Different irrigation periods and K fertilizer effects on water use efficiency of rice *Oryza sativa* L . mishkhab 1 cultivar.

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Abstract:

A field experiment was carried out at the Rice Research Station at Al-Mishkhab - Najaf province - Iraq country during 2019 season to investigate effect of irrigation periods and K fertilizer on Water-Use Efficiency (WUE) of rice mishkhab1 cultivar using Randomized Completely Block Design (RCBD) in a factorial arrangement with three replicates , Irrigation periods were the first factor namely, continuous flooding Irrigation (I_1) as control , every 5 days Irrigation (I_2) ,every 7 days Irrigation (I_3) and every 10 days Irrigation (I_4) and the second factor was K fertilizer levels namely, 30 Kg Donum^{-1}(K_1) as control 40 Kg K D^{-1}, (K_2) , 50 Kg D^{-1} (K_3) and 60 Kg D^{-1} (K_4) , means were compered using Least Significant Difference test (L.S.D) among treatments at 0.05 probability level and the results shows the following:

The (I_2) treatment was significant superior on traits of (WUE) by 270 %, 17.1 % biological yield ,32.6% grain yield and for (WUE) by 86% as comparison with control (I_1) .

Introduction:

Rice *Oryza sativa* L. is considered essential food for more than half of world's population (5) , (11) .it's most important cereal crops in Iraq country, also it's the crop which increase requesting , rice planting regression in Iraq due to need much quantities of irrigation water as aquatic summery cereal crop, especially when planting by flooding irrigation regime , that have been the most spread regime in Iraq . Najaf province consider first province of rice production , 2.4 ton ha^{-1} as average yield .rice inter agriculture care cycle in Iraq as strategy of food security, faced many problems , rice planting was banning in Iraq for many seasons due to water shortage problem (3) indicated that global average of irrigation water quantity was 2500 liters for one crude Kg of rice product , this quantity was different from field to other within range of 800-5000(LW Kg^{-1}) depended upon crop management , irrigation periods one of them (4) remind that flooding irrigation regime with pre puddling during growth season was dominant cultivation rice crop.

At present , many irrigation periods were following to guarantee plant (WUE),contrary optimal production , global predictions indicate to water crisis probability more specifically at Asia continent that consume more than 85% of rice crop water (6) .Nutrition rice by potassium guided to decrease water loss by transpiration due to laborer physiological role to control open and close stomata that, increase plant ability of water conservation, especially at water irrigation shortage, it is one of major nutrition elements for plant growth and development (10).

Materials and methods:

A field experiment was carried out at the Rice Research Station at Al-Mishkhab – Najaf province - Iraq country related to International Rice Researches Program during 2019 season to study effect of different irrigation periods and K fertilizer on Water - Use Efficiency (WUE) of rice mishkhab 1cultivar during following plant growth and yield .

The experiment was carried out using Randomized Completely Block Design (RCBD) in a factorial arrangement , treatments were randomized at three replicates , The means were compared with LSD at 0.05 level , different irrigation periods were the first factor which were marked as continuous

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flooding irrigation (I_1) as control , every 5 days irrigation (I_2) , every 7days irrigation (I_3), and every 10 days irrigation (I_4), fertilizer levels were the second factor which were 30 Kg Donum^{-1}(K_1) as control , 40 Kg D^{-1} (K_2) , 50 Kg D^{-1} (K_3) and 60 Kg D^{-1} (K_4) as K_2O salt added to irrigation water , experiment soil was divided to equally plots(4 x 4) m dimensions as 16m^2 area with 48 experimental plots , planting doing by equal disperse seeds with the average , 30 kg D^{-1} than following with all agricultural services which needed to rice at that region , the grain yield , biological yield, were calculated based on (1m^2) than conversion into (ton ha^{-1}) for every treatment of present experiment , quantity of irrigation water was calculated through controlling water flow by counting it using gauge meter in (m^3) unit with 0.001 m^3 accuracy, while Water Use Efficiency (WUE) calculated by divided grain yield (kg grain D^{-1}) on consumed water quantity (m^3 Irrigation water D^{-1})to became (kg grain m^{-3} irrigation water) using WUE = Y ÷ Q tot equation according to (2), (1) with change Hectare to Donum (Donum = 2500 m^2) in Iraqi country, potassium was estimated flam spectrophotometrically.

Results and Discussion :

Rice : of Water Use Efficiency (WUE)

From data in table (1) notice , all mention data on table (2) were reflected on (WUE) of rice which is resulted from grains yield (Kg D^{-1}) divided upon consuming water use irrigation (m^3 D^{-1}) (2) , when consuming water average decrease the (WUE) average increase on that consuming , so all irrigation water treatment (I) significant superior reached highest at (I_3) treatment that reached to 0.200 by 270% percentage increment as compare with control treatment which was 0.054 (Kg grain m^{-3} irrigation water) ,results ,also shows significant increment taking place for all K fertilizer treatments reached highest at (K_4) treatment ,to 0.199 by 86% percentage approximately as compare with control treatment that was 0.107(Kg grain m^{-3} irrigation water) ,and there were number of significant interactions treatments of that trait (research subject) reached highest at (I_3xK_4) interaction reached to 0.259 by 502% percentage and control treatment was 0.043 (Kg grain m^{-3} irrigation water) indicated to important role of potassium playing to increment plant (WUE) during lessening of irrigation water utilization , as result of potassium soil content increment that added to irrigation water (60 ton D^{-1}) subsequently , increment plant content as appeared on table (3) and water loss adjustment through stomata open and close control (10) .

Table (1).Effect of irrigation periods , K fertilizer and it's interactions on (WUE) (Kg grain m^{-3} irrigation water).

K concentrations	irrigation periods				means effect of K
	I_1	I_2	I_3	I_4	
K_1	0.043	0.130	0.147	0.109	0.107
K_2	0.047	0.161	0.171	0.154	0.133
K_3	0.060	0.199	0.221	0.198	0.169
K_4	0.066	0.227	0.259	0.246	0.199
means effect of irrigation periods	0.054	0.179	0.200	0.177	
L .S.D (0.05)	K=0.200 I = 0.200 I x K = 0.400				

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Water utilization:

From data of table (2) notice, the average of irrigation water plants need during its life cycle period reached to (28250) ($m^3 D^{-1}$) at (I_1) control treatment whereas , evidently decrease shows on remainder treatments (I_2,I_3,I_4) reached to (8500,7655,700)($m^3 D^{-1}$),respectively and by (70%, 73%, 75%) percentages, respectively approximately also, all K fertilization treatments caused significant decrease of this trait at (K_2,K_3,K_4) treatments that reached to (13434 , 12235 , 11067) ($m^3 D^{-1}$) percentages , respectively and by (8.4% ,16.6% ,24.5%) , respectively ,as compare with control treatment that was 14672 ($m^3 D^{-1}$) indicated to the clear potassium role (11) especially at high concentration (60 Kg D^{-1}) on decrease water utilization average in view of its an important to loss water control by transpiration (10) also, there were number of interactions have been effected to reduce that trait significantly by percentage 81.7% at (K_4 x I_4) interaction , which reached to 5700 ($m^3 D^{-1}$) whereas, it was 3118 ($m^3 D^{-1}$) at control treatment.

Table (2).Effect of irrigation periods , K fertilizer and it's interactions on water utilization ($m^3 D^{-1}$).

K concentrations	irrigation periods				means effect of K
	I_1	I_2	I_3	I_4	
K_1	31189	10100	8900	8500	14672
K_2	29234	8800	8300	7400	13434
K_3	27329	8000	7210	6400	12235
K_4	25249	7100	6210	5700	11065
means effect of irrigation periods	28250	8500	7655	7000	
L .S.D (0.05)	K =500 I = 500 I x K = 1000				

Leaves content:

Potassium

From table (3) notice , (I_2) treatment caused non-significant increment of potassium leaves content (%) in comparison with control (I_1) treatment , while (I_3 and I_4) treatments caused significant devaluation of potassium leaves content , but K fertilization treatments shows significant superiority at (K_4 and K_3) treatments ,increment reached highest at (K_4) treatment by 1.558% percentage as compare with (K_1) control treatment which was 1.397% percentage because of potassium soil content increasing (60 Kg D^{-1}),that lead to high potassium absorption by plant roots ,also results indicated significant interactions taking place on number of interactions , reached highest increment at (K_4xI_2) by 17% percentage approximately , that confirm on (I_2) treatment important . So it be clear from table (3) results that , when potassium soil content increase as fertilizer the potassium leaves content increase as percentage (7) ,make clear that's potassium existence in plant cells with high concentrations decrease water loss by transpiration, that is to say increase the ability of plant water conservation and that's very important in case of water shortage existence specially at arid and semiarid regions , despite potassium did not inter at any organic compound of plant ,but it contribute to active more than 70 enzymes like Redox and protein creation enzymes and regulate osmotic pressure into plant cells (8).

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Table (3).Effect of irrigation periods , K fertilizer and it's interactions on potassium leaves content (%).

K concentrations	irrigation periods				means effect of K
	I_1	I_2	I_3	I_4	
K_1	1.420	1.45	1.416	1.303	1.397
K_2	1.530	1.450	1.475	1.320	1.444
K_3	1.600	1.630	1.550	1.380	1.540
K_4	1.621	1.660	1.512	1.440	1.558
means effect of irrigation periods	1.543	1.548	1.488	1.361	
L .S.D (0.05)	K=0.149 I = 0.149 I x K = 0.298				

Biological yield

Notice from table (4) there is no significant different between (I_2) (every 5 days irrigation) treatment and (I_1) control treatment , K fertilizer indicated to be superior of K_3 and K_4 (50 and 60 Kg D^{-1}) treatments , respectively on this trait as compare with control treatment , increment reached highest at K_4 treatment with in 9.99 (ton ha^{-1}) by 17.1% percentage as compared with control treatment that was 8.53 (ton ha^{-1}) indicated to necessity of potassium to support growth , results indicated significant interactions in biological yield increment at number of combinations reached highest at (K_4xI_1) combination with increment 16% percentage approximately without significant different mentioned between it and (K_4 x I_2) combination , that indicated to (I_2) treatment important at that conditions .

Table (4).Effect of irrigation periods , K fertilizer and it's interactions on biological yield (ton ha^{-1}).

as comparison with control (K_1) treatment that

K concentrations	irrigation periods				means effect of K
	I_1	I_2	I_3	I_4	
K_1	10.33	10.23	7.15	6.40	8.53
K_2	10.58	10.42	7.22	6.97	8.80
K_3	11.62	10.54	8.07	7.17	9.35
K_4	11.98	11.82	8.47	7.70	9.99
means effect of irrigation regimes	11.13	10.75	7.73	7.06	
L .S.D (0.05)	K = 0.393 I = 0.393 I x K == 0.786				

Grains yield:

From table (5) notice there is no significant different between (I_2) (every 5 days irrigation) treatment and (I_1) control treatment ,while (I_3 and I_4) treatments caused significant devaluation on yield ,but all K fertilization shows significant superiority on this trait , reached highest at (K_4) treatment to 6.14 (ton ha^{-1}) by 32.6% percentage was 4.63 (ton ha^{-1}), which indicated to potassium important for increment grains yield at this conditions also, results shows significant interactions increment taking place reached highest at(K_4xI_1) by 23% percentage increment approximately without existence of significant different between it and (K_4xI_2) interaction which confirm on (I_2) treatment.

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Table (5).Effect of irrigation periods , K fertilizer and it's interactions on grains yield (ton ha^{-1}).

K concentrations	irrigation periods				means effect of K
	I_1	I_2	I_3	I_4	
K_1	5.40	5.25	4.18	3.70	4.63
K_2	5.47	5.67	4.91	4.57	5.16
K_3	6.52	6.37	5.44	5.07	5.85
K_4	6.64	6.44	5.89	5.60	6.14
means effect of irrigation periods	6.01	5.93	5.11	4.74	
L .S.D (0.05)	K = 0.121 I = 0.121 I x K =0.242				

From present research results , It has been appear can adoption (I_2) treatment (every 5days irrigation) and leaving (I_1) treatment which plenty water use , because there is no significant different existence at grains yield and biological yield as shows on tables(5),(4) ,respectively to guarantee not excessive on irrigation water ,especially at arid and semiarid regions which Iraqi one of them ,also potassium active role appear at these conditions on significant increment for grains yield by 32.6% as shows on table (5) and biological yield by 17.1% as shows on table (4),also K fertilization treatment shows clearly production increment by superiority of (K_4) treatment on control treatment (K_1) for all traits of this conditions during clearly synergistic relationship among (K) and (I) treatments, (9) recommend on his yearly report of Vietnamese experts, it's necessary to fertilization by potassium within the range of(50-80) (Kg D^{-1}) at Al-Mishkhab-Najaf government-Iraq .

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