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Effect of Plant Density and Planting Depth on Saffron (Crocus sativus) Yield and Plant Vegetative Growth Under Greenhouse Conditions

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Background

Saffron (Crocus sativus L.) is one of the highest-priced spices in the world (Winterhalter and Straubinger, 2000). It is grown for its red scarlet stigmas that are used as spice and natural dye. KSA is considered as one of the largest Saffron imported country, in 2020, KSA imported 125 tons of dry saffron stigma (General authority for statistics ,2020). Saffron flower induction, growth and new corms formation affected by environmental conditions (Kafi et al., 2002), plant density (El Hajj, et al., 2019) and planting depth (Skinner et al., 2017). The aim of this study was to evaluate the effect of corms plant density and planting depth on flowering induction, stigmas yield, and plant growth under greenhouse conditions in KSA.

Objective

In this study, the effect of three plant densities of saffron corms (High density: 200 corms m^{-2}, Moderate 100 corms m^{-2}, and low 67 corms m^{-2}) and two planting depth (8 and 13 cm) on flowering induction, stigmas yield, and plant growth will be examined under greenhouse conditions in KSA.

Methods

This study was carried out during 2023/2022 growing season at the National Research and development Center for sustainable Agriculture, KSA. Imported saffron corms from Bloembollenbedrijf. J.C. Koot, Netherlands with an average weight 25 g/corm were used in this experiment. The corms were planted on Sep.2022 ,17 in soil with three plant densities high density: 200 corms m^{-2}, Moderate 100 corms m^{-2}, and low density 67 corms m^{-2}) and two planting depth 8 and 13 cm under greenhouse conditions using split plot experimental design and four replicates. Plant densities were assigned for the main plots and planting depth for the subplots.

Results

The results showed a significant effect of plant density on average number of flowers per plant. With increasing plant density to 200 plants, average flowers number was decreased significantly to 1.4 and 1.5 flowers in both planting depth. With decreasing plant density to 100 and 67 plants m^2, average fruit number per plant was increased significantly to 2.5 and 2.6 flowers per plant (Figure.1). No significant effects of planting depth on flowers number was observed in each plant density (Figure.1).

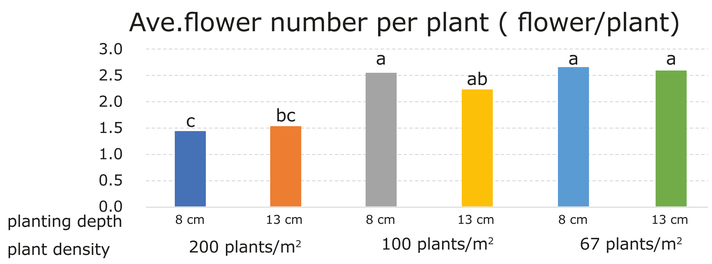


Figure 1. Effect of plant density and planting depth on average flower number per plant.

Dry stigma yield per plant was significantly affected by plant density (Figure.2). The highest yield was observed with low plant density (67 plants/m^2), this yield was not significantly different when using 100 plants/m^2 plant density and significantly higher from yield when using high plant density (200 plants/m2).

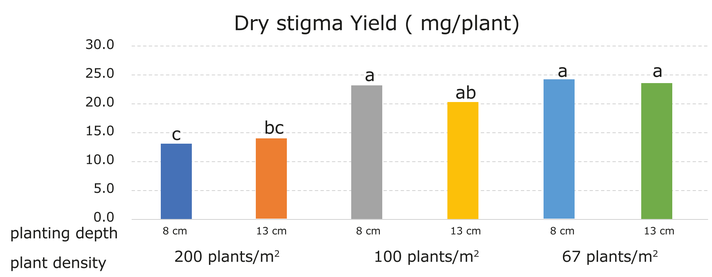
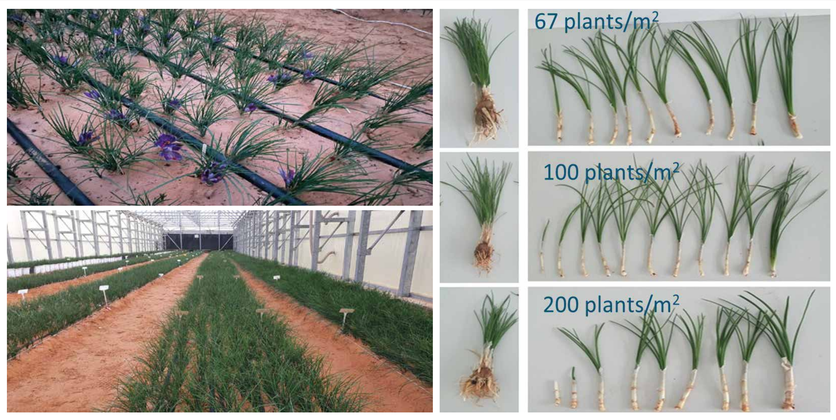


Figure 2. Effect of plant density and planting depth on average dry stigma yield per plant.



Although, stigma yield per plant was significantly improved by low plant density (Figure.2), however, dry stigma yield per m^2 was improved significantly by higher plant density (Figure.3). The highest dry stigma yield was produced when using 200 plants/m^2 and reached above 2500 mg/m^2. This yield was not significantly greater than yield of 100 plants/m^2 but significantly higher as compared with 67 plant/m^2 density.

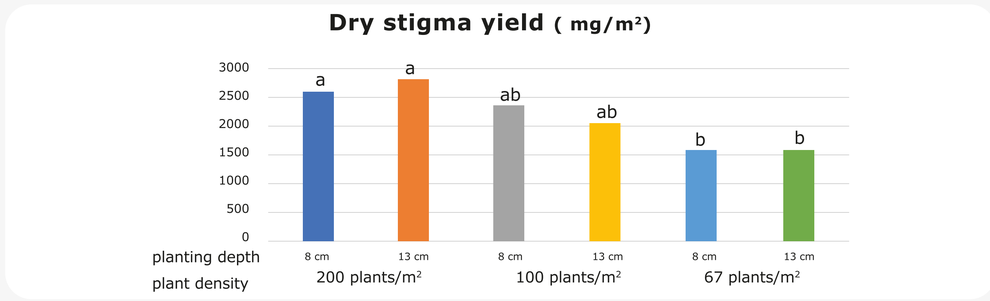


Figure 3. Effect of plant density and planting depth on average dry stigma yield per m2.

The highest average plant fresh weight was produced from plants grown under low plant densities (67 plants /m2), with no significant differences win using medium plant density (100 plants/m2). The lowest significant plant fresh weight was produced when using high plant density (200 plants/m20 and 8 cm planting depth (Figure .4)

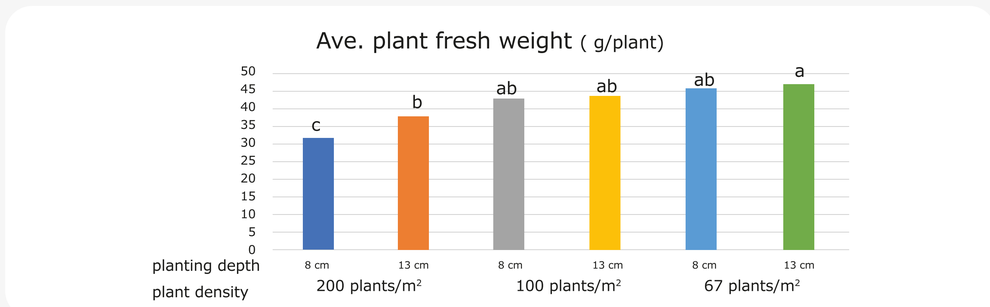


Figure 4. Effect of plant density and planting depth on saffron average plant fresh weight.

Discussion

Saffron yield results per unit area showed that using high plant density produce high number of flowers and dry stigma yield. However, when calculated per plant, flowers number and stigma yield were decreased in high density because of competition for water and nutrient. Average plant fresh weight was decreased by increasing plant density.

Conclusion

Using high plant densities produced higher flower number and stigma yield per m^2. But the yield of stigma per plant was negatively affected by the highest plant density. Planting corms at 13 cm depth has no significant effect on flower number and stigma yield under controlled greenhouse conditions.

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