Effects of water supply and sowing date on water use efficiency of Anise (*Pimpinella anisum* L.)

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Abstract

Field and greenhouse experiments were carried out in order to determine the effects of water supply and sowing date on water use efficiency of anise (*Pimpinella anisum* L.) at the agricultural research station of Tabriz university in Iran. The results indicated that WUE of dry matter production decreased, while WUE of essential oil production was not affected by the amount of soil available water in a greenhouse trial. It was concluded from the field study that for higher grain and essential oil production, and for efficient use of water, anise must be sown early in the spring (April 4 to 16) in Tabriz. Water deficit during stem elongation and umbel appearance reduced WUE in producing dry matter and essential oil, but irrigation disruption during grain filling period had no significant effect on WUE of anise.

Media summary

Investigating the effects of soil available water, sowing date and irrigation disruption on WUE of anise for producing dry matter and essential oil.

Key words

Anise, *Pimpinella anisum.* sowing date, water supply, water use efficiency, essential oil.

Introduction

Anise (*Pimpinella anisum* L.) is one of the important medicinal plants of Apiaceae family, it is used as an antiseptic, an antispasmodic, a digestive (Gangrade et al. 1989; Hornok 1992; and Chevallier 1996), and fungicide(Sigh et al. 1998).

For annual medicinal plants in dry environments, both efficient use of available water and a higher yield with better quality are desirable(Omidbaigi 2000) Water supply and sowing date are two important factors those effect grain yield and essential oil content. (Randhawa et al. 1992; and Fazecas et al. 1981).

In this study, the effects of water supply and sowing date on WUE for dry matter and essential oil production of anise which was grown for the first time in Tabriz, were investigated in both greenhouse and field experiments.

Methods

The greenhouse and field experiment were both conducted at Tabriz University (Lat. 38 ? , 5 ? ; Long 46 ? , 17 ? and Elevation 1362 m) during 1999/2000 growing season. The seeds of anise (*Pimpinella anisum* L.) cv. Soroksari were imported from Hungary.

In the field experiment five irrigation treatments were used: I_1 = irrigation was skipped during stem elongation (SE), I_2 = irrigations were skipped during stem elongation and grain filling stages (SE + GF), I_3 = irrigation was skipped during umbel appearance (UA) , I_4 = irrigation was skipped during grain filling period (GF) , and I_5 = plots were irrigated at all growing stages (control).These IRR treatments were imposed on three sowing dates (April 4, 16, and 29) in a factorial experiment. Plots of 5 rows , 0.32 m

wide and 2.5 m long were arranged in a randomized complete block design (RCBD) with three replications. Soil texture was Sandy-loam with 7.37 pH and 17 % FC.

Results

The results indicated that WUE for dry matter production decreased significantly (P≤0.01), while WUE for essential oil production was not affected by soil available water in greenhouse. Anethole content of seeds also decreased with increasing the soil available water. The essential oil percent was increased in greenhouse by decreasing (((soil available water from 60 %,))) – no data but total amount of oil per plant was reduced by water deficit (Fig. 1).

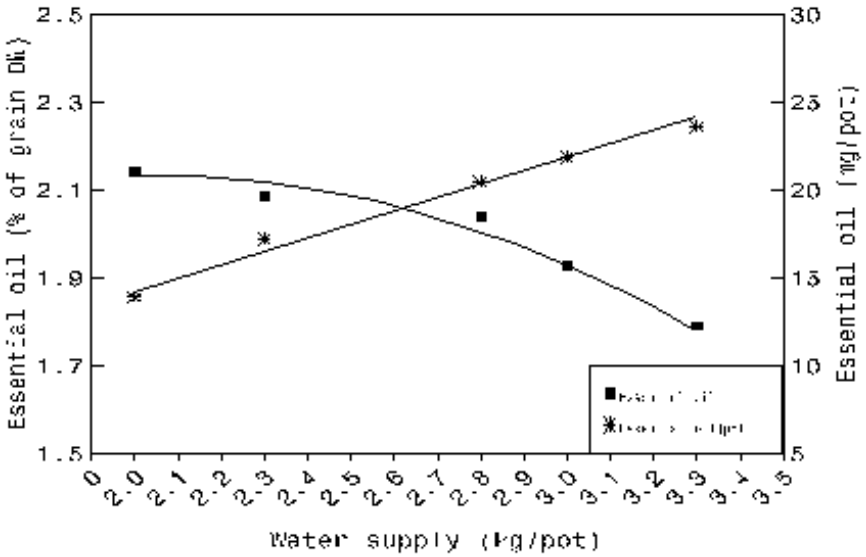


Fig. 1. The relationship of essential oil percent and oil yield per plant with water supply. Predicted values of essential oil percent were obtained by the equation Y = 1.1941+ 0.9151 X - 0.2237 $X^{2,}$ (r^2 = 0.956). Predicted amounts of oil per plant were calculated , using the equation Y = 7.71371 X - 1.32355 , (r^2 = 0.996).

In the field experiment, WUE in dry matter production was affected by sowing date and water supply (Fig. 2). The mean essential oil yield (Kg ha^{-1}) was highest on plots sown earlier (April 4 to 16). Also I_4 water deficit level had no appreciable effect on essential oil yield, however essential oil production were reduced significantly in other water stress treatments (Fig. 3).

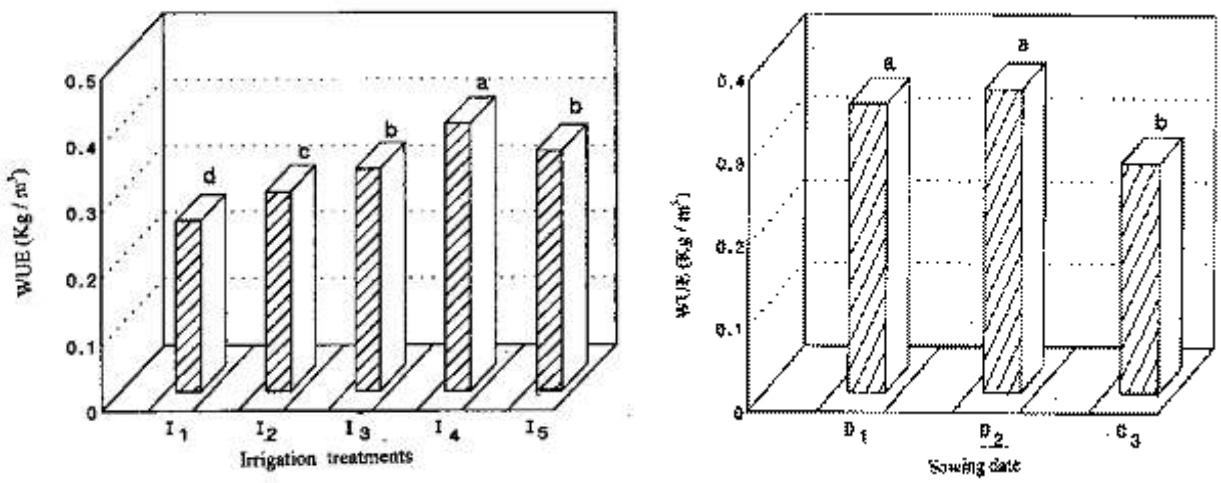
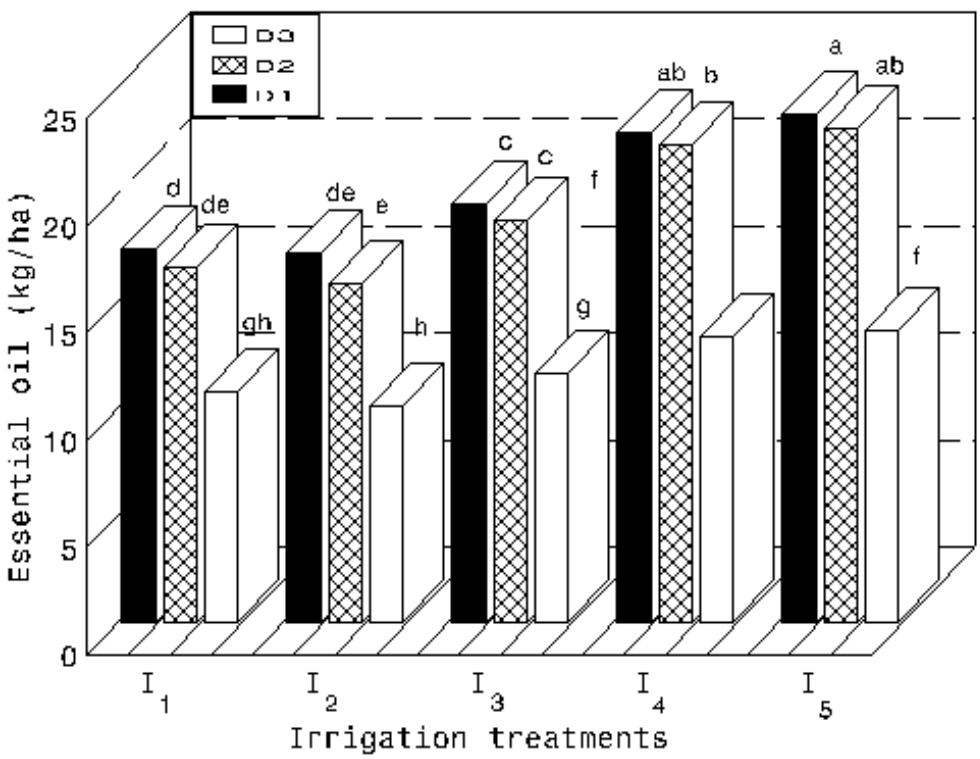


Fig. 2. Effects of sowing date (left) and irrigation treatments (right) on WUE of anise. Different letters indicating significant difference at P < 0.05.



D3 – Sown April 29, D2 – Sown April 16, D1 – Sown April 4

Fig. 3. Mean essential oil yield of anise affected by water limitation at different sowing dates. Different letters indicating significant difference at P < 0.05.

Conclusion

It may be concluded that the low available soil water ((((less than 80 %)))) – no data for soil water status – need to include soil water data relative to yields of oil to clarify figure 1 i.e. what does water supply kg/pot mean in terms of available water? affects dry matter and essential oil production of anise. The results also showed that for successful grain and essential oil production, this plant must be sown in early spring (April 4 to 16) at Tabriz. Water stress at stem elongation grain filling and umbel emergence periods can reduce yield and essential oil production of anise appreciably.

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