Study of phenological, morphological and phytochemical characteristics of cumin ecotypes under Mashhad climatic conditions

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Extended Abstract

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Introduction

Cumin (*Cuminum cyminum*) is an economically important plant from the Apiaceae family. It has medicinal properties and exhibits tolerance to drought stress. Cumin is mainly cultivated in Iran, India, Syria, Pakistan and Turkey and is widely used in foods, beverages and perfume and pharmaceutical industries. The mature dried fruit of cumin contains 2-5% essential oil (Gohari and Saeidnia, 2011, Li & Jiang, 2004). It is a monotypic species with low phenotypic and genetic variability (Bahraminejad*, et al.*, 2011). Evaluation of variability in plant species for genetic resources preservation and practical and scientific application of these plant germplasm resources are crucial for plant breeders. Attempts were made in this research to investigate various morphological and phenological traits as well as yield components and essential oil yield of cumin and also to explore relationship between cumin yield and its components. This will help identify traits that have impact on seed and essential oil yields of cumin so that they can be used for indirect selection on farm level.

Materials and Methods

This study was carried out at research station of agricultural research and education center of Khorasan Razavi, Iran during 2012-2013 cropping season. In this experiment, 24 cumin ecotypes obtained from plant genetic bank were tested

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in a completely randomized block design with three replications. Seed samples were first cultivated in the greenhouse and then transferred to the field and were grown under drip irrigation conditions. Phenological stages for each ecotype were recorded as follows; days to 50 % of seedling emergence and stem elongation, days to 50 % flowering and at physiological maturity. At the end of growing season, five plants were collected from each plot and were transferred to laboratory to measure the morphological traits. To determine the contribution of each trait to total variability and to decrease the volume of data that needs to be processed and to better interpret the relationships between the traits, analysis into main components was performed for the measured traits of cumin ecotypes and dispersion diagram was constructed on the main components.

Results and Discussion

According to the results, there was a significant variation ($p \leq 0.05$) among the genotypes for the phenological characteristics (days from sowing to stem elongation (16-3 days), to 50% flowering (39- 63 days) and to physiological maturity (85-94 days)) and also for the morphological traits. The number of stem branches in the genotypes was significantly ($p \leq 0.05$) different (3.5-5.7). The observed differences in the yield components were: number of umbels per plant)8.5-8.7(, number of umbellate per umbel (3-4), number of seeds in umbellate (23-13), 1000-seed weight (2.8-4.2 g), total plant biomass (6-22 g), seed yield per plant (2-8 g), essential oil percentage (0.99-3.11) and essential oil yield (0.02-0.2 g/plant), which were significantly different at $p \leq 0.05$. The results of stepwise linear regression analysis showed that the total plant biomass was the first trait that entered to the regression model and alone accounted for 51% of the variations in essential oil yield. The three more characters entered to the regression model included 1000-seed weight, crown and canopy area and number of umbellate per umbel, which explained 60% of variation in the dependent variable (essential oil yield). In order to identify the direct and indirect effects of traits on seed yield, path-way analysis was performed based on the variables entered into the final regression stage. The number of stem branches and number of umbels per plant had the most direct effect on seed yield and essential oil. PCA and cluster analysis were used to identify the genetic distance among accessions. The first and second component in cumin explained 71% of variation in the variables. Crown and canopy cover, plant height, plant weight and essential oil percentage were found to be the most important traits in cumin. The accessions located in cluster 1 were mainly originated from Markazi province, which had lower essential oil yield.

Conclusion

The traits including total plant biomass, number of umbellate per umbel, crown

and canopy cover and 1000-seed weight had the most direct effect on the essential oil yield of cumin. These traits were identified as a suitable criterion for determining the production ability of cumin ecotypes.

Keywords: Pathway analysis, essential oils, diversity

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