INFLUENCE OF IRRIGATION AND TILLAGE PATTERNS ON YIELD AND ITS COMPONENTS FOR FIVE RICE VARIETIES (*Oryza sativa* L.) UNDER THE SYSTEM OF THE RICE INTENSIFICATION (SRI)

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ABSTRACT

A field Experiment was conducted at Al-Mishkhab Rice Research Station at Najaf province in Iraq during 2019-2020 rice season, which is located between N 0°17́ 4.5075 and E 40°54́ 29.6959,assess Analysis Of The influence of irrigation and tillage patterns on yield and its components for five rice varieties under the System of Rice Intensification (SRI). The trial was performed as split split plot in based on a randomized complete blocks design (RCBD) having three replications. The experiment parameters of the irrigation patterns were : daily irrigation and intervals irrigation (3 days, 6 days, and 9 days intervals) with five varieties of rice: Anbar 33, Jasmine, Mishkhab 2, , Baraka and Dijla . The Tillage pattern: Soil tillage and the non-Tillage, by using principles of the System of Rice Intensification (SRI) are: transplanted method, and seedlings were transplanted pattern square 30×30 cm between other with one seedlings per hill and early transplanted 15 days seedling old. The results of this research showed that there are significant differences in the yield and its components (The number of active tillers, weight of 1000 grains, Sterility percentage, Grain yield and biological yield) with the interval of irrigation each 3 days under a non-tillage soil compared with 9 days interval.

Keywords/ Rice, Irrigation periods, Tillage soil system and the non-Tillage soil system, System of Rice Intensification (SRI) **Sterility percentage**

تأثير أنماط الري والحراثة في الحاصل ومكوناته لخمسة أصناف من الرز تحت نظام التكثيف للرز(SRI)

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المستخلص

أجريت تجربة حقلية في محطة بحوث الرز في المشخاب والتابعة إلى قسم بحوث النجف الأشرف - دائرة البحوث الزراعية خلال الموسم الزراعي الصيفي 2019-2020 و الواقعة بين خطي عرض N 31536.17 وطول E 44306.02 بهدف دراسة تأثير أنماط الري والحراثة المختلفة في الحاصل ومكوناته لخمسة اصناف من الرز تحت نظام التكثيف للرز(SRI). نفذت التجربة

ISSN 2072-3875

على وفق تصميم القطاعات التام التعشية (RCBD) بترتيب الألواح منشقة المنشقة ((Split Split Plot وبثلاثة مكررات, تمثلت معاملات التجربة نمط الري: الري اليومي, الري بفاصلة كل 3 يوم, الري بفاصلة كل 6 يوم, الري بفاصلة كل 9 يوم, ولخمسة اصناف من الرز: عنبر33, الياسمين, مشخاب2, البركة , دجلة . ونمط الحراثة: تحت نظام التربة المحروثة ونظام التربة الغير محروثة، وخضعت المعاملات وفق الزراعة بمبادئ نظام التكثيف للرز (SRI) وهي: بطريقة الشتال بعمر 15 يوم, الشتال على مسافات وبنمط الشتال المربع 30×30 سم بين شتلة واخرى وبين خط واخر، وبشتلة واحدة في الجورة. بينت نتائج البحث وجود تفوق معنوي لعامل فاصلة الري كل 3 يوم تحت نمط عدم الحراثة في صفات الحاصل ومكوناته (عدد الفروع الفعالة، وزن 1000 حبة، نسبة عدم الخصب، حاصل الحبوب، والحاصل البايولوجي) مقارنة مع فاصلة الري كل 9 يوم التي أعطت أقل متوسط.

الكلمات المفتاحية: الرز, نمط الري, نمط الحراثة, نظام التكثيف للرز (SRI)، الحاصل ومكوناته.

INTRODUCTION

In Iraq the Rice is one of the basic crops and comes after wheat and barley in the cultivated and productive areas, in 2019 rice was planted with a total area of approximately 127,673 hectares and produced approximately 574,705 tons of raw rice, with a productivity rate of 4.5 ton.h^{-1}. (Central Statistical Organization. 2019).The average production unit area is little, compared with the production of Arab countries, the reason for that is come back to the weak of soil fertility. In Iraq usually they are using Successive cultivation which is cultivation the wheat crop after rice, and that led us to stresses the soil. Also use a traditional irrigation method, which is to flood the crop with water at a level of 5-10 cm throughout the period of growth, as this method requires the disposal of large quantities of water, which is difficult to provide for irrigating rice fields at a time of water scarcity in Iraq annually, especially in the summer season, which requires the provision of quantities of water due to high temperatures, and accordingly, the areas planted with the rice crop fluctuate as a result of its dependence on the amount of available water annually.

In addition to its impact on the nature and quantity of production, water resources are the main determinant of agricultural production and expansion, especially in arid and semi-arid areas, and the agricultural sector is the main consumer of water (Al-Badri. 2010). Irrigation is considered the primary factor for raising the productivity of lands in the world. According to the Food and Agriculture Organization of the United Nations (FAO) roughly 20% of the world's croplands are irrigated, but they produce around 40% of the global harvest. In developing countries, irrigation also improves economic returns and can boost production by up to 40%, but due to poor management about one-third of the world's irrigated lands have reduced productivity.(FAO, 2019). In the case of Iraq, about half of Iraq's farmers would directly benefit economically from improvements in the irrigation based on international experience confirming that irrigation development can have a significant positive effect on the situation of financially disadvantaged populations.

Through out the years, tillage systems have changed as new technologies have become available and the costs of fuel and labor increased. With adoption of reduced tillage systems, many producers are realizing the negative effects of tillage as they see the soil and water conservation benefits of leaving the residue on the soil surface. No-till crop production systems leave the most residue and often prove to be the most profitable methods of crop production. With no-till, the improved soil structure and moisture conserving residue cover makes more water available for crop production by improving infiltration and decreasing evaporation from the soil surface.

Rice is the second most cultivated cereal after wheat. It provides 20% of the per capita energy, and 13% of the protein consumed worldwide. Rice cultivation is spread in 114 countries out of 193 countries in the world, and the Asian continent alone produces and consumes rice at a rate of 90% of global rice production (Kumar et al., 2007).

Rice is known as a semi-aquatic, annual grass plant and grows in a wide range of soil and water regimes: irrigated, rain fed lowland, upland, and flood prone. In other words, it is found in a wide range of areas, from deeply flooded to dry flat fields or hilly terraced or no terraced slopes(Rao et al., 2017). The average area planted with rice in the Arab world for the years (2008-2010) amounted to 740 thousand hectares, with an annual production rate of 6.4 million tons, and a productivity of about 8600 kg .h^{-1}. (.(Arab Organization for Agricultural Development. 2011.)

Water rationing is important to control of management of water which is adding to the fields of rice crop, in order for the farmer to be able to increase productivity with the least amount of water, and carry on the quality of the soil, so we should thinking of a new system far away of the traditional system, like system of rice intensification (SRI). It is considered a suitable alternative to solve this problem. The system for rice intensification (SRI) was developed by French Priest Father Henri de Laulani in Madagascar in the 1980"s in an effort to find sustainable agricultural practices which lead to higher productivity, optimum use of capital and labour, less input cost and less requirement of water. System of rice intensification (SRI) is an acronym that is defined as system for rice intensification. The System of Rice Intensification (SRI) is a way of harmonizing the elements of soil, water, light and plant to allow the plant to achieve its fullest potential, which is often hidden when inappropriate techniques are used (Dahiru, 2018). SRI, as opposed to traditional rice production, involves alternate wetting and drying (AWD) of rice fields (Kepha, et al, 2014). Research and demonstration plots in several tropical countries have shown SRI techniques as productive resource-saving and environmentally benign when compared to conventional or traditional rice production (Sato and Uphoff, 2007).

MATERIALS AND METHODS

A field experiment was conducted at the Rice Research Station in Al-Mishkhab, which is affiliated to the Najaf Research Department - Agricultural Research Office, during the summer agricultural season 2019-2020, located between latitude N 31536.17 and E longitude 44306.02, with the aim of studying spatial variation. The hydraulic properties and their effect on rice yield and its components under drying and moisturizing conditions. The site of the experiment was chosen in an area relatively high from the general level of the neighboring fields and the level of ground water, and this land was not cultivated for about five years, and for the purpose of implementing the site design of the experiment, the angle of 90 degrees was calculated to adjust the measurements, the dimensions and the degree of deviation of the experimental units, according to the Pythagorean Triangle. Divided the field into three replicates, and each repeater was divided into plates with dimensions of 1.5 x 3 m with an interval of 0.5 m between them, and between the repeaters and their perimeter were separated by secondary stems, 2 m wide. The trial was performed as split split plot based on a randomized complete blocks design (RCBD) having three replications.

The experiment parameters of irrigation pattern were: daily irrigation, intervals irrigation (3 days, 6 days, and 9 days intervals), with five rice varieties: Anbar 33, Jasmine, Meshkhab 2, Baraka and Dijla . Whereas tillage soil patterns were: tillage soil and non-tillage soil using System of Rice Intensification (SRI) principles.

Random samples were taken from the surface layer 0-30 cm before planting and before harvesting and after harvesting, it was dried naturally, then milled and passed through a manual sieve with a diameter of 0.2

cm aperture, the soil analysis are: PH(7.1), EC (3.8 ms.cm^{-1}), and the soil texture (Silty clay loam to clay loam).

The rice varieties seedlings were prepared by using plastic plates perforated from the bottom of dimensions 3 ×28 × 58 cm. The method of seedlings planting in a square pattern of 30 x × 30 cm spaces between one seedling each other, used one seedling per hill with 15 days old. Dap fertilizer (N,P,K) was added before the transplanting process mixed with soil. The amount of urea fertilizer (280 kg.ha^{-1}) was added in two batches, the first: half batch at 12 days after seedlings, and the second half batch a month after the first addition, also (100 kg. ha^{-1})p(calcium superphosphate 20% P) and (400 kg.ha^{-1})K (potassium sulfate 41.5% K). (Al-Hasanie, and Al-Maadhedi. 2017).

The experiment was subjected to following irrigation patterns :

1. Irrigation daily: as the experimental units subjected to irrigation were watered daily and the quantities of water were calculated from after the seedlings to Harvesting, since only the readings were recorded for the water actually entering the experimental units.
2. Irrigation intervals 3 days: This irrigation schedule was implemented 14 days after seedlings, that is, after fertilization with the first batch of urea fertilizer intended for the experimental units subject to the irrigation schedule. The method of irrigation was by entering the water into the experimental units with a layer of about 5 cm above the surface of the soil, leaving the field for three days, then being irrigated, and so on, and the quantities of water were recorded according to this schedule.
3. Irrigation intervals 6 days: This schedule was implemented for irrigation after 14 days of seedlings, that is, after fertilization with the first batch of urea fertilizer intended for the experimental units, and the method of irrigation was by entering the water into the experimental units with a layer of about 5 cm above the surface of the soil and leaving the field for six days Then it is quenched and so on, and the quantities of water are recorded according to this schedule.
4. Irrigation intervals 9 days: This schedule was implemented for irrigation after 14 days of seedlings, that is, after fertilization with the first batch of urea fertilizer intended for the experimental units, and the method of irrigation was by entering the water into the experimental units with a layer of about 5 cm above the surface of the soil and leaving the field for nine days,

At maturity stage, the number of active branches per m^2 was harvested to calculated the results, including the number of active branches and with three replications, 1000 grain weight on the basis of 14% humidity, seeds sterile percent, and grain yield.

RESULTS AND DISCUSSION

1- Number of effective tillers . m^{-2}

The table 1 show the effect of the tillage system, irrigation scheduling, and varieties and the interaction between them on the number of effective tillers . m^{-2}. The results were no significant differences in the effect of the tillage system in the average number of effective tillers. The treatment T2 gave the highest number reached to 245.8 tillers/ m^2, while treatment T1 gave the lowest reached to 211.6 tillers/ m^2 . In the same table, there was a significant effect of irrigation scheduling on the average number of effective tillers, as treatment (P2) gave the highest number reached to 360.6 tillers. m^{-2} , while the treatment P4 gave the lowest reached to 45.3 tillers. m^{-2}. The reason may referred to the decrease in the growth of the stalk nodes below the soil surface and the intensity of competition between the old and newly formed tillers over the nutrients prepared by the main irrigation below the soil surface under conditions of water stress. The materials are insufficient to meet the requirements of these tillers to survive and continue to grow, which leads to the death of a large part of them, their number decreases, and their ineffectiveness for active tillers due to they do not get the adequate amount of nutrients, and this result is agreed with (Serheed and Ahmed, 2019). The results in Table 1show that the varieties had a significant effect on the average number of active tillers, as V2 gave the highest average number of active tillers reached to 290.7.m^{-2}, which was significantly higher to the rest of the varieties, while variety V4 gave the lowest average for the number of active tillers 189.4 Per m^{2}. The reason for this discrepancy between the varieties under study in this character is due to the difference in its tillers capacity as well as their variation in terms of the number of tillers that arise and have the ability to carry panicles. Irregular seeding and exposure to harsh environmental conditions, which in turn reduces the number of tillers to the smallest number as possible, and this is one of the determinants of productivity. This study is agree with (Haque and Pervin, 2015) whom indicated the existence of significant differences in the number of active tillers/ m^{-2} for different rice varieties. The same show there is a significant effect of the interaction between the tillage and irrigation pattern, as the two interference coefficients for the T1 and T2 tillage system and the irrigation with 9 day interval P4 gave the lowest average for the number of active tillers, reached to 41.0 and 49.7 Per m^{2}. The reason for this decrease in the number of effective tillers can be attributed to the long period of water stress and the nature of the traditional deep tillage, which led to a decrease in the number of shoots grew on the stem nodes, which caused a decrease in the number of effective tillers.

The data of the same table also showed that there are significant differences due to the interaction between the type of tillage system and the varieties in the number of active tillers, the interaction treatment T2 × V2 recorded the highest number of tillers reached to 308.8 . m^{-2}, while the interaction treatment T1× V4 recorded the lowest number 170.5. m^{-2}. The results in the same table indicated that the interaction between irrigation scheduling and varieties had a significant effect on the number of effective tillers, as the interaction treatment P2 × V2 recorded the highest value of the average number of tillers reached to 487.0 . m^{-2}, while the interaction were recorded for all varieties with irrigation at a 9-day interval, the lowest number of effective tillers, which did not differ significantly between them.

Table1 show that there is a significant effect of triple interaction between the tillage system, irrigation scheduling, and varieties on the average number of effective tillers/ m^{-2} as the triple interaction treatment, T2 × P2 × V2, gave the highest average number of effective tillers reached to 517.0, while it gave the three-interference coefficients between the two systems of cultivation and irrigation with a 9-day interval, and all varieties has the lowest average number of effective tillers.

Table 1: The effect of the tillage system, irrigation scheduling, and varieties and the interaction between them on the number of effective tillers. m^{-2}.

TPV		V1	V2	V3	V4	V5
T1	P1	241.0	434.3	396.3	293.0	228.3
	P2	299.7	457.0	309.0	239.0	360.0
	P3	142.0	150.0	242.0	113.0	121.3
	P4	50.7	49.0	34.0	37.0	34.3
T2	P1	291.7	489.7	424.0	359.3	279.0
	P2	353.0	517.0	366.7	293.0	412.0
	P3	183.0	169.3	257.3	131.0	142.0
	P4	59.7	59.0	56.0	49.7	24.0
L.S.D		71.78*				

TP	P1	P2	P3	P4
T1	318.6	332.9	153.7	41.0
T2	368.7	388.3	176.5	49.7
L.S.D	60.67*			

Score OF L.S.D 5%	
*	Significant
n.s	non significant

TV	V1	V2	V3	V4	V5	T
T1	183.3	272.6	245.3	170.5	186.0	211.6

ISSN 2072-3875

T2	221.8	308.8	276.0	208.3	214.3	245.8
L.S.D	60.66*					79.44 n.s
PV	V1	V2	V3	V4	V5	P
P1	266.3	462.0	410.2	326.2	253.7	343.7
P2	326.3	487.0	337.8	266.0	386.0	360.6
P3	162.5	159.7	249.7	122.0	131.7	165.1
P4	55.2	54.0	45.0	43.3	29.2	45.3
L.S.D	42.97*					26.94*
V	V1	V2	V3	V4	V5	L.S.D
	202.6	290.7	260.7	189.4	200.1	19.64*

V1: Anbar 33	**V2:** Jasmine	**V3:** Mishkhab 2	**V4:** Baraka	**V5:** Dijla
P1: Irrigation daily	**P2:** intervals 3 days	**P3:** intervals 6 days	**P4:** intervals 9 days	
T1: Tillage soil		**T2:Non-tillage soil**		

1000 grains weight (gm) -2

From the table 2 effect of tillage pattern (T) and irrigation pattern (P) and varieties (V) and the interaction between them on average 1000 grains weight (gm), results refered to the difference significant of the tillage pattern on the average of 1000 grains weight. The treatment (T2) gave the highest average of 1000 grains weight reached to 21.05 g compare with treatment (T1). The reason for this difference is due to the high rate of seeds fertility with the tillage soil, which increased the single ration for each grain of material. The prepared food for each delicacy, and this result agreed with (Al Jubouri and al Jubouri, 2015).

The results in Table 2 indicated that a significant effect on the average 1000 grains weight due to the difference in irrigation scheduling, the irrigation intervals with 3 day (P2) gave the highest average of 1000 grains weight reached to 25.40 g, compare with the treatment (P4) which gave as a lower weight was 12.70 g. The reason for this difference may be that the P2 irrigation intervals caused soil aerobic conditions that led to the formation of active, abundant and healthy roots, which helped increase the absorption of nutrients from the soil to the panicles at the stage of emergence and maturity. These results are consistent with the findings of (Hameed et al., 2013).

The result in table 2 showed that there was a significant effect of varieties on the average 1000 grains weight, variety V3 gave the highest weight of 1000 grains weight reached 22.67 g, while the two varieties V1 and V2, which did not differ significantly between them, scored the lowest 1000 grains weight reached 18.92 and 18.33 g, respectively. due to the difference in these varieties in the period of filling the grain and the efficiency of the transfer of photosynthetic products, this result is consistent with his findings. (Haque and Pervin, 2015).

The results of Table 2 showed a significant effect of the interaction between the tillage and the irrigation pattern, the two-interference treatment T2 × P2 gave the highest average of 1000 grains weight reached to 26.33 g, while the interaction treatment T1 × P4 gave the lowest weight of 11.80 g. The interaction between the tillage pattern and varieties showed a significant differences between them in the average 1000 grains weight, the interaction treatment T2 × V3 gave the highest average 1000 grains weight reached to 23.33 g, while the treatment T1 × V2 recorded the lowest weight of 17.33 g. The results of table 2 showed a significant effect between irrigation scheduling and varieties on average 1000 grains weight, the interaction treatment P2 × V4 gave the highest weight of 28.83 g, and did not differ significantly from the two interaction factors P1 × V4 and P2 × V3, while the treatment of double interaction P4 × V4 was given the lowest weight was 7.67 g.

The results of the same table showed a significant effect of triple interaction between the tillage and irrigation patterns, and the varieties in 1000 grain weight, the treatment T2 × P2 × V4 gave the highest rate of 1000-grain weight, while the two interaction factors, T1 × P4 × V4 and T2 × P4 × V4 . The same variety had the lowest average weight of 6.67 and 8.67 g, respectively.

Table 2: Effect of tillage pattern (T) and irrigation pattern (P) and varieties (V) and the interaction between them on average 1000 grains weight (gm)

TPV		V1	V2	V3	V4	V5
T1	P1	22.00	19.33	24.67	26.67	23.67
	P2	21.67	21.67	27.00	28.00	24.00
	P3	15.67	18.33	20.33	19.00	15.33
	P4	13.00	10.00	16.00	6.67	13.33
T2	P1	23.33	21.67	25.67	28.67	24.67
	P2	23.00	23.67	28.67	29.67	26.67
	P3	17.67	20.33	21.67	20.67	17.00
	P4	15.00	11.67	17.33	8.67	15.33
L.S.D		2.333*				
TP	P1	P2	P3	P4	Score OF L.S.D 5%	
T1	23.27	24.47	17.73	11.80	*	Significant
T2	24.80	26.33	19.47	13.60		

ISSN 2072-3875

					n.s	non significant
L.S.D	1.357*					
TV	V1	V2	V3	V4	V5	T
T1	18.08	17.33	22.00	20.08	19.08	19.32
T2	19.75	19.33	23.33	21.92	20.92	21.05
L.S.D	1.179*					1.244*
PV	V1	V2	V3	V4	V5	P
P1	22.67	20.50	25.17	27.67	24.17	24.03
P2	22.33	22.67	27.83	28.83	25.33	25.40
P3	16.67	19.33	21.00	19.83	16.17	18.60
P4	14.00	10.83	16.67	7.67	14.33	12.70
L.S.D	1.665*					0.996*
V	V1	V2	V3	V4	V5	L.S.D
	18.92	18.33	22.67	21.00	20.00	0.779*

V1: Anbar 33	**V2:** Jasmine	**V3:** Mishkhab 2	**V4:** Baraka	**V5:** Dijla
P1: Irrigation daily	**P2:** intervals 3 days	**P3:** intervals 6 days	**P4:** intervals 9 days	
T1: Tillage soil		**T2:Non-tillage soil**		

Sterility percentage (%) -3

The results in table 3 refer that there is no significant effect of the tillage and irrigation pattern on sterility percentage, treatment (P1) gave the lowest weight reached to 14.31% , while irrigation treatment (P4) gave the highest percent reached to 50.35%. The reason may be that the lack of water and the length of the watery stress period have negatively affected the pollination and fertilization process and thus led to a clear increased in the number of unfilled seeds, which led to an increase in the sterility percentage. These results mentioned by (Azarpour et al., 2011).

The results of the same table also showed a significant differences between the varieties, the two varieties V3 and V5 gave the lowest percent of 17.25% and 20.16%, which were significantly higher to the rest of the treatments, and this could be attributed to the genetic nature of the variety and the variation of the varieties in the time period. These results are consistent with founded of (Al Isawi, 2004) and (Al Mashhadani, 2010).

Table 3 showed there was a significant effected of interaction of the tillage and irrigation pattern in the sterility percentage, the interaction treatment T2 × P2 gave the lowest percent of 13.84%, while the two interaction between the tillage pattern T1 and T2 and the irrigation were found at an interval of 9 days, the highest percent of 50.51 % and 50.19%, respectively.

The results of table 3, showed a significant effect of the interaction of the tillage and the irrigation pattern in the sterility percentage, the interaction treatment T2 × P2 gave the lowest percent of 13.84%, while the two interaction between the tillage

system T1 and T2 and the irrigation were recorded at 9 days interval, the highest percent reached to 50.51 % and 50.19%, respectively.

From the same table, it is noticed that there are significant differences between the tillage pattern and the varieties in this characteristic, the treatment T1 × V3 gave the lowest percent of 16.59%, while the two interaction gave the tillage pattern with two types T1 and T2 and type V4 the highest percent in the sterility percentage, which amounted to 40.73% and 37.67% respectively.

The results of Table 3 confirmed that there was a significant effect of the interaction of the irrigation pattern and the varieties in the sterility percentage, the treatment of the interaction P2 × V3 gave the lowest percent of 8.79%, while the interaction between varieties and irrigation with a P4 interval recorded the highest percent, the reason for that differences due to the variation in varieties being affected by the water deficiency stage and its effect on physiological processes, then its effect on the absorption of elements from soil, which negatively affects the pollination process and the filling of the grains.

Table 3 showed a significant effect of triple interaction for the tillage, irrigation pattern, and varieties in the sterility percentage , the treatment T1 × P2 × V3 gave the lowest percentage of sterility reached to 7.98%, while the triple interaction treatment, T1 × P4 × V4, recorded the highest percentage reached 79.14%.

Table 3: Effect of tillage pattern (T), Irrigation pattern (P), varieties (V), and the interaction between them on the average the sterility percentage (%)

TPV		V1	V2	V3	V4	V5
T1	P1	11.05	10.60	10.97	25.33	13.38
	P2	16.26	27.59	7.98	21.90	10.33
	P3	29.29	23.68	22.97	36.57	23.46
	P4	67.07	47.98	24.42	79.14	33.96
T2	P1	12.97	9.33	8.71	25.49	15.24
	P2	14.48	17.64	9.61	19.29	8.20
	P3	37.17	26.26	21.49	32.11	23.76
	P4	59.39	52.96	31.83	73.81	32.98
L.S.D		11.034*				

TP	P1	P2	P3	P4	Score OF L.S.D 5%	
T1	14.27	16.81	27.20	50.51	*	Significant
T2	14.35	13.84	28.16	50.19	n.s	non significant
L.S.D	6.929*					
TV	V1	V2	V3	V4	V5	T
T1	30.92	27.46	16.59	40.73	20.28	27.20
T2	31.00	26.55	17.91	37.67	20.05	26.64
L.S.D	6.950*					8.881 n.s
PV	V1	V2	V3	V4	V5	P
P1	12.01	9.96	9.84	25.41	14.31	14.31
P2	15.37	22.62	8.79	20.59	9.27	15.33
P3	33.23	24.97	22.23	34.34	23.61	27.68
P4	63.23	50.47	28.12	76.47	33.47	50.35
L.S.D	7.369*					3.665*
V	V1	V2	V3	V4	V5	L.S.D
	30.96	27.01	17.25	39.20	20.16	3.679*

V1: Anbar 33	**V2:** Jasmine	**V3:** Mishkhab 2	**V4:** Baraka	**V5:** Dijla
P1: Irrigation daily	**P2:** intervals 3 days	**P3:** intervals 6 days	**P4:** intervals 9 days	
T1: Tillage soil		**T2:Non-tillage soil**		

Grain yield weight (ton.h^{-1}) -4

The statistical analysis of the data in table 4 showed that there was significant differences between the two types of the tillage patterns, the productivity under (T2) of 3.800 ton.h^{-1}, while the tillage pattern (T1) gave the lowest grain yield reached to 3.459 ton.h^{-1}, the reason may attributed to difference in the tillage pattern. These results are consistent with the results of the study of (Jassim, et al. 2017) they refer the superiority of the tillage pattern non- tillage in the characteristic of grain yield.

The results in table 4 indicated that there was significant differences in the effect of irrigation at different intervals in average grain yield weight, the treatment (P2) gave the highest weight of grain yield amounting to 5.352 ton.h^{-1}, while the treatment (P4) gave the lowest weight, which amounted to 1.671 ton.h^{-1}. The results above showed can be explained by using irrigation at different intervals and the length of the water stress period has negatively affected the overall vital processes in the plant, which affected the vegetative and flowering stages, thus affected the total grain yield weight. These results are agreed with (Azarpour et al., 2011(.

The same table indicated that there was a significant effected of the varieties on the average grain yield, as variety V5 gave the highest weight reached to 4.442 ton. h^{-1}. The

ISSN 2072-3875

reason for these difference in the biological yield of varieties due to the difference in their high tillers ability and the grain yield, this result was agreed with which was found of (Isa et al., 2015).

The interaction between the pattern of tillage and irrigation showed significant differences between them, the interaction treatment T2 × P2 recorded the highest grain yield weight reached to 5.507 ton.h $^{-1}$, followed by the interaction treatment for the same irrigation interval with the tillage pattern T1, which recorded grain yield weight of 5.196 ton.h^{-1}.

Noticed from table 4, there was a significant effect of the interaction between the tillage pattern and the varieties on the average grain yield weight, the combination T2 × V5 gave the highest values of 4.607 tons. h $^{-1}$, while the interaction treatment T1 × V1 gave the lowest average grain yield reached to 2,48 ton.h^{-1}.

Through the results of the statistical analysis of Table 4, it was found that there was a significant difference between the irrigation pattern and the varieties in the average grain yield weight, the interaction treatment P2 × V5 gave the highest grain yield weight reached to 7.067 ton.h^{-1}, while the irrigation combinations gave an 9 days intervals with all varieties less weight for average grain yield.

The results of the same table also indicated a significant effect of the triple interaction between the type of tillage, irrigation pattern and varieties on the average grain yield weight, the triple interaction treatment, T2 × P2 × V5, gave the highest grain yield reached to 7.287 ton/h^{1}, while the combination gave T1 × P4 × V5, the lowest rate was 1.347 ton.h^{-1}.

Table 4: The effect of tillage system (T), irrigation scheduling (P) and varieties (V), and the interaction between them on average grain yield, ton.h^{-1}

TPV		V1	V2	V3	V4	V5
T1	P1	2.813	4.767	4.920	4.020	5.996
	P2	3.490	6.203	5.517	3.923	6.847
	P3	2.220	2.720	2.980	2.513	2.917
	P4	1.427	1.463	1.733	1.373	1.347
T2	P1	3.220	5.427	5.257	4.199	6.250
	P2	3.647	6.680	5.763	4.160	7.287
	P3	2.537	3.017	3.193	2.810	3.183

	P4	**1.653**	**2.227**	**2.070**	**1.703**	**1.710**
L.S.D		**0.5408***				
TP	**P1**	**P2**	**P3**	**P4**	**Score OF L.S.D 5%**	
T1	**4.503**	**5.196**	**2.670**	**1.469**	*	Significant
T2	**4.871**	**5.507**	**2.948**	**1.873**	n.s	non significant
L.S.D	**0.2589***					
TV	**V1**	**V2**	**V3**	**V4**	**V5**	**T**
T1	**2.487**	**3.788**	**3.787**	**2.957**	**4.277**	**3.459**
T2	**2.764**	**4.337**	**4.071**	**3.218**	**4.607**	**3.800**
L.S.D	**0.2697***					**0.2349 $^{n.s}$**
PV	**V1**	**V2**	**V3**	**V4**	**V5**	**P**
P1	**3.017**	**5.097**	**5.088**	**4.110**	**6.123**	**4.687**
P2	**3.568**	**6.442**	**5.640**	**4.042**	**7.067**	**5.352**
P3	**2.378**	**2.868**	**3.087**	**2.662**	**3.050**	**2.809**
P4	**1.540**	**1.845**	**1.902**	**1.538**	**1.528**	**1.671**
L.S.D	**0.3848***					**0.1905***
V	**V1**	**V2**	**V3**	**V4**	**V5**	**L.S.D**
	2.626	**4.063**	**3.929**	**3.088**	**4.442**	**0.1924***

V1: Anbar 33	**V2:** Jasmine	**V3:** Mishkhab 2	**V4:** Baraka	**V5:** Dijla
P1: Irrigation daily	**P2:** intervals 3 days	**P3:** intervals 6 days	**P4:** intervals 9 days	
T1: Tillage soil		**T2:Non-tillage soil**		

Biological yield (ton.h^{-1}) -5

The results in Table 5 indicated that the treatment T2 gave the highest average biological yield of 9.218 ton.h^{-1} ,while the treatment T1 gave the lowest rate of 8.576 ton/h^{-1}, but no significant difference was. These results are agree with the results of (Kumar et al., 2005), whom indicated that the no-till system is the best in plant intensification led to an increase in the biological yield.

The data mentioned in this table showed that there was a significant effect of the irrigation pattern in average biological yield, through treatment (P2) recorded the highest biological yield of 12.65 ton.h^{-1}, while the treatment (P4) gave the lowest reached to 4.127 ton.h^{-1}, may attributed to the good conditions for plant growth with many nutrients that contributed to increasing the biomass weight above the soil surface by increased the yield of grains and tillers.

The results in table 5 showed a significant effect of varieties on the average biological yield, the variety V5 with the highest biological yield of 9.380 ton.h^{-1}, while the

ISSN 2072-3875

variety V3 gave the lowest biological yield of 8.643 ton.h^{-1}. These data are agree with the data of (Isa, 2015). The reason is due to the different in the varieties in the biological yield due to the difference in their high tillers capacity and to the grain yield.

Noticed from table 5 that there is a significant effect in interaction between the tillage and irrigation intervals on the average biological yield, as the two parameters T2 × P2 gave the highest biological yield rate of 5.269 and 13.005 ton.h^{-1}respectively, while the parameter P4×T1 gave the low rate 4.130 ton.h^{-1}

As for interaction between the tillage pattern and the varieties, the results indicated in the same table showed the significant effect of the interaction between them on the average biological yield, the treatment T2 × V5 gave the highest weight 9.700 ton.h^{-1}, while the treatment T1 × V3 gave the lowest weight was 8.007 ton.h^{-1}.

Table 5 showed the significant effect of the interaction between irrigation pattern and varieties on the average biological yield, the interaction treatment P2 × V5 gave the highest weight of 13.635 tons. h^{-1}, while the treatment P4 × V1 gave the lowest average biological yield of 3.733 ton.h^{-1}.

The results of table 5 showed a significant effect of triple interaction of the tillage, irrigation pattern and varieties on the average biological yield, the triple interaction treatment, T2 × P2 × V5, gave the highest biological yield weight of 14.023 ton.h^{-1}, while the interaction treatment, T1 × P4 × V1, gave the lowest biological yield weight of 3.580 ton.h^{-1}.

Table 5: The effect of tillage pattern (T), irrigation pattern (P) and varieties (V), and the interaction between its on average biological yield ton.h^{-1}

TPV		V1	V2	V3	V4	V5
T1	**P1**	**10.927**	**10.770**	**10.623**	**12.217**	**11.930**
	P2	**12.357**	**12.533**	**11.607**	**11.810**	**13.247**
	P3	**7.117**	**6.137**	**6.243**	**6.120**	**7.240**
	P4	**3.580**	**4.153**	**3.833**	**5.257**	**3.827**
T2	**P1**	**11.890**	**11.640**	**11.197**	**10.846**	**12.533**
	P2	**12.883**	**13.340**	**12.100**	**12.677**	**14.023**
	P3	**7.880**	**6.740**	**6.757**	**6.767**	**7.817**

	P4	3.887	4.517	6.783	6.013	4.427
LSD		1.4266*				
TP	P1	P2	P3	P4	Score of L.S.D %5	
T1	11.293	12.311	6.571	4.130	*	Significant
T2	11.549	13.005	7.192	5.125	n.s	non significant
LSD	0.7224*					
TV	V1	V2	V3	V4	V5	T
T1	8.495	8.398	8.077	8.851	9.061	8.576
T2	9.135	9.059	9.209	8.986	9.700	9.218
LSD	0.6887*					0.5615*
PV	V1	V2	V3	V4	V5	P
P1	11.409	11.205	10.910	11.351	12.232	11.41
P2	12.620	12.937	11.853	12.244	13.635	12.65
P3	7.498	6.438	6.500	6.433	7.528	7.528
P4	3.733	4.335	5.308	5.635	4.127	4.127
LSD	1.0246*					0.5524*
V	V1	V2	V3	V4	V5	LSD
	8.815	8.729	8.643	8.918	9.380	0.4993*

V1: Anbar 33	**V2:** Jasmine	**V3:** Mishkhab 2	**V4:** Baraka	**V5:** Dijla
P1: Irrigation daily	**P2:** intervals 3 days	**P3:** intervals 6 days	**P4:** intervals 9 days	
T1: Tillage soil		**T2:Non-tillage soil**		

REFERENCES

Al Badri, B. H. 2010. The impact of scarcity of water resources on irrigated agriculture in Iraq. Journal of Management and Economics, (80): 1-18. .1

Al Hasanie, L.N. and A. D. Al-Maadhedi. 2017. influence of irrigation periods and organic fertilizer on tow rice varieties grown under the system of rice intensification (SRI). the Iraqi journal of agricultural sciences, 48 (3) : 823 -840. .2

Al Isawi, S.F.H. 2004. Estimating some genetic information and analyzing pathway parameters in rice. PhD thesis. faculty of Agriculture. Baghdad University. .3

Al Jubouri, J. M. A. and A.Q. A. R. al Jubouri. 2015. Evaluating some genotypes of sorghum (Sorghum .4

bicolor L.) as genetic sources suitable for different cultivation systems. Tikrit University Journal of Agricultural Sciences, Volume (15) Issue (1): 1-80

5. **Al Mashhadani**, A. Sh. 2010. The effect of seedling age and seedling distances on growth and yield of some rice varieties. PhD thesis. faculty of Agriculture. Baghdad University.

6. **Arab Organization for Agricultural Development**. 2011. The Arab Agricultural Statistics Yearbook for the period 2008-2010.

7. **Azarpour**, E., F. Tarighi, M. moradi, and H. R. Bazargi. 2011. Effect of different nitrogen fertilizer rates under irrigation management in rice Farming warld Applied sciences Jaumal 13(5):1248-1252.

8. **Central Statistical Organization**. 2019. Annual Statistical Abstract 2012-2013, Central Statistical Organization, Ministry of Planning, Baghdad.

9. **Dahiru**,T.M. 2018. System of Rice Intensification: A Review. International Journal of Innovative Agriculture & Biology Research 6(2):27-38.

10. **Food and Agriculture Organization**. 2019. Year Book. Production , Vol.52.

11. **Haddadin**, M. 2014. Switching to zero agriculture in the cultivation of field crops. National Center for Agricultural Research and Extension.

12. **Hameed**, K. A., F. A. Jaber, A. J. Mosa. 2013. Irrigation water use efficiency for rice production in Southern Iraq under System of Rice Intensification (SRI) management. Taiwan Water Conservancy Journal, 61(4): 86-93.

13. **Haque**, M. M., and E. Pervin . 2015. Interaction Effect of Different Doses of Guti Urea HilΓ [1] on Yield and Yield Contributing Characters of Rice Varieties (*Oryza Sativa* L.). International Journal of Agriculture, Forestry and Fisheries, 3(2): 37-43.

14. **Isa**, M. D., Sh. Ch. Ghosh, A. AL-Asif, S. M. Ahsan, S. Akram, S. Shahriyar, and A. Ali. 2015. Performances of short growing photoinsensitive rice varieties to evade cyclonie hazard in the coastal region during aman season. Asian J. Med. Biol. Res. 1(2), 304-315.

15. **Jassim**, A.R.A.L., A. A. Ghali and K. H. Jassim. 2017. Comparison of the cultivation of wheat under non-tillage with the system of tillage with the dump plow. Iraqi Agricultural Research Journal, 22 (7): 214-222.

16. **Kepha**, G. O., Bancy, M. M. and Patrick, G. H. 2014. Determination of the effect of the system of rice intensification (SRI) on rice Yields and water saving in Mivea irrigation scheme, Kenya. Journal of Water Resource and protection, 6, 895-901.

17. **Kumar**, R. M., K. Surekha, Ch. Padmavathi, L.V. Subba Rao, V.R. Babu, S.P. Singh, S.V. Subbaiah, P. Muthuraman, and R. C. Viraktamath. 2007. Technical bulletin on System of Rice Intensification – Water 127 saving and productivity enhancing strategy in irrigated rice, Directorate of Rice Research, Indian Council of Agricultural Research, Rajendranagar, Hyderabad, India.

18. **Kumar**, U., U. S. Gautam, S. S. Singh, N. Subhash, K. Singh, and R. Kumar. 2005. Zero Tillage Technology in Wheat Cultivation, Directorate of Extension Education CCS Haryana Agricultural University Hisar-124 004 (Haryana), India, pp: 239 - 246.

19. **Rao,** A.N., S.P. Wani, M.S. Ramesha, and J.K. Ladha. 2017. Rice Production Systems. International Crop Research Institute for the Semi-Arid Tropics (ICRISAT):185-205

20. **Sato**, S. and N. Uphoff. 2007. A review of on-farm evaluation of system of rice intensification (SRI) methods in eastern Indonesia. CAB Reviews:

ISSN 2072-3875

Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, 2:54. Commonwealth Agricultural Bureau International, Wallingford, UK.

21. **Serheed**, A.F., H.B. Ahmed. 2019. Estimation of the Genetic Parameters of the Growth Characteristics in Rice crop (*Oryza sativa* L.) by Effect of Two Methods Irrigation. Journal of University of Babylon for Pure and Applied Sciences, 27 (2): 86-94.