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Influence of nitrogen fertilizer, drought stress and super absorbent on chlorophyll a, chlorophyll b and Carotenoid of *Trachyspermum ammi*

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ABSTRACT: Ajwain is highly esteemed as a therapeutic agent for flatulence, flatulent colic, atonic dyspepsia, diarrhoea - in short, as a digestive aid and as well as an antiseptic. Oil of desi ajwain contains thymol and its particular gravity and smell resembles the volatile oil. Water is one of the main and essential abiotic components that regulate plant growth and development and its shortage alters the morphological, physiological and biochemical properties of plants. In agriculture Superabsorbent polymers are used as a soil additive, as reservoir of nutrients, and as water superabsorbent in the soil. Biodegradation rate of super absorbent polymers in soil depends on the dimensions of soil particle and quantity of organic matter. The field experiment was laid out in split split plot design with factorial design with three replications. Analysis of variance showed that the effect of water stress, superabsorbent and fertilizer on all characteristics was significant.

Key words: Chlorophyll a, Chlorophyll b, Carotenoid

INTRODUCTION

Desi ajwain (*Trachyspermum ammi* L.) is an aromatic herb and belongs to family Apiaceae (Umbelliferae). It originated in the Eastern Mediterranean region, probably in Egypt, and came to India with the Greeks, who were called Yavanas by South Indians (Boskabady & Shaikhi, 2000). The name ajwain originated from the Sanskrit words yavanaka or ajomoda. Ajwain is very widely cultivated in black soil, particularly along the riverbanks in Egypt and many other countries like India, Iran and Afghanistan (Kiritikar & Basu, 1999; Boskabady & Shaikhi, 2000). Ajwain is highly esteemed as a remedial agent for flatulence, flatulent colic, atonic dyspepsia, diarrhoea - in short, as a digestive aid and also as an antiseptic (Bentely & Trimen, 1999; Kiritikar & Basu, 1999; Cragg & Newman, 2005). Oil of desi ajwain contains thymol and its specific gravity and odour resembles the volatile oil. The oil contains a liquid hydrocarbon, 1-methyl-4-isopropylbenzol, and another hydrocarbon which is isomeric with oil of turpentine (Bentely & Trimen, 1999). Water is one of the major and essential abiotic components that regulate plant growth and development and its deficiency alters the morphological, physiological and biochemical properties of plants. Decreasing the external water potential by only -0.1 MPa or less results in a perceptible decrease in cellular growth (which is irreversible cell enlargement). The quantity and quality of plant growth depend on cell division enlargement, and differentiation and all of these events are affected by water stress (Cabuslay *et al.*, 2002, Correia *et al.*, 2001). Drought stress limits plant growth crop productivity. This problem can be solved with two Strategies: decreasing water loss by better understanding of physiological responses for adaptation to drought or increasing irrigation effectiveness by soil correctives and additives such as super absorbent polymers which can reserve different amounts of water in itself and so increases the soil ability of water storing and preserving and approve plant growth under water deficiency (Roshan, 2005). The Severe water stress may result in the arrest of photosynthesis, disturbance of metabolism and finally the death of plant (Jaleel *et al.*, 2008c). Soil water is the most crucial factor in arid and semi-arid regions and yield potential is directly a function of water available for plant growth so it is concluded that Drought has been the major environmental constraint to peanut survival and to crop productivity in this aria (Boyer, 1983). Drought stress has adverse influence on water relations (Babu and Rao., 1983), photosynthesis (Bhagsari *et al.*, 1976), mineral nutrition, metabolism, growth and yield of groundnut (Suther and Patel., 1992).

On the other hand the crop has a good ability for growing in lightly soil, and thrives in improving the characteristics of the newly reclaimed sandy soils which commonly suffer from some constraints such as poor physical properties and nutrients deficiency. Oilseeds are energy-rich crops and the requirement of major nutrients as well as secondary and micronutrients is very high, So Less or no use of plant nutrient is one of the important factors for low productivity of peanut (Mandal *et al* ., 2001; Migawer *et al.,* 2001; Veeramani, and Subrahmaniyan., 2011). When the water status in a leaf falls below a threshold value, stomata respond by closing with consequent reduction in CO_2 assimilation as well as transpiration. Stomatal closure decreases the carbon dioxide influx which limits photosynthesis and supports photoinhibition under high irradiance. Non-stomatal photosynthesis limitation has been attributed to the reduced carboxylation efficiency (Jia and Gray, 2004), reduction in ribulose 1-5, biphosphate regeneration, reduced amount of functional Rubisco (Kanechi *et al.,* 1995) and decrease in electron transport chain activities. Water stress caused negative effect on seedlings of Mediterranean water saver *Pinus halepensis* and water spenders *Quercus coccifera* and *Q. ilex*., As a result stomatal conductance, CO_2 assimilation and transpiration rate reduced (Baquedano and Castillo, 2006). In agriculture Superabsorbent polymers are used as a soil additive, as reservoir of nutrients, and as water superabsorbent in the soil. Properties of this material are dependent on many factors, such as their chemical and compositional characteristics, soil texture, plant species and also environmental factors. Super absorbent polymers made from Polyacrylamide are of these materials and are used as water adsorbents for increased capacity of the soil to absorb and retain water and this property is very important to encounter the impacts of dehydration and reduce impacts of drought stress in crops.

Biodegradation rate of super absorbent polymers in soil depends on the dimensions of soil particle and amount of organic matter. Also, with decreasing Oxygen in soil and in turn reducing activities of bacteria, biodegradation rate of super absorbent polymers will be reduced. Super absorbent polymers have influence on water infiltration rate in soil, bulk density, soil structure and the rate of evaporation from the soil surface (Seyed Seraji *et al* 2010).

MATERIAL AND METHODS

Location of experiment. The experiment was conducted at the zahak station

Composite soil sampling. Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics.

Field experiment. The field experiment was laid out in split split plot design with factorial design with three replications.

Treatments. Treatments consisted the Drought (40% Water depletion, 60% Water depletion , 80% Water depletion), Nitrogen fertilizer (100% Nitrogen + 20 ton Livestock manure, 50% Nitrogen + 20 ton Livestock manure, No nitrogen + 20 ton Livestock manure, No nitrogen + No Livestock manure) and super absorbent (150 kg super absorbent, 75 kg super absorbent, 0 kg super absorbent)

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

RESULTS AND DISCUSSION

A. Chlorophyll a

Analysis of variance showed that the effect of water stress on chlorophyll a was significant (Table 1).

Table 1: Anova analysis of the *trachyspermum ammi* affected by drought, fertilizer and super absorbent.

S.O.V	df	Chlorophyll a	Chlorophyll b	Carotenoid
Year	1	0.004 ns	0.040 ns	0.0002 ns
A	2	1.33**	10.30**	0.29**
Year *A	2	0.005 ns	0.01 ns	0.003 ns
Block*Year *A	12	0.005 ns	0.01 ns	0.003 ns
B	3	0.49**	3.87**	0.05**
AB	6	0.04**	0.33**	0.01**
Year*B	3	0.004 ns	0.01 ns	0.001 ns
C	2	0.28**	1.19**	0.03**
A*C	4	0.01*	0.072**	0.006*
B*C	6	0.04**	0.23**	0.01**
Year*C	2	0.004 ns	0.01 ns	0.004 ns
A*B*C	12	0.025**	0.23**	0.01**
Year*A*B	6	0.004 ns	0.02 ns	0.0009 ns
Year*A*C	4	0.004 ns	0.02 ns	0.003 ns
Year*B*C	6	0.004 ns	0.01 ns	0.002 ns
Error	215	0.005	0.01	0.002
C.V	-	4.20	5.29	4.00

*, **, ns: significant at $p<0.05$ and $p<0.01$ and non-significant, respectively.
A: Water stress, B: fertilizer, C: super absorbent

The maximum of chlorophyll a of treatments 40% Water depletion was obtained (Table 2). The minimum of chlorophyll a of treatments 80% Water depletion was obtained (Table 2). Analysis of variance showed that the effect of fertilizer on chlorophyll a was significant (Table 1). The maximum of chlorophyll a of treatments 100% Nitrogen + 20 ton livestock manure was obtained (Table 2). The minimum of chlorophyll a of treatments No nitrogen + No livestock manure was obtained Table 2). Analysis of variance showed that the effect of super absorbent on chlorophyll a was significant (Table 1). The maximum of chlorophyll a of treatments 150 kg super absorbent was obtained (Table 2). The minimum of chlorophyll a of treatments 0 kg super absorbent was obtained Table 2).

B. Chlorophyll b

Analysis of variance showed that the effect of water stress on chlorophyll b was significant (Table 1). The maximum of chlorophyll b of treatments 40% Water depletion was obtained (Table 2). The minimum of chlorophyll b of treatments 80% Water depletion was obtained (Table 2). Analysis of variance showed that the effect of fertilizer on chlorophyll b was significant (Table 1). The maximum of chlorophyll b of treatments 50% Nitrogen + 20 ton livestock manure was obtained (Table 2). The minimum of chlorophyll b of treatments No nitrogen + No livestock manure was obtained Table 2). Analysis of variance showed that the effect of super absorbent on chlorophyll b was significant (Table 1).
The maximum of chlorophyll b of treatments 150 kg super absorbent was obtained (Table 2). The minimum of chlorophyll b of treatments 0 kg super absorbent was obtained Table 2).

C. Carotenoid

Analysis of variance showed that the effect of water stress on carotenoid was significant (Table 1). The maximum of carotenoid of treatments 40% Water depletion was obtained (Table 2). The minimum of carotenoid of treatments 80% Water depletion was obtained (Table 2). Analysis of variance showed that the effect of fertilizer on carotenoid was significant (Table 1). The maximum of carotenoid of treatments 50% Nitrogen + 20 ton Livestock manure was obtained (Table 2). The minimum of carotenoid of treatments No nitrogen + No livestock manure was obtained Table 2). Analysis of variance showed that the effect of super absorbent on carotenoid was significant (Table 1). The maximum of carotenoid of treatments 150 kg super absorbent was obtained (Table 2). The minimum of carotenoid of treatments 0 kg super absorbent was obtained Table 2).

Table 2: Comparison of different traits affected drought, fertilizer and super absorbent.

Treatment	Chlorophyll a	Chlorophyll b	Carotenoid
Drought stress			
40% Water depletion	1.88a	2.83a	1.35a
60% Water depletion	1.78b	2.61b	1.34a
80% Water depletion	1.01c	2.08c	1.23b
Fertilizer			
100% Nitrogen + 20 ton Livestock manure	1.78b	2.62b	1.32a
50% Nitrogen + 20 ton Livestock manure	1.86a	2.74a	1.34a
No nitrogen + 20 ton Livestock manure	1.76b	2.53c	1.32a
No nitrogen + No Livestock manure	1.63c	2.12d	1.26b
super absorbent			
0 kg super absorbent	1.68b	2.36a	1.28b
75 kg super absorbent	1.78a	2.56a	1.32a
150 kg super absorbent	1.8a	2.6b	1.329a
Any two means not sharing a common letter differ significantly from each other at 5% probability			

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