Thus, its maximum value with average of 44.70 L ha^{-1} was recorded from the consumption of 80 kg N ha^{-1}. Increasing essential oil yield in consequence of nitrogen fertilizer consumption can be due to the fact that nitrogen plays an important role in the development and divisions of new cells contain essential oil, essential oil channels, secretory ducts and glandular trichomes (Agena, 1994; Moore, 1979). Another reason can be attributed to better photosynthesis and better breathing, because secondary metabolites engender from plant photosynthesis and better photosynthesis produces more secondary metabolites and more essential oil. A similar result as regards of significant differences in essential oil yield of ajwain and non-significant differences in case of essential oil percentage was also reported by Vahidipour *et al.* (2013).

CONCLUSIONS

In the light of results summarized above, it observed that increasing NPK application is of great advantage and the maximum benefit from the crop of ajwain as well as fertility status of soil.

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