Effect of saffron-mallow intercropping patterns in the third year on possible cooling of corms for climate change adaptation

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Introduction

Saffron (*Crocus sativus* L.) a member of the Iridaceae family, called red gold, is the costliest spice in the world (Koocheki & Khajeh-Hosseini, 2020). Saffron is a fall-flowering geophyte plant and grass-like leaves that seem on or shortly after flowering. It has an important role in agricultural economy, especially in semi-arid regions (Koocheki et al., 2016; Koocheki & Khajeh-Hosseini, 2020).

Intercropping has been an important production system in all regions for many hundreds of years (Vandermeer, 1989). Proper implementation of intercropping, especially in medicinal and aromatic plants, helps to cover soil and avoid loss of water and nutrients (Weisany et al., 2016). Therefore, it seems that in saffron intercropping systems, companion crops' residues can effectively decline the adverse effects of high temperatures on dormant replacement corms.

Therefore the current study was aimed to evaluate the effects of saffron and mallow intercropping flower and corm yield and quality of saffron.

Materials and methods

This experiment was conducted based on a randomized complete block design with three replications at Agricultural Research Station, College of Agriculture, Ferdowsi University of Mashhad during 2015-2016, 2016-2017 and 2017-2018 growing seasons. Treatments were 15, 30, 45 and 60-cm row spacings for saffron from mallow planting rows and sole saffron and mallow cultivations. The experimental field was prepared according to the local practice for saffron and cumin production and then plots were established. Saffron mother corms were planted using basin method on 5th of Sep. 2012. Mallow seeds were sown in the first growing seasons on 1st of May 2015. In the third year, picking began on 9th of October and finished on 9th of November. In the year, flower number and dried stigma yield were recorded. Stigmas were dried in an oven at 30°C for 24 h to a constant weight before weighing (Gresta et al., 2009). Crocin, picrocrocin and safranal were measured based on ISO3632 trade standard. They are expressed as direct reading of the absorbance of 1% aqueous solution of dried saffron at 440, 257 and 330 nm, respectively (Lage and Cantrell, 2009).

All the measured and derived data were subjected to the analysis of variance carried out by least significant difference (LSD) test ($P \leq 0.05$) using SAS 9.1 software.

Results and discussion

The effect of row spacings for saffron from mallow planting was significant on fresh flower yield, flower number and dried stigma yield of saffron. The maximum fresh flower yield, flower number, stigma yield and dry weight of daughter corms of saffron were observed in its monoculture with 26.51 g.m^{-2}, 81 flowers.m^{-2} and 0.212 g.m^{-2} and 380.11 g.m^{-2}, respectively (Figure 1, 2, 3 and 4). In comparisons amongst intercropping treatments with mallow, the highest values for these criteria were recorded for 30-cm row spacings for saffron from mallow with 13.39 g.m^{-2}, 46 flowers.m^{-2}, 0.155 g.m^{-2} and 362.22 g.m^{-2}, respectively (Figure 1, 2, 3 and 4).

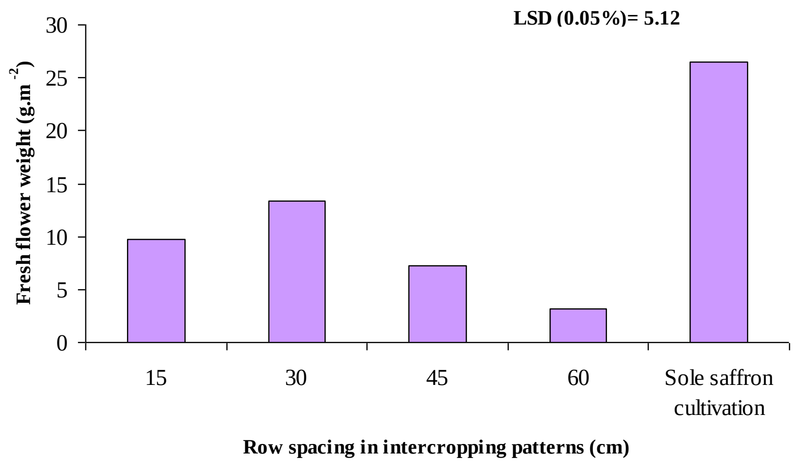

Fig. 1- Effect of row spacings for saffron from mallow planting on fresh flower weight of saffron

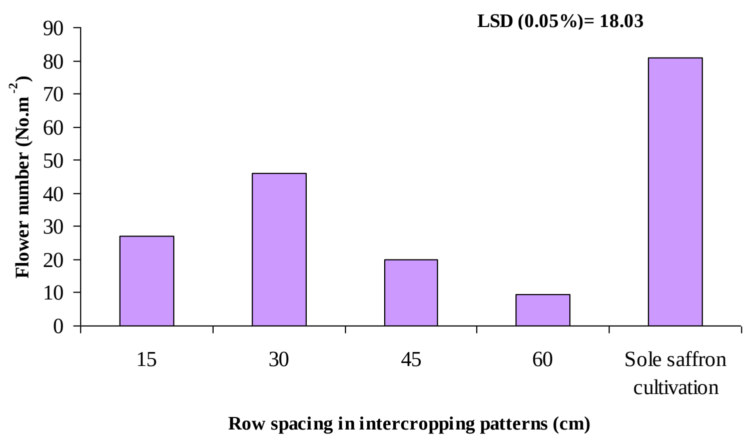

Fig. 2- Effect of row spacings for saffron from mallow planting on flower number of saffron

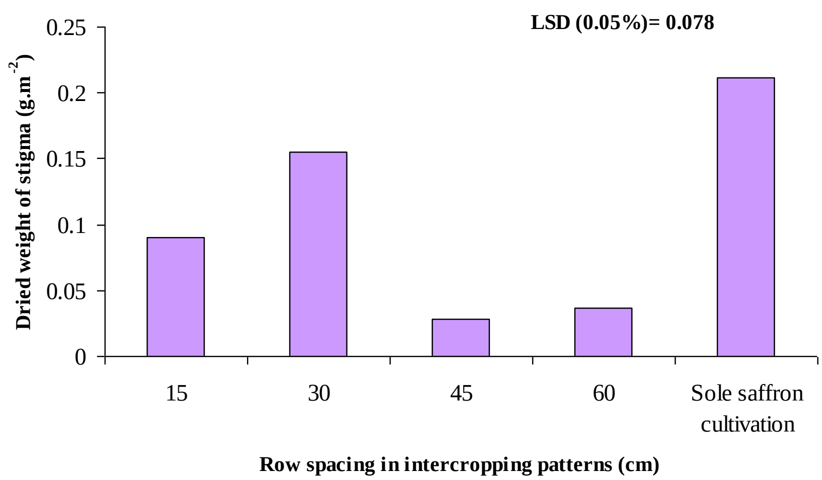

Fig. 3- Effect of row spacings for saffron from mallow planting on dried weight of stigma of saffron

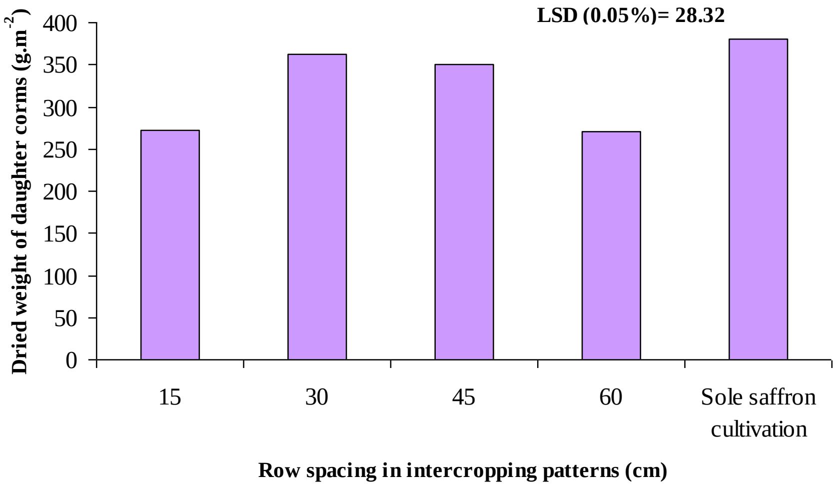

Fig. 4- Effect of row spacings for saffron from mallow planting on dried weight of daughter corms of saffron

Intercropped saffron with mallow enhanced the flower number, stigma yield and daughter corm of saffron due to decreasing soil temperature which could be regarded as an alternative to the possible effect of soil warming for climate change adaptation. Flower induction of saffron is directly affected by temperature (Koocheki et al., 2010; Molina et al., 2004; Koocheki & Khajeh-Hosseini, 2020), so that high temperatures during summer negatively affect flowering. Generally, optimum temperature for flower induction in saffron is 23–25°C (Koocheki et al., 2010).

Crocin, picrocrocin and safranal contents of saffron were not affected by row spacings for saffron from mallow planting. Saffron quality is primarily related to the concentration of its three major metabolites including crocin, picrocrocin, and safranal (Lage and Cantrell, 2009). The secondary metabolites synthesis in saffron is controlled by genetic characteristics and environmental conditions (Lage and Cantrell, 2009; Zarinkamar et al., 2011) rather than agronomic management.

Significant difference was recorded between row spacings for saffron from mallow planting in terms of land equivalent ratio (LER). The maximum LERs (with 1.77 and 1.56) were found in 15-cm and 30-cm row spacings for saffron from mallow planting (Fig. 5).

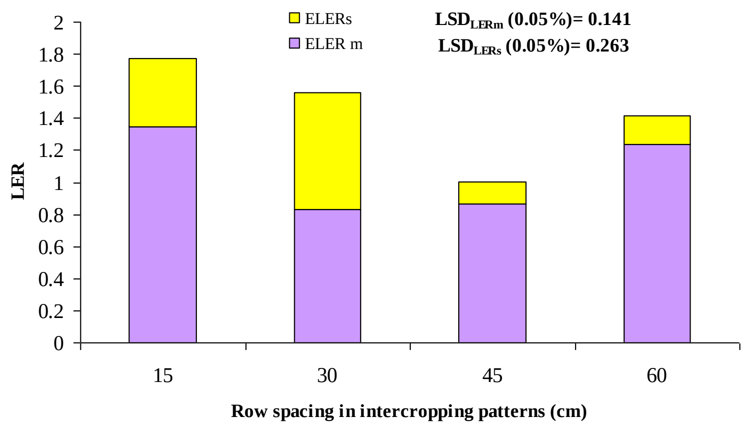

Fig. 5- Effect of row spacings for saffron from mallow planting on LER

Conclusion

According to the results, saffron–mallow intercropping increased fresh flower weight, flower number and flower number of saffron. Increase in growth and flower yield due to higher ability of mallow in decreasing soil temperature. Crocin, picrocrocin and safranal contents of saffron were not significantly affected by intercropping ratios with cumin. Hence, 30 cm-row spacings for saffron from mallow planting is recommended for saffron- mallow intercropping.

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