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Effects of Some Variables on Seed Germination and Seedling Growth of Cumin (*Cuminum cyminum* L.)*

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Abstract: Effects of different temperature treatments were evaluated on seed germination and seedling growth of cumin (*Cuminum cyminum* L.). A temperature range between 15 to 25°C found to be the optimum temperature for cumin seed germination percentage. However, the maximum germination percentage (96.25%) occurred at 15°C. Similarly, the maximum germination rate occurred at a temperature range between 15 to 25°C. Optimum seedling growth evaluated by seedling weight and height was increased with raising temperatures up to 20°C. Temperatures higher than 25°C adversely affected both seedling weight and height. Among the five dates of cumin field planting, April 4 was the best planting time. This treatment had significantly shortest emergence time, highest plant height and yield.

Key words: Cumin, *Cuminum cyminum*, seed germination, seedling growth, sowing time

Introduction

As early as 5000 BC, Egyptians preserved the bodies of their kings by mummifying them with cumin, anise and marjoratum and later cinnamon and cassia were used (Farrell, 1985).

Cumin (*Cuminum cyminum* L.), from Apiaceae family, is an important medicinal and spice crops which have been planted from ancient times in Iran and some other countries. Iran is one of the major producer and exporter of this plants which are mainly planted in Khorasan and Kerman provinces of this country (Khosravi, 1991).

Cumin is a small, slender herb which grows to a height of about 60 cm. It has finely dissected leaves, white or rose flowers and grayish bristly fruits about 6 cm long, tapering towards both ends. The seed is yellowish brown with a short stem. The aroma is strong and distinctive. Cumin herbs and seeds have volatile oil and cumin aldehyde was found as the main component for herb oil (El-Sawi and Mohammed 2002). The fixed oil content approximates 10%. The oleoresin of cumin is brownish to yellowish-green in color; it contains 60 mL of volatile oil in every 100 g. Approximate composition of 100 g of edible portion of cumin is as follows: water 8.1 g, food energy 375 kcal, protein 17.8 g, fat 22.3 g, total carbohydrate 44.2 g, fiber 10.5 g, ash 7.6 g, calcium 931 mg, iron 66 mg, magnesium 366 mg, phosphorous 499 mg, potassium 1788 mg, sodium 168 mg, zinc 5 mg, ascorbic acid 8 mg, thiamin 1 mg, niacin 5 mg, vitamin A 1270 IU, other vitamins insignificant (Farrell, 1985). Genetic variabilities are shown for cumin by different investigators (Mathur *et al*., 1971; Jha and Roy, 1983; Avatar *et al*., 1991).

Failure of germination in Apiaceae family seeds were reported by many investigators (Gupta, 2003). A variation of 8.4 to 80.5 in germination percentages is reported between seed lots of cumin (Arslan and Bozkurt, 1991). Results of field culture of cumin at different times showed that planting

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at 5 March resulted in highest yield (Arslan and Bayrak, 1987). Application of some fertilizer increased significantly yield and oil content in cumin (Amin *et al*., 1999). In other experiment cumin seeds were sowed at different row space and with different seed rate. Results showed that a row spacing of 22.5 cm and sowing rate or 14 kg/ha produced the highest seed yield (Chaudhary, 1999).

Although in Iran the production and export of this crop have been increased in recent years, little work has been done on seed germination and seedling growth of this plant. This investigation was an attempt to study the influences of several factors on cumin seeds and seedling growth.

Materials and Methods

Seeds of a local cultivar of cumin were obtained from Kerman, Iran in the year of 2000. They were transferred to the laboratory of Department of Horticultural Science, College of Agriculture, Shiraz University. The Experiment Station is located at Bajgah, 1810 m above the sea level, longitude 52°32′ E and latitude 29°36′ N, 15 km north of Shiraz, Iran. The soil was classified as Daneshkadeh soil series fine, mixed, mesic, Calcixerollic Xerochrepts with a cloddy structure from the surface down to 540 mm depth. The soil texture for the entire depth (0-540 mm) was clay loam and moderately compacted. The soil bulk density varied from 1.31 to 1.52 mg m^{-3} as the soil depth was increased from 250 to 500 mm. The average moisture content of the soil was 16% (dry-weight basis) from the surface to 500 mm depth. After some preliminary tests, the following experiments were conducted on cumin seeds.

Experiment No. 1

Effects of different temperature regimes consisting of 5, 10, 15, 20, 25 and 30°C on seed germination of cumin were evaluated. Mean daily germination was calculated by using the following formula (Hartmann *et al*., 1990):

$$\text{Mean daily germination} = \frac{N_1T_1 + N_2T_2 + \ldots\ldots\ldots + N_xT_x}{\text{Total number of seeds germinated}}$$

Where, N values are the numbers of seeds germinating within consecutive intervals of time; T values indicate the time between the beginning of the test and the end of a particular interval or measurement. This experiment was conducted as a completely randomized design with 4 replications. Each plot consisted of one petri dish with 100 seeds placed on one sheet of Whatman No. 1 filter paper.

Experiment No. 2

In this experiment the effects of different temperatures on seedling growth of cumin were evaluated. Germinated seeds were exposed to temperatures of 5, 10, 15, 20, 25 and 30°C. After 7 days seedling weight and length were measured. This experiment was conducted as a completely randomized design with 4 replications. Each plot consisted of 100 germinated seeds placed on one sheet of Whatman No. 1 filter paper.

Experiment No. 3

In a field experiment at the Experiment Station of College of Agriculture of Shiraz University, cumin seeds were sown at 4 October, 4 November, 4 February, 4 March and 4 April 2000 to find the suitable planting time. After April 4, it was too warm in southern part of Iran to cultivate cumin. This experiment was conducted as a completely randomized block design with 4 replications. Each plot was

consisted of four 3.8 m rows with row spacing of 0.6 m. Seeding rate was 4 g for each row. At the harvest time, to omit the margin effects, the yield of 3.2 m of two middle rows was used for statistical analysis. Factors such as number of days to seedling emergence, plant height at flowering and at harvest times, number of days from sowing to harvest, yield and weight of 1000 seeds were measured.

In all above experiments means were compared using Duncan's new multiple range test (DNMRT).

Results

The maximum germination percentage occurred at 15°C (96.25%). However, this treatment had no significant difference with 5, 10 and 20°C. The least mean day germination rate occurred at a temperature range between 15 to 25°C (Fig. 1).

In cumin, seedling weight and height were increased with raising temperatures up to 20°C. Temperatures higher than 25°C adversely affected both seedling weight and height (Table 1).

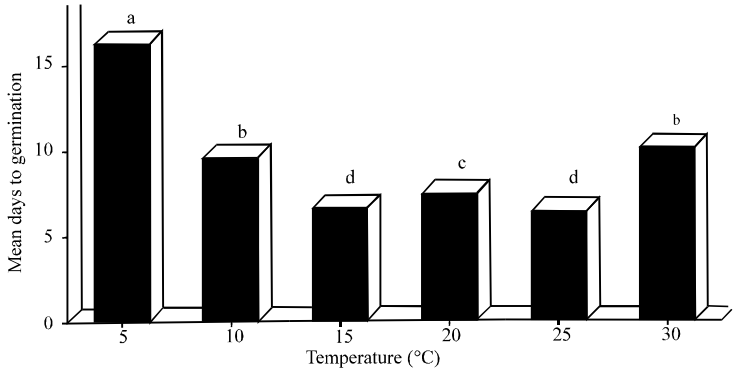

Fig. 1: Effects of different temperatures on mean days to germination of cumin seeds. Bars with the same letters are not significantly different at 5% level of probability using DNMRT

Table 1: Effects of different temperatures on seedling length and weight of cumin

Temperature (°C)	Seedling length (mm)	Seedling weight (g)
5	16.7^{f†}	0.89^{d}
10	25.55^{e}	1.16^{b}
15	59.94^{b}	1.54^{a}
20	74.10^{a}	1.69^{a}
25	53.45^{c}	1.07^{bc}
30	48.70^{d}	0.93^{cd}

† Means in each column followed by the same letter(s) are not significantly different at 1% of probability using DNMRT

Table 2: Effects of sowing dates on germination time, plant height, yield and seed weight of cumin

Sowing date	Emergence time (day)	Height in harvest (cm)	Yield (g/plot)	Weight of 1000 seeds (g)
4th October	16^{d†}	-§	-	-
4th November	33^{a}	-	-	-
4th February	30^{b}	14.9^{a}	6.38^{b}	2.50^{a}
4th March	21c	14.3^{b}	49.85^{a}	3.00^{a}
4th April	14^{d}	15.4^{c}	58.60^{a}	2.43^{a}

†In each column means followed by the same letter(s) are not significantly different at %1 of probability level using DNMRT, § Not detected

Among the 5 dates of cumin field planting, 4th April was the best planting time (Table 2). This treatment had significantly shortest emergence time, highest plant height and yield. The yield obtained for the best planting time was 152.6 kg ha^{-1}.

Discussion

The optimum temperature for seed germination and seeding growth of cumin was between 15 to 25°C. The decrease in seedling height and weight in higher temperatures may be the consequence of increase in respiration rate, decrease in CO_2 absorption and low food reserves (Malek *et al*., 1992; Booth and Bai, 1999).

In field planting, plants of first and second treatments were destroyed by frost. This result showed that cumin is a semihardy plant and can not tolerate temperatures below the -5°C. Planting in spring resulted in a rapid growth with highest yield and the lowest weed problem in the areas it is shown that cumin seed yield increased significantly when cultivated under a weed-free condition (Subhas, 2001). The yield obtained in this experiment for Fars province of Iran was much lower than those obtained in Khorasan and Kerman provinces where the traditionally the cumin is planted in earlier dates and the yield of about 500 kg ha^{-1} is obtained. The cooler weather or longer growing season are responsible for higher yield However, farmers are eager to extend the planting of this crop into areas with similar climates to Fars province because of its high value, attention to economic considerations is important before planting this crop in comparison to the other possible planting crops. Arslan and Bayrak (1987) showed that planting at 5 March resulted in highest yield in Turkey. Soil fertilizing is also reported to affect cumin yield (Amin and Wahab, 1999).

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