Australian Journal of Basic and Applied Sciences, 5(3): 151-157, 2011
ISSN 1991-8178

Productivity of Cumin (*Cuminum cyminum* L.) As Affected by Irrigation Levels and Row Spacing

Abdolhossein Rezaei Nejad

Department of Horticultural Sciences, Faculty of Agriculture, Lorestan University, Khorramabad, Iran

Abstract: In Order to study the effect of irrigation levels and row spacing on seed yield and essential oil of cumin (*Cuminum cyminum* L.), an experiment was conducted at research field of Faculty of Agriculture, Lorestan University, Khorramabad, Iran in 2000. The experiment was carried out as a split-plot arranegment based on a randomized complete block design with three replications. Irrigation level was the main factor with three levels (no irrigation, one irrigation at sowing, and two irrigations at sowing and seed formation). Row spacing was the subsidiary factor with three levels (20 cm, 30 cm, 40 cm). Seed yield, essential oil content and essential oil yield were recorded. Essential oil was extracted by hydro-distillation using Clevenger apparatus. Results showed that seed yield and essential oil yield increased with decreasing row spacing. Two irrigations increased seed yield and essential oil yield, while, one irrigation didn't show any significant difference with no irrigation. The maximum seed yield and essential oil yield (with 721.7 and 7.48 $kg.ha^{-1}$, respctively) were produced by two irrigations combined with 20 cm row spacing. Moreover, essential oil content decreased as irrigation levels increased, whereas, row spacing had no effect on essential oil content. No irrigation combined with 40 cm row spacing produced the highest essential oil content (1.37%). It is suggested that, irrigation at seed formation stage combined with row distance of 20 cm (150 $plants.m^{-2}$) could produce desirable seed and essential oil yield in cumin under Iran (Khorramabad) climatic conditions.

Key words: *Cuminum cyminum* L., irrigation, essential oil, seed yield.

INTRODUCTION

Cumin (*Cuminum cyminum L.*), a member of Apiaceae, is an annual plant which is originated from Egypt and East Mediterranean. But it is widely cultivated in Iran, Japan, China and Turkey. At the present, Iran is an important cumin exporter in the world market and cumin production of Iran is approximately 20- 40% of world market (Kafi, M. 2003). Cumin has a long history of use as food flavours, perfumes and medicine. Its essential oil is used for bactericidal applications, giving smell to some medicines, sterilizing of surgical operation fiber and producing some veterinary and agricultural medicines (Bakkali, F., 2008; Simon, J.E.1984). The seeds of cumin have an aromatic odor and bitter taste. They are used as an essential ingredient in soup, sausages, cheese, cakes and candies (Behera, S., 2004). In semi-arid area such as Iran, water is the most limiting factor for farming. Cumin has a potential to be a rainfed crop, but supplemental irrigation is needed to produce more productivity. Little information is available about its consumptive use of water. Also, using an appropriate plant density is necessary for maximum utility of existing environmental factors (water, air, light and soil). As a result, inter specific or intra specific competition is minimum. Thus, many researches has been done to determine the best level of irrigation and plant density and their effects on vegetative and generative parameters of agricultural and medicinal plants. However, much little has been carried out on cumin. Of the few studies that have been made, most of them have been carried out on seed yield and the information about the changes in essential oil is scarce. Alizadeh *et al* (2002) reported that additional irrigation had no advantages in cumin production. However, Esfandiari *et al* (2010) resulted that complete irrigation produced the highest seed yield in cumin. Jangir and Singh (1996) showed that five irrigations at sowing, 10, 30, 55 and 80 days after sowing increased the seed yield and higher irrigation frequencies had no additional advantage. Yava and Dahama (2003) reported that four irrigations resulted in a significantly higher seed yield of cumin under 15

Corresponding Author: Abdolhossein Rezaei Nejad, Department of Horticultural Sciences, Faculty of Agriculture, Lorestan University, Khorramabad, Iran
E-mail: Rezaeinejad.Hossein@gmail.com

November planting, while, under late-sown condition of 30 November, three irrigations gave the best results.

The results reported on plant density of cumin are also contradictory. Heidari Zolleh *et al* (2009) recomended 200 plants.m^{-2} for the highest seed yield. Azizi and Kahrizi (2008) resulted that 120 plants.m^{-2} was the best density for higher seed and essential oil yield compared with 80 and 120 plants.m^{-2}. In this paper we aimed to study the effect of different irrigation levels and row spacing on seed and essential oil yield of cumin under the climatic conditions of Khorramabad, Iran.

MATERIALS AND METHODS

This study was conducted at research field of Faculty of Agriculture, Lorestan University, Khorramabad, Iran (33^{o} , 29$^{/}$ N and 48^{o}, 22$^{/}$ E, 1125 m above see level) in 2000. The field soil properties of the top 30 cm, taken just before sowing, was silty clay loam with pH of 7.6, K 390 mg.kg^{-1}, P 5.1 mg.kg^{-1}, total N 0.147%, organic carbon 0.96%, EC 0.6 ds.m^{-1}, Fe 6 mg.kg^{-1}, Mn 19.9 mg.kg^{-1}, Zn 0.88 mg.kg^{-1}, Cu 1.8 mg.kg^{-1}.

The experimental design was laid out in a split-plot arrangement based on a randomized complete block design with three replications. Irrigation level and row spacing were given in main and sub plots, respectively. Irrigation levels were: no irrigation (I_0), one irrigation: at sowing (I_1) and two irrigations: at sowing and seed formation stage (I_2). Row spacing were: 20 cm (S_1), 30 cm (S_2) and 40 cm (S_3). Each sub-plot (experimental unit) had 4 m length in which 5 lines of the plants were cultivated. The distance of sub-plots, from each other, was 0.5 m and the distace of main plots and replicates was determined about 2 m due to irrigation treatments.

The experimental field was well prepared through deep plough, good harrowing, leveling, ridging and thereafter, dividing the experimental land into main and sub-plots by construction irrigation canals and alleys. Cumin seeds were sown manually as in March 11. In I_0 no irrigation was done. In I_1, irrigation was carried out only at sowing and in I_2 two irrigations were carried out at sowing as well as at seed formation stage (May 8). When the seedling were 3-4 leaves, they were thinned to have about 30 plants.m^{-1} which produced 150, 100 and 75 plants.m^{-2} in 20 cm, 30 cm and 40 cm row spacing, respectively. Other appropriate cultural management practices such as weeding and pest management were done properly to ensure a good stand of the crop. The rainfall was 173.96 mm during cumin growth period. Seeds were collected at June 5, dried in shade at about 30 ^{o}C and stored in capped bottle. Essential oil of seeds was obtained by hydro-distillation for three hours using Clevenger apparatus and expressed as dry weight basis. The data were subjected to analysis of variance using the MSTAT- C software. Mean comparison was done using a conventional Duncan's multiple rang test ($p<0.05$).

Results:

Results of analysis of variance (ANOVA) showed that irrigation levels and row spacing had a very significant effect on seed yield (Table 1). The interaction of irrigation levels and row spacing on seed yield was not significant ($P>0.05$). Two irrigations increased seed yield, while, one irrigation didn't show any significant difference with no irrigation (Fig. 1A). Seed yield decreased as row spacing increased (Fig. 1B). The maximum seed yield with 721.7 kg.ha^{-1} was produced by two irrigations combined with 20 cm row spacing (Fig. 1C).

Irrigation levels also showed a very significant effect on essential oil content (Table 1).
Essential oil content decreased as irrigation level increased (Fig. 2A). However, essential oil content was not affected by row spacing (Fig. 2B). The interaction of irrigation levels and row spacing on essential oil content was significant ($P<0.05$). No irrigation combined with 40 cm row spacing produced the highest essential oil content with 1.37% (Fig. 2C).

Moreover, ANOVA showed that irrigation levels and row spacing had a very significant effect on essential oil yield (Table 1). The interaction of irrigation levels and row spacing on essential oil yield was significant ($P<0.05$). Two irrigations increased essential oil yield, while, one irrigation didn't show any significant difference with no irrigation (Fig. 3A). Essential oil yield decreased as row spacing increased (Fig. 3B). The maximum essential oil yield with 7.48 kg.ha^{-1} was produced by two irrigations combined with 20 cm row spacing (Fig. 3C).