Effect of bio-fertilizers, organic fertilizer and irrigation periods on the traits of vegetative growth for rice plant (Oryza sativa L.) Anbar 33 cultivar

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ABSTRACT

This study was conducted in the Abu Al-Jasim region located in northern of Babylon province, in order to know the effect of bio-fertilizers, organic fertilizer and irrigation periods on the traits of vegetative growth for rice plant. The spilt-spilt plots were used according to the Randomized Complete Block Design (RCBD), with three replicates, where the treatments of irrigation periods (continuous irrigation, irrigation every 6 days) occupied the main plots, while the organic fertilizer (300: 150: 100 kg.ha^{-1}) NPK of the recommended quantity, 85% sheep manure: 15% poultry waste, 70% sheep manure: 30% poultry waste, 100% sheep manure) occupied sub-plots, while the bio-fertilization treatments (0, 83.33 g.ml^{-1} Mycorrhiza, 1.67 g.ml^{-1} Trichoderma, 10 ml.L^{-1} water EM1) occupied sub-sub-plots. The results showed the following:

Bio-fertilizers were significantly excelled in the traits of vegetative growth for rice plants (plant height, area of flag leaf, the flag leaf content of chlorophyll, length of panicle, number of tillers per m^2). where the plants treated with Mycorrhiza (C1) has excelled by giving it the highest average for the number of tillers per m^2 amounted to (449.24, 437.26 tillers.m^{-2}) for both seasons, respectively, while plants of control treatment (C0) gave the lowest average amounted to (406.70, 408.75 tillers.m^{-2}) for both seasons, respectively. The adding of the organic fertilizer affected in the increasing the traits of vegetative growth for rice plant (plant height, area of flag leaf, the flag leaf content of chlorophyll, length of panicle, number of tillers per m^2), where the plant treated with organic fertilizer (B3) has excelled by giving it the highest average for the number of tillers per m^2 which amounted to (461.52, 449.32 tillers.m^{-2}) for both seasons, respectively, while the plants of the control treatment (B0) gave the lowest average amounted to (413.86, 409.89 tillers.m^{-2}) for both seasons respectively. The irrigation treatment every 6 days was significantly excelled in the traits of (plant height, area of flag leaf, the flag leaf content of chlorophyll, length of panicle, number of tillers per m^2), where the plants of the irrigation treatment every 6 days has excelled by giving them the highest average for the numbers of tillers amounted to (439.66, 410.13 tillers.m^{-2}) for both seasons, respectively, while the plants of continuous irrigation treatment gave the lowest average amounted to (418.14, 407.38 tillers.m^{-2}) for both seasons, respectively. The bi-interaction between irrigation periods and bio-fertilizers affected significantly for some studied traits. The bi-interaction between irrigation periods and organic fertilizers also affected significantly for some studied traits. The bi-interaction between organic fertilizers and bio-fertilizers showed a significant effect on some studied traits. The triple interaction between the study factors gave a significant increase in the traits of the vegetative growth for the rice plant (plant height, area of flag leaf, the flag leaf content of chlorophyll, length of panicle, number of tillers per m^2), respectively.

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تأثير المخصبات الحيوية والسماد العضوي ومدد الري في صفات النمو الخضري لنبات الرز (*Oryza sativa* L.) صنف عنبر33

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المستخلص

نفذت الدراسة في منطقة ابو الجاسم الواقعة شمال محافظة بابل، بهدف معرفة تأثير المخصبات الحيوية و السماد العضوي ومدد الري في صفات النمو الخضري لنبات الرز، طبقت التجربة بتصميم القطاعات الكاملة المعشاة بترتيب الالواح المنشقة المنشقة بثلاثة مكررات ،إذ شغلت معاملات مدد الري الألواح الرئيسة (الري المستمر، الري كل 6 أيام) ، في حين شغلت معاملات اضافة السماد العضوي الالواح الثانوية (300:150:100 كغم.ه$^{-1}$ NPK من الكمية الموصى بها، 85% مخلفات اغنام : 15% مخلفات دواجن ، 70% مخلفات اغنام : 30 % مخلفات دواجن ،100% اغنام بمعدل 15طن.ه$^{-1}$) ، بينما احتلت معاملات التسميد الحيوي الألواح تحت الثانوية (0، 83.33غم.م$^{-1}$مايكورايزا،1.67 غم.م$^{-1}$ تريكوديرما، 10مل .لتر$^{-1}$ماء EM1) ، واظهرت النتائج ما يلي : تفوق المخصبات الحيوية معنوياً في صفات النمو الخضري لنبات الرز (ارتفاع النبات ،مساحة ورقة العلم ،محتوى ورقة العلم من الكلوروفيل ،طول الدالية وعدد الاشطاء.م$^{-2}$) اذ تفوقت النباتات المعاملة بالمخصبات الحيوية (C_1) مايكورايزا في اعطاء أعلى متوسط لعدد الاشطاء. م^2 بلغ 449.24 ،437.26 شطئاًه ولكلا الموسمين بالتتابع ،في حين أعطت نباتات المعاملة C_0 أقل متوسط بلغ 406.70 ،408.75 شطأه لكلا الموسمين بالتتابع. اثر اضافة السماد العضوي في زيادة في صفات النمو الخضري لنبات الرز (ارتفاع النبات ،مساحة ورقة العلم ،محتوى ورقة العلم من الكلوروفيل ،طول الدالية وعدد الاشطاء.م$^{-2}$) اذ تفوقت النباتات المعاملة بالسماد العضوي (B_3) في اعطاء اعلى متوسط لعدد الاشطاء .م^2 بلغ461.52 ، 449.32 شطئاً.م^2 ولكلا الموسمين بالتتابع، في حين اعطت نباتات المعاملة المقارنة B_0اقل متوسط بلغ 413.86 ،409.89 شطئاً.م^2 ولكلا الموسمين بالتتابع . تفوقت معاملة الري كل (6 أيام) معنويا في صفات (ارتفاع النبات ،مساحة ورقة العلم ،محتوى ورقة العلم من الكلوروفيل ،طول الدالية وعدد الاشطاء.م$^{-2}$) ،اذ تفوقت نباتات معاملة الري كل(6 أيام) في اعطاء اعلى متوسط لعدد الاشطاء .م^2 بلغ439.66 ، 410.13 شطئاً.م^2 ولكلا الموسمين بالتتابع ، في حين اعطت نباتات معاملة (الري المستمر)اقل متوسط بلغ 418.14،407.38 شطئاً.م^2 ولكلا الموسمين بالتتابع. اثر التداخل الثنائي بين مدد الري والمخصبات الحيوية معنوياً لبعض الصفات المدروسة. كذلك اثر التداخل الثنائي بين مدد الري والسماد العضوي تأثيرا معنويا لبعض الصفات المدروسة .اظهر التداخل الثنائي بين السماد العضوي والمخصبات الحيوية تأثيراً معنويا لبعض الصفات المدروسة .اثر التداخل الثلاثي بين عوامل الدراسة زيادة معنوية في صفات النمو الخضري لنبات الرز (ارتفاع النبات ،مساحة ورقة العلم ،محتوى ورقة العلم من الكلوروفيل ،طول الدالية وعدد الاشطاء.م$^{-2}$) بالتتابع.

البحث مستل من اطروحة دكتوراه للباحث الاول.

1. INTRODUCTION

Rice crop (*Oryza sativa* L.) is considered one of the most important grain crops in Iraq, comes third order in terms of the cultivated area after wheat and barley, despite the instability of the area planted with it and change it according to the abundance of water, but the production of rice in Iraq amounted to (4.788 thousand tons.ha^{-1}) (5). The local cultivar of Anbar 33 is known as the oldest cultivar that has been cultivated in Iraq, it is characterized by its flavor and aromatic smell. It belongs to the submerged rice group with water, Rice farmers in Iraq believe that the cultivation of this cultivar and other cultivars of rice cannot be successful without flooding the fields with water for the duration of the growth, while the global and local studies have shown the possibility of cultivating rice in an Alternative Irrigation method with good productivity in the unit area. Therefore, it is necessary to make accurate scientific work to increase productivity in the unit area through the addition of organic fertilizer in the fertilization of rice in addition to some other treatments, such as bio-fertilizers because of their distinctive and important role in improving the soil physical, chemical and biological traits and increase the efficiency of its preservation with water, Thus providing the plant needs with water and reducing the addition of chemical fertilizers to the soil, thereby reducing environmental pollution (13). Bio-fertilizers are microorganisms (fungal or bacterial) that are living in the soil or when added to the soil, increase the soil's ability to retain water, It works to increase plant growth by increasing nutrient elements availability (23). This study aims to:

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The possibility of changing from flooding irrigation to Alternating irrigation to produce rice crop, determining the best level of organic fertilizer in the growth and yield of rice plant, determining the best bio-fertilizer in the growth and yield of rice plant, Knowing the effect of the interaction of the study factors (bi-interaction and triple interaction) in the growth of the grain yield and its components and some qualitative traits.

2. MATERIALS AND METHODS

A field experiment was conducted during the two agricultural seasons, the first one in 2017 and the second one in 2018 in the field of one farmers in Abu Al-Jasim area which located in the north of Babylon province (Longitude 32.5 and latitude 44.5), In order to know the effect of bio-fertilizers, levels of organic fertilizers and irrigation periods on the traits of vegetative growth for the rice plant. Samples from the experiment soil taken from depth (0-30 cm) were analyzed to identify some of the physical and chemical traits for the soil.

Table 1: Some chemical and physical traits of the field soil and for both seasons (2017, 2018).

pH	Electrical conduction ($ds.m^{-1}$)	Apparent density (%)	Porosity (%)	Organic matter (%)	Volumetric distribution for soil separates			Soil texture
					Clay (%)	Silt (%)	Sand (%)	Clay loam
7.4	3.2	1.7	36	1.3	35.3	34.2	30.5	

The experiment was conducted for two seasons according to the order of split-split-plots using the Randomized Complete Block Design (RCBD), with three replicates. The irrigation treatments (continuous irrigation, irrigation every 6 days) occupied the main plots which are symbolized by (A1, A2), respectively, which applied directly after the seedling. While the levels of the organic fertilizer (15 $tons.ha^{-1}$) (85% sheep manure: 15% poultry waste, 70% sheep manure: 30% poultry waste, 100% sheep manure) occupied sub-plots, which is symbolized by (B0, B1, B2, B3), respectively. The control treatment was (300: 150: 100 $kg.ha^{-1}$) NPK of the recommended quantity, while the bio-fertilization treatments (0, 83.33 $g.ml^{-1}$, 1.67 $g.ml^{-1}$, 10 $ml.L^{-1}$ water) occupied sub-sub-plots, which is symbolized by (C0, C1, C2, C3), respectively. The land was prepared for cultivating through plowing it two perpendicular plowings by the moldboard plow, it was smoothed using the disc combs and were divided according to the design used, with leaving 2 m distance between the replicates, It was left the distance of (1.5 m) between the main units toward the plot to control the movement of water and leaving distance of (1 m) between sub-plots and sub-sub plots, The plants were cultivated on 15/6/2017 for the first season and 20/6/2018 for the second season. After one month from the date of cultivating, the seedlings were transferred to the permanent field for cultivating. The cultivating was done by the seedling method. The plants were harvested on 27/11/2017 For the first season and 22/11/2018 for the second season, the following traits were measured (plant height (cm), area of flag leaf (cm^2), the flag leaf content of chlorophyll (spad), length of panicle (cm), number of tillers per m^2).

3. RESULTS AND DISCUSSION

1- Plant height

Table (2) shows the presence of significant differences between the averages of plant height by the effect of the interaction between the fertilization treatments, where the plants of the C1 treatment has excelled by giving it the highest average of plant height amounted to (121.86, 125.49 cm) for both seasons, respectively, while the plants of the C0 treatment gave the lowest average amounted to (109.05, 110.05 cm). The reason may be due to the superiority of the plants treated with mycorrhiza in increasing the plant height due to the mycorrhiza secretion of stimulating

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materials for growth such as Auxins, gibberellins, cytokines and some enzymes that work to increase cell division and expansion and elongating plant tissue (11). In addition to the role of mycorrhiza as an agent in transporting nutrients from the growth environment to the roots of the plant and facilitates the absorption of nutrients such as nitrogen, phosphorus, and potassium, which contribute to increasing the efficiency of photosynthesis and the biological and physiological activity for the plant, this is reflected positively in increasing the height of the rice plant. These results agree with (23, 28). The organic fertilizer affected significantly on the trait of the plant height, where the plants of the treatment (B3) have excelled by giving it the highest average plant height amounted to (119.07 cm) in the first season. The plants of the B2 treatment has excelled by giving it the highest average plant height amounted to (123.33 cm) in the second season, while the plants of the B0 treatment gave the lowest average plant height amounted to (114.00, 117.62 cm) for both seasons, respectively. The increase in plant height may be attributed to the role of organic fertilizer in increasing soil fertility and improving the physical and chemical traits for the soil, thus increasing the nutrients availability such as nitrogen, phosphorus, potassium, magnesium, and iron and increasing the efficiency of their absorption by the plant, which affects the various physiological and biological processes of the plant that are related to photosynthesis and manufacture nutrients, which reflects positively on the increase in the height of the rice plant. These results agree with (1, 27). The plants of irrigation treatment every (6 days) have excelled by giving it the highest average plant height amounted to (119.84, 126.83 cm) for both seasons, respectively, while the plants of the irrigation treatment with immersion (A1) gave the lowest average plant height amounted to (111.66, 115.53 cm) for both seasons respectively. The reason may be that the irrigation periods every (6 days) allow good ventilation and activity of microorganisms in the soil, which increased the absorption of nutrients in the soil, unlike continuous irrigation, it may lead to loss of nutrients from the growth media with washing water, these results agree with (1, 4). Significant effects were found among plant height averages due to the effect of interaction between organic fertilizers and bio-fertilization, where the plants of the B2 C1 treatment has excelled by giving it the highest average of plant height amounted to (124.20, 128.29 cm) for both seasons, respectively, while the plant of the C0B0 treatment gave the lowest average plant height amounted to (105.58, 103.14 cm) for both seasons, respectively. The reason may be due to the role of organic fertilizer in increasing the organic acids, its role in increasing the activity of the microorganisms (Mycorrhiza) and increasing their effective numbers that help in fixing nitrogen and increasing the amount of phosphorus available for absorption. Nitrogen stimulates the plant to produce Auxins and manufacturing proteins, which encourages the process of cell division and its elongation, which leads to an increase in the height of the rice plant (18, 25). The interaction between the organic fertilizer and the irrigation periods significantly affected the plant height for both seasons, where the plants of the A2B3 treatment has excelled by giving it the highest average of the plant height amounted to (123.07, 129.67 cm), compared to the plants of the A1B0 treatment which gave the lowest average of the plant height amounted to (107.17, 110.36 cm). The reason may be due to the role of organic fertilizer in adding organic matter, including acids, some compounds, and enzymes that increase nutrients and their availability for absorption by plant roots, which improves the efficiency of physiological and biological processes for the plant and its reflection on cell division and its elongation, which leads to an increase in the rice plant. In addition, the organic matter contributed to increasing the percentage of macro and micronutrients, as well as improving the physical and chemical soil properties and increasing their ability to retain moisture, these results agree with (1, 7). The triple interaction significantly affected on the plant height for both seasons, where the plants of the B0A2C1 treatment have excelled by giving them the highest average of the plant

height amounted to (130.27, 131.98 cm) for both seasons, respectively, while the plants of the B0A1C0 treatment gave the lowest average of plant height amounted to (100.13, 98.21 cm), respectively.

Table 2: Effect of Bio-fertilizers, Organic Fertilizers, Irrigation periods and their interactions on the plant height (cm).

Irrigation periods (A)	Organic Fertilizers (B)	The first season 2017					The second season 2018				
		Bio-fertilizers (C)				Average AxB	Bio-fertilizers (C)				Average AxB
		C0	C1	C2	C 3		C0	C1	C2	C 3	
A1	B 0	100.13	109.00	105.33	114.20	107.17	98.21	111.07	115.74	116.41	110.36
	B 1	104.58	117.53	117.89	102.29	110.57	103.90	121.93	121.60	115.04	115.62
	B 2	107.33	123.10	112.90	111.97	113.83	104.43	124.90	124.82	124.01	119.54
	B 3	107.03	119.99	122.63	110.67	115.08	106.74	122.19	117.80	119.65	116.59
A2	B 0	111.02	130.27	128.44	113.57	120.83	108.07	131.98	128.62	130.88	124.89
	B 1	108.13	124.68	120.12	120.25	118.30	114.31	130.38	130.80	127.13	125.65
	B 2	112.40	125.29	114.32	116.73	117.19	116.31	131.69	131.67	128.81	127.12
	B 3	121.78	124.98	123.03	122.47	123.07	128.40	129.79	129.87	130.61	129.67
L.S.D 0.05		(A×B×C)=6.268				4.169	(A×B×C)=3.997				3.111
Irrigation periods × Bio-fertilizers						A	Irrigation periods × Bio-fertilizers				A
Interaction AxC	A1	104.77	117.41	114.69	109.78	111.66	103.32	120.02	119.99	118.78	115.53
	A2	113.33	126.31	121.48	118.26	119.84	116.77	130.96	130.24	129.36	126.83
L.S.D 0.05		N.S				1.147	N.S				2.966
Organic Fertilizers × Bio-fertilizers						B	Organic Fertilizers × Bio-fertilizers				B
Interaction BxC	B 0	105.58	119.64	116.89	113.89	114.00	103.14	121.53	122.18	123.65	117.62
	B 1	106.36	121.10	119.01	111.27	114.43	109.11	126.16	126.20	121.09	120.64
	B 2	109.87	124.20	113.61	114.35	115.51	110.37	128.29	128.25	126.41	123.33
	B 3	114.41	122.49	122.83	116.57	119.07	117.57	125.99	123.84	125.13	123.13
L.S.D 0.05		4.432				3.404	2.826				2.540
Bio-fertilizers (C)		109.05	121.86	118.08	114.02		110.05	125.49	125.12	124.07	
L.S.D 0.05		2.216					1.413				

Area of the flag leaf

Table (3) shows the presence of significant effects for bio-fertilization treatments for the area of the flag leaf, where the plants of the C1 treatment has excelled by giving it the highest average for the area of the flag leaf amounted to (27.23, 28.09 cm^2) for both seasons, respectively, while the plants of the C0 treatment gave the lowest average amounted to (23.15, 22.53 cm^2). The reason may be due to the positive role of bio-fertilizers, especially mycorrhiza, in increasing the surface area for absorption of nutrients, especially the macronutrients, including phosphorus, its speed of transmission, encouraging biosynthesis and increasing the efficiency of absorption, which reflected on the metabolic activities inside the plant and increasing the traits of vegetative growth, such as plant height as shown in table (1). these results agree with (22, 23). The organic fertilizer affected significantly on the trait of the area of the flag leaf, where the plants of the treatment (B3) have excelled by giving them the highest average for the area of the flag leaf amounted to (26.03, 27.38 cm^2) for both seasons, respectively, while the plants of the control treatment gave the lowest average amounted to (23.62, 24.53 cm^2) for both seasons, respectively. The reason may be that

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the addition of organic fertilizer to the soil contributed to supplying the necessary nutrients for plant growth, which in turn plays an important role in the expansion of the flag leaf, by adding some organic acids that improve the properties of the soil and the availability of the nutrients for absorption. It also contributes to the transformation of elements from the complex state into the availability state for absorption by the plant, this affected in increasing the duration of its survival, which gave way to the emergence and expansion of the size of the cells of the flag leaf, which contributed to the large area of the leaf for the rice plant, these results agree with (1, 27). Significant differences were found between the irrigation periods in the area of the flag leaf, where the plants of irrigation treatment every (6 days) have excelled by giving them the highest average for the area of the flag leaf amounted to (119.84, 126.83 cm^2) for both seasons, respectively, which significantly excelled on the daily irrigation treatment, which gave the lowest average amounted to (24.22, 24.87 cm^2) for both seasons, respectively. The reason for increasing the area of the flag leaf during periods of alternating irrigation, but continuous irrigation may lead to the loss of nutrients from the growth media with the washing water, which causes a decrease in the growth rates. Conversely, irrigation every (6 days) leads to a reduction in the loss of nutrients, which contributes to increasing the physiological and bio-processes of the plant, especially during the stage of development and expansion of the flag leaf, which in turn leads to an increase in the area of the flag leaf, this result agrees with (6, 16). Significant differences were found between irrigation periods and bio-fertilizers, where the plants of the C1A2 treatment have excelled by giving them the highest average area of the flag leaf amounted to (29.46 cm^2) in the second season, compared to the plants of the control treatment (C0A1) which gave the lowest average amounted to (22.16 cm^2). The reason of the increase in the area of the flag leaf when alternating irrigation treatments and the plants treated with bio-fertilizers is due to the role of bio-fertilizers in increasing the effectiveness of microorganisms in the circumference of the roots which in turn played a big role in increasing the absorption of nutrients and increasing the susceptibility of the soil to water preservation by the plant and the activity of enzymes, which affected the Increase of cell division, which is reflected in the expansion of the flag leaf and increasing the plant's ability to withstand water stress (15, 23). The interaction treatments between irrigation periods and organic fertilization indicated significant differences, where the plants of the A2B3 treatment excelled by giving them the highest average area of the flag leaf amounted to (27.47 cm^2) in the first season, compared to the plants of the control treatment (A1B0) gave the lowest average amounted to (22.81 cm^2). The reason is due to the addition of the organic matter that plays an important role in increasing the susceptibility of the soil to retaining water and providing nutrients. This is reflected in the availability of irrigation water during the different stages of plant growth as well as the increase of nutrients where they have an important role in the expansion and elongation of cells for all plant members, including flag leaf. This result agrees with (1). Significant triple interactions were found between the studied factors, where the plants of the A2C1B2 treatment have excelled in the second season which gave the highest average area of the flag leaf amounted to (30.37 cm^2), compared to the plants of the A1 C0B0 treatment which gave the lowest average amounted to (20.05 cm^2).

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Table 3: Effect of Bio-fertilizers, Organic Fertilizers, Irrigation periods and their interactions on the area of the flag leaf (cm^2).

Irrigation periods (A)	Organic Fertilizers (B)	The first season 2017					The second season 2018				
		Bio-fertilizers (C)				Average AxB	Bio-fertilizers (C)				Average AxB
		C0	C1	C2	C 3		C0	C1	C2	C 3	
A1	B 0	20.28	25.30	23.57	22.09	22.81	20.05	25.29	23.64	22.78	22.94
	B 1	22.22	26.65	24.82	23.93	24.41	22.84	26.36	25.76	25.78	25.19
	B 2	24.50	27.21	25.15	23.37	25.06	24.41	26.20	25.60	26.68	25.72
	B 3	22.94	27.81	24.03	23.58	24.59	21.34	29.05	25.75	26.43	25.64
A2	B 0	23.40	26.18	25.83	22.32	24.43	21.70	28.73	27.18	26.88	26.12
	B 1	21.82	26.40	22.87	22.51	23.40	21.27	28.69	29.39	26.41	26.44
	B 2	24.07	28.47	26.15	24.10	25.70	22.17	30.37	28.84	27.94	27.33
	B 3	26.01	29.83	27.93	26.10	27.47	26.44	30.03	30.08	29.91	29.12
L.S.D 0.05		(A×B×C)= N.S				1.552	(A×B×C)=2.524				N.S
Irrigation periods × Bio-fertilizers						A	Irrigation periods × Bio-fertilizers				A
Interaction AxC	A1	22.49	26.74	24.39	23.24	24.22	22.16	26.73	25.19	25.42	24.87
	A2	23.82	27.72	25.70	23.76	25.25	22.89	29.46	28.87	27.79	27.25
L.S.D 0.05		N.S				0.985	1.262				0.683
Organic Fertilizers × Bio-fertilizers						B	Organic Fertilizers × Bio-fertilizers				B
Interaction BxC	B 0	21.84	25.74	24.70	22.21	23.62	20.88	27.01	25.41	24.83	24.53
	B 1	22.02	26.53	23.85	23.22	23.91	22.06	27.53	27.57	26.09	25.81
	B 2	24.28	27.84	25.65	23.74	25.38	23.29	28.29	27.22	27.31	26.53
	B 3	24.47	28.82	25.98	24.84	26.03	23.89	29.54	27.92	28.17	27.38
L.S.D 0.05		N.S				1.267	N.S				1.250
Bio-fertilizers (C)		23.15	27.23	25.05	23.50		22.53	28.09	27.03	26.60	
L.S.D 0.05		0.921					0.892				

The flag leaf content of chlorophyll

Table (4) shows the presence of significant effects in the flag leaf content of chlorophyll for the rice plant, where the plants of the C1 treatment have excelled by giving it the highest average for the flag leaf content of chlorophyll amounted to (41.07, 42.50 SPAD) for both seasons, respectively, while the plants of the C0 treatment gave the lowest average amounted to (36.02,35.26 SPAD). The reason may be that the bio-fertilizers led to an increase in the activity of microorganisms in the soil, which in turn contributed to the release of nutrients, including nitrogen, which plays a role in building and synthesizing the chlorophyll pigment, and this result agrees with (21). The organic fertilizer affected significantly on the trait of the flag leaf content of chlorophyll, where the plants of the treatment (B3) have excelled by giving them the highest average for the flag leaf content of chlorophyll amounted to (41.84, 42.11 SPAD) for both seasons, respectively, while the plants of the control treatment gave the lowest average amounted to (36.36, 39.12 SPAD) for both seasons, respectively, where the iron element is the link between the macro and micronutrients, it is considered a catalyst in the formation of chlorophyll, it also enters in the synthesis of important pigments in the photosynthesis process, which may lead to an increase in photosynthesis products and increasing the flag leaf content of chlorophyll. These results agree with (26). Significant differences were found between the irrigation periods in the flag leaf

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content of chlorophyll, where the plants of irrigation treatment every (6 days) have excelled by giving them the highest average for the flag leaf content of chlorophyll amounted to (38.54, 41.17 SPAD) for both seasons, respectively, while the plants of the daily irrigation treatment gave the lowest average amounted to (38.17, 37.95 SPAD) for both seasons, respectively. The reason may be attributed to the fact that irrigation with alternating periods every (6 days) leads to the provision of appropriate amounts of air that in turn stimulate the roots to absorb water and nutrients, especially nitrogen and micronutrients that are not available for absorption under conditions of continuous immersion in addition to the role of immersion in leaching nutrients and draining them with drainage water, which negatively affects growth (18). These results agree with (3). The interaction between irrigation periods and bio-fertilizers has affected significantly, where the plants of the C1A2 treatment have excelled by giving them the highest average for the flag leaf content of chlorophyll amounted to (42.30 SPAD) in the first season, while the plants of the A2C0 treatment gave the lowest average amounted to (35.55 SPAD). The reason is that the secretion of mycorrhiza for growth regulators and some enzymes that are considered to be a source for the reception of the potassium, iron and magnesium elements necessary in the synthesis of the chlorophyll molecule that is important in the carbon building process, which the carbohydrates is its products, which worked to increase the processes of division and elongation of cells and maintain the prevention of the decomposition of proteins and chlorophyll in the leaf, which had a great effect on increasing the content of chlorophyll where the plant was under low stress each (6 days) and the importance of mycorrhiza in increasing growth regulators (8, 21). Significant differences were found between organic fertilization and bio-fertilizers, where the plants of the B3C1 treatment have excelled by giving them the highest average for the flag leaf content of chlorophyll amounted to (43.97, 44.56 SPAD) for both seasons, respectively, while the plants of the B1C0 treatment gave the lowest average amounted to (30.38, 31.75 SPAD) for both seasons, respectively. The reason may be due to the role of organic matter and bio-fertilizers in increasing microorganism in soil and its activity, which have the ability to secrete some enzymes such as Phosphatase and Protease, as well as releasing organic acids from organic fertilizers that lead to a decrease in the soil PH, which affects dissolving minerals and making them more availability in increasing the chlorophyll content for rice plant (9). Significant differences were found between irrigation periods and organic fertilization in the flag leaf content of chlorophyll, where the plants of the A2B3 treatment excelled by giving them the highest average for the flag leaf content of chlorophyll amounted to (42.40 SPAD) in the second season, while the plants of the A1B0 treatment gave the lowest average amounted to (34.34, 35.48 SPAD) for both seasons, respectively. The reason is attributed to the role of the organic matter in increasing the susceptibility of the soil to retaining water, increasing the availability of nutrients for absorption by the plant and improving soil traits, which are factors that encourage plant growth in addition to the role of organic fertilizer in increasing organic and Amino acids which in turn works to increase nitrogen for its entry into the bio-processes in the plant and the composition of many plant materials and compounds and It also enters into the construction of a chlorophyll molecule which leads to an increase in the flag leaf content of chlorophyll (26). Significant differences were found in the flag leaf content of chlorophyll by the effect of interaction between the studied factors, where the plants of the A2C1B2 treatment have excelled in the second season which gave the highest average area of the flag leaf content of chlorophyll amounted to (47.45 SPAD), while the plants of the C0B0A1 treatment gave the lowest average amounted to (29.54 SPAD).

Table 4: Effect of Bio-fertilizers, Organic Fertilizers, Irrigation periods and their interactions on the flag leaf content of chlorophyll (SPAD).

Irrigation periods (A)	Organic Fertilizers (B)	The first season 2017					The second season 2018				
		Bio-fertilizers (C)				Average AxB	Bio-fertilizers (C)				Average AxB
		C0	C1	C2	C 3		C0	C1	C2	C 3	
A1	B 0	30.46	35.56	36.56	34.77	34.34	29.54	37.97	36.27	38.14	35.48
	B 1	33.38	42.79	42.30	39.95	39.61	32.06	40.01	38.58	38.63	37.32
	B 2	37.42	37.06	35.56	35.34	36.35	35.39	41.73	38.27	38.51	38.47
	B 3	44.72	43.90	40.42	40.56	42.40	36.55	43.61	42.31	39.70	40.54
A2	B 0	30.30	43.22	41.48	38.56	38.39	33.97	47.45	43.83	45.81	42.76
	B 1	32.38	40.59	38.65	36.36	36.99	35.09	43.27	41.78	39.15	39.82
	B 2	37.28	41.37	39.42	31.93	37.50	34.29	40.45	40.42	38.47	38.41
	B 3	42.26	44.03	40.21	38.62	41.28	45.23	45.50	41.16	42.84	43.68
L.S.D 0.05		(A×B×C)= N.S				1.334	(A×B×C)=2.584				1.132
Irrigation periods × Bio-fertilizers						A	Irrigation periods × Bio-fertilizers				A
Interaction AxC	A1	36.50	39.83	38.71	37.65	38.17	33.38	40.83	38.86	38.75	37.95
	A2	35.55	42.30	39.94	36.37	38.54	37.14	44.17	41.80	41.57	41.17
L.S.D 0.05		1.627				0.210	N.S				1.179
Organic Fertilizers × Bio-fertilizers						B	Organic Fertilizers × Bio-fertilizers				B
Interaction BxC	B 0	30.38	39.39	39.02	36.67	36.36	31.75	42.71	40.05	41.98	39.12
	B 1	32.88	41.69	40.47	38.15	38.30	33.58	41.64	40.18	38.89	38.57
	B 2	37.35	39.21	37.49	33.64	36.92	34.84	41.09	39.34	38.49	38.44
	B 3	43.49	43.97	40.31	39.59	41.84	40.89	44.56	41.74	41.27	42.11
L.S.D 0.05		2.301				1.089	1.827				0.924
Bio-fertilizers (C)		36.02	41.07	39.32	37.01		35.26	42.50	40.33	40.16	
L.S.D 0.05		1.150					0.914				

The length of panicles (cm)

Table (5) shows the plants of the C1 treatment have excelled by giving it the highest average for the length of panicles amounted to (25.21, 26.49 cm) for both seasons, respectively, while the plants of the C0 treatment gave the lowest average amounted to (21.42, 23.61 cm) for both seasons, respectively. The reason may be due to the symbiosis relationship between the mycorrhiza and the plant in addition to the activity of microorganisms in the soil that work on the secretion of some organizations and enzymes, improving the soil traits, increasing the availability of nutrients and increasing their availability for absorption by the plant. Mycorrhiza has the ability to transfer some of the compounds that contribute to the liberation of the elements and converting them from the complex state to the availability state for absorption, including the nitrogen element that increases its concentration in the soil and it is one of the important elements in the course of bio-processes in the plant where it enters the building of chlorophyll, which leads to an increase in the area of the flag leaf and the flag leaf content of chlorophyll as shown in Table (4,5). This reflected positively on increasing the length of panicles of the rice plant. These results agree with (22, 23). Significant differences were found between the treatments of the organic fertilizer, where the plants of the treatment (B3) have excelled by giving them the highest average for the length of panicles amounted to (23.24, 26.11 cm) for both seasons, respectively, while the plants of the

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control treatment gave the lowest average amounted to (23.14, 24.29 cm) for both seasons, respectively. The reason for the role of organic fertilizer has created a better incentive for the growth and development of panicle as a result of the availability of continuous nutritional supply. On the other hand, the role of nutrients in raising the efficiency of photosynthesis, which encouraged better growth for the panicle, which clearly reflected on the increase in its length. These results agree with (Bhaih et al., 2015). The plants of irrigation treatment every (6 days) have excelled by giving them the highest average for the length of panicles amounted to (24.61, 26.27 cm) for both seasons, respectively, while the plants of the daily irrigation treatment gave the lowest average amounted to (22.25, 24.31 cm) for both seasons, respectively. The reason may be attributed to increasing the susceptibility of the soil to water retention in alternating irrigation treatments due to increasing the activity of micro-organisms and allowing them to ventilate and secrete many compounds that improve physiological processes. In addition, continuous irrigation causes leaching of mineral elements and draining them through drainage water, This result agrees with (3). As for the effect of the interaction between irrigation periods and bio-fertilizers, where the plants of the C1A2 treatment have excelled by giving them the highest average for the length of panicles amounted to (27.19 cm) in the first season, while the plants of the A1C0 treatment gave the lowest average amounted to (20.88 cm). The reason may be due to the role of the bio-fertilizers in increasing the activity of microorganisms and improving the ventilation of the soil. Mycorrhiza also has the ability to produce phytohormones, such as cytokines, and these compounds have an important role in increasing nutrients, absorbing water by the roots, and transporting mineral ions that are driven by the transpiration process and this reflected positively on increasing the length of panicles for the rice plant (10, 16). Significant differences were found between organic fertilization and bio-fertilizers, where the plants of the B1C1 treatment have excelled by giving them the highest average for the length of panicle amounted to (26.85 cm) in the first seasons, the plants of the B2C1 treatment has excelled by giving them the highest average for the length of panicle amounted to (27.11 cm) in the second season, while the plants of the B0C0 treatment gave the lowest average amounted to (20.81, 22.05 cm) for both seasons, respectively. It may be attributed to the role of bio-fertilizers in increasing the activity of microorganism and the availability of nutrients that coincided with the emergence and development of panicles from the formation stage of the branch to the booting stage, which created a better incentive for the growth and development of the panicles that contributed to raising the efficiency of photosynthesis in addition to the role of nutrients in the Organic fertilizer in increasing the length of panicles (19, 25). As for the effect of interaction between irrigation periods and organic fertilization, where the plants of the A2B3 treatment excelled by giving them the highest average for the length of panicle amounted to (27.80 cm) in the second season, while the plants of the A1B0 treatment gave the lowest average amounted to (23.94 cm). The reason may be due to the role of organic fertilizer in increasing the activity of microorganisms in the soil, thus increasing the susceptibility of the soil to retaining water and providing appropriate moisture for plant growth. In general, it is noted that the sheep manures have led to improving the vegetative traits for the plant, including the area of the flag leaf and the flag leaf content of chlorophyll as shown in Tables (3, 4) compared to other fertilizers in addition to its high content of nutrients, especially nitrogen, which led to encouraging growth and increasing the size of the cells, thus increase the length of the panicle (12). The triple interaction had a significant effect among the study factors (irrigation periods, organic fertilizers, and bio-fertilization, where the plants of the A2C1B1 treatment have excelled in the first season which gave the highest average for the length of the panicle amounted to (27.84 cm), As for the second season, the plants of the C1B2A2 treatment

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have excelled by giving them the highest average amounted to (28.62 cm), while the plants of the C0B0A1 treatment gave the lowest average amounted to (20.38, 21.91 cm) for both seasons, respectively.

Table 5: Effect of Bio-fertilizers, Organic Fertilizers, Irrigation periods and their interactions on the length of the panicle (cm).

Irrigation periods (A)	Organic Fertilizers (B)	The first season 2017					The second season 2018				
		Bio-fertilizers (C)				Average AxB	Bio-fertilizers (C)				Average AxB
		C0	C1	C2	C 3		C0	C1	C2	C 3	
A1	B 0	20.38	22.13	23.16	21.78	21.87	21.91	24.94	24.64	24.28	23.94
	B 1	21.18	25.87	24.35	22.26	23.41	23.36	25.53	24.98	24.57	24.61
	B 2	21.46	22.82	21.47	22.89	22.16	22.52	25.60	24.87	24.13	24.28
	B 3	20.49	22.11	22.14	21.47	21.55	22.80	24.94	24.97	24.92	24.41
A2	B 0	21.23	28.16	25.84	22.40	24.41	22.19	27.14	24.85	24.37	24.64
	B 1	21.46	27.84	25.73	24.61	24.91	23.29	27.74	25.86	26.60	25.87
	B 2	21.81	26.44	25.21	23.33	24.20	24.63	28.62	27.00	26.86	26.78
	B 3	23.31	26.32	25.51	24.59	24.93	28.18	27.43	27.84	27.76	27.80
L.S.D 0.05		(A×B×C)=1.390				N.S	(A×B×C)=1.494				0.816
Irrigation periods × Bio-fertilizers						A	Irrigation periods × Bio-fertilizers				A
Interaction AxC	A1	20.88	23.23	22.78	22.10	22.25	22.65	25.25	24.87	24.48	24.31
	A2	21.95	27.19	25.57	23.73	24.61	24.57	27.74	26.39	26.40	26.27
L.S.D 0.05		0.695				1.684	N.S				1.510
Organic Fertilizers × Bio-fertilizers						B	Organic Fertilizers × Bio-fertilizers				B
Interaction BxC	B 0	20.81	25.15	24.50	22.09	23.14	22.05	26.04	24.75	24.33	24.29
	B 1	21.32	26.85	25.04	23.43	24.16	23.33	26.64	25.42	25.59	25.24
	B 2	21.64	24.63	23.34	23.11	23.18	23.57	27.11	25.94	25.50	25.53
	B 3	21.90	24.22	23.82	23.03	23.24	25.49	26.19	26.41	26.34	26.11
L.S.D 0.05		0.983				0.798	1.057				0.667
Bio-fertilizers (C)		21.42	25.21	24.18	22.91		23.61	26.49	25.63	25.44	
L.S.D 0.05		0.491					0.528				

The number of tillers per m^2 (tillers.m^{-2})

Table (6) shows the plants of the C1 treatment have excelled by giving it the highest average for the number of tillers per m^2 amounted to (449.24, 437.26 tillers.m^{-2}) for both seasons, respectively, while the plants of the C0 treatment gave the lowest average amounted to (406.70, 408.75 tillers.m^{-2}) for both seasons, respectively. The reason may be due to the role of the bio-fertilizers in increasing the ability of branching through its role in increasing the effectiveness of enzymes that play a role in increasing the photosynthesis process, which contributes to the manufacture of nutrients that improve the vegetative traits for the rice plant, such as plant height and increase in the number of tilers per m2 as shown in Tables (1, 5). In addition to that, the mycorrhiza works to form the lateral roots by forming root capillaries, thus increasing the traits of the vegetative growth for the plant. This reflected positively on the increase in the number of tillers per m^2 for the rice plant. These results agree with (22). Significant differences were found between the treatments of the organic fertilizer, where the plants of the treatment (B3) have excelled by giving them the highest average for the number of tillers per m^2 amounted to (461.52, 449.32 tillers.m^{-2}) for both seasons, respectively, while

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the plants of the control treatment gave the lowest average amounted to (413.86,409.89 tillers.m^{-2}) for both seasons, respectively. The reason may be due to the superiority of the plants treated with organic fertilization as a result of the role of organic fertilizer in providing nutrients in the circumference of the roots and making it more balanced in addition to the formation of humic material which in turn liberates the organic acids, which contributed to the formation of lateral buds and the growth and emergence of Crown roots and reducing competition between the formed tillers on the nutrient materials, which led to its survival and completing its effective growth, this reflected positively in increasing the number of tillers for the rice plant. This result agrees with (12). The plants of irrigation treatment every (6 days) have excelled by giving them the highest average for the number of tillers per m^2 amounted to (439.66, 410.13 tillers.m^{-2}) for both seasons, respectively, while the plants of the daily irrigation treatment gave the lowest average amounted to (418.14, 407.38 tillers.m^{-2}) for both seasons, respectively. The reason is due to the role of the bio-fertilizers in increasing the number of tillers under the conditions of alternating irrigation periods because the mycorrhiza plays an important role in increasing microorganisms and increasing soil fertility and increasing the growth of roots that helped retain water, thus provides the needs of the plant for growth, which led to the survival of the newly formed branches and supplying it with Nutrients required to complete its growth, especially under water stress conditions (17). Significant differences were found between organic fertilization and bio-fertilizers, where the plants of the B3C1 treatment have excelled by giving them the highest average number of tillers per m^2 amounted to (483.11 tillers.m^{-2}) in the first season, while the plants of the B0C0 treatment gave the lowest average amounted to (380.98 tillers.m^{-2}). The reason may be that the presence of organic matter and bio-fertilizers played an important role in increasing the ability to branch through its role in increasing the effectiveness of enzymes that play a role in increasing the Photosynthesis process, which contributes to manufacturing nutrients that improve the vegetative traits of the rice plant. In addition to increasing the absorption of the nutrients for the plant from its organic sources due to increasing the activity of microbial soil activity and increasing soil fertility and this reflected positively on the increase in a number of tillers per m^2, and this is an important and improved trait for rice plant production (19). Triple interaction was obtained between the study factors (the irrigation periods, organic fertilization, and bio-fertilization). The combination C1B1A2 gave the highest average number of tillers per m^2 amounted to (484.80 tillers.m^{-2}) while the combination C0B0A2 gave the lowest average number of tillers per m^2 amounted to (365.26 tillers.m^{-2}).

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Table 6: Effect of Bio-fertilizers, Organic Fertilizers, Irrigation periods and their interactions on the number of tillers per m^2 amounted to (tillers.m^{-2}).

Irrigation periods (A)	Organic Fertilizers (B)	The first season 2017					The second season 2018				
		Bio-fertilizers (C)				Average AxB	Bio-fertilizers (C)				Average AxB
		C0	C1	C2	C 3		C0	C1	C2	C 3	
A1	B 0	396.69	436.84	417.55	407.94	414.76	400.65	408.23	404.52	413.96	406.84
	B 1	402.01	429.74	408.36	389.56	407.42	402.86	408.29	404.34	402.66	404.54
	B 2	405.00	397.91	377.81	429.07	402.45	400.83	414.43	410.33	408.30	408.47
	B 3	417.30	483.85	454.12	436.45	447.93	425.17	460.45	425.06	418.22	432.23
A2	B 0	365.26	437.82	423.84	424.94	412.97	376.17	433.88	420.22	421.46	412.93
	B 1	400.62	484.80	469.89	417.45	443.19	402.47	464.04	459.71	419.66	436.47
	B 2	406.04	440.56	441.60	421.26	427.37	405.17	436.20	435.12	414.41	422.72
	B 3	460.65	482.37	480.41	477.02	475.11	456.70	472.56	471.17	465.22	466.41
L.S.D 0.05		(A×B×C)=33.080				N.S	(A×B×C)= N.S				N.S
Irrigation periods × Bio-fertilizers						A	Irrigation periods × Bio-fertilizers				A
Interaction AxC	A1	405.25	437.09	414.46	415.76	418.14	407.38	422.85	411.06	410.79	407.38
	A2	408.14	461.39	453.93	435.17	439.66	410.13	451.67	446.55	430.19	410.13
L.S.D 0.05		16.540				11.912	12.216				18.952
Organic Fertilizers × Bio-fertilizers						B	Organic Fertilizers × Bio-fertilizers				B
Interaction BxC	B 0	380.98	437.33	420.70	416.44	413.86	388.41	421.05	412.37	417.71	409.89
	B 1	401.32	457.27	439.12	403.50	425.30	402.66	436.17	432.02	411.16	420.50
	B 2	405.52	419.24	409.70	425.17	414.91	403.00	425.31	422.72	411.35	415.60
	B 3	438.97	483.11	467.26	456.73	461.52	440.93	466.51	448.12	441.72	449.32
L.S.D 0.05		23.391				14.524	N.S				13.749
Bio-fertilizers (C)		406.70	449.24	434.20	425.46		408.75	437.26	428.81	420.49	
L.S.D 0.05		11.696					8.638				

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