Study effect drought stress and different levels potassium fertilizer on K^+ accumulation in corn

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Abstract: the necessity of exertion of irrigation regimes proportional to absorb process of nutritious element of potassium appear necessary duo to famine periods, saltines problem, and the shortage of drainage irrigation net in agricultural lands of Khuzestan province(southwest of Iran). This research is performed in the form of split plot test in accidentally complete bloke plan (main treatment: various levels in irrigation I. = 7, I_1 =12, I_2 = 17, I_3 = 22 day and secondary treatment: potassium fertilizer various levels K_1 =50, K_2= 100, and K_3=150(kg/ h) with 3 repetition. Plant date of first half of 2008 August is done in Shahid Salami irrigation institute farm in Ahvaz County. According to variance breakdown results the effect of irrigation cycles, different potassium and their interaction at level %5 effects on biological performance, seed function, harvest index and potassium assembling process were meaningful. But in case of the row number of maize, the effect of different levels of potassium fertilizer and reciprocal effect of water tension and different levels caused reduction of biological performance, seed function, harvest index, and row number of maize, seed number of row and weight of thousand seed. Treatment with seed yield of 15/5 ton in hectare has dedicated highest function to itself. And I_3 with 10/33 ton in hectare has lowest function which regarding to ware shortage and famine phenomena, it is under consideration. [Nature and Science. 2010;8(5):23-27]. (ISSN: 1545-0740).

Key Words: corn, drought stress, potassium

1. Introduction

Having flat and productivity lands as well as great solar energy Khuzestan is potentially an appropriate area for cultivating the plant like corn. In many years, due to insufficient water availability or when it grows with such plants as rice and melon ground simultaneously, the corn is affected by water deficits especially during growing phase. Adverse effect of water deficit on growth, development and yield in corn much more depend on occurrence time, severity of the stress, growth phase and genotype (Lack et al 2007).

Saki nejad (2002) reported that seasonal drought is the most important factor limiting corn production in the world, so that in average it decreases 17 percent of global corn yield annually. At some areas, decreased yield induced by drought has been reported by 70 percent. Moisture stress also affects the plant growth through anatomical, morphological, physiological, and biochemical changes.

The resistance of cultivating plant to accumulated elements in roots environment is very different. This resistance depends on such factors as ion accumulation degree in tissue, prevention of entering some ions into plant and capability of generating osmotic regulators (Heidari et al 2007).

In stress condition and presence of high sodium ion, the uptake of potassium ion will be disordered because the sodium removes the entire cell membrane and decreases the selective cell uptake (Izzo 1999).

Jose et al (2000) by studying the effect of drought-induced stress on corn reported that if it is irrigated properly a high yield will be obtained. Hugh et al (2003) by examining the effect of moisture stress on corn stated that intermediate and severe stress in 2000 and 2001 decreased grain corn yield by %63, %85 and %13, %26 respectively.

Besides the water deficits, the nitrogen deficits could also multiply the stress on growth and yield so that mismanaging of irrigation and nitrogen is regarded as the most basic factor decreasing corn yield. (Norwood 2000, Winhold 1995).

Asborne et al (2002) reported that the water – induced stress at the pre-flowering, flowering, post-flowering phases, compared to control plants, decreased the corn yield by 21%, 5%, 25% respectively. Water deficit at flowering pollination phases induces intense yield decrease through abnormal embryonic sac development, grain pollen abortion and ultimately reduces the number of productive grain (Denmead & Shaw 1999).

Rashidi (1999) by studying the effect of different irrigation regimes 0, 40, 70, 90cm evaporation from wash tube Class A on grain corn yield at Jiroft of Iran area has obtained the maximum grain yield in irrigation cycle 40mm from the wash tube.

Almost 90 percent of countries farmlands are located in arid and semi- arid regions, drought–

induced stress are more obvious especially in Khuzestan due to high temperature.

The aim of this research is to evaluate the accumulation and transport trend of the nutritional element (potassium) grain yield and dry matter of single cross corn 704 in the different irrigation regimes and levels of potassium fertilizer and understand a part of plant changes in order to prevent of negative effects on metabolic process.

2. Material and methods

This experiment was been considered at the field of Ahvaz's shahid salami Irrigation institute in summer of 2008 as spilt plot within basic plan of random completely blocks with main care (various periods of irrigation I_0=7, I_1=12, I_2=17 I_3=2.2 days and auxiliary care of different levels of potassium fertilizer k_1=50, $k_2$100, k_3=150kg/h) with 3 times repetition (Table 1).

Table 1.Soil Analysis Results

Depth	Potash %	Organic %	PH	EC	Soil Type
0-30	123	0.45	7.51	1.9	**Loam**
30-60	107	0.53	7.52	4.4	**Clay Loam**

The land preparation at late May was conducted by plowing, disc, fertilizing (before planting the phosphate ammonium and during planting the pure nitrogen and phosphorus fertilizers were used 200 kg and 90kg /ha respectively) and again a disc was done. In maintenance stage, the weeds were removed by an extirpator three times. The irrigation was done based on experiment treatment in the field and a half of N was applied as a topdressing fertilizer during establishing the stem into ground.

Estimating of seed performance and its components complete randomly sampling method from existing section of field was done on the basis of requirement and plan of experiment and in each experimental section, seven line were planted that two middle lines were examined in order to final performance studying. To obtain seed performance and its components, the sampling was done as follow. At each plot, its two middle line with its sampling margins as FHA(Final Harvest Area) was considered and seed performance was obtained.

Performance components of corn were studied and calculated. Row number of maize, seed number of row and weight of thousand seed were calculated and then on the basis of product of this components, seed performance was prided

For estimating of potassium element, every 14of day ,3 plant from each plot were sent to Determining and Analyzing food Elements laboratory after putting in plastic bags that potassium estimation was done by photometry way. In every sampling.3 plants were harvested to analyze potassium element and in period of growing, minimum 8 samples were got at on interval of 14 days. Variance Analysis was done by SAS software and the diagrams were drawn by Excel 2007 software program and average comparison was done as Duncan's multi- slope test at5% level.

3. Results

The results of variance analysis of various irrigation cycles, different potassium and their reciprocal effect on biological performance, seed function, harvest index and potassium assembling process were meaningful. But in case of the row number of maize, the effect of different levels of potassium fertilizer and reciprocal effect of water tension and different levels caused reduction of biological performance, seed function, harvest index, and row number of maize, seed number of row and weight of thousand seed (Table 2).

3.1. Biological yield: in Duncan test, the highest assembling of day substance obtained at 5% level of I_0 care with average of 29/71 Tons per Hectare and the lowest assembling was obtained at I_3 care with 21/4 tons per Hectare (Table 3). Increasing of plant biomass in terms of desirable irrigation has been due to more development and better duration that is caused to produce enough strong physiological resource in order to using of much received light and production of day substance.

3.2. Seed yield: I_0 care with 15.5 ton per Hectare allocated the highest seed function to itself and I_3 care wint 10.33 T ph had the lowest seed function, (Table3). The main reason of reed function reduction at different irrigation cycles can be assigned to LAI reduction and decline of photosynthesis in order to filling of seeds that caused decreasing of seed weights.

3.3. Row number of seed: the highest row number at I_0 care with numerical value of 17/3 row and the lowest of it at I_3 care with numerical value 15/4 row was obtained (table3). It is appeared that the cause of reduction of row nub men of maize at different cycle of irrigation relate to compare of physiological purposes for receiving photosynthetic materials. But against this theory, Richie and Henry (1997) reported that with regard to determining of row number of maize, there has not been comparison between other components to use of photosynthetic materials and in result row number of maize have a relative stability.

3.4. Seed Number of row: I_0 care with numerical value of 28/9 assigned the highest seed number of row and I_3 care with numerical value of 22/9 assigned the lowest seed number of row. (table3). The reasons of reducing of growing stages of plant, especially at stage of 12 leafing after that and productive growing stage, with drought tension.

3.5. Weight of thousand seeds: the highest value of weight of thousand seed obtained at I_0 car with 310 g and the lowest of it obtained at I_3 care with 2/92, g (table 3).

3.6. Harvest Index: the highest index percent of harvest obtained at I_0 care with value of 52/1% and the lowest of it obtained at I_3 care with value of 48/2% and by performing of different irrigation cycles, the percent of harvest reduced (table 3). In terms of severe drought tension, high decreasing of seed performance brought meaningful reduction of harvest index.

3.7. Potassium accumulation process: I_3 care with numerical value of 2/47 showed the highest percent of potassium assembling in plant, in the other hand, by increasing of tension intensity, potassium assembling percent in plant showed meaningful increasing. By performing different levels of water tension, potassium element assembling showed significant increasing to example care (without water tension) (table 3). One of reasons of it can be allocated to plant need to this element at various water conditions and drought tension.

4. Discussion

Liker man (2002) stated that under drought tension, the degree of potassium uptake is increased 2-3 times above desired conditions, also with presence of potassium ion, the water stress and its effect on dry matter accumulation trend, leaf area index, plant height is adjusted. The reason of such phenomenon can be attributed to high capability of photosynthesis by increasing the capturing carbon and enzyme robisco and encouraging synthesis and matter transport.

Smith (2003) the trend of potassium accumulation during initial growth stages is very severe compared to accumulation of dry matter. The maximum potassium uptake is taken place when the grain begins to get milky and before grain formation the accumulation is completed.

Smith (1999) showed that the trend of increased maize product during drought, ordinary and wet years is 4800 kg, 900 kg and 5400 kg respectively. Therefore, under drought condition, the trend of potassium absorption in order to improve the plant resistance against water deficit shows move severity and as the potassium uptake increases when emerging maize tuft, the product will increase. When the water stress is applied the potassium uptake be increased during flowering stage or by root or the transport of this element from lower leaf toward upper leaf is quickly conducted, so that the water potential in aerial point is greatly decreased and water moved in to these organs.

Rafiee (2002) stated that relative moisture content of leaf at time of flowering of corn plant have high correlate with seed function, negative correlation between drought tension with leaf surface index and potential of leaf water have provided reduction of leaf surface and reduction of photosynthesis at leaf water unit at level of sinking and result, reduction of supplying processed substances and negative effect of it on seed production in maize was led to the result of seed performance reduction. Sepehry et al (2002) declared that the most effect of drought tension on seed weight was during filling of seeds and tensions would happen after giving silk cause being small of seed by reducing the duration of seed filling.

Khokpour (1994) observed that strict drought tension caused reduction of corn harvest index, but aligned this reduction to more declination of seed function to total dry weight.

Likely (1999) said that at water tension conditions, process of potassium absorption perform with consuming energy and in from of active. Sony et al (2001) have reported the reason of increased potassium uptake under drought stress can be attributed to active uptake mechanism of this ion by which the plant in order to promote its resistance to drought, increases the potassium concentration in root and other organs through energy consumption. The other reason is attributed to extended drought and wet periods in the dried and semi-dried regions which it causes potassium release through day layers. Guiyang (2002) stated that a large amount of the plant energy spent for adjusting osmosis pressure of the leaf tubing & rising the stomas 'insistence; in other words, the dry tension created conditions with which spent a lot of energy to confront it; for example about adjusting osmosis pressure, it took approximately one month to decreasing its osmosis potential that a lot of energy have been spent for increasing active absorption of potassium& also protein polymers.

Table2: summary of variance analysis results (square averages) and meaningful level of components of corn function in examination.

Potassium accumulation	Harvest index	Seed yield	Weight of thousand	Seed number of row	Row number of seed	Performance of dry material	df	Changes resources
$0.96^{n.s}$	0.19^{*}	$0.014^{n.s}$	0.89^{**}	$0.15^{n.s}$	$0.80^{n.s}$	$0.061^{n.s}$	2	Repetition
8.02^{**}	56.91^{**}	41.02^{**}	48.9^{**}	10.76^{**}	$15./01^{**}$	137.45^{**}	3	I treatment
0.086	0.024	0.015	0.58	0.59	0.46	0.039	6	Error (I)
11.32^{**}	0.50^{**}	1.35^{**}	0.99^{**}	5.36^{**}	$0.79^{n.s}$	8.39^{**}	2	K treatment
14.33^{**}	0.30^{**}	0.30^{**}	24.6^{**}	4.16^{**}	$0.68^{n.s}$	1.94^{**}	6	Interaction I×K
0.053	0.015	0.011	0.32	0.37	0.23	0.021	16	Error (K)
9.91	12.20	10.45	13.65	13.4	13.95	10.55	-	CV%

*, **, ns show meaning fullness at level of 1%, 5% and unmeaning fullness, respectively

Table3: comparison of average with Duncan test wag at 5% level

Potassium accumulation	Harvest index	Seed yield	Weight of thousand seeds	Seed number of row	Row number of seed	Performance of day material	Treatment
							Drought stress(I)
1.91b	52.1A	15.5A	310A	28.9A	17.3A	29.71A	I_0
2/05b	51.4B	14B	309A	26.3B	17.2A	27.21B	I_1
2.33ab	50C	13.6C	305B	26.8B	16.6AB	27.2B	I_2
2.47a	48.2D	10.33D	292C	22.9C	15.4AB	21.4C	I_3
					Various levels of potassium fertilizer(k)		
1.61a	43.2B	12.24B	307Ab	22.1C	18A	28.31B	K_1
2.62b	49.7A	15.12A	308A	27.5B	17.8A	30.11A	K_2
2.61b	51.5A	15.51A	306B	28.4A	17.8A	30.38A	K_3

In each column, being on common article between 2avernage show unmeaning fullness 5% level.

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