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Effect of spacing and nitrogen levels on growth, yield and quality of ajwain (*Trachyspermum ammi* L. Sprague)

I. S. Naruka, P. P. Singh, Megha Barde, and S.S. Rathore

Department of Plantation and Spice Crops, College of Horticulture, Mandsaur - 458001 (M.P.) India

ABSTRACT

An experiment was conducted during rabi season of 2008-09 at Farm, College of Horticulture, Mandsaur to study the effect of spacing and nitrogen on the productivity and quality of ajowan. The experiment was consisting of 3 spacing (45 x 10 cm, 45 x 20 cm and 45 x 30 cm) and 4 levels of nitrogen (0, 20, 40 and 60 Kg N ha^{-1}). Wider 45 x 30 cm spacing significantly increased the number of primary and secondary branches per plant at harvest, fresh weight per plant (g), dry weight per plant, days to 50% flowering, number of umbels per plant, number of umbellets per umbel, yield per plant (g) chlorophyll content of leaves (mg g^{-1}), carotenoids content of leaves (mg g^{-1}) and essential oil of seed (ml 100 g^{-1}) expect plant height (cm), seed yield (q ha^{-1}), straw yield (q ha^{-1}) and biological yield (q ha^{-1}), these attributes are maximum in 45 x 10 cm spacing. Whereas non significant effect was observed on test weight (g) and harvest index (%). Among various levels of nitrogen tried 60 kg ha^{-1} exhibit growth, yield and quality attributes. The maximum benefit: cost ratio (6.26:1) was found with "45 x 30 cm + 60 Kg N ha^{-1}" treatment combination.

Keywords: Ajowan, Growth, Nitrogen, Quality, Spacing, Yield.

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INTRODUCTION

Ajwain (*Trachyspermum ammi* L. Sprague) is an annual spice herb. It owes its characteristic odour and taste due to presence of an essential oil (2-4%). Ajowan 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. The maximum exploitation of the factors available for growth of any crop can be achieved only when the plant population exerts maximum pressure on all the production factors. Under this situation individual plant remains under stress conditions because of inter/intra plant competition. In other word the maximum yield can be obtained from the plant population which does not allow individual plants to achieve their maximum potential (Donald 1963, 4). 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

* Corresponding Author: Email:drisnaruka@yahoo.com

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 & Palaniappan 2005, 3). Keeping all these in mind, an experiment was conducted to study the effect of spacing and nitrogen on the productivity and quality of ajwain.

MATERIALS AND METHODS

The experiment was undertaken to study the effect of spacing and nitrogen on the productivity and quality of ajwain at the Farm, College of Horticulture, Mandsaur, Madhya Pradesh using ajwain cultivar NRCSS-AA-2 during rabi season of 2008- 2009. Treatment consisted of three spacing i.e. 45 x 10 cm, 45 x 20 cm and 45 x 30 cm with four levels of nitrogen i.e. 0, 20, 40 and 60 Kg N ha^{-1}. The experiment was conducted in split plot design having spacing in main plot and nitrogen level in subplot, replicated four times and recommended practices were undertaken. The experimental soil was light black loamy in texture with 7.1 pH and 0.24 ds/m EC having low available of nitrogen (140.0 Kg ha^{-1}) and medium in available phosphorus (21.0 Kg ha^{-1}). Economics of various treatments was calculated using the prevailing market prices of the ajwain crop.

RESULTS AND DISCUSSION

Effect of spacing

The 45 x 30 cm spacing significantly increased growth attributes like number of primary branches (16.0) at harvest, number of secondary branches (56.1) at harvest, fresh weight (9.06 g and 93.84 g) per plant at 60 and 90 DAS, dry weight (11.53 g) per plant at 90 DAS. Whereas the maximum plant height (33.5, 88.0 and 106.0 cm) at 60, 90 and 120 DAS was observed in 45 x 10 cm spacing. However non - significant effect was observed on dry weight at 60 DAS.

Similarly 45 x 30 cm spacing significantly increased yield and quality attributes like days taken to 50% flowering (88.7), number of umbels (183.1) per plant, number of umbellets (18.5) per umbels, yield per plant (15.65 g), chlorophyll content in leaves at 60 and 90 DAS (1.685 mg g^{-1} and 2.057 mg g^{-1}), carotenoids content in leaves at 60 and 90 DAS (0.761 mg g^{-1} and 0.868 mg g^{-1}) and essential oil content (3.475 ml 100 g^{-1}),. Whereas the maximum seed yield (15.54 q ha^{-1}), straw yield (73.05 q ha^{-1}) and biological yield (88.60 q ha^{-1}) were observed in 45 x 10 cm. However non significant effect was observed on test weight and harvest index.

The larger canopy development associated with profuse branching has increased interception, absorption and utilization of solar energy resulting in formation of higher photosynthates and finally dry matter per plant. The observed crop behaviour with respect to yield potential under the influence of spacing could be mainly ascribed to primary function of number of plant per hectare and secondarily growth and development of the crop. Further, it was observed that variation in spacing from 45 x 10 cm to 45 x 30 cm resulted in marked difference in number of plant per unit area whereas, variation in seed yield was too marginal (13.61 q ha^{-1} to 15.54 q ha^{-1}). These results amply justify that over crowding plants at closer spacing significantly reduced growth and yield attributes of the crop but compensated the yield to a certain level due to more plants per unit area. While, under wider spacing reduced population per unit area though, improved over all growth of crop and increased crop yield components but failed to record highest yield due to less number of plants per hectare. The findings of these investigations are in close conformity with those of Krishnamoorthy *et al.* 2000 (7) and Nath *et al.* 2008(11) in ajowan. Similar results were also reported by Malav and Yadav 1997 (8)and Nehra *et al.* 1998 (10)in coriander and in fennel (Maneria & Maliwal 2007, 9).

Effect of nitrogen

Application of 60 Kg N ha^{-1} significantly increased the growth attributes like plant height (33.0, 89.8 and 108.3 cm) at 60, 90 and 120 DAS, number of primary branches per plant (18) at harvest, number of secondary branches per plant (61.1) at harvest, fresh weight per plant (9.58 g and 93.48 g) at 60 and 90 DAS, dry weight per plant (2.00 g and 13.29 g) at 60 and 90 DAS. Similarly, 60 kg N ha^{-1} significantly increased the yield and quality attributes like days taken to 50% flowering (88.9), number of umbels (182.2) per plant, umbellets (18.9) per umbels, test weight (1.38 g), yield per plant (15.30 g), seed yield (16.25 q ha^{-1}), straw yield (72.10 q ha^{-1}), biological yield (88.36 q ha^{-1}), chlorophyll content in leaves at 60 and 90 DAS (1.715 mg g^{-1} and 2.309 mg g^{-1}), carotenoids content in leaves at 60 and 90 DAS (0.786 and 0.852 mg g^{-1}) and essential oil content (3.167 ml 100 g^{-1}).

It is an established fact that nitrogen is one of the essential constituent required for the synthesis of protein, chlorophyll and other organic compounds of physiological significance in the plant system. Since, in the plant system most of the nitrogen accumulated in the reproductive structure is translocated from vegetative parts, the assumption seems to be justify that nitrogen

Table 1. Effect of spacing and nitrogen on growth and yield attributes of ajwain

Treatment	Plant height (cm)			No. of branches at harvest		Fresh weight (g)		Dry weight (g)		Days to 50% flowering	No. of umbels per plant	No. of umbellets per umbel	Tes weig (g)
	60 DAS	90 DAS	120 DAS	Primary	Secondary	60 DAS	90 DAS	60 DAS	90 DAS				
Spacing (cm)													
45 x 10	33.5	88.0	106.1	6.84	67.75	88.0	106.1	1.28	8.12	86.9	146.2	15.1	1.2
45 x 20	31.2	82.3	103.8	8.84	79.50	82.3	103.8	1.40	10.03	87.7	161.5	17.9	1.3
45 x 30	29.6	80.4	98.0	9.06	93.84	80.4	98.0	1.43	11.53	88.7	183.1	18.5	1.3
SEm±	0.71	1.72	1.81	0.329	1.779	1.72	1.81	0.107	0.401	0.17	3.29	0.49	0.01
CD at 5%	2.46	5.98	6.27	1.139	6.157	5,98	6.27	NS	1.388	0.60	11.41	1.71	NS
Nitrogen (N kg ha^{-1})													
0	29.7	78.3	98.9	6.20	66.75	78.3	98.9	1.04	6.70	86.6	129.5	15.7	1.2
20	30.9	81.5	100.5	8.12	73.50	81.5	100.5	1.12	8.33	87.5	167.1	16.5	1.3
40	32.3	84.9	104.9	9.08	87.75	84.9	104.9	1.33	10.58	88.0	175.5	17.5	1.3
60	33.0	89.8	108.3	9.58	93.48	89.8	108.3	2.00	13.29	88.9	182.2	18.9	1.3
SEm±	0.77	1.31	0.95	0.353	1.965	1.31	0.95	0.142	0.532	0.20	4.14	0.46	0.01
CD at 5%	2.25	3.80	2.76	1.024	5.703	3.80	2.79	0.413	1.556	0.59	12.03	1.34	0.03

Table 2. Effect of spacing and nitrogen on yield and quality attributes of ajwain

Treatment	Chlorophyll content (mg g^{-1})		Carotenoids content (mg g^{-1})		Essential oil content of seed (ml $100g^{-1}$)	Yield per plant (g)	Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest inde (%)
	60 DAS	90 DAS	60 DAS	90 DAS						
Spacing (cm)										
45 x 10	1.387	1.671	0.690	0.815	2.776	9.47	15.54	73.05	88.60	17.55
45 x 20	1.510	1.911	0.710	0.836	2.800	13.32	14.20	69.54	83.75	16.96
45 x 30	1.685	2.057	0.761	0.868	3.475	15.65	13.61	58.12	71.74	19.00
SEm±	0.0297	0.0001	0.0029	0.0019	0.0003	0.329	0.383	1.256	1.546	0.498
CD at 5%	0.1028	0.0035	0.0101	0.0068	0.0012	1.140	1.326	4.349	5.349	NS
Nitrogen (N kg ha^{-1})										
0	1.362	1.441	0.669	0.832	2.834	11.44	13.30	59.26	72.56	18.44
20	1.451	1.812	0.687	0.837	3.000	11.90	13.62	67.01	80.63	16.89
40	1.623	1.956	0.738	0.840	3.067	13.62	14.64	69.25	83.89	17.54
60	1.715	2.309	0.786	0.852	3.167	15.30	16.25	72.10	88.36	18.48
SEm±	0.0256	0.0015	0.0033	0.0021	0.0004	0.304	0.370	1.032	1.229	0.789
CD at 5%	0.0744	0.0043	0.0096	0.0063	0.0013	0.884	1.075	2.997	3.566	NS

Table 3. Economics of different treatment combinations in ajwain

S.No.	Treatment combinations	Yield (q ha^{-1})	Cost of cultivation (Rs ha^{-1})	Gross return ha^{-1} @ Rs 4500 q^{-1}	Net profit (Rs ha^{-1})	Benefit : cost ratio
1	S_1N_0	14.62	10034	65790	55756	5.55:1
2	S_1N_1	15.25	10135	68625	58490	5.77:1
3	S_1N_2	15.79	10236	71055	60819	5.94:1
4	S_1N_3	16.52	10337	73890	63553	6.14:1
5	S_2N_0	13.07	9834	58815	48981	4.98:1
6	S_2N_1	13.09	9935	58905	48970	4.92:1
7	S_2N_2	14.44	10036	64980	54944	5.47:1
8	S_2N_3	16.21	10137	72945	62808	6.19:1
9	S_3N_0	12.22	9634	54990	45356	4.70:1
10	S_3N_1	12.52	9735	56340	46605	4.78:1
11	S_3N_2	13.69	9836	61605	51769	5.26:1
12	S_3N_3	16.04	9937	72180	62243	6.26:1

application lead to increased nitrogen content in the plants right from early stage of crop growth. The faster growth of plants evidenced from increased biomass per plant at successive stages of crop growth with nitrogen subscribe to the views that there was better availability of metabolites and nutrients, which synchronized to the demand for the growth and development of each reproductive structure of the ajwain plant. The present trend of increased growth, yield and quality attributes of ajwain with the application of nitrogen is in close conformity with the findings of Krishnamoorthy and Madalgari, 2000(5); Krishnamoorthy and Madalgari, 2002(6); Asharf and Noman 2006(2); Wahab and Mohamed, 2007(14); Nath *et al.* 2008(11). Similar results were also reported by Tiwari and Banafar, 1995(13); Malav and Yadav 1997 (8) in coriander, Amin and Patel 2001(1); Rai *et al.* (2002) (12) in fennel crop.

The spacing and nitrogen levels significantly influenced the growth, yield and quality of ajowan. The yield potential of ajwain increased by treatment combination of 45 x 30 cm + 60 kg N ha^{-1} giving a benefit cost ratio of 6.26:1.

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