Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(1): 2555-2557
Received: 19-11-2020
Accepted: 21-12-2020

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Influence of integrated nutrient management and plant geometry on quality of ajowan (*Trachyspermum ammi* L. Sprague) in Southern zone of Telangana

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DOI: https://doi.org/10.22271/phyto.2021.v10.i1aj.13747

Abstract
The present investigation entitled on "Influence of integrated nutrient management and plant geometry on quality of ajowan (*Trachyspermum ammi* L. Sprague) in Southern zone of Telangana" was carried out during the *late kharif* season of the year 2019-20 at College of Horticulture, Rajendranagar, Hyderabad. The experiment was laid out in a factorial randomized block design with 12 treatments, replicated thrice. The treatments include four integrated nutrient management levels [INM_1] 100% NPK (20:40:20 kg/ha) + FYM (12 t/ha) + VC (6 t/ha) + NC (3 t/ha) + AMC (7.5 litres/ha), [INM_2] 75% NPK (15:30:15 kg/ha) + FYM (12 t/ha) + VC (6 t/ha) + NC (3 t/ha) + AMC (7.5 litres/ha), [INM_3] 50% NPK (10:20:10 kg/ha) + FYM (12 t/ha) + VC (6 t/ha) + NC (3 t/ha) + AMC (7.5 litres/ha), [INM_4] 100% NPK + FYM (12 t/ha) (Control), at three plant geometries (S_1) 30 cm x 10 cm, (S_2) 30 cm x 30 cm and (S_3) 45 cm x 30 cm. Among the quality parameters, essential oil content was found significantly more with T_3 (INM_1+ S_3) (3.26) and was at par with T_2 (INM_1+ S_2) (3.19) while, the lowest was recorded in T_7 (INM+ S_1) (2.02). The highest protein content was observed in T_3 (INM_1+ S_3) (19.76), followed by T_6 (INM_2+ S_3) (18.30) while, the lowest was recorded in T_7 (INM_3+ S_1) (12.61).

Keywords: essential oil, protein content, vermicompost, neem cake, arka microbial consortium, plant geometry, integrated nutrient management

Introduction
Ajowan or Bishop's weed (*Trachyspermum ammi* L. Sprague) is an annual herb belonging to the family Apiaceae, native of Egypt. The variety Lam Sel.-2 was used in the present investigation. It is suitable for cultivation both under irrigated and rainfed situations. This is a spreading and bushy type. Flowering starts at 90 days after sowing and matures in 135 -145 days after sowing. The variety possesses high yield potential with an average yield of about 1170 $kgha^{-1}$. Hence organic manures and bio fertilizers are the important components of Integrated nutrient management. There is a need to seek alternative nutrient sources which could be cheap and eco-friendly so that farmers may be able to reduce the investment on chemical fertilizers along with maintaining good soil environment conditions leading to ecological sustainable farming. Integrated nutrient management including compost, vermi compost and use of bio NPK consortium either alone or in combination of chemical fertilizers not only help to curtail chemical load in the soil, but also improves soil physical condition and augments microbial activities in the soil and thereby enhances sustainable yield potential (Gamar *et al*., 2018) [1].

Materials and Methods
The present investigation entitled "Studies on the influence of integrated nutrient management and plant geometry on growth, seed yield and quality of ajowan (*Trachyspermum ammi* L. Sprague) in southern zone of Telangana" was carried out during 2019-20 at College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad. The experiment was laid out in a factorial randomized block design with 12 treatments, replicated thrice. The treatments include four INM levels [INM_1] 100% NPK (20:40:20 kg/ha) + FYM (12 t/ha) + VC (6 t/ha) + NC (3 t/ha) + AMC (7.5 litres/ha), [INM_2] 75% NPK (15:30:15 kg/ha) + FYM (12 t/ha) + VC (6 t/ha) + NC (3 t/ha) + AMC (7.5 litres/ha), [INM_3] 50% NPK (10:20:10 kg/ha) + FYM (12 t/ha) + VC (6 t/ha) + NC (3 t/ha) +

AMC (7.5 litres/ha), [INM_4] 100% NPK + FYM (12 t/ha) (Control), at three plant geometries (S_1) 30 cm x 10 cm, (S_2) 30 cm x 30 cm and (S_3) 45 cm x 30 cm. Observations were recorded on quality attributes are

1. Essential oil content (%)

Essential oil obtained from hydro distillation (Clevenger's apparatus) was expressed as percentage. Seed yield from each treatment was used to compute essential oil yield (ml) per plot and per hectare (litre) with the help of data on per cent essential oil content in the seeds obtained from each treatment

$$\text{Essential oil yield} = \frac{\text{Seed yield x per cent essential oil content}}{100}$$

2. Protein content (mg/100 g)

Protein content in fresh and dried powder was estimated by using Lowry's method. 500 mg of sample was weighed and grinded well with pestle and motor in 5 ml of buffer. The sample was centrifuged and the supernatant was used for protein estimation. 0.2, 0.4, 0.6, 0.8 and 1.0 ml of working standards were pipetted out into a series of test tubes and 0.1 and 0.2 ml of sample extract in two other test tubes. The volume was made up to 1 ml in all the test tubes. 5 ml of reagent C (alkaline copper solution) was added to each test tube and 0.3 ml of Folin reagent added and kept in dark condition for 30 min. The OD readings were taken at 660 nm, a standard graph was drawn and the amount of protein in the sample was calculated.

Results and Discussion

1. Essential oil content (%)

The essential oil content was significantly influenced by integrated nutrient management, plant geometry and their interaction (Table. 1 and Fig.1). The results indicated that plants grown at INM_1 had significantly more essential oil content (3.16 %) than all other combinations. The least essential oil content was found when plants were grown with INM_3 (2.14%). The essential oil content in the plants grown with plant geometry (S_3) 45cm x 30cm (2.87 %) was significantly higher, followed by plant geometry (S_2) 30cm x 30cm (2.82 %). Among the interactions, significantly more essential oil was recorded with the application of T_3 (INM_1 + S_3): 100% NPK (20:40:20 kg/ha) + Farm Yard Manure (12 t/ha) + Vermicompost (6 t/ha) + Neem cake (3 t/ha) + Arka Microbial consortium (7.5 litres/ha) with plant geometry 45 cm x 30 cm (3.26 %), which were on par with T_2 (INM_1 + S_2) (3.19 %). The least essential oil content was observed with the application of T_7(INM_3 + S_1) : 50% NPK (10:20:10 kg/ha) + Farm Yard Manure (12 t/ha) + Vermicompost (6 t/ha) + Neem cake (3 t/ha) + Arka Microbial consortium (7.5 litres/ha) with plant geometry 30 cm x 10 cm (2.02 %). The above results indicated that plant grown with higher doses of fertilizer and wider spacing resulted in higher essential oil content. As the nitrogen plays an important role in development and divisions of new cells containing essential oil. It also plays important role in essential oil channels secretary ducts development and growth of glandular trichrome. Hence, availability of soil N might have helped the accumulation of essential oil in the plants and seed. Further, increased availability of photosynthates in the plants grown in nutrient rich soil, might have increased the production of essential oils which actually engender from specific pathways which need regular availability of primary metabolites. Similar results have also been reported by Singh and Singh [2] (2016) in dill and Valiki [3], *et al.*, (2015) in fennel and Singh [4], (2011) in coriander and Naruka [5] *et al.* (2012) in ajowan.

2. Protein content (%)

The protein content is presented in table 1. There were significant changes in protein content with integrated nutrient management, plant geometry and their interaction. The results obtained indicated that significantly higher protein content was recorded with INM_1 (18.69 %), followed by INM_2 (16.82%). The lowest protein content was found when plants grown at INM_3 (12.99%). Regarding the effect of plant geometry on protein content of seed, significantly higher protein content was observed with plant geometry (S_3) 45 cm x 30 cm (17.24%) compared to the other two geometries. Among the interaction effect, the maximum protein content was found at T_3 (INM_1 + S_3) : 100% NPK (20:40:20 kg/ha) + Farm Yard Manure (12 t/ha) + Vermicompost (6 t/ha) +Neem cake (3 t/ha) + Arka Microbial consortium (7.5 litres/ha) with plant geometry 45 cm x 30 cm (19.76%), followed by T_6 (INM_2 + S_3) (18.30 %). The lowest protein content was found at T_7 (INM_3 + S_1): 50% NPK (10:20:10 kg/ha) + Farm Yard Manure (12 t/ha) + Vermicompost (6 t/ha) + Neem cake (3 t/ha) + Arka Microbial consortium (7.5 litres/ha) with plant geometry 30 cm x 10 cm (12.61%). The higher protein content observed in plants grown with wider spacing and higher doses of fertilizer might have been due to continuous supply of nitrogen from the soil which in turn helped biosynthesis of protein. The increased availability of potassium in soil and plants might have helped in better utilization of nitrogen and synthesis proteins. The results are similar to the findings of Kumar [6] *et al.* (2015) in fenugreek.

Table 1: Influence of integrated nutrient management (INM) and plant geometry(S) on essential oil content (%) and protein content (%) in ajowan

Treatments	Seed quality							
	Essential oil content (%)				Protein content (%)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
INM_1	3.03	3.19	3.26	3.16 ^{a}	18.09	18.22	19.76	18.69 ^{a}
INM_2	2.52	3.02	3.10	2.88 ^{b}	15.36	16.81	18.30	16.82 ^{b}
INM_3	2.02	2.18	2.22	2.14 ^{d}	12.61	12.95	13.43	12.99 ^{d}
INM_4	2.36	2.89	2.90	2.71 ^{c}	15.37	15.94	17.47	16.26 ^{c}
Mean	2.48 ^{c}	2.82 ^{b}	2.87 ^{a}		15.35 ^{c}	15.98 ^{b}	17.24 ^{a}	
	S Em ±		CD at 5%		S Em ±		CD at 5%	
INM	0.013		0.04		0.01		0.04	
S	0.012		0.03		0.01		0.03	
INM X S	0.024		0.07		0.02		0.06	

INM = Integrated nutrient management
INM_1: 100% NPK (20:40:20 kg/ha)+ FYM(12t/ha) +VC(6t/ha) +NC (3t/ha) + AMC (7.5 l/ha)
INM_2: 75% NPK (15:30:15 kg/ha) + FYM(12t/ha) +VC(6t/ha) +NC (3t/ha) + AMC (7.5 l/ha)
INM_3: 50% NPK (10:20:10 kg/ha)+ FYM(12t/ha) +VC(6t/ha) +NC (3t/ha) + AMC (7.5 l/ha)
INM_4: 100% NPK (20:40:20 kg/ha) + FYM (12 t/ha) (Control)

S= Plant geometry (spacing)
S_1 (30X10 cm)
S_2 (30X30 cm)
S_3 (45X30 cm)

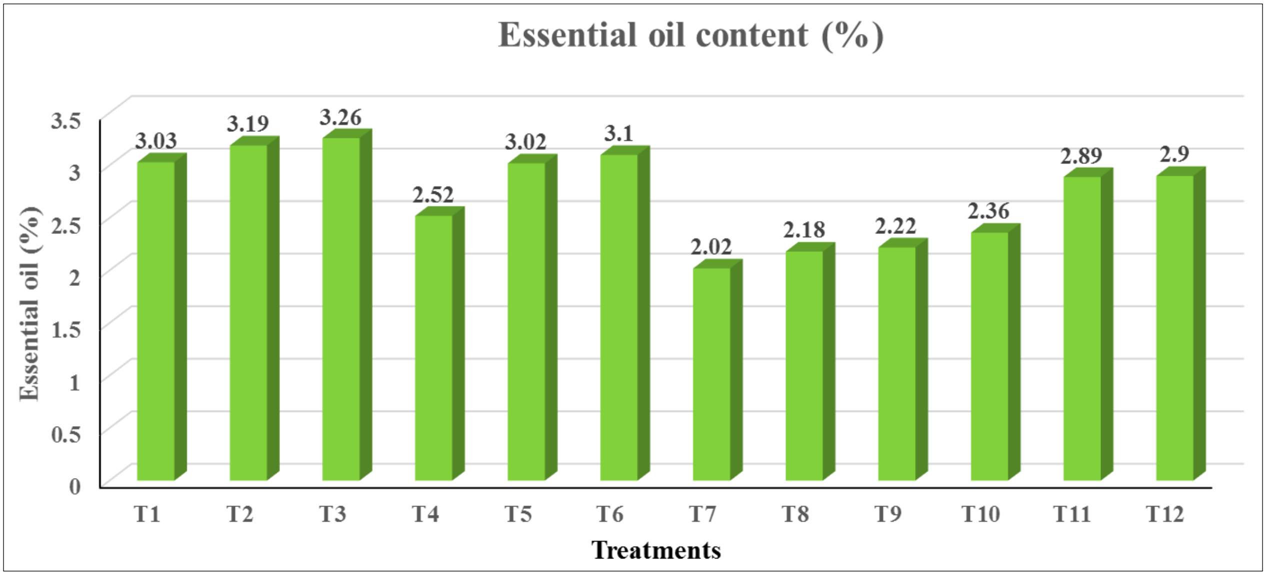

Fig 1: Influence of integrated nutrient management (INM) and plant geometry(S) on essential oil content (%) in ajowan

Conclusion

It could be concluded that plant grown with higher doses of fertilizer and wider spacing resulted in higher essential oil and protein content. As the nitrogen plays an important role in development and divisions of new cells containing essential oil and biosynthesis of protein. It also plays important role in essential oil channels secretary ducts development and growth of glandular trichrome. Among the quality parameters, essential oil content and protein content was found significantly more with T_3 (INM_1+ S_3), while, the lowest was recorded in T_7 (INM_3+ S_1).

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