

Effect of Plant Density and Nitrogen Fertilizer on Morphological Traits, Seed and Essential Oil Yield and Essential Oil Content of Ajowan (*Carum copticum* L.)

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Introduction: Ajowan (*Carum copticum* Benth. & Hook.) is an annual herbaceous essential oil bearing plant belonging to the Apiaceae family, which grows in India, Iran, and Egypt. Ajowan seeds have essential oil as an active substance, which is used in pharmaceutical industry as a diuretic, antiemetic, analgesic, antiasthma, antispasmodic and a carminative. Nitrogen is a part of all living cells and is a necessary part of all proteins, enzymes and metabolic processes involved in the synthesis and transfer of energy. Also, nitrogen is a part of chlorophyll, the green pigment of the plant that is responsible for photosynthesis. Generally, proper agronomic management including suitable plant density has a high influence on growth and yield of medicinal plants. In this regard, Kloss et al., (2012) highlighted the need for strategies to improve crop growth, make irrigation more efficient and sustainable and conserve farmlands. In addition, yield is influenced by inter-row spacing and sowing density. Ghilavizadeh et al., (2013) have reported that application of suitable amount of nitrogen fertilizer and plant density of 25 plant/m² increased seed yield, essential oil yield and essential oil content of ajowan. In another research, Borumand Rezazadeh et al., (2009) reported that the plant density of 50 plant/m² have produced the highest seed yield, essential oil yield and essential oil content. Generally, with regard to importance of medicinal plants and the necessity of understanding their crop and the impact of plant density and nitrogen fertilizer on the performance of these plants, this study was conducted to investigate the impact of these factors on some traits of ajowan.

Materials and Methods: In order to evaluate the effect of plant density and nitrogen fertilizer on different traits of ajowan (*Carum copticum* L.), an experiment was conducted using factorial based on randomized complete block design with three replications at Agricultural and Natural Resources Research Center of Yazd in 2012 growing season. Treatments included three levels of plant density (60, 120 and 180 plant per m²) and three levels of nitrogen fertilizer (60, 90 and 120 kg/ha). The geographical location of the experimental station was 55°52' S and 29°52' N with the altitude of 1120 m. Each experimental plot was 6 m long and 2 m wide with the spacing of 30 cm between the rows. Ajowan seeds were directly sown by hand on 3 April, 2012. To measure the characteristics of number of umbel per plant, flowering branches and diameter of top of plant with respect to the margin effect, 10 plants were randomly selected from two central rows of each plot and mentioned traits were measured and the means of each traits in each plot were used in the analysis. For evaluating seed yield, essential oil yield and content, 1 meter of each plot was harvested. For statistical analysis, MSTAT-C software was used to compare means at the 5% probability level by Duncan's multiple range test.

Results and Discussion: The results showed that the highest number of flowers per plant (25/27), number of flowering branches (7/77), diameter of top of plant (32 cm), seed yield (301/4 kg/ha) and essential oil yield (12/45 kg/ha) were obtained from 60 plant per m² and 120 kg/ha nitrogen. Among the treatments, only the effect of nitrogen fertilizer was significant on essential oil content, so that, application of 120 kg/ha nitrogen produced the highest essential oil content (4/07). Our results are in agreement with the findings of Borumand Rezazadeh et al., (2009) who reported that, the highest traits of ajowan was obtained in plant density of 50 plant/m². Seed yield had positive and significant correlation with plant height, number of umbel per plant and number of flowering branches.

Conclusion: Generally, it is concluded that, increasing the plant density with enhancing the interspecific competition for light, nutrients, water and other resources, had negative effect on traits of ajowan. Furthermore, the findings of this research indicated that ajowan had high requirement for nitrogen to produce a reasonable yield. So, more researches at different conditions are necessary to evaluate the effect of intercropping, rotation, bio-fertilizers and composts on different traits of ajowan. Generally, it seems that more researches are needed for

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investigating the effect of different plant densities and nitrogen fertilizers on qualitative and quantitative traits of ajowan.

Keywords: Diameter of top of plant, Flowering branches, Umbels/plant.

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