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Evaluation of Water Stress on Mineral Status of Egyptian clover *(trifolium alexandrinum)* Varieties

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ABSTRACT

A pot experiment was conducted in the greenhouse of the National Research Center, Dokki, Cairo, Egypt to study the effect of missing of irrigation on mineral status of three Egyptian clover varieties (Giza 6 and Giza 10 and Helali), Irrigation treatments were: after depletion of 40, 60 and 80 % of available soil moisture. The results indicated that the drought stress at all treatments of drought of Egyptian clover plant adversely affected plant's nutrients uptake .The tested Egyptian clover varieties varied in its concentration and content of macronutrients. The highest % of N as well as Ca was obtained in V1 while for P and K it was shown in V2 but Mg % seemed to be without differences.V2 surpassed the other two varieties in all determinate macronutrients in this work. Nitrogen, potassium and manganese % showed negative relationship with the increase of moisture depletion in the soil, while Ca increased only by the 60% moisture depletion and opposite response was true for phosphorus % which increased with water deficit. Increasing depletion of moisture before irrigation decreased N and P contents, however, K, Mg and Ca content increased with treatment of 60% moisture depletion and tended to decrease with the treatment moisture depletion of 80% to be less than the control. There is a negative relationship between macronutrients content and increase the depletion of available moisture before irrigation for V1 as well as V3. However, where for V2 the highest values of all estimated nutrients resulted when plants irrigated after depletion of 60% available moisIture in the soil.
KEYWORDS: Egyptian clover (*Trifolium alexandirinum* L.)- Varieties-Water deficit- Minerals stutas.

INTERODUCTION

Water stress Drought is the main environmental constraint limiting yield under Mediterranean conditions and it develops progressively during the last part of the crop cycle. Crops grown in these areas display varied responses to water stress. A dominant response is the reduction of water loss by plants. Thus, plants close the stomata apparatus and modulate their leaf area, and thereby adjust the loss of water from the canopy (Passioura, 1997 and Tardieu, 1997). During drought plants closed its stomata and exchange of CO2 was affected and also transpiration. Water flow was lowered and this intern affected mineral absorption and translocation (**Marschner, 1995** Passioura, 1997; Tardieu, 1997 and Hussein, et al 2012a & 2012b). Water stress is one of the main problems of agriculture in arid and semi arid areas. Lack of water influence on most plant physiological processes such as photosynthesis, photosynthetic material transmission to seeds and cellular development, coalescence and transmission of nutrients in plants (**Davis., 2007)**.Generally, drought reduces both nutrients uptake by the roots transport from the roots to the shoots, because of restricted transpiration rates and impaired active transport and membrane permeability (**Viets, 1972; Alam, 1999)**. The decline in soil moisture also results in decease in the diffusion rate of nutrients in the soil to the absorbing root surface (**pinkerton and Simpon, 1988, Alam, 1999**). The availability of K^+ to the plant decrease with decrease soil water content, due to the decease mobility of K under this condition. Agriculture policy has been directed for 40 years towards intensive reclamation of land particularly sandy soil to cover the population with a special emphasis for animal production (**Hathout, et al 1997**). The results indicated that the drought stress at all three critical growth stages of wheat adversely affected plant nutrients uptake, water potential, osmotic potential and turgor potential of wheat plants **(M.A. Samar Raza et al., 2013).** Egyptian clover is the main winter forage In Egypt occupied about one million hectare in old lands which satisfies animal population requirements in winter. Also, **Oushi (2008**) reported that Egyptian clover is a winter and spring annual grown in nearly four million acres as a winter forage or green manure crop usually preceding cotton or summer vegetable crop. Most modern Egyptian clover varieties can be traces to one of the Egyptian landraces: Mescawi, Saidie or Fahl differ according to its basal branching. Egyptian clover is a fertility foundation of agriculture in Nile delta and had nourished soils in the Mediterranean region as a green manure for thousands of years.

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Therefore, the objective of this work was to investigate the effect of different percentage of soil moisture depletion before irrigation on macronutrients status of some Egyptian clover varieties.

MATERIALS AND METHODS

A pot experiment was conducted in the greenhouse of the National Research Center, Dokki, and Cairo, Egypt to study the effect of missing of irrigation on mineral status of some Egyptian clover varieties. The treatments were as follows:

Varieties: Giza 6 (V1) and Giza 10(V2) and Helali(V3)

Irrigation level consisted of:

I1: Reirrigation time 40% of available water was used.

I2: Reirrigation time 60% of available water was used.

I3: Reirrigation time 80% of available water was used.

The experiment included nine treatments, 3 varieties and 3 irrigation treatment. The experimental design was split plot in 6 replicates.

Seeds of Egyptian clover *(Trifolium alexandirinum* L.) varieties were sown in the 1^{st} of Dec., 2010 in plastic pots 45 cm in diameter and contained 10 kg clay soil. Physic- chemical of the experimental soil showed that it contained; sand 21.5%, silt 30.2%, clay 48.3%, organic matter 2.53%, $CaCO_3$ 2.53%,available N 47ppm, available P 25 ppm, available K 95 ppm. The pH of the soil was 7.15. Seeds were inoculated by the suitable ryzopium-sp. Calcium superphosphate (15.5 % P2O5) and Potassium sulfate (48 % K_2O) was added before sowing.

Plants from every sub-treatment were picked, cleaned, dried in electric oven at 70 Cº and ground in stainless steel mill. Digestion and macronutrients determination were done according to the methods described by **Cottene, et al (1982**).

Data of content were subjected to the proper statistical analysis according to the methods described by **Snedecor and Cochran (1982).**

RESULTS AND DISCUSSION

Varieties: This study showed that the difference in mineral element between tested Egyptian clover varieties (table 1)

Table (1): Mineral concentration of some Egyptian clover varieties

Varieties	N%	P%	K%	Mg%	Ca%	Na%
V1	2.01	0.29	0.85	0.15	0.86	0.71
V2	1.62	0.32	1.20	0.16	0.79	0.57
V2	1.45	0.28	1.01	0.17	0.68	0.72

V1: Giza 6, V2: Giza 10, V3: Helali

Table (2): Mineral uptake of some Egyptian clover varieties (mg/plants)

Varieties	N	P	K	Mg	Ca	Na
V1	75	28	41	6	34	28.1
V2	112	64	82	11	55	39.7
V3	72	45	47	8	30	31.8

The tested Egyptian clover varieties varied in its concentration and content of macronutrients as shown in Table (1). The highest percentage of N as well as Ca was obtained in V1 while for P and K it was shown in V2 but Mg percentage seemed to be without differences. V2 (Giza30) surpassed the other two varieties in all determinate uptakes of macronutrients in this work when the lowest mineral values were attained by V1 (Giza 6). This phenomenon was clearly shown in the case of P and K content. Certain species and cultivars growing under the same conditions may differ in their ability to use mineral elements available in the soil. Plants have also inherent variability in nutrients level (Easton, et al 1997).Hussein, et al (2012) showed the differences between the three clover varieties in dry mater of leaves, stem and whole plants. Hussein and El-Diewny (2011) pointed out that the three fenugreek varieties differ in its content of macro and micronutrients, Giza 30 surpassed the other two varieties (Giza 1 and Giza 6) in P,K,N and Cu concentration while Giza 6 surpassed the other two varieties(Giza 1 and Giza 30)in Zn, Fe and Mn concentration. Silva, et al (2005) concluded that plants have inherent variability of minerals which affected their physiology.

Drought

Water stress also affects plant mineral nutrition and disrupts ion homeostasis. Nitrogen concentration showed negative relationship with the increase of moisture depletion in the soil. Missing of 80 of water used caused more reduction of N%, while no marked differences were observed in N% between other two treatments (I1and I2). Generally, the more stress, the less nitrogen and phosphor absorption in roots like shoot but potassium absorption increase (Omid and Habib, 2010). Some studies showed the reduction of nitrate uptake and decrease in nitrate reeducates activity under water stress. K % increased with water deficit but K uptake decrease with water deficit increase .Potassium is an important nutrient and plays an essential role in water relation, osmotic adjustment, stomata movement and finally plant resistance to drought. Decrease in K+ concentration was reported in many plant species under deficient condition (yuncal Hu and Urs Schmidhalter, 2005). Calcium percentage increased only with the 60% moisture depletion and opposite response was true for phosphorus concentration which decreased with water deficit increase, Turner (1985) pointed out that P deficiency appears to be one of the earliest effects of mild to moderate drought stress in soil- grown plants. Calcium plays an essential role in structural and functional integrity of plant membrane and other structures. Water stress approximately 50% decrease in drought stressed maize leaves , while in roots Ca2+ concentration was higher compared to control. Although Ca uptake as for other elements is decrease under drought conditions, overall Ca accumulation is depressed only slightly compared with P and K . in mature maize plants grown in dry conditions , for example , component accumulations of P,K, and Ca were 40%, 71%,and 91%, respectively, of this found in mature plants grown in well-watered conditions(Jenne et al.,1958).

Table (3): influences of the different percentages of soil moisture depletion before irrigation on mineral concentration.

Water depletion	N%	P%	K%	Mg%	Ca%	Na%
I1	1.82	0.25	1.19	0.17	0.73	0.70
I2	1.72	0.30	1.24	0.16	0.86	0.66
I3	1.55	0.35	1.44	o.15	0.74	0.81

Table (4): Influences of different percentages of soil moisture depletion b on mineral uptake (mg/plants) of Egyptian clover

Water depletion	N	P	K	Mg	Ca	Na
I1	112	21.8	73	8	40	27.7
I2	94	16.4	68	10	46	46.0
I3	68	15.4	63	7	32	35.7

Mg concentration decrease with increased water deficit especially with I3 treatment but about I2 (60%) the change not appear compared with I2 (40%). Little information is available on the effect of drought on Mg of plants. The results have also demonstrated an increased sodium absorption in both 60 and 80% of water depletion

Data in Table (3) indicated that increasing depletion of moisture before irrigation decreased N and P contents, however, K, Mg and Ca content increased with treatment of 60% moisture depletion and tended to decrease with the treatment moisture depletion of 80% to be less than the control.

The response of clover and other legumes were studied before by many authors: Abd El-Gaffar, et al (1981); Socias, et al (1997); Xu Zing, et al (2002) and Hussein, et al (2012). Abd El-Gafar, et al (1981) mentioned that irrigation caused large in N2 fixation of Ficia faba and P. vulgaris compared to un-irrigated treatments. Growth rate of plants under drought was lower compared to that of irrigated ones. This resulted in a reduction of the above ground dry biomass to one third of irrigated plants (2.3 vs 6.8 g/plant). Leaf area and transpiration rate were also lower in plants under drought than under irrigation. Results indicated that berseem clover reduced substantially the plant water losses by decreasing the transpiration rate and the leaf area (Lazaridou and. Koutroubas, 2004).

Water stress decreased the availability of moisture in the soil and this consequently decreased the availability of nutrients and intern affected the absorption of minerals (Marschner, 1995). The less availability of water around plant roots decreased the water absorption and this uptake of minerals of the upper plant parts (Van Rensdburg and Kriiger, 1993).

Hussein and El-Dewiny (2011) revealed that water stress affected the mineral uptake in fenugreek plants. It is clearly shown that both missing of irrigation lowered the concentration of N, P, K and Cu. The missing of the 2nd irrigation caused more reduction in N and Cu concentrations and increased in Fe concentration. However, Mn concentration was limited due to drought but K concentration was almost constant under water stress condition.

Varieties x Drought

This study showed that the difference in the mineral element between varieties under drought stress condition (Table 5). Based on the result, it was revealed that V1 had the highest value of N and Ca but V2 had the highest value of K and Mg. but difference in Na and P between varieties were erratic. (F.Ganji Arjenaki et al., 2012)

Data in Table (5) showed that Irrigation after depletion of 80% soil moisture decreased N or K percentage in the three varieties but this decrease was more in V3 than V1 and V2 in case of N but for K it was equal in response of V1 and V3. In Phosphorus this treatment increased clearly its concentration in V2 and V3. Concerning Ca percentage it was increased by 60% treatment only but on the two varieties.

Table(5): Influences of the different percentages of soil moisture depletion before irrigation on mineral concentration of some Egyptian clover varieties.

VARIETIES	Water depletion	N%	P%	K%	Mg%	Ca%	Na
V1 (Giza6)	I1	2.20	0.29	1.05	0.18	0.88	0.51
	I2	2.06	0.32	1.2	0.14	1.10	0.72
	I3	1.78	0.25	1.29	0.12	0.79	0.90
V2 (Giza 10)	I1	1.65	0.33	1.23	0.16	0.83	0.47
	I2	1.60	0.25	1.35	0.17	0.82	0.53
	I3	1.61	0.25	1.20	0.16	0.72	0.71
V3 (Helali)	I1	1.61	0.32	1.30	0.16	0.67	0.61
	I2	1.50	0.27	1.03	0.17	0.65	0.72
	I3	1.25	0.24	1.50	0.17	0.71	0.82

Table (6): Influence of irrigation after depletion of available soil moisture on the content of macro Nutrients of three clover varieties (mg/ plant)

Varieties	Water depletion	N	P	K	Mg	Ca	Na
V1	I1	147	19.4	70	10	46	34.0
	I2	74	11.5	33	5	34	25.9
	I3	52	10.4	19	3	21	26.3
V2	I1	71	14.2	51	7	35	20.2
	I2	154	24.1	81	16	81	51.0
	I3	110	24.0	81	11	49	48.5
V3	I1	119	18.5	79	8	40	45.1
	I2	54	9.7	38	10	24	25.9
	!3	43	8.3	25	6	25	52.5
LSD							

Examination of Data in Table (6) pointed out that there is a negative relationship between macronutrients content and increase the depletion of available moisture before irrigation for V1 as well as V3. However, where for V2 the highest values of all estimated nutrients resulted when plants irrigated after depletion of 60% available moisture in the soil. **XU Zing, et al (2002**) mentioned that the response to water stress (80 depletion before irrigation) of all genotypes (11 genotypes) of clover used were similar. The plants water content was decreased from 88 to 78 % in drought treatments among all genotypes with interesting variation among them (**Vadell and Medrano, 1992**). Irrigation increased nodule size, nodulation, and seasonal N2(C2H2) fixation. The response was proportionally larger in white bean than soybean (**Smith and Hume, 1985). Hussein and El-Diweny (2011)** showed generally, drought introduced through missing of irrigation decreased the content of macro and micronutrients in fenugreek varieties. There was a negative relationship between missing of irrigation and varieties nutrients. The depression in N,P, K and Cu content in Giza 1 variety caused by missing of 2nd irrigation exceeded those induced by missing of 4th irrigation. In variety Giza 6 the depression by missing of 2nd irrigation was less than that caused by missing of 4th irrigation. **Ghooenia, et al (2006)** observed that some genotypes induced great acidification and having prolific root hair and significantly higher amount of those nutrients (K, P, Fe, Mn and Zn) whose availability in the soil very low.

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