# The effect of nitrogen fertilization on the growth and yield of rice (*Oryza sativa L.*) and its content of some medically effective compounds

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## Abstract

A field experiment was conducted for the 2020 agricultural season in Babylon province / Bid'a Al-Musayyab 45 km north of the province with the aim of evaluating the performance of five cultivars of rice (Oryza sativa L.) and the content of these cultivars of some active substances by the effect of three levels of nitrogen fertilization (0, 175 and 225 kg ha<sup>-1</sup>) The cultivars are (Amber 33, Michkhab 2, Al-Furat, Yasmin and Black) obtained from the rice research station in Michkhab using a factorial experiment with randomized complete block design (RCBD) with three replicates. The results can be summarized as follows: The cultivars differed significantly at the 5% probability level for all the studied traits, the Amber 33 cultivar significantly excelled them in most of the traits. While the black cultivar was excelled in the amount of active substances, the third level of fertilization (225 kg H-1) was excelled for most of the studied growth and yield traits, except for the two characteristics of the number of days from sowing to 50% heading of the panicle and from 50% until physiological maturity.While the level of the second fertilization was excelled in the content of cultivars of effective medicinal compounds, the black cultivar in the content of the rice plant of the active substances excelled in all the effective medicinal compounds.

المستخلص

نفذت تجربة حقلية للموسم الزراعي 2020 في محافظة بابل / بدعة المسيب 45 كم شمال المحافظة بهدف تقويم أداء خمسة أصناف من الرز (.Cryza sativa L)ومحتوى هذه الاصناف من بعض المواد الفعالة بتاثير ثلاثة مستويات من التسميد النتروجيني (.O ، 17 و 225 كغم هه <sup>1-</sup>) والاصناف هي (عنبر 33 ، مشخاب 2 ، فرات ، ياسمين و الاسود ) التي تم الحصول عليها من محطة ابحاث الرز في المشخاب باستعمال تجربة عامليه بتصميم القطاعات الكاملة المعشاة(RCBD) بثلاثة مكرارت.

ويمكن تلخيص النتائج كما يلي: أختلفت الأصناف معنوياًعند مستوى احتمال 5% لجميع الصفات المدروسة، تفوق الصنفعنبر 33 معنوياً فيأغلب الصفات فيما تفوق الصنف الاسود في كمية المواد الفعالة ، تفوقمستوى التسميد الثالث (225 كغم هـ<sup>1</sup>)لأغلب صفات النمو والحاصل المدروسة باستثناء صفتي عدد الأيام من الزراعة إلى 50% طرد الدالية ومن 50% حتى النصج الفسيولوجي . فيما تفوق مستوى التسميد الثاني في محتوى الاصناف من المركبات الطبية الفعالة ، تفوق الصنف الاسود في محتوى المدروسة، تفوق المناف

## Introduction

Rice is one of the major and important grain crops in the world. It ranks second after wheat in terms of importance. It nutrition about half of the world's population. It is the main economic resource for hundreds of millions of Asians (9). The cultivated area of rice in the world is about (150 million) hectares, located between latitudes 45 North and 40 South, and global production reaches (562 million) tons, with a yield average of (3.73) tons/ha (8). In Iraq, rice comes second after the wheat crop in terms of importance and production. It is an important strategic crop in our food security. The cultivated area of it for the year 2000 reached (119680) ha, the total production was (251650) tons, and the average yield was (2102.69) kg/ha (4). The production rate per hectare in Iraq is low compared to its productivity in the countries of the world, although Iraq is one of the countries known for cultivating this crop since ancient times, especially since the environmental conditions in Iraq are suitable for its cultivation (5), Nitrogen affects the degree of sluggishness, which is considered an undesirable trait because of the losses it causes as a result of losing grains by dropping them from the deltoid in dormant plants. Therefore, this element must be added in the form of several batches to prevent the sluggish phenomenon or reduce it to the least possible extent. Black rice is a type of medicinal rice that grows in a very limited number of countries in the world and has been successfully cultivated in Iraq. The most important health benefits of black rice include its effects on heart health, digestion, diabetes, and weight loss, Chronic diseases, it contains anthocyanins which are well-known antioxidants, which have the ability to reduce oxidative stress throughout the body and prevent the negative effects of free radicals. This can reduce the risk of cancer, heart disease, rheumatoid arthritis, as well as premature aging. It contains more fiber than any other type of rice. As well as a negligible amount of fat, fiber helps scrape excess cholesterol and lower blood pressure, while low

levels of fat and cholesterol prevent atherosclerosis and coronary heart disease. So the research aims to:

- 1- Evaluating the performance of the cultivars used in the research and comparing them with the medical black cultivar.
- 2- Determining the best level of nitrogen addition in the growth and yield of rice.

3-Estimating the effective medicinal compounds in black rice and comparing them with the rest of the cultivars used in the research.

## **Materials and Methods**

A field experiment was conducted in the fields of a farmer in the Bida'a Al-Musayyab region / 45 km north of Babylon province in the summer season 2020 to study the effect of nitrogen fertilization levels on the growth, yield, and components of rice cultivars and their content of effective medicinal compounds. Using а factorial experiment with a randomized complete block design (RCBD) with three replications. The first factor represented the cultivars (Anbar 33, Yasmin, Miskhab 2, Al-Furat in addition to the black cultivar), which were obtained from the rice research station in Michkhab / Najaf Al-Ashraf, while the nitrogen fertilizer levels were represented (0, 175 and 225) kg N/ha in the form of Urea 64% N is the bringing the number second factor, of experimental units to 45. The soil of the field was plowed by two orthogonal plows with a Moldboard plow, at a depth of 30 cm, then smoothed with disc harrows and leveled the soil with a leveling machine. After that, the field was divided into slabs, the plot length was 3 m, width was 1 m. Thus, the area of the experimental unit was 3 m2. The experiment soil was fertilized with superphosphate fertilizer (100 kg/ ha) Added at once before planting and planting was done manually on 15/6/2020 with a distance of 10 cm between one line and another and 5 cm between one plant and another and

with a seed quantity of 35 kg/dunum.As for nitrogen fertilization, it was added in three batches, where 25% of each level was added as a first batch after a month of cultivation, and 50% of each level was added at the beginning of the branching stage(30 days after the first batch) as a second batch and the remaining 25% from each level It was added as a third batch at the beginning of the flowering stage. For the purpose of combating the weeds, a pesticide was added at a spraying average of 50-100gm per 100 liters of water after cultivation, by means of holders of a volume of 100 liters for the purpose of controlling weeds growing with rice, especially the Echinochloa crus-galli (L.) Beauv weed. In addition to manual weeding whenever needed, manual harvesting of the experimental units was conducted on November 15, 2020.

S	oil texture		K	Р	Ν	Ecds.m	PH
sand%	clay%	silt%	Ppm	Ppm	Ppm		
18	55	27	167	11	33.17	5.3	6.7

 Table (1) some chemical and physical properties of field soil

The results were analyzed for soil in the laboratories of the Soil Department at the Technical Institute / Musayyib.

- 3-2 Studied traits (field traits, yield and its components):
- 3-2-1 Number of days from planting to 50% flowering.
- 3-2-2 Number of days from 50% flowering to physiological maturity.

3-2-3 Plant height (cm): measured from the soil surface level to the end of the panicles for 10 random plants at maturity from each experimental unit and according to their average.

3-2-4 The length of the panicles(cm): according to the measurement of the confined distance between the node of the panicle stalk and the end of the panicle for 10 random panicles at maturity from each experimental unit and according to their average.

3-2-5 Number of branches/panicles: The primary branches in the panicle were calculated

for 10 random dahlias at maturity and according to their average.

3-2-6 The flag leaf area (cm2): was calculated for 10 random flag leaves at maturity according to the following equation:

Leaf area = Leaf length x Max width x 0.74(10)

3-2-7 the flag leaf weight (mg): Ten random flag leaves were weighed with a sensitive electric scale and their average was taken.

3-4 Determination of the mineral content in the leaves

The plant samples of leaves were digested with a weight of 0.2 g of dry ground matter and placed in a 100 ml glass digestion flask, to which 5 ml of concentrated sulfuric acid (H2SO4) and 1 ml of perchloric acid (HCIO4) were added as a catalyst.Put the beaker on the heating plate and gradually raise the temperature (until the solution becomes clear), then cool the beaker and fill the volume to 50 ml by adding distilled water.After that, the elements were estimated as the percentage of nitrogen in the leaves, the nitrogen percentage of the digested samples was measured according to the method (6) using a Microkjeldhal distillation device.

3-5 Chemical Indicators

Determine the concentration using highperformance liquid chromatography (HPLC).

## statistical analysis

The data were statistically analyzed by the method of analysis of variance and using the least significant difference test (LSD) under the 5% probability level to diagnose the statistical differences between the arithmetic means of the transactions (Torrie, 13)).

### **Results and discussion**

## Number of days from planting to 50% flowering

Table (2)showed that there are significant differences between the cultivars, where the (yasamin) cultivar excelled by giving the least

number of days for flowering it reached (92.777 days), which did not differ significantly with the cultivar (Amber 33) which gave (92,887 days), while the black cultivar gave the highest the number of days for flowering reached (104.780 days) and the reason is due to the genetic structures of the cultivar. As for the fertilizer levels, the first level was excelled by giving it the least number of days for flowering, which amounted to (92,398) days, compared to the third level, which gave (99.868) days. The reason for this is that the increase in nitrogen fertilization led to the encouragement of vegetative growth and the prolongation of the plant growth period. As for the interaction between cultivars and levels of fertilization, the combination (Amber 33 X first level) excelled as it gave (88.330) days, while the combination (Black X third level) gave the largest number. The number of days reached (106.670) days. These results are consistent with what was found (3)

Table 2. The values of the arithmetic averages for the traits of the number of days from plantingto 50% flowering

Cultingue				
Cultivars	0	175	255	cultivars average
Amber 33	88.330	94.330	96.000	92.887
Yasmin	90.330	93.000	95.000	92.777
Mashkhab2	90.330	90.670	101.670	94.223
Al-Furat	90.000	94.000	100.000	94.667
black	103.000	104.670	106.670	104.780
lsd5%		2.314		1.336
Fertilization	02 308	05 334	00 868	
average	92.390	75.554	<b>77.000</b>	
lsd5%		1.035		

## Number of days from 50% flowering to physiological maturity

Table (3)showed that there are significant differences between the cultivars, where the cultivar (Amber 33) excelled by giving it the least number of days for maturity amounted to (121.110 days). As for the levels of fertilization,

the first level gave the lowest number of days for ripening (128.998 days), while the third level gave the highest number of days (140.132 days). maturity period. As for the interaction (cultivars X levels of fertilization), the combination (Al-Furat cultivar X first level) excelled by giving it (115,000 days), while the combination (yasaminX third level) gave the highest number of days to maturity, which reached (148,670

days). These results are consistent with what

was found (30).

Cultingue		aultivora avonaga		
Cultivars	0	175	255	cultivars average
Amber 33	116.330	122.670	124.330	121.110
Yasmin	135.330	140.330	148.670	141.443
Mashkhab2	135.000	141.000	147.330	141.110
Al-Furat	115.000	128.330	135.330	126.220
black	143.330	144.000	145.000	144.110
lsd5%		3.657		2.111
Fertilization	128 008	125 266	140 132	
average	120.990	155.200	140.132	
lsd5%		1.635		

## Table 3. Arithmetic mean values for the number of days trait from 50% flowering to physiological maturity

## plant height/cm

Table (4) showed that there are significant differences between the cultivars, where the cultivar (Amber 33) excelled by giving it the highest plant height that reached (109,290 cm). While the cultivar (Mishkhab 2) gave the lowest height of (89,533 cm), and the reason is due to the genetic structure of the cultivar. As for the levels of fertilization, the third level (250 kg / ha) was excelled by giving the highest plant height, which reached (104.320), while the first level (the comparison) gave the lowest plant **Table 4. Arithmetic me** 

height, which amounted to (95,808). The reason is due to the role of nitrogen fertilization in encouraging growth by increasing cell division when the plant is supplied with element N, which led to an increase in plant height. As for the interaction between (cultivars x levels of fertilization), the combination (amber 33 x third level) excelled by giving it the highest plant height that reached (116.170 cm). While the combination (Mishkhab 2 X first Level ) gave the lowest plant height (85,870 days). These results are consistent with what was found (2).

Table 4.	Arithmetic	mean	values	of p	olant	height/ci	m

		14		
Cultivars	0	175	255	cultivars average
Amber 33	101.800	109.900	116.170	109.290
Yasmin	92.430	99.000	102.200	97.877
Mashkhab2	85.870	88.600	94.130	89.533
Al-Furat	100.170	100.400	107.230	102.600
black	98.770	99.570	101.870	100.070
lsd5%		2.083		1.202
Fertilization	05 808	00.404	104 320	
average	95.000	<b>99.494</b>	104.320	
lsd5%		0.931		

## panicle length/cm

Table (5)showed that there are significant differences between the varieties, Where the cultivar(Amber 33) excelled by giving it the longest panicle reaching (25,000 cm).While the (black) cultivar gave the lowest length of (18.966 cm) and the reason is due to the genetic structure of the cultivar.As for the levels of fertilization, the third level (225 kg / ha) was excelled by giving it the longest length of panicle of the plant, which reached (23.693 cm), while the first level (control ) gave the lowest

panicle length of the plant, which was (21.707 cm)The reason is due to the role of nitrogen fertilization in encouraging growth bv increasing cell division when the plant is supplied with element N, which led to an increase in plant height. As for the interaction between (cultivars X levels of fertilization), the combination (Amber 33 X third level) excelled by giving it the highest panicle length of the plant reached (26.633 cm).While the combination (black X first level) gave the lowest plant height (18,333 cm). These results are in agreement with (1)

C14'				
Cultivars	0	175	255	cultivars average
Amber 33	23.433	24.933	26.633	25.000
Yasmin	22.267	23.367	23.800	23.145
Mashkhab2	22.400	22.800	23.033	22.744
Al-Furat	22.100	23.567	25.567	23.745
black	18.333	19.133	19.433	18.966
lsd5%		0.435		0.251
Fertilization	21 707	22 760	23 603	
average	21./0/	22.700	23.093	
lsd5%		0.195		

Table 5 Audithursed	la magan malu	a fan tmaita al	fmanialal		~~~
Table 5. Arithmet	uc mean vaint	es for traits o	г ряпісіе і	engin /	стп
			- panere -		~

## The number of branches per panicle

Table (6) notes that there are significant differences between the cultivars, where (Amber 33) excelled by giving the most number of branches to the panicle, reaching (10.117 branches. panicle), which did not differ significantly from the cultivar Yasmine (10,022 branches. panicle), while the cultivar gave (Al-Mashkhab 2). The fewest number of branches of the panicle(8,833 branches .panicle) and the reason is due to the genetic structures. As for the levels of fertilization, the third level (225 kg / ha) excelled by giving it the highest number of branches of panicle(9.953 branches. dahlia), while the first level gave the least number of branches of panicle (8.673 branches, panicle). The reason is due to the role of nitrogen fertilization in encouraging growth through Increased cell division when increasing the plant's supply of element N, which led to an increase in the number of deltoid branches. As for the interaction between (cultivars X levels of fertilization), the combination (Amber 33 X third level) excelled by giving it the highest number of branches of panicle(11,000), while the combination (black X the first level) gave the least number of branches of panicle when it reached (7.833 branches. panicle). These results are in line with the findings (1)

Cultingue				
Cultivars	0	175	255	cultivars average
Amber 33	9.200	10.150	11.000	10.117
Yasmin	9.700	10.033	10.333	10.022
Mashkhab2	8.500	8.767	9.233	8.833
Al-Furat	8.133	9.133	9.433	8.900
black	7.833	9.500	9.767	9.033
lsd5%		0.533		0.307
Fertilization	8.673	9.517	9.953	
average				
lsd5%		0.238		

Table 6. The	values of the	arithmetic a	verages of the	e number of	branches of	panicle

## Flag leaf area /cm<sup>2</sup>

Table (7)showed that there are significant differences between the cultivars, Where the cultivar(Amber 33) excelled by giving the highest leaf area (17.013 cm2), while the (black) cultivar gave the least leaf area (12.287 cm<sup>2</sup>). The reason is due to the genetic structure of the cultivar.As for the levels of fertilization, the third level (225 kg / ha) was excelled by giving it the highest leaf area, which reached (20,998 cm<sup>2</sup>), while the first level (control) gave the

least leaf area of the plant, reaching (11,340  $\text{cm}^2$ ). The reason is due to the role of nitrogen fertilization in encouraging vegetative growth through increased cell division when the plant is supplied with fertilization to increase the leaf area. As for the interaction between (cultivars X levels of fertilization), the combination (Amber 33 X third level) excelled by giving it (23.670  $\text{cm}^2$ ), while the combination (black X first level) gave the least leaf area, reaching (9,800  $\text{cm}^2$ ).

These results agree with what was found (1)

Cultivars		aultivora ovorogo		
	0	175	255	cultivars average
Amber 33	12.470	14.900	23.670	17.013
Yasmin	11.130	13.500	21.230	15.287
Mashkhab2	12.270	14.730	23.530	16.843
Al-Furat	11.030	13.370	21.030	15.143
black	9.800	11.530	15.530	12.287
lsd5%		1.665		0.961
Fertilization average	11.340	13.606	20.998	
lsd5%		0.744		

Table 7.	7. The values of the arithmetic averages for trait of leaf area / c	$m^2$

## Flag leaf weight/mg

Table (8) showed that there are significant differences between the cultivars, Where the cultivar (Amber 33) excelled by giving the highest leaf weight, which reached (145.467 mg), while the cultivar (Al-Furat) gave the lowest leaf weight, reaching (125.310 mg) and the reason is due to the genetic structures of the cultivar. The levels of fertilization excelled the third level (225 H/kg) by giving the highest leaf weight (145,154 mg), while the first level gave

the lowest leaf weight, reaching (121.818 mg). The reason is due to the role of nitrogen fertilization in encouraging vegetative growth during increased cell division. When the plant is supplied with element N, which leads to an increase in the weight of the time.As for the interactions between (cultivars x levels of fertilization), the combination (Amber 33 x level three) excelled by giving the highest leaf weight, which reached (163.200 mg), while the combination (Al-Furat x first level) gave the lowest leaf weight (117,030 mg).

Cultingue					
Cultivars	0	175	255	cultivars average	
Amber 33	134.170	139.030	163.200	145.467	
Yasmin	119.430	122.830	137.070	126.443	
Mashkhab2	121.230	131.370	145.300	132.633	
Al-Furat	117.030	123.500	140.730	127.087	
black	117.230	119.230	139.470	125.310	
lsd5%		7.162			
Fertilization	121 818	127 102	145 154		
average	121.010	127.192	143,134		
lsd5%		3.203			

#### Table 8: values of the arithmetic averages for trait of the weight of the flag leaf / mg

### **Qurcetine compound ( ppm )**

Table (9)showed that there are significant differences between the cultivars, where the cultivar (Black) excelled by giving it the highest ppm), value of (16.06)while the cultivars(Yasamin) gave the lowest value of (12.25 ppm). The reason is due to the genotypes of the cultivar, the second level (175 kg / ha) excelled by giving it the highest value of (14.67ppm), while the first level gave the lowest value, which amounted to (13.07ppm). The reason is due to the role of nitrogen fertilization in encouraging growth by increasing cell division when the plant is supplied with element N, which indicates an increase in yield. As for the interaction between (cultivars X levels of fertilization)The combination (Black X second level) excelled by giving the highest value to Qurcetine, reaching (17.89ppm), while the combination (Yasamin X first level) gave the lowest value, reaching (11.55ppm).

Cultivars -	Fertilization			
	0	175	255	cultivars average
Amber 33	11.78	14.28	13.66	19.24
Yasmin	11.55	12.33	12.88	12.25
Mashkhab2	14.55	15.39	16.77	15.57
Al-Furat	12.79	13.44	12.98	13.07
black	14.66	17.89	15.63	16.06
lsd5%	1.68			0.96
Fertilization average	13.07	14.67	14.38	
lsd5%		0.75		

Table 9. Arithmetic mean values of the compound Qurcetine

### **Protocatechin compound (ppm)**

Table (10) showed that there are significant differences between the cultivars, where the (black) cultivar excelled in the compound Protocatechin by giving it the highest value of (10.09ppm), while the cultivar (A-Furat) gave the lowest value, which amounted to (6.53ppm).The reason is due to the genotypes of the cultivar, the second level (175 kg / ha) excelled by giving it the highest value of (8.92ppm), while the first level gave the lowest value, which amounted to (8.68ppm) and did not

differ significantly from the third level by giving it (8.69 ppm). The reason is due to the role of nitrogen fertilization in encouraging growth by increasing cell division when the plant is supplied with element N, which led to an increase in yield.As for the interaction between (cultivar X levels of fertilization). the (black combination Х second level) outperformed by giving it the highest value, reaching (10.68ppm), while the combination (Al--Furat X third level) gave the lowest value, reaching (5.35ppm).

Cultivars -	Fertilization			aultivara avaraga
	0	175	255	cultivars average
Amber 33	8.47	9.89	8.79	9.05
Yasmin	7.86	8.50	8.98	8.45
Mashkhab2	9.21	9.74	10.13	9.69
Al-Furat	8.49	5.77	5.35	6.53
black	9.37	10.68	10.23	10.09
lsd5%	1.63			0.94
Fertilization average	8.68	8.92	8.69	
lsd5%		0.73		

Table 10. Arithmetic mean values for Protocatechin

## **Hibicetine compound(ppm)**

It is noticed from Appendix (2) and Table (20) that there are significant differences between the cultivars, where the (black) cultivar excelled the compound Hibicetine by giving it the highest value of (7.06ppm), while the cultivar (Yasamin) gave the lowest value, which amounted to (4.86ppm). The reason is due to the genotypes of the cultivar, the second level (175 kg / ha) excelled by giving it the highest value of (6.38ppm), while the first level (control )

gave the lowest value, which amounted to (5.72ppm).The reason is due to the role of nitrogen fertilization in encouraging growth by increasing cell division when the plant is supplied with element N, which leads to an increase in the yield.As for the interaction between (cultivarsX levels of fertilization), the combination (black X second level) excelled by giving the highest value of Hibicetine, which reached (7.55ppm). While the combination (Yasamin X first level) gave the lowest value as it reached (4.54ppm).

Cultivars	Fertilization			
	0	175	255	cultivars average
Amber 33	5.12	5.97	5.44	5.51
Yasmin	4.54	4.75	5.29	4.86
Mashkhab2	6.35	6.89	7.24	6.83
Al-Furat	6.14	6.74	6.35	6.41
black	6.47	7.55	7.15	7.06
lsd5%	1.69			0.97
Fertilization	5.72	6.38	6.29	
average				
lsd5%	0.75			

## Table 20. Arithmetic mean values for Hibicetine

## 4-2-5 Hibiscin Glycoside (ppm)

It is noticed from Appendix (2) and Table (21) that there are significant differences between the cultivars, where the (black) cultivar excelled the compound Hibiscin Glycoside by giving it the highest value of (8.30ppm), while the cultivar (Yasamin) gave the lowest value, which amounted to (6.32ppm). The reason is due to the genotypes of the cultivar. As for the levels of fertilization, the second level (175 kg / ha) excelled by giving it the highest value of (7.67ppm), while the first level (control) gave the lowest value, which amounted to (6.48ppm). The reason is due to the role of nitrogen fertilization in encouraging growth by increasing cell division when the plant is supplied with element N, which led to an increase in yield. As for the interaction between (cultivar levels fertilization)The Х of

combination (Black X second Level ) excelled by giving the highest value to Hibiscin Glycosideg, reaching (9.22ppm), while the combination (Yasamin X first Level) gave the lowest value, reaching (5.79ppm).

Cultivars -	Fertilization			aultivara avaraga
	0	175	255	cultivars average
Amber 33	6.32	8.41	7.55	7.43
Yasmin	5.79	6.27	6.89	6.32
Mashkhab2	6.48	7.05	7.19	6.91
Al-Furat	6.57	7.42	7.06	7.02
black	7.24	9.22	8.43	8.30
lsd5%	1.63			0.94
Fertilization	6 48	7.67	7 42	
average	0.70	7.07	/.72	
lsd5%		0.73		

## Table 21. Arithmetic mean values for Hibiscin Glycoside

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