Calculated equation and specific absorption rate roots (*SAR*) for the nutrient

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Abstract: The experiment conducted in Islamic Azad University research farm of Ahwaz city (IRAN). Average of rain was 256mm based on split plot design and along with complete random block pillar, two factors and four repetitions. After measuring the parameters of root morphology and nutrient elements specific absorption rate (***SAR***), which is an indicator of the efficiency of root uptake based on the calculated parameters were measured, using the following formula based on root weight (R_W) and mg unit g/g root dry matter per day was calculated:

$$\bar{A} = (M_2 - M_1)/(t_2 - t_1)/(LnR_2 - LnR_1)/R_2 - R_1$$

$\bar{A}$: Average speed of absorption of mineral nutrients ($mgg^{-1}day^{-1}$),
R: root dry weight (g)
M: Dry weight root element value (mg)
t: sampling time (day)
Specific absorption rate (*SAR*) four elements: nitrogen, phosphorus, potassium and sodium were measured. Numeric value to attract the highest speed with the amount of potassium element 0.19 mg / g. day in the severe stress and was calculated with the lowest amount of sodium was 0.001 mg/g day. Although in mild stress, nitrogen value increased to 0.21 mg / g. day, which are because of osmotic pressure phenomenon, but the element phosphorus absorption to the wilting point plant (PWP) element did not decrease. *SAR* of nutrient nitrogen, phosphorus, in comparison to control with full irrigation decreased the N *SAR* decreased even with the incidence of mild water stress found, although in severe stress treatment, water, SAR value of N increased, but severe water stress treatment, *SAR* showed a significant reduction of nitrogen. SAR of P only to stress that in the permanent wilting point (PWP) reduced, did not show decreasing to PWP. *SAR* of K^+ applying different levels of water stress than the control group showed an increasing trend, especially between these two elements, *SAR* K^+ increases much higher than the sodium was almost *SAR* sodium potassium approximately 55 times the most stress treatments water respectively. Conditions without water stress, the highest *SAR*-related elements nitrogen phosphorus and potassium elements was then that water stress, especially severe water stress, the highest *SAR* related to the element potassium phosphate, nitrogen and sodium were. Nitrogen absorption rate equations shows that reducing the amount of water absorption of this element also severely reduce (Y_N=0.016X+0.046). But the element phosphorus, the absorption process does not stop until the point wilt (Y_P=0.02X+0.002), Potassium absorption process according to the equation is increasing (Y_K=0.016X+0.030), Element in the situation is different sodium absorption rate of this element is extremely low (Y_{Na}=0.006X+0.003).

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Key words: specific absorption rate roots (SAR), nutritional elements and corn

1. Introduction

Absorption capacity of a root system depends on the permeability or conduction is. And is expressed as follows:

LR = LP + AR

In this connection LR absorption capacity or root system guidance, LP Hydraulic conductivity and permeability or AR root surface (cm^2).

Different physical and chemical factors in rhizosphere, plant-like properties, responsible for absorption of minerals by the roots are. According to Zhong and Klasn (1998) the important factors are:

1 **- Chemical composition of food**, their concentration in soil solution and small trip, pH and ventilation.

2 **- Position proportional to the distance element in soil plant roots.**

3 **- Moving element with a mass flow and diffusion**, which implies the ability to create plants gradient potential of concentration and water is traveling.

4 **- Growth, distribution and physiological roots** of form and strength to move on and earn uptake.

5 **- Secretion of organic compounds** with low molecular mass of roots, such as amino acid, gelatinous material with high molecular mass (Mucilage) and peel and repair cells and tissues may cause mobility minerals either directly or indirectly that their energy for the microbial activity in the rhizosphere provides makes (29).

Although the intensity of absorption of water and nutrients or ions is different from single solution, as soluble materials into the root are the same directions with water flow follow. When plant roots completely in the solution with uniform concentration is to be established in most cases concentration of pipes Vascular much more than the concentration in the external solution. Ions during physical movement (mass flow or diffusion) to the exterior space root, during more than anions cautions and thus the frequency of negative charges is at the level of cell walls.

Total cautions and anions into roots are often not equal with the name of ion exit from the root to be out of balance. Amount of food that solutions with fixed concentration into the roots are, depending on the status of plants and salt has transpiration rate (metabolic demand).

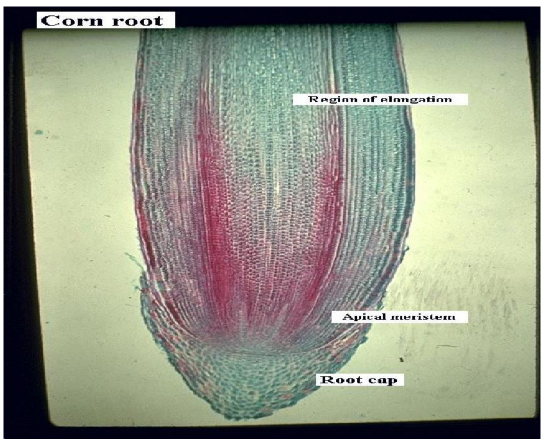

Figure 1. Corn root (32)
http://www.emc.maricopa.edu/faculty/farabee/biobK/rootts.gif

Relationship between fluorescence and absorption of root ion (e.g. iron absorption by soybean) by Dyer and Brown (1998) is shown. Ions into the roots as active or inactive come to move on. Active movement and energy metabolism to act, usually by breathing comes depends on moving ions and including a region with low to high electrochemical potential on both sides of the membrane and concentration gradient is the opposite. Physical process by moving ions may cause active transport ions move opposite to be the concentration gradient. (Transmission disabled). These two types of transmission reflection absorption materials by roots intact when the concentration of foreign substances low (mechanism I: characteristics of a process of active displays) or be much (Mechanism II: characteristics of a process to disable shows.) Many minerals as ions are released into the roots, but there are also exceptions, such as urea or elements. Describe the flow of elements in the root level, the term; root absorbed (Flux); is discussed as the ratio of elements in entry-level unit (X) can be expressed.

Zhong and Klasn (1998) flow to the roots of phosphorus and potassium as a function of concentration as; saturation; and using equation Adjusted infected (Nielsen) of these were described (29):

$$I_n = \frac{I_{max}(C - C_{min})}{(K_m + (C - C_{min})}$$

This formula in net flow of food, I_{MAX} maximum current intensity, K_m is a constant Michelins mentum (1998) affinity nutrient uptake of a show. Minimum concentration of ionic plant that is able to absorb it. Tibet and colleagues (1895), the rate of magnesium uptake by plants using a change in Mg concentration in solution and the net weight change roots outreach calculated that income to the following equation:

$$I_m = \frac{(M_2 - M_1/WR_2 - WR_1)\times 1n(WR_2/WR_1)}{(t_2 - t_1)}$$

In the absorption intensity of fresh root weight, M the total amount of material Skives long (leaves and roots), WR root fresh weight and t is the time of day.

Models absorption properties of materials by plant roots like other root expansion rate, average root radius, the average hair length and density fatal are included. Some other authors as well as environmental factors such as temperature, pH, and soil moisture also consider effective models washmen (1998), for example, models of different plants to accumulation of sodium ions from the show which can plant requires ion Na + pointed out that a completely can replace potassium and increased growth will be like: sugar beet or plants that absorb sodium done but could not quite substitution ions K +, the growth amount of minor by ion Na + is observed, such as: cabbage, cotton, chickpea, cotton, wheat and spinach, but plants a small amount of ions Na + uptake that these amounts replacement ion K + is, like: barley, rice, oats, tomato, potato and other plants Ryegrass model in which substitution by Na + K + ion is not observed and growth by sodium in these plants does not make sense, such as: corn, rye, soybean, common bean and Timothy(27).

Salisbury and colleagues (1995) response of dry weight of C3 and C4 in the treatment of sodium and without the presence of these ions studied were, they stated that in the presence of ions Na +, dry matter accumulation per plant C4 increases, which This due to increased concentration of acid pyrovat in cells

Mesophyll these plants is that increased uptake CO2 than is, but in plants C3 change in dry matter by ion Na + report did not, of course, this experiment plants C3 and C4 relatively resistant to ion Na + was used. When the ions K + sufficient and accessible, the condition that the amount of ions of potassium and the percentage of moisture is the result of corn absorbed K + completely done and the substitution K+ by Na^+ very minor and insignificant, the coursein the absence of K^+ and moisture content low, ions Na + and its absorption more was that the effect of salinity on corn shows, comparing the size of ion hydrated 0.331 = K + and 0.353 = Na + nm, absorption of ions of K+ moisture adequate and optimal concentration of potassium, most evident under conditions of salinity absorbed K + by Na + limit is the ratio of the vacuoles in the amount of low salinity to medium (200 mmol) is higher in salinity above this ratio sharply decreased, which due This replacement of Na+ ions instead of K+ ions are. The ratio of stem less, indicates the mechanism of resistance in the way of absorbing ions Na + and transfer of low sodium shoots are possible, due to layer multiple is possible that the wall radial cells, the six-way its four funds and Sabrina Caspar ring that acts selectively share Simplest move towards apoplast increases, whatever the contribution increases than decreases, the plant has resistance against the entry of salt of course, mechanisms resistance, such as another exit from the leaves and roots of salt, ionic regulation in shoots and reduced plant transpiration in this regard has been reported(20).

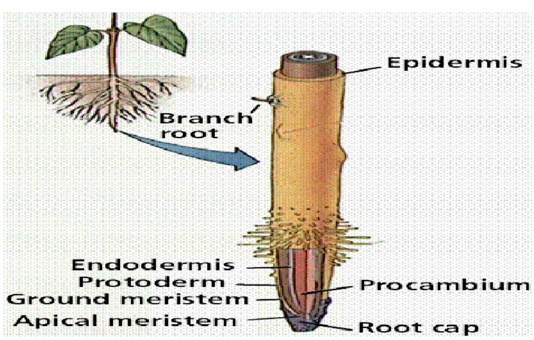

Figure 2. Corn root (32)
[http://www.iowacorn.org/cornuse/cornuse_3.html Usage of Iowa a U.S. Corn Crop]

2. Materials and methods

The experiment conducted in Ahwaz Azad university research farm 3 Km to south of Ahwaz city during in 2006-7 year. A split plot design experiment in randomized complete block design (treatments main plot: different amounts of irrigation (I) and sub-plots: plant growth phases(S)) was performed with four replications

After measuring the parameters of root morphology and nutrient elements specific absorption rate (SAR), which is an indicator of the efficiency of root uptake based on the calculated parameters were measured, using the following formula based on root weight (RW) and mg unit g/g root dry matter per day was calculated:

$$\bar{A} = (M_2 - M_1)/(t_2 - t_1)/(LnR_2 - LnR_1)/R_2 - R_1$$

$\bar{A}$: Average speed of absorption of mineral nutrients (mgg-1day-1),

R: root dry weight (g)

M: Dry weight root element value (mg)

t: sampling time (day)

3. Result

Numeric value to attract the highest speed with the amount of potassium element 0.19 mg / g. day in the severe stress and was calculated with the lowest amount of sodium was 0.001 mg / g. day. Although in mild stress, nitrogen value increased to 0.21 mg / g. day, which are because of osmotic pressure phenomenon, but the element phosphorus absorption to the wilting point plant (PWP) element did not decrease. *SAR* of nutrient nitrogen, phosphorus, in comparison to control with full irrigation decreased the N *SAR* decreased even with the incidence of mild water stress found, although in severe stress treatment, water, SAR value of N increased, but severe water stress treatment, *SAR* showed a significant reduction of nitrogen. SAR P only to stress that the permanent wilting point plant conditions (PWP) contract, did not show decreasing trend. *SAR* K applying different levels of water stress than the control group showed an increasing trend, especially between these two elements, *SAR* K^+ increases much higher than the sodium was almost *SAR* sodium potassium approximately 55 times the most stress treatments water respectively. Conditions without water stress, the highest *SAR*-related elements nitrogen phosphorus and potassium elements was then that water stress, especially severe water stress, the highest *SAR* related to the element potassium phosphate, nitrogen and sodium were shown in Table 1.

Table1: Rated SAR values of nutrient elements during growth (mg / g. day)

111	99	87	75	63	51	39	27	15	Days after sowing
0.13	0.17	0.19	0.21	0.17	0.14	0.08	0.05	0.04	N
0.15	0.16	0.162	0.15	0.13	0.097	0.057	0.021	0.014	P
0.16	0.175	0.18	0.19	0.19	0.14	0.067	0.04	0.03	K
0.001	0.0017	0.002	0.003	0.0035	0.004	0.005	0.0014	0.001	Na

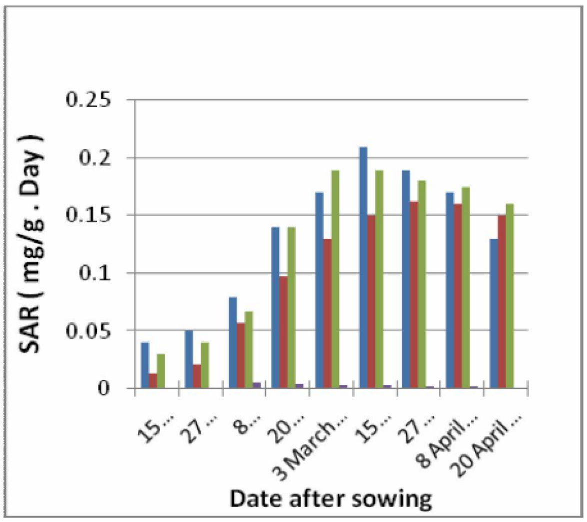

Fig 3. SAR nutrients in during seasonal growth

Nitrogen absorption rate equations shows that reducing the amount of water absorption of this element also severely reduce (Y_N=0.016X+0.046).

But the element phosphorus, the absorption process does not stop until the point wilt (Y_P=0.02X+0.002), Potassium absorption process according to the equation is increasing (Y_K=0.016X+0.030), Element in the situation is different sodium absorption rate of this element is extremely low (Y_{Na}=0.006X+0.003) (Table2).

Table 2. Calculation SAR equations

Nutrients	SAR Equation	R^2
N	Y=0.016X+0.046	0.561
P	Y=0.02X+0.002	0.871
K	Y=0.016X+0.030	0.690
Na	Y=0.006X+0.003	0.037

4. Discussion

The study of specific nutrient uptake rate (SAR) in the process of accumulation of root nitrogen, phosphorus, potassium is clear that by applying different levels of water stress, especially nutrient uptake rate (SAR) of nitrogen and phosphorus can be decreased. The decreasing trend of N SAR even mild water stress occurrence found, although more severe treatments water stress (treatment I2), SAR value of N increased, but treatment I3, SAR nitrogen reduction can be significant. Mild stress applied before the point of many changes in the SAR PWP plant phosphorus in comparison to control without water stress showed. The cause of this problem, not the element phosphorus uptake in plant roots when treated in the most severe water stress occurred in the plant was at the point of PWP and phosphorus in this SAR conditions suddenly decreased. SAR phosphorus treatment to I3, a significant decreasing trend did not, but that this treatment plant water stress conditions, permanent wilting (PWP) was, SAR phosphorus reduction was significant increase in these elements under drought stress conditions cause high accumulation of the elements sodium and potassium in plant roots were. Particular element of potassium sodium SAR 55 times its estimated water stress conditions, the highest SAR-related elements nitrogen phosphorus and potassium elements was then that water stress, especially severe water stress, the highest SAR related to the element K phosphorus, nitrogen was sodium, sodium SAR Although water stress conditions, but it increases the size of this increase nothing SAR K is not even comparable to that limitation of this nutrient by the plant showed.

Because plants need nitrogen and potassium elements in intervals beginning of growth can be seen that the two SAR element in this interval than SAR phosphorus and sodium, but after a while the growth (40 days after planting) plants that need SAR element phosphorus can increase the process of this element increased SAR and K to the end of seed maturity to process high SAR won all four elements nitrogen, phosphorus, potassium growth during the period of growth And at the highest S 2 S1, which spread root weight and the number is not complete, showed the lowest amounts of nitrogen and potassium SAR period of 35-30 days after sowing of the SAR and sodium phosphate was much higher than the 40 days after planting increased considerably accelerated by phosphorus SAR will amount to close before the flowering period of SAR values was potassium N, N SAR maximum flowering period was obtained after this step, SAR decreased nitrogen, but potassium SAR 15 days before their pea K flowering period of the course Receipt K, grain filling in some samples even up to grain maturity K, SAR K range was from their pea K, SAR phosphorus during flowering horse grain had the maximum value, the maximum SAR sodium after double ring appearance was achieved what every age plant will increase the amount of sodium SAR showed downtrend. In other words, specific absorption rate of Sodium in the older plant vegetative period and then declined rapidly due to water stress conditions, changes in the behavior of root absorption, SAR elements nitrogen and phosphorus were dramatically decreased, which due to restriction of root growth and components solubility of these two elements are slightly (Mashner 1989)(6). But the SAR, especially potassium and sodium potassium SAR can be increased and due to high accumulation of potassium in plants to increase the SAR element. Root morph physiological changes such delusion rhizosphere water status of drought, especially absorption rate (SAR) nutrient nitrogen, phosphorus, potassium and sodium remarkable changes in comparison to control (without water stress), presented, as well as in each growth period, the rate of absorption of this nutrient, especially, showed different values.

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[http://caliban.mpizKoeln.mpg.de/~stueber/thome/band1/tafel_088.html Image of Zea mays from Flora von Deutschland Österreich und der Schweiz]
[http://www.pfaf.org/database/plants.php?Zea+mays&CAN=WIKPEDIA Zea mays at Plants for a Future]
[http://www.iowacorn.org/cornuse/cornuse_3.html Usage of Iowa and U.S. Corn Crop]
[http://www.Kallipolis.com/diet/food.php?id=11168&w=3 Corn nutrition information]
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[http://www.howtocooKcornonthecob.com How to cook corn on the cob]
[http://www.milpa.nl Maize of Guatemala]

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