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Research Article

Effect of irrigation regimes and nitrogen fertilizer on some characteristics of *Tagetes tenuifolia*

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ABSTRACT

Water is one of the most important factors that are necessary for proper growth, balanced development and higher yield of all crops. Water deficiency affects plant growth and grain yield. Limited irrigation means that the soil water deficit is controlled at certain stages of crop growth, a practice that has become more important in recent years in areas where water resources are limited. Water use efficiency (WUE) is defined here as the ratio between grain yield and total evapotranspiration during the growing season. For other definitions, see the review of WUE. The greenhouse experiment was laid out factorial with randomized complete block design with three replications. Treatments included two factors: factor a: water stress in three level: 2 day, 4 day and 6 day and factor b consisted of nitrogen in four levels: 0, 50, 100 and 150 kg/ha. Analysis of variance showed that the effect of Irrigation and nitrogen on all characteristics was significant.

Key words: Plant height, Stem diameter, number of branch

INTRODUCTION

Efficient nitrogen (N) fertilization is crucial for economic plant production and the protection of ground and surface waters (Alley *et al*., 1999). Nitrogen fertilizer rate and timing are the major tools available after planting for manipulating plant growth and development to produce a greater grain yield per unit area (Simons, 1982; Alley *et al*., 1999). Water is one of the most important factors that are necessary for proper growth, balanced development and higher yield of all crops. Water deficiency affects plant growth and grain yield (Hussain *et al*. 2004; Wajid *et al*., 2004). Limited irrigation means that the soil water deficit is controlled at certain stages of crop growth, a practice that has become more important in recent years in areas where water resources are limited. Water use efficiency (WUE) is defined here as the ratio between grain yield and total evapotranspiration during the growing season. For other definitions, see the review of WUE. Studies on the effects of limited irrigation show that crop yield can be largely maintained and product quality can sometimes be improved while substantially reducing irrigation volume (Li 1982; Shan 1983; Fapohunda *et al*. 1984; Sharma *et al*. 1986; Singh *et al*. 1991; Zhang *et al*. 1999). In recent years, limited or deficit irrigation methods have been well studied and widely practiced for improving crop yield and WUE; however, most of these studies have only focused on the effect of irrigation scheduling in a type of irrigation method on winter wheat yield and WUE (Schneider and Howell, 1997; Zhang *et al*., 1998; Zhang *et al*., 1999; Zhang and Oweis, 1999; Li *et al*., 2000; Kang *et al*., 2002; Li *et al*., 2005). In addition, studies conducted on irrigation demand management often focus only on irrigation scheduling (Endale and Fipps, 2001), and pay minimal attention to irrigation methods. Similarly, research on crop responses to irrigation and water productivity that was conducted in China, often, did not consider constraints relative to the irrigation method (Huang, 2000; Liu *et al*., 2002; Wang *et al*., 2001). A combined approach is required (Pereira, 1999; Pereira *et al*., 2002) for more accurate information on irrigation requirements. Guttieri *et al*., (2001) reported that water stress during tillering until physiological maturity causes significant reduction of wheat grain yield cultivars. Also, this reduction results from both grain weight reduction and number of grain per spike. In a controlled research, Ramezanpoor and Dastfal (2004) reported the 25 and 50

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percents reduction of water consumption may decrease grain wheat yield 21.8 % and 40.7 % respectively. In another experiment, Guttieri *et al*., (2000) reported that different irrigation treatments have significant effect over wheat protein index; therefore, the increase in water stress would lead to grain protein percentage rise in all cultivars. They report that the decrease in moderate and intense stresses would bring a drop in grain yield 23% and 46% respectively. Water stress and nitrogen deficiencies during the vegetative phase can cause early senescence and maturity. During grain development N stress shortens the duration of grain filling (Singh & Wilkens, 1999). Yang *et al*., (2000) studied the effect of two levels of nitrogen, normal (NN) or high (HN), applied at heading and controlled soil drying imposed 9 days after anthesis until maturity. They observed that soil drying shortened the grain filling period but the nitrogen application along with soil drying substantially increased grain filling period except in severe soil drying treatments. Guller, (2002) reported that the increase in water use leaded to increase of 1000- grain weight in cultivars. Furthermore, this research showed the highest protein concentration was achieved by irrigation treatment on sowing and heading. Nevertheless, the increase in water use caused the decrease in grain protein percentage. Salemi *et al*., (2006) reported the 19.3 % decrease of grain yield was due to 40% decrease of water use in another related experiment. Thus, this water saving leaded to 34.5% water use efficiency, and the quality characteristics were increased in this water treatment. In another report by Ahmadi *et al*., (2006) it was found that there was a significant reduction in grain yield and 1000-grain weight under drought stress treatment condition. Accordingly, Kaveh (1993) concluded that drought stress would bring about starch production disorder and reduction sink power, then this trend decreases wheat grain weight in arid and warm conditions. However, grain protein content increases under similar conditions.

MATERIALS AND METHODS

Greenhouse experiment

The greenhouse experiment was laid out factorial with randomized complete block design with three replications.

Treatments

Treatments included two factors: factor a: water stress in three level: 2 day, 4 day and 6 day and factor b consisted of nitrogen in four levels: 0, 50, 100 and 150 kg/ha

Data collected

Data collected were subjected to statistical analysis by using a computer program SAS. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means.

RESULTS AND DISCUSSION

Plant height

Analysis of variance showed that the effect of Irrigation on plant height was significant (Table 1). The maximum of plant height of treatments 2 day was obtained (Table 2). The minimum of plant height of treatments 6 day was obtained (Table 2). Analysis of variance showed that the effect of nitrogen on plant height was significant (Table 1). The maximum of plant height of treatments 150 kg/ha was obtained (Table 2). The minimum of plant height of treatments control was obtained (Table 2).

Stem diameter

Analysis of variance showed that the effect of Irrigation on Stem diameter was significant (Table 1). The maximum of Stem diameter of treatments 2 day was obtained (Table 2). The minimum of Stem diameter of treatments 6 day was obtained (Table 2). Analysis of variance showed that the effect of nitrogen on Stem diameter was significant (Table 1). The maximum of Stem diameter of treatments 150 kg/ha was obtained (Table 2). The minimum of Stem diameter of treatments control was obtained (Table 2).

Number of branch

Analysis of variance showed that the effect of Irrigation on number of branch was significant (Table 1). The maximum of number of branch of treatments 2 day was obtained (Table 2). The minimum of number of branch of treatments 6 day was obtained (Table 2). Analysis of variance showed that the effect of nitrogen on number of branch was significant (Table 1). The maximum of number of branch of treatments 150 kg/ha was obtained (Table 2). The minimum of number of branch of treatments control was obtained (Table 2).

Leaf dry weight

Analysis of variance showed that the effect of Irrigation on leaf dry weight was significant (Table 1). The maximum of leaf dry weight of treatments 2 day was obtained (Table 2). The minimum of leaf dry weight of treatments 6 day was obtained (Table 2). Analysis of variance showed that the effect of nitrogen on leaf dry weight was significant (Table 1). The maximum of leaf dry weight of treatments 150 kg/ha was obtained (Table 2). The minimum of leaf dry weight of treatments control was obtained (Table 2).

Table 1: Anova analysis of the tagetes tenuifolia affected by irrigation regimes and nitrogen

S.O.V	df	Plant height	Stem diameter	number of branch	leaf dry weight
R	1	24*	0.202ns	3.375ns	0.00007ns
Irrigation (I)	2	861.13**	4.697**	50.583**	4.697**
Nitrogen (N)	3	508.2**	3.980*	191.889**	2.046**
I*N	6	8.417*	0.113ns	7.806ns	0.270*
Error	23	3.246	0.112	3.129	0.100
CV (%)	-	7.54	11.48	17.40	21.005

*, **, ns: significant at p<0.05 and p<0.01 and non-significant, respectively.

Table 2: Comparison of different traits affected by irrigation regimes and nitrogen

Treatment	Plant height	Stem diameter	number of branch	leaf dry weight
Irrigation regimes				
2 day	27.58a	3.52a	12.08a	2.20a
4day	23.00b	2.95b	10.42b	1.35b
6day	21.08c	2.27c	8.00c	0.97c
nitrogen				
control	14.89d	2.26d	5.22d	1.02c
50	21.78c	2.60c	7.67c	1.23c
100	26.11b	3.01b	12.22b	1.68b
150	32.78a	3.80a	15.56a	2.09a

Any two means not sharing a common letter differ significantly from each other at 5% probability

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