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Influence of Super Absorbent, Drought Stress and Nitrogen Fertilizer on some Characteristic of *Trachyspermum ammi*

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ABSTRACT: Desi Ajwain (*Trachyspermum ammi*) is an aromatic herb. It belongs to family apiaceae (Umbelliferae). This plant has several medical uses. It is very widely grown in black soil, particularly along the river banks in Egypt as well as many other countries like India, Iran and Afghanistan as mentioned. The plants under dry condition change their metabolism to overcome the changed environmental condition. The complexity response of the plant to the drought stress could be justified. Seed germination is one of the most important phases in the life cycle of plant and is highly responsive to existing environment. Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of n in excess promotes development of the above ground aground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth. SAR is a new high water absorption characteristic of functional polymer material, which has a strong water retention capacity. Its shape is mainly particles and powdered, white, pH value is neutral and it does not dissolve in water. Analysis of variance showed that the effect of super absorbent and nitrogen fertiizer on all characteristics was significant.

Key words: Root weight, Plant weight, Number of seed in plant, Plant height

INTRODUCTION

Desi Ajwain (*Trachyspermum ammi* L.) is an aromatic herb. It belongs to family Apiaceae (Umbelliferae). This plant has several medical uses. It is very widely grown in black soil, particularly along the river banks in Egypt as well as many other countries like India, Iran and Afghanistan as mentioned by Boskabady and Shaikhi (2000). It is highly esteemed as a remedial agent for flatulence, flatulent colic, tonic dyspepsia, diarrhoea - in short, as a digestive aid and also as an antiseptic (Cragg and Newman (2005). Water is commonly the most limiting factor in intensive orchards all over the world. Consequently, drought stress is a situation fruit trees have to deal with frequently. The increasing worldwide shortages of water are leading to an emphasis on developing thrifty irrigation systems and planting resistant plants. In recent years there has been a wide range of proposed novel approaches to irrigation scheduling which are based on sensing the plant response to water deficit directly, as opposed to sensing the soil moisture status (Jones, 2004).

Drought is one of the major physical parameter of an environment, which determines the success or failure of plants establishment (Gamze *et al*., 2005). Drought is the most important limiting factor for crop production and it is becoming an increasingly severe problem in many regions of the world (Passioura, 1996 and Passioura, 2007). Generally drought stress occurs when the available water in the soil is reduced and atmospheric conditions cause continuous loss of water by transpiration or evaporation. (Khaje Hosseini *et al*., 2003). The plants under dry condition change their metabolism to overcome the changed environmental condition. The complexity response of the plant to the drought stress could be justified. Seed germination is one of the most important phases in the life cycle of plant and is highly responsive to existing environment. The study of drought tolerance during germination early and late growth of plants is important for determining dry limits at each developmental phase. Drought decrease germination and seedling growth, and this are one important case to produce crops (Gamze *et al*., 2005).

Stages of seed germination and seedling emergence are critical stages for plant establishment in crops grown in arid and semi-arid regions. It is at these critical stages that crop stand density and final yield are determined (Hadas, 1976). It has been reported that water stress can reduce or delay germination or completely prevent germination (Turk *et al*., 2004). Affected plants at various: subcellular compartment, cell, organs and whole plant levels of their organization. The plant response to drought at the crop level is complex because it reflects the integration of stress effects at all underlying levels of organizations over space and time (Blum, 1996). Water stress inhibits cell enlargement more than cell division. It reduces plant growth by affecting various physiological and biochemical processes, such as photosynthesis, respiration, translocation, ion uptake, carbohydrates, nutrient metabolism and growth promoters (Jaleel *et al*., 2008; Farooq *et al*., 2008). Water stress will almost invariably decrease fresh root weight, but sucrose concentration, on a fresh weight basis, can be increased by dehydration of the root due to water stress. These effects on yields were mainly caused by dehydration of the beet tops and roots so sucrose production was scarcely affected even though only 70% of the normal irrigation water was applied. Fertilizer is very important input for intensive rice production the profitability of rice production systems depends on yield and input quantities. So the appropriate fertilizer input that is not only for getting high grain yield but also for attaining maximum profertility (Khuang *et al*, 2008). Nitrogen and phosphorus fertilizer is a major essential plant nutrient and key input for in increasing crop yield (Dastan *et al*, 2012- Alinajoati sisie & Mirshekari, 2011-Alam *et al*, 2009). Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of n in excess promotes development of the above ground aground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth. This increases the risk of loding and reduces the plants resistance to brash climatic condition and foliar diseases (Mohammadian Rushan *et al*, 2011). Nitrogen contributes to carbohydrate accumulation in culms and leaf sheaths during the pre-heading stage and in the grain during the ripening stage of rice (Swin *et al*, 2010). Nitrogen is required by plants in comparatively larger amounts than other elements (Marschner., 1995). Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of N in excess promotes development of the above ground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth. This increases the risk of lodging and reduces the plants resistance to harsh climatic conditions and to foliar diseases (Lincoln and Edvardo, 2006). Nitrogen (N) fertilizer use has played a significant role in increase of crop yield (Modhej *et al*., 2008). Mazaheri and Hoseini (2003) and Abayomi *et al* (2008), with study effects of nitrogen fertilizer application in cowpea farming, were reported that use of nitrogen fertilizer had positive effect nitrogen on yield and yield components of cowpea. Gohari *et al*. (2010). With study optimization of nitrogen and potassium fertilizer consumption in cowpea production were reported that, the highest seed yield, 100 seed weight, number of pods per plant and number of seeds per plant was obtained by use of 30 kg/ha nitrogen fertilizer. Demotes-mainard and Jeuffroy (2004) showed that N deficiency during wheat growth period resulted in the loss of spike dry weight as well as grain number per spike. Kazemeini *et al*. (2007) studied the effect of N on growth and yield of rain-fed wheat and concluded that the increase in N fertilization rate from 0 to 40 and 80 kg ha^{-1} increased grain number per spike significantly. In a study on the effect of different N rates on sorghum yield, Zaongo *et al*. (1997) found a direct relationship between N and 1000-grain weight. Lak *et al*. (2006) studied the effect of different N fertilization levels and plant densities on grain maize and reported that the application of higher levels of N fertilizer resulted in the increase in leaf area index and the availability of assimilates for corns owing to photosynthesis duration and that grain number per corn was increased due to the decrease in the competition between grains for nutrients. In a study on the effect of two N fertilization rates of 100 and 150 kg ha^{-1} and three densities of 20, 33.3 and 66.6 plants m^{-2} on yield and yield components of two grain sorghum cultivars, Miri (2007) reported that the highest grain yield was obtained from the density of 33.3 plants m^{-2} fertilized with 100 kg N ha^{-1}. Onset of practical researches in the world on the polymer super absorbent, that in some references it is referred to as hydrogel, dates back to 1980s, and since about the year 2000 in some African, central American and Far East countries these materials were used to halter damaging floods and keep soil moisture in farmlands. In Iran using them as a soil additive has no much history, and just in recent years some researches have been carried out on them (Abedi Kopaee, 2004). SAR is a new high water absorption characteristic of functional polymer material, which has a strong water retention capacity. Its shape is mainly particles and powdered, white, pH value is neutral and it does not dissolve in water. SAR not only can absorb hundreds of times or even more than a thousand times its own weight in deionized water, the number of times to nearly a hundred times in the salinity of water, but also it has repeatedly absorbing function.

SAR expandsto be hydrogels after absorbing and can slowly release water for crop use in dry conditions (Taisheng *et al*., 2000; Zhanbin *et al*., 2003; Xinxi, 2002). SAR application can promote root development, increase seedling emergence and survival rate, and improve water use efficiency (Dianhong *et al*., 2007; Fen and Yanbei, 1994; Jicheng *et al*., 2007). What's more, it can also promote the formation of soil aggregates, improve soil pore structure, prevent fertilizers, pesticides and soil erosion, and improve fertilizer utilization efficiency (Tengbing *et al*., 1997), increase crop production. Use of super absorbent polymers in drinking water and wastewater treatment, mining and food industries has been reported. Super absorbent polymers come with three types of anionic, cationic and neutral which in agriculture anionic one is important. (Allahdady, 2002) Polymers are synthetic compounds and are produced artificially. These materials are made from potassium polyacrylate and Polyacrylamide copolymers and are capable of quickly absorbing water after contact with it and holding it up to many times of its volume and as the result increase water retention in the related soil. These materials are odorless and colorless, and don't pollute soil, water and plant tissues. According to Degaiorgi (2002) using super absorbents will increase the activity of microorganisms and mycorrhiza. 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). Also, the super absorbent polymers while raising water-holding capacity of light soils can address soil permeability problems of heavy soils and difficulties in washing fertilizers (Askari *et al* 1994). Since that Super absorbents absorb water hundreds times of its own weight and being converted to long lasting gels, have a special place in agriculture, landscaping, erosion control and desert reduction. Quickly absorbing water and keeping it by super absorbents, raises absorption efficiency of water obtained from scattered rainfall. In the case of irrigating soil, they increase irrigation intervals (Allahdadi 2002).

MATERIAL AND METHODS

The experiment was conducted at the zahak station.Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics. The field experiment was laid out in split split plot design with factorial design with three replications. 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 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. Root weight

Analysis of variance showed that the effect of drought stress on root weight was not significant (Table 1). The maximum of root weight (5.65) of treatments 40% Water depletion was obtained (Table 2). The minimum of root weight (5.58) of treatments 80% Water depletion was obtained (Table 2). Analysis of variance showed that the effect of fertilizer on root weight was significant (Table 1). The maximum of root weight (6.72) of treatments 50% Nitrogen + 20 ton Livestock manure was obtained (Table 2). The minimum of root weight (4.14) of treatments No nitrogen + No Livestock manure was obtained (Table 2). Analysis of variance showed that the effect of super absorbent on root weight was significant (Table 1). The maximum of root weight (6.09) of treatments 150 kg super absorbent was obtained (Table 2). The minimum of root weight (4.91) of treatments 0 kg super absorbent was obtained (Table 2). Since that Super absorbents absorb water hundreds times of its own weight and being converted to long lasting gels, have a special place in agriculture, landscaping, erosion control and desert reduction. Quickly absorbing water and keeping it by super absorbents, raises absorption efficiency of water obtained from scattered rainfall. In the case of irrigating soil, they increase irrigation intervals (Allahdadi 2002). Water stress inhibits cell enlargement more than cell division.

It reduces plant growth by affecting various physiological and biochemical processes, such as photosynthesis, respiration, translocation, ion uptake, carbohydrates, nutrient metabolism and growth promoters (Jaleel *et al.*, 2008; Farooq *et al*., 2008). Water stress will almost invariably decrease fresh root weight, but sucrose concentration, on a fresh weight basis, can be increased by dehydration of the root due to water stress. Nitrogen (N) fertilizer use has played a significant role in increase of crop yield (Modhej *et al.*, 2008). Mazaheri and Hoseini (2003) and Abayomi et al (2008), with study effects of nitrogen fertilizer application in cowpea farming, were reported that use of nitrogen fertilizer had positive effect nitrogen on yield and yield components of cowpea. Gohari *et al.* (2010).

B. Plant weight

Analysis of variance showed that the effect of drought stress on plant weight was not significant (Table 1). The maximum of plant weight (161.52) of treatments 40% Water depletion was obtained (Table 2). The minimum of plant weight (153.48) of treatments 80% Water depletion was obtained (Table 2). Analysis of variance showed that the effect of fertilizer on plant weight was significant (Table 1). The maximum of plant weight (169.55) of treatments 50% Nitrogen + 20 ton Livestock manure was obtained (Table 2). The minimum of plant weight (135.74) of treatments No nitrogen + No Livestock manure was obtained (Table 2). Analysis of variance showed that the effect of super absorbent on plant weight was significant (Table 1). The maximum of plant weight (161.35) of treatments 150 kg super absorbent was obtained (Table 2). The minimum of plant weight (146.63) of treatments 0 kg super absorbent was obtained (Table 2). According to Degaiorgi (2002) using super absorbents will increase the activity of microorganisms and mycorrhiza. 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. Generally drought stress occurs when the available water in the soil is reduced and atmospheric conditions cause continuous loss of water by transpiration or evaporation. (Khaje Hosseini *et al.*, 2003). The plants under dry condition change their metabolism to overcome the changed environmental condition. The complexity response of the plant to the drought stress could be justified. Seed germination is one of the most important phases in the life cycle of plant and is highly responsive to existing environment. Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of N in excess promotes development of the above ground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth. This increases the risk of lodging and reduces the plants resistance to harsh climatic conditions and to foliar diseases (Lincoln and Edvardo, 2006).

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

S.O.V	df	Root weight	Plant weight	Number of seed in plant	Plant height
block	2	116.83**	24303.41**	4174448.89**	1768.66**
Drought (d)	2	0.039 n.s	745.59 n.s	20109.23 n.s	1.61 n.s
block*d	4	0.22 n.s	263.62 n.s	27706.59 n.s	12.67 n.s
Fertilizer (f)	3	31.46 **	5634.47**	702625.09**	490.38**
d*f	6	0.26 n.s	599.39 n.s	14384.24 n.s	30.60 n.s
block*f(d)	18	1.01 n.s	297.17 n.s	58380.21 n.s	70.85 n.s
Super absorbent (s)	2	13.99**	2511.17*	302447.28*	243.36*
d*s	4	0.28 n.s	495.59 n.s	12466.85 n.s	16.29 n.s
s*f	6	3.96*	1369.13*	38641.59**	55.45 n.s
d*s*f	12	0.30 n.s	382.36 n.s	16788.86 n.s	41.43 n.s
C.V	--	23.18824	14.30946	28.13826	10.29189

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

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

Treatment	Root weight (gr)	Plant weight (gr)	Number of seed in plant	Plant height (cm)
40% Water depletion	5.65a	161.52a	1101.94a	83.05a
60% Water depletion	5.64a	153.80a	1082.81a	83.00a
80% Water depletion	5.58a	153.48a	1054.94a	82.69a
100% Nitrogen + 20 ton Livestock manure	5.92b	160.82ab	1262.33a	85.37a
50% Nitrogen + 20 ton Livestock manure	6.72a	169.55a	1134.19ab	86.62a
No nitrogen + 20 ton Livestock manure	5.70b	158.94b	1044.67bc	82.72a
No nitrogen + No Livestock manure	4.14c	135.74c	878.41c	77.02b
150 kg super absorbent	6.09a	161.35a	1149.75a	85.53a
75 kg super absorbent	5.86a	160.83a	1113.83ab	82.94ab
0 kg super absorbent	4.91b	146.63b	976.11b	80.33b
Any two means not sharing a common letter differ significantly from each other at 5% probability				

C. Number of seed in plant

Analysis of variance showed that the effect of drought stress on number of seed in plant was not significant (Table 1). The maximum of number of seed in plant (1101.94) of treatments 40% Water depletion was obtained (Table 2). The minimum of number of seed in plant (1054.94) of treatments 80% Water depletion was obtained (Table 2). Analysis of variance showed that the effect of fertilizer on number of seed in plant was significant (Table 1). The maximum of number of seed in plant (1262.33) of treatments 100% Nitrogen + 20 ton Livestock manure was obtained (Table 2). The minimum of number of seed in plant (878.41) of treatments No nitrogen + No Livestock manure was obtained (Table 2). Analysis of variance showed that the effect of super absorbent on number of seed in plant was significant (Table 1). The maximum of number of seed in plant (1149.75) of treatments 150 kg super absorbent was obtained (Table 2).

The minimum of number of seed in plant (976.11) of treatments 0 kg super absorbent was obtained (Table 2). 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). Also, the super absorbent polymers while raising water-holding capacity of light soils can address soil permeability problems of heavy soils and difficulties in washing fertilizers (Askari *et al* 1994). Water is commonly the most limiting factor in intensive orchards all over the world.

Consequently, drought stress is a situation fruit trees have to deal with frequently. The increasing worldwide shortages of water are leading to an emphasis on developing thrifty irrigation systems and planting resistant plants. In recent years there has been a wide range of proposed novel approaches to irrigation scheduling which are based on sensing the plant response to water deficit directly, as opposed to sensing the soil moisture status (Jones, 2004). Drought is one of the major physical parameter of an environment, which determines the success or failure of plants establishment (Gamze *et al.*, 2005). Nitrogen and phosphorus fertilizer is a major essential plant nutrient and key input for in increasing crop yield (Dastan *et al*, 2012- Alinajoatisisie & Mirshekari, 2011-Alam *et al*, 2009). Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of n in excess promotes development of the above ground aground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth.

D. Plant height

Analysis of variance showed that the effect of drought stress on plant height was not significant (Table 1). The maximum of plant height (83.05) of treatments 40% Water depletion was obtained (Table 2). The minimum of plant height (82.69) of treatments 80% Water depletion was obtained (Table 2). Analysis of variance showed that the effect of fertilizer on number of seed in plant was significant (Table 1). The maximum of plant height (86.62) of treatments 50% Nitrogen + 20 ton Livestock manure was obtained (Table 2).

The minimum of plant height (77.02) of treatments No nitrogen + No Livestock manure was obtained (Table 2). Analysis of variance showed that the effect of super absorbent on plant height was significant (Table 1). The maximum of plant height (85.53) of treatments 150 kg super absorbent was obtained (Table 2). The minimum of plant height (80.33) of treatments 0 kg super absorbent was obtained (Table 2). Super absorbent polymers come with three types of anionic, cationic and neutral which in agriculture anionic one is important. (Allahdady, 2002) Polymers are synthetic compounds and are produced artificially. These materials are made from potassium polyacrylate and Polyacrylamide copolymers and are capable of quickly absorbing water after contact with it and holding it up to many times of its volume and as the result increase water retention in the related soil. These materials are odorless and colorless, and don't pollute soil, water and plant tissues. The study of drought tolerance during germination early and late growth of plants is important for determining dry limits at each developmental phase. Drought decrease germination and seedling growth, and this are one important case to produce crops (Gamze *et al.,* 2005). Stages of seed germination and seedling emergence are critical stages for plant establishment in crops grown in arid and semi-arid regions. It is at these critical stages that crop stand density and final yield are determined (Hadas, 1976). Demotes-mainard and Jeuffroy (2004) showed that N deficiency during wheat growth period resulted in the loss of spike dry weight as well as grain number per spike. Kazemeini *et al.* (2007) studied the effect of N on growth and yield of rain-fed wheat and concluded that the increase in N fertilization rate from 0 to 40 and 80 kg ha-1 increased grain number per spike significantly. In a study on the effect of different N rates on sorghum yield, Zaongo *et al.* (1997) found a direct relationship between N and 1000-grain weight. Lak *et al.* (2006) studied the effect of different N fertilization levels and plant densities on grain maize and reported that the application of higher levels of N fertilizer resulted in the increase in leaf area index and the availability of assimilates for corns owing to photosynthesis duration and that grain number per corn was increased due to the decrease in the competition between grains for nutrients.

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