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Article Effect of cultivars and harvest dates on rice seeds vigore

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Abstract

A laboratory experiment was carried out according to a completely randomized design with four repetitions on the seeds resulting from a field experiment applied for the two seasons, 2020 and 2021, to find out the effect of the cultivars (Ambar 33, Yasamin, Dijlah, Ambar Al-Baraka and Furat 1) and the harvest dates (at physiological maturity and after 7 and 14, 21 and 28 days of physiological maturity) on the vigour of rice seeds. The results showed the superiority of the seeds of the cultivar Anbar Al-Baraka at first and final counting, dry weight of the seedling, seedling vigor index and electrical conductivity, and the superiority of the seeds of Dijla cultivar at accelerated aging test and cold test without significant difference with the Anbar Al-Baraka cultivar in both seasons. The harvest date exceeded 14 days after physiological maturity at all studied traits in both seasons. Anbar Al-Baraka at the harvest 14 days after physiological maturity was superior at most studied traits. It can be concluded that the seeds of the cultivar Amber Al-Baraka showed the best performance at seed vigor, primarily harvested after 14 days of physiological maturity.

Keywords: accelerating aging, cold test, Oryza sativa, first count, seedling vigour, physiological maturity

Introduction

The development of a rice cultivation strategy Ensures meeting the needs of this sector and its competitiveness. This can be done by obtaining high-quality seeds at the right time. The yield and quality of rice depend on the Seed vegore. It is the primary material for crop performance, production and food security. The Seed vegore determines the emergence and withstand storage periods. Seed vegore of a seed is its ability to quickly and vigorously form seedlings under the influence of different environmental conditions ¹² because an early seedling activity is a characteristic of high-quality seeds. Also, rapid and uniform germination leads to the establishment of solid seedlings ¹³. Seed vegore is not a single measurable property. Instead, it is a concept that describes many characteristics such as germination percentage ions leakage, acceleration of age and other indicators that are criteria for assessing the Seed vegore.

Seed vigor is influenced by genetic composition (variety) and environmental conditions that affect the mother plant and nutrition during maturity and harvest time. Harvesting seeds at the right stage is essential because seeds are crucial in crop production. It can only increase the yield by 20% using high-quality seeds ¹⁹. Most of the genotypes of the rice crop vary, like its vegetative growth and

grain yield. Therefore, the variety and the harvest date affect the grain's characteristics. In addition, the understanding of seed performance under the influence of these two factors shows seed variation due to the interaction between genetic and environmental factors to get high-quality seeds when germination occurs later. This study aims to determine the best date for harvesting grain to get seeds of high vitality and seed vigor for five approved varieties of rice commonly grown in the governorates where rice is grown. That is, understanding the relationship between maturity and harvest time and the viability and seed vigor of the seeds produced in different rice varieties.

Materials and methods

Seed vigore tests were carried out in the laboratories of the Department of Seed Examination and Certification in Baghdad according to a complete randomized design with four replicators after completing the field trial for the 2020 and 2021 seasons. The treatments involved in the experiment became seeds of five cultivars resulting from five harvest dates, representing the cultivars Ambar33, Yasmin, Dijlah, Ambar Baraka and Furat1, and five dates of harvest; the harvest at physiological maturity, and the harvest after 7, 14, 21, 28, days after physiological maturity. One hundred seeds were taken to represent the combination of the effect of varieties and harvest dates for the seeds resulting from the field experiment for the 2020 season and repeated for the year 2021, then put on paper towels and in the manner of folding or wrapping the paper in four replicators then it was put in the terminator at a temperature of 25°C and 95% humidity.

Studied traits

1. The first and final count in the standard germination test (%):

The first count was calculated by counting the natural seedlings only on the fifth day of putting the seeds into the germinator. The final count was calculated after 14 days. The results were then converted into percentages ¹².

2. The length of the plumule and the radical (cm) in the standard germination test:

After the end of the standard germination test period (14 days), 10 natural seedlings were taken. The radical and the plumule were separated from the connection point with the seed coat. 3. The length of the radical and plumule (cm) was measured separately using a ruler. The average was extracted for these two traits.

3. Dry seedling weight (mg. seedling⁻¹): Seedlings were placed in a perforated paper bag and dried at 80° C for 24 hours. Then, the average dry weight of the seedling was calculated ^{at 12}.

4. Accelerated aging test:

A sample of seeds was taken from each experimental unit and then placed in a small wire basket in the germinator. Then, the seeds were stressed for 72 hours at 40°C ± 1 and 100% humidity. Then, the seeds were taken, and their moisture after acceleration was about 20-30%. They were subjected to a standard germination test, and only one count was done after 7 days of changing the germination temperature; then, the results were converted to percentages $9^{\text{ and } 12}$. 5. Cold test:

Soil was taken from the field in which the experiment was carried out, cleaned of plant residues and mixed with sand in a ratio of $1:1^{11}$ to be used to cover the seeds in this test. Paper towels were moistened, and the soil was in cold water at 10 C°. The seeds were covered with a light layer of moist soil and then transferred and placed in the germinator at 10° C ±5 for 7 days. Then, the

germination temperature was changed to $25^{\circ}C \pm 5$ for another five days. Only normal seedlings were counted after the end of the examination period (11 days) ^{9,12} then the results were converted into percentages.

6. Seedling vigore index: It was calculated using equation 9 .

Index of seedling vigour = (length of radical+length of plumule) \times final count 7. Electrical conductivity test (micro Siemens cm⁻¹.gm⁻¹)

Humidity was checked before preparation, then the seeds were weighed and placed in deionized water in a box of 500 ml and with 50 seeds in each box, it was placed in the plant at a temperature of 20° C and then measured by an electrical conduction device ⁹.

Statistical analysis

The analysis of variance was carried out by Completely Randomized Design with four replicators, and the averages of the treatments were compared with the least significant difference (l.s.d) test. The simple correlation coefficient was calculated between the studied traits.

Results

First count in the standard germination test (%).

The results of Table 1 indicated the superiority of the cultivar Anbar Albaraka with the highest average of the trait in both seasons, which amounted to 51.0 and 50.4%, respectively, without significant difference in the second season on the mean of the trait for the two cultivars Dijlah and Yasmin, which averaged 50.1 and 49.9% for the trait, respectively. In contrast, the cultivar Furat 1 recorded the lowest average of the trait in both seasons, which amounted to 43.7 and 44.4%, respectively. This may refer to the cultivars' difference in germination speed to their differences in the genetic mechanism that controls germination. Also, the superiority of the variety (Amber Baraka and Dijlah) is evidence of the vigour and vitality of the seeds of these cultivars. These results agree with the results obtained by (2 and 17) in the difference of rice cultivars significantly in germination speed. The third harvest date (14 days after physiological maturity) recorded the highest mean of the trait in both seasons, which was 41.6% and 42.6%. A decrease in the speed of germination at the first harvest date may indicate that the grains were harvested with a high percentage of moisture, which leads to the breathing of embryo and loss of a percentage of dry matter as a result of consuming carbohydrates in this process, and occurred a percentage of deterioration that affected the speed of germination or the percentage of germination in the first count, , and so for the second date then the percentage increased with the decrease in the moisture content of the grains to give the highest average at the third date in which the grains may have been harvested in an appropriate moisture content that prevented their deterioration to give the highest average germination, also, the decrease in germination speed at the fourth and last date due to the beginning of deterioration of the grains, this indicates that the rice seeds are dormant due to the hardening of the seed coats, which prevents water from entering them, and prevent its germination while it is in the panicles, and this is the case the rice seeds that remain for a long time in the field. At the same time, the cultivar Furat1 at the first harvest date recorded the lowest average for the trait of 37.6 and 36.7% for the two seasons, respectively.

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	Harves	Harvest date at or after physiological maturity for the 2020 season							
Cultivars	At	days later 7	days later 14	days later 21	days later 28	average			
	physiological								
	maturity								
Ambar	38.8	46.1	52.3	50.9	49.1	47.4			
33									
Yasmin	41.4	48.0	50.9	48.1	47.4	47.2			
Dijlah	46.1	51.8	49.1	47.2	47.8	48.4			
Ambar.	44.0	52.1	56.0	52.8	50.2	51.0			
Baraka									
Furat 1	37.6	45.0	48.6	46.3	44.5	44.4			
Average	41.6	48.6	51.4	49.1	47.8				
LSD 0.05	Cultivar harve	st dates i	nteraction						
	1.7	1.	7	3.8					
	Harve	est date at or a	fter physiologic	al maturity for	the 2021 seasor	ı			
Cultivars	At	days later 7	days later 14	days later 21	days later 28	average			
	physiological								
	maturity								
Ambar	43.1	46.6	51.8	50.7	48.3	48.1			
33									
Yasmin	41.1	48.1	54.6	53.8	52.1	49.9			
Dijlah	47.2	54.1	52.8	48.8	47.5	50.1			
Ambar.	43.0	50.8	56.0	51.9	50.3	50.4			
Baraka									
Furat 1	36.7	45.0	47.1	45.4	44.2	43.7			
Average	42.2	48.9	52.4	50.1	48.5				
LSD 0.05	Cultivar harve	st dates	interaction						
	1.1		1.1	2	5				

Table 1: The effect of cultivars, harvest dates and their interaction on the first count in the standard germination test (%) For seeds resulting from field experience for the 2020 and 2021 seasons.

Final Count in Standard Germination test (%)

The results of Table (2) indicated that the cultivar Amber al-Baraka registered in the first season the highest rate of the trait was 89.1%, without a significant difference from the cultivar Dijlah (88.0%). The cultivar Furat 1 recorded the lowest average (84.8%), and the cultivar Dijlah recorded the highest trait average in the second season, at 89.2%. There was no significant difference between the mean of the two cultivars, Yasmin and Amber Al Baraka, which averaged 88.8% %, and the Furat cultivar, which came last, with an average of 84.8%. This may refer to cultivars' differences in germination speed to their differences in the genetic mechanism that controls germination and the difference in the stored nutrient content of the seed and its chemical composition and its effect on its vitality, which leads to an increase in their ability to germinate ¹². It should be noted that the cultivars whose seeds gave the highest averages in the standard

germination test are the same cultivars that gave the highest averages in the first count test or germination speed (Table 1), indicating the vigour and vitality of these seeds. Table (2) results indicated significant differences in the effect of the interaction between cultivars and harvest dates in the standard germination percentage. The cultivar Amber AL-Baraka at the third harvest time gave the highest average of 94.2%. In comparison, the cultivar Furat 1 at the first harvest time gave the lowest average of 70.9% in the first season. In the second season, the cultivar Yasmin, at the third harvest time, gave the highest average of 94.3%, While the cultivar Furat1 at the first harvest time gave the lowest mean of the trait, which was 70.9%.

	Harvest date at or after physiological maturity for the 2020 season						
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average	
		later	later	later	later		
Ambar 33	74.9	85.6	91.8	89.2	90.6	86.4	
Yasmin	78.4	89.4	93.2	90.4	87.8	87.9	
Dijlah	80.4	87.2	93.1	90.2	89.3	88.0	
Ambar. Baraka	81.8	88.8	94.2	91.4	89.2	89.1	
Furat 1	70.9	82.4	92.2	90.4	88.1	84.8	
Average	77.3	86.7	92.9	90.3	89.0		
LSD 0.05	Cultivar harvest dates	interacti	on				
	1.3	1.3		2.9			
	Harvest da	te at or after p	physiological	maturity for t	the 2021 seaso	n	
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average	
		later	later	later	later		
Ambar 33	76.0	82.3	94.2	92.4	89.6	86.9	
Yasmin	75.9	90.9	94.3	92.7	89.9	88.8	
Dijlah	82.9	88.2	94.2	91.8	88.9	89.2	
Ambar. Baraka	80.6	90.1	92.9	91.4	88.0	88.6	
Furat 1	72.9	83.8	93.8	92.1	89.6	86.4	
Average	77.6	87.1	93.9	92.1	89.2		
LSD 0.05	Cultivar harvest dates	interactior	1				
	1.1	1.1		2.4			

Table 2: The effect of cultivars, harvest dates and their interaction on the final count in the standard germination test (%)For seeds resulting from field experience for the 2020 and 2021 seasons.

The plumule length (cm) in the standard germination test

Table (3) shows the recording of the cultivar Anbar Al-Baraka. The highest average for the plumule length was 11.2 cm compared to the Yasmin. That record lowest average for the trait was 9.9 cm in the first season, as for the second season. In the second season, the cultivar Amber 33 and Amber Al Baraka recorded the highest rate of 10.9 cm for both, finally coming the Variety Furat1 (10.0 cm). This may refer to the cultivars' difference in length of plumule to structural differences in the genes that control this trait, which is reflected in phenotypic behavior. The variations between the varieties of this trait express it.

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Also, this may indicate that the seeds of cultivars that outperformed in the speed of germination deplete their nutritional reserves quickly and takes more time to grow and establish a strong plumule in its qualities, and this is related to the vigour of the seed, that the seed with the longest plumule has the highest vigour compared to the seed with the shortest plumule length (9). These results agree with the results of (2 and 17) in different rice varieties in a trait of the plumule length. The resulting seeds from the third harvest date (14 days after physiological maturity) gave the highest mean for the length of the plumule, for both seasons it reached 11.1 and 11.4 cm, respectively, while the seeds obtained from the harvest date at physiological maturity recorded the lowest average of 9.3 cm for both seasons.

It should be noted that the treatments that gave the highest averages in germination speed are the same ones that gave the highest averages of the length of the plumule, and this is the same case for transactions in which the length of the plumule has decreased. This indicates that the seeds that excel in the speed of germination deplete their nutritional reserves quickly. It also takes more time to grow and establish a strong plumule in its characteristics, including the length of the plumule, with evidence of the positive significant correlation between the characteristic of the length of the plumule and the first count of germination. The correlation coefficient was 0.6860 and 0.6560 (Table 4). Furthermore, this is agreed with (1) in the deterioration of seeds when harvest time is late. The cultivar Amber 33 recorded the highest average length of the plumule at the third harvest time, reaching 11.7 cm. In comparison, the cultivar Furat 1 at the first harvest time recorded the lowest average of 8.7 cm, as for the second season Amber 33 and Amber al-Baraka in the third harvest time, recorded the highest average characteristic was 11.8 for both. The same average (9.1 cm) was recorded for the cultivars Yasmin, Dijlah and Furat1 at the first harvest time, the lowest average for the trait.

	Harvest date at or after physiological maturity for the 2020 season						
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average	
		later	later	later	later		
Ambar 33	9.0	10.3	11.7	11.5	11.5	10.8	
Yasmin	.39	9.8	10.3	10.2	9.9	9.9	
Dijlah	9.1	10.2	11.1	10.7	10.9	10.4	
Ambar. Baraka	10.2	11.2	11.6	11.6	11.3	11.2	
Furat 1	8.9	9.7	10.8	10.7	10.4	10.1	
Average	9.3	10.2	111.	11.0	10.8		
LSD 0.05	Cultivar harvest dates	interaction					
	0.2	0.2	(0.4			
	Harvest da	te at or after	physiological	maturity for I	he 2021 seaso	n	
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average	
		later	later	later	later		
Ambar 33	9.5	10.8	11.8	11.4	11.0	10.9	
Yasmin	9.1	9.6	10.8	10.5	10.3	10.1	
Dijlah	9.1	10.5	11.6	11.2	10.9	10.6	
Ambar. Baraka	9.5	10.6	11.8	11.4	11.0	10.9	

Furat 1	9.1	9.8	10.9	10.2	9.9	10.0
Average	9.3	10.3	11.4	10.9	10.6	
LSD 0.05	Cultivar harvest dates	interaction	l			
	0.3	0.3		0.6		

Table 3: The effect of cultivars, harvest dates and their interaction on the plumule length in the standard germination test
(%) For seeds resulting from field experience for the 2020 and 2021 seasons.

Long of	Long of	Electrical	Dry	Cold test	Accelerated	First count	Final	studied
radical	plumule	conductivity	weight		aging		germination	traits
*0.9226	*0.8551	*0.6051-	*0.7060	*0.6161	*0.6682	*0.6764	*0.7519	Seed vigor
*0.9344	*0.8662	*0.5645-	*0.6833	*0.7014	* 0.6844	*0.7823	*0.8189	index
	*0.6258	*0.4480-	*0.6952	*0.4216	*0.4954	*0.5008	*0.4933	Long of
	*0.6845	* 0.4580-	*0.6352	*0.5467	*0.5742	*0.6970	*0.6468	radical
		*0.6368-	*0.6031	*0.6738	*0.6701	*0.6860	*0.7435	Long of
		*0.5375-	*0.6836	*0.6741	*0.5964	*0.6565	*0.6612	plumul
			*0.3801-	*0.5825-	*0.5976-	*0.4415-	*0.6108-	Electrical
			*0.3813-	*-0.5038	*-0.5293	*0.5127 -	*-0.5538	conductivity
				*0.3320	*0.3427	*0.5644	*0.4087	Dry weight
				* 0.3627	*0.4117	*0.5260	*0.4450	
					*0.6872	*0.5780	*0.6786	Cold test
					*0.6794	*0.6009	*0.7397	
						*0.5634	*0.7183	Accelerated
						*0.5960	*0.7062	aging
							0.7162*	First count
							*0.7488	

Table 4: The values of the simple correlation coefficient between vitality and seed vigor tests for the seeds obtained from the field experiment for the 2020 and 2021 seasons.

The tabular value of r at df 98 = 0.1946 * significant at the level 0.05

The radical length (cm) in the standard germination test

Table (4) indicated that the seedlings of cultivar Amber 33 were superior in both seasons by giving the highest average for root lengths of 11.2 and 11.0 cm, respectively. It was followed by, without significant difference, the seedlings of the cultivar Amber Albaraka with an average of 10.8 cm, while the cultivar Furat1 came last in both seasons with an average root length of 8.6 and 8.8 cm for the two seasons, respectively. This indicates that the seeds that excel in the speed of germination have established a strong seedling in its qualities to excel in the characteristic of the length of the radical, and the superior seedlings of cultivars in the characteristic of the length of plumule can be considered an indication of their superiority in trait the length of radical. Because to have an active growth of the vegetative parts requires the presence of solid roots. It is noticed from the results of Table 6 that the seedlings obtained from the third harvest date (14 days after physiological maturity) were superior in giving the highest average root length for both seasons, with an average of 10.8 and 11.3 cm, respectively. Without a significant difference from the mean of trait for

seedlings obtained from the fourth, second and fifth harvest dates, which averaged 10.7, 10.5 and 10.3 cm, respectively, for the first season, and without a significant difference with the dates of the fourth and fifth harvests in the second season, which averaged 10.8 and 10.4 cm, respectively, while the difference was significant with the date of the second harvest which averaged for the trait 10.2 cm, and came The harvest date at physiological maturity with the lowest average for the trait in both seasons, which reached 8.7 and 8.6 cm, respectively. This agrees with the results (1) in seed deterioration when harvest time is late.

It should be noted that the treatments that gave the highest averages in germination speed and plumule length gave the highest averages in root length. The same is true for the treatments in which the length of the radical is decreased. The evidence for this is the positive significant correlation between this trait and the first count of germination and length of plumule, as the correlation coefficient was 0.5008 and 0.6258, respectively and 0.6970 and 0.6845, respectively, for the second season (Table 4). This indicates that the seeds that excel in the speed of germination quickly deplete their nutritional reserves. It also takes more time to grow to establish a strong seedling in its qualities, including the trait of the length of the radical. At the first harvest time, the cultivar Yasmin recorded the lowest average of 7.9 cm in the first season. In contrast, the cultivar Furat 1 at the first harvest time recorded the lowest average for the trait in the second season, with an average of 7.4 cm (Table 5).

	Harvest date at or after physiological maturity for the 2020 season					
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average
		later	later	later	later	
Ambar 33	10.9	311.	11.6	11.6	311.	11.2
Yasmin	7.9	10.6	10.8	10.5	110.	110.
Dijlah	8.9	10.6	11.1	10.7	10.4	310.
Ambar. Baraka	10.1	11.2	11.7	11.5	11.2	810.
Furat 1	8.1	88.	9.1	9.0	7.8	68.
Average	8.7	10.5	10.8	10.7	310.	
LSD 0.05	Cultivar harvest dates	interact	ion			
	0.6	0.6		1.4		
	Harvest da	ate at or after	physiological	maturity for	the 2021 seaso	n
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average
		later	later	later	later	
Ambar 33	9.8	10.8	11.9	11.5	10.9	11.0
Yasmin	8.0	10.3	11.6	11.2	10.4	10.3
Dijlah	8.6	10.4	11.6	11.2	10.9	10.6
Ambar. Baraka	9.2	11.0	12.0	10.9	10.6	10.7
Furat 1	7.4	8.7	9.6	9.4	9.0	8.8
Average	8.6	10.2	11.3	10.8	10.4	
LSD 0.05	Cultivar harvest dates	intera	ction			
	0.5	0.5		1.	.1	

 Table 5: The effect of cultivars, harvest dates and their interaction on the length of radical in the standard germination test (%) For seeds resulting from field experience for the 2020 and 2021 seasons.

Dry weight of seedling (g) in standard germination test

The results of Table (6) referred to the superiority of the seedlings variety Amber Baraka for both seasons, with the highest average for dry weight of 9.800 and 10.085 g, respectively, compared with the average of Furat 1 cultivar, which recorded the lowest average in both seasons, it reached 7.055 and 7.645 g, respectively. This may indicate that the seeds previously achieved the highest averages in the germination speed test or the first count, which is one of the characteristics of the seed's vigore. This means that it can efficiently manufacture new materials and quickly transfer them to the emerging embryonic axis, which leads to an increase in the accumulation of dry weight (6) with evidence of the positive significant correlation relationship between this trait and the first count, where the correlation coefficient was 0.564 and 0.5260 for the two seasons, respectively (Table 4). The seedlings resulting from the third harvest (14 days after physiological maturity) recorded the highest mean for the trait, which reached 9.160 g. At the same time, the average dry weight of seedlings resulting from harvest time at physiological maturity recorded the lowest average for the trait, which was 7.805 g.

In contrast, in the second season, the date of the third harvest also had the highest average of 9,670 g. At the same time, the harvest date at physiological maturity recorded the lowest average for the trait, which amounted to 7.660 g (Table 6). The results of Table (6) indicated the interaction's significant effect on the seedling's dry weight in both seasons. The cultivar Amber al-Baraka at the third harvest date recorded the highest average of 10.550 and 10.950 gm, respectively. At the same time, the cultivar Furat 1 at the first harvest time recorded the lowest average of 6.325 and 6.325 gm, respectively.

	Harvest date at or after physiological maturity for the 2020									
		season								
Cultivars	At	At days 7 days 14 days 21 days 2								
	physiol	later	later	later	later					
	ogical									
	maturity									
Ambar 33	8.650	9.900	10.300	10.000	9.600	9.690				
Yasmin	7.150	8.225	8.500	7.900	7.575	7.870				
Dijlah	7.550	8.350	8.700	7.950	7.600	8.030				
Ambar.	9.350	10.100	10.550	9.700	9.300	9.800				
Baraka										
Furat 1	6.325	7.275	7.750	7.100	6.825	7.055				
Average	7.805	8.770	9.160	8.530	8.180					
LSD 0.05	Cultivar h	arvest dates	interac	ction						
	0.276		0.276		0.617					
	Harvest d	ate at or afte	r physiologi	ical maturity	y for the 202	21 season				
Cultivars	At	days 7	days 14	days 21	days 28	average				
	physiol	later	later	later	later					
	ogical									

	maturity					
Ambar 33	8.350	10.050	10.650	10.350	10.100	9.900
Yasmin	6.900	8.225	8.850	8.250	8.175	8.080
Dijlah	7.300	7.900	9.150	8.500	7.950	8.160
Ambar.	8.925	9.900	10.950	10.350	10.300	10.085
Baraka						
Furat 1	6.825	7.525	8.750	7.950	7.175	7.645
Average	7.660	8.720	9.670	9.080	8.740	
LSD 0.05	Cultivar h	arvest dates	intera	oction		
	0.343		0.343		0.384	1

Table 6: The effect of cultivars, harvest dates and their interaction on the Dry weight of seedlings (gm) in standard germination test (%) For seeds resulting from field experience for the 2020 and 2021 seasons.

Percentage of normal seedlings in accelerated aging test (%)

The results of Table (7) indicated the superiority of The Dijlah cultivar by recording the highest average in the accelerated aging test (67.9%), without a significant difference from the cultivar Amber al-Baraka (65.8%), While the Yasmin cultivar recorded the lowest average (59.8%), also, in the second season, the cultivar Dijlah recorded the highest average (67.3%), it was followed by, without significant difference, the cultivar Amber 33 (66.6%), compared with the last cultivar Furat1 (65.3%) (Table 7). This may be due to the different seeds in the extent of tolerance of the physiological stress to which it was exposed and membranes rupture and increased levels of fatty acids and free radicals and decreased levels of ATP and protein significantly. The superiority of the cultivar Dijlah in this test is because this variety has the genotype that gives its seeds the ability to germinate and produce normal seedlings under stress conditions within the accelerated aging test. The seeds obtained from the third harvest date (14 days of physiological maturity) gave the highest average for the trait the highest average (69.4 and 70.9%) for the two seasons, respectively, and without a significant difference in the first season for the seeds produced from the fourth harvest time (21 days after physiological maturity) with an average of 67.2% and a significant difference in the second season (69.0%), Finally, the first harvest date (at physiological maturity) comes with the lowest average (55.1 and 58.9%) for the two seasons, respectively (Table 7). In the third harvest date, the cultivar Dijlah recorded the highest average of 73.0% for the two seasons. In comparison, the cultivar Furat 1 at the first harvest time recorded the lowest average of 47.3% for the trait. In the second season, the cultivar Yasmin at the first harvest date also recorded the lowest average (53.3%).

	Harvest date at or after physiological maturity for the 2020 season						
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average	
		later	later	later	later		
Ambar 33	53.8	65.5	70.0	66.3	63.3	63.8	
Yasmin	52.0	58.8	64.8	62.5	61.0	59.8	
Dijlah	61.0	67.0	73.0	71.0	67.5	67.9	
Ambar. Baraka	61.3	64.8	68.0	68.3	66.8	65.8	

Furat 1	47.3	54.3	71.3	68.3	64.3	61.1
Average	55.1	62.1	69.4	67.2	64.6	
LSD 0.05	Cultivar harvest dates	interaction				
	2.8	2.8		6.2		
	Harvest da	ate at or after	physiological	maturity for t	he 2021 seasor	n
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average
		later	later	later	later	
Ambar 33	62.7	64.6	69.3	68.0	68.3	66.6
Yasmin	53.3	65.8	71.3	69.3	67.2	65.3
Dijlah	61.3	64.8	73.0	70.5	66.8	67.3
Ambar. Baraka	58.0	67.0	71.3	68.5	67.8	66.5
Furat 1	59.5	61.8	69.5	68.5	67.0	65.3
Average	58.9	64.8	70.9	69.0	67.4	
LSD 0.05	Cultivar harvest dates	interaction				
	1.1	1.1	2.5			

Table 7: The effect of cultivars, harvest dates and their interaction on accelerated aging test in the standard germination test (%) For seeds resulting from field experience for the 2020 and 2021 seasons.

Percentage of normal seedlings in cold test (%)

The results of Table (8) indicate the superiority of the seeds of the cultivar Dijla by giving the highest average in the cold test, which amounted to 72.3%, without a significant difference from the seeds of the cultivar Anbar Al-Baraka (69.0%). Finally, the cultivar Yasmin (58.2%), in the second season, the cultivar Dijla recorded the highest average (68.1%) and without significant difference with the cultivar Anbar Al-Baraka (66.5%). Finally, the cultivar Yasmin came with the lowest average (64.1%). This may be attributed to the difference in the genotypes' germination percentage in the cold test due to their different response to environmental stress (low temperatures and high humidity). This may be due to the influence of the environmental conditions surrounding the mother plant ¹⁰. The third harvest date (14 days after physiological maturity) was superior in recording the highest average of the trait for both seasons, with an average of 72.4 and 71.2%, respectively, without a significant difference from the average of the fourth harvest date (21 days after physiological maturity), which averaged 70.0 and 69.2% for the two seasons respectively. This indicates that the seeds harvested after 14 and 21 days of physiological maturity can give the highest percentage of natural seedlings under low temperature, high humidity, and resistance to rot-causing organisms that are active in such conditions compared to seeds obtained from other harvest dates.

It should be noted that the seeds of these treatments have outperformed in the previous tests of speed, percentage of germination, radical length and plumule, dry weight of the seedlings, and the accelerated aging test (Table 1, 2, 3, 5, 6 and 7), The harvest date at physiological maturity finally came with the lowest average for the trait, which was 51.6 and 56.2% for the two seasons respectively (Table 8). The cultivar Dijlah at the third harvest time gave the highest average for the trait, 79.5 and 73.5%, whereas the lowest average for the Yasmin variety was at the first harvest time, reaching 45.0% in the first season. In the second

	Harvest date at or after physiological maturity for the 2020 season						
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average	
		later	later	later	later		
Ambar 33	50.3	62.5	70.0	62.5	50.3	62.2	
Yasmin	45.0	50.3	66.3	50.3	45.0	58.2	
Dijlah	62.8	69.5	79.5	69.5	62.8	72.3	
Ambar. Baraka	53.5	65.5	77.3	65.5	53.5	69.0	
Furat 1	46.3	65.5	68.8	65.5	46.3	60.2	
Average	51.6	60.5	72.4	70.0	67.4		
LSD 0.05	Cultivar harvest dates	interaction					
	3.6 3.6 8.1						
	Harvest date at or after physiological maturity for the 2021 season						
Cultivars	At physiological maturity	days 7	days 14	days 21	days 28	average	
		later	later	later	later		
Ambar33	57.0	65.0	68.3	67.5	66.8	64.9	
Yasmin	54.8	59.8	69.8	69.3	67.0	64.1	
Dijlah	60.8	66.0	73.5	71.3	68.8	68.1	
Ambar. Baraka	54.3	66.8	72.3	69.8	69.3	66.5	
Furat 1	54.0	65.8	72.0	68.0	66.3	65.2	
Average	56.2	64.7	71.2	69.2	67.6		
LSD 0.05	Cultivar harvest dates	interacti	on				
	2.3	2.3	5	5.1			

season, the cultivar Furat 1 recorded the first harvest season with the lowest average of 54.0% for the trait.

Table 8: The effect of cultivars, harvest dates and their interaction on the cold seedling (gm) test in standard germination test (%) For seeds resulting from field experience for the 2020 and 2021 seasons.

Seedling vigor index

Table 9 shows the superiority of the cultivar Anbar Al-Baraka in both seasons with the highest mean of the seedling vigore index, which reached 2029 and 1921 for the two seasons, respectively. Without a significant difference from the Amber 33 variety, which reached 2002 and 1913, finally, in both seasons, the cultivar Furat 1 came with the lowest average for seedling vigore of 1647 and 1633, respectively. This refers to rice varieties whose seeds outperformed in the percentage of germination and its seedlings in the characteristics of the plumule length and the radical. It gave the highest averages in the seedling vigore index. This confirms the positive significant correlation between this trait and the standard germination test, and the length of the radical and the plumule, the correlation coefficient was 0.6958, 0.9375 and 0.9097, respectively (Table 4). The third harvest date (14 days after physiological maturity) exceeded in both seasons with the highest mean of seedling vigore index of 2098 and 2133, respectively. Compared with the average harvest date at physiological maturity, which recorded the lowest average (1426 and 1392) (Table 9). The cultivar

Amber 33 at the third harvest time gave the highest mean for the trait that reached 2277 and 2237 respectively. At the same time, the cultivar Furat1 at the first harvest time gave the lowest average for the trait, which was 1202 and 1206 for the two seasons, respectively.

	Harvest date at or after physiological maturity for the 2020 season						
Cultivars	At physiological maturity	days later 7	days 14	days 21	days 28	average	
			later	later	later		
Ambar 33	1489	1975	2277	2153	2115	2002	
Yasmin	1344	1779	1953	1862	1748	1737	
Dijlah	1441	1779	2104	1990	1946	1852	
Ambar. Baraka	1656	2040	2251	2154	2044	2029	
Furat 1	1202	1600	1906	1827	1698	1647	
Average	1426	1834	2098	1997	1910		
LSD 0.05	Cultivar harvest dates	interaction					
	68 68	;	153				
	Harvest date at or after physiological maturity for the 2020 season						
Cultivars	At physiological maturity	days later 7	days 14	days 21	days 28	average	
			later	later	later		
Ambar 33	1470	1774	2237	2117	1965	1913	
Yasmin	1302	1809	2114	2011	1859	1819	
Dijlah	1469	1848	2180	2049	1940	1897	
Ambar. Baraka	1513	1951	2209	2033	1898	1921	
Furat 1	1206	1547	1922	1799	1692	1633	
Average	1392	1786	2133	2002	1871		
LSD 0.05	Cultivar harvest dates	interactio	on				
	53	53		119			

Table 9: The effect of cultivars, harvest dates and their interaction on seed vigore index of seedling (gm) in standard germination test (%) For seeds resulting from field experience for the 2020 and 2021 seasons.

Electrical conductivity test

Table 10 shows the registration of seeds of the Amber Al-Baraka cultivar with the lowest average electrical conductivity of 16.68 microsiemens.cm-1.gm-1 without a significant difference from the mean of the trait for the seeds of the cultivars Dijlah and Anbar 33, whose mean for the trait was 17.26 and 17.73 microsiemens.cm⁻¹.gm⁻¹, respectively, compared with the mean of the trait for the cultivar Yasmin, which recorded the highest electrical conductivity, averaging 20.11 microsiemens.cm⁻¹.gm⁻¹, In the second season, the seeds of the cultivar Dijlah recorded the lowest electrical conductivity, with an average of 16.66 microsiemens.cm⁻¹.gm⁻¹, It was followed by, and without a significant difference, the average of trait for seeds of cultivar Amber 33, which amounted to 17.05 micro siemens.cm⁻¹.gm⁻¹. Also, the Yasmin cultivar seeds recorded the highest electrical conductivity with an average of 18.06 microsiemens.cm⁻¹.gm⁻¹ (Table 10). The difference in cultivar seeds in the electrical conductivity test may indicate the difference in vitality and vigore of these seeds under the control of genetic factors, with evidence of the seeds of cultivars that excelled in this trait are the same as in the previous seed vegore traits and indicators, such as germination speed, plumule and radical length, seedling dry weight, and stress tests such as accelerated aging test and cold test (Tables 1, 2, 3, 6, 7 and 8). The third date harvest (14 days after physiological maturity) gave the lowest mean for electrical conductivity for both seasons, which was 15.87 and 16.04 micro siemens.cm⁻¹.gm⁻¹, respectively. Then came the fourth harvest date (21 days of physiological maturity) without significant difference, with an average of 16.17 and 16.50 microsiemens.cm⁻¹.gm⁻¹, respectively. Finally, it came with the highest electrical conductivity, and for both seasons, the harvest date at physiological maturity (22.54 and 19.36 microsiemens.cm⁻¹.gm⁻¹) sequentially. At the third harvest time, the cultivar Dijlah recorded the lowest average for the trait, 14.47 microsiemens.cm⁻¹.gm⁻¹, while the cultivar Yasmin at the first harvest date recorded the highest average of 28.23 microsiemens.cm⁻¹.gm⁻¹. In the second season, the seeds of the Dijlah cultivar were recorded at the third harvest time. Amber 33 at the fourth harvest time had the lowest electrical conductivity with an average of 15.52 microsiemens.cm⁻¹.gm⁻¹ for both. The seeds of the cultivar Amber Albaraka at the first harvest time recorded the highest electrical conductivity of 20.20 microsiemens.cm⁻¹.gm⁻¹ (Table 10).

	Harvest date at or after physiological maturity for the 2020 season							
Cultivars	At physiological maturity	days later 7	days later 14	days later 21	days later 28	averag		
Ambar 33	21.68	17.55	15.78	16.53	17.10	17.73		
Yasmin	28.23	23.00	16.22	15.97	17.12	20.11		
Dijlah	21.07	19.77	14.47	15.10	15.88	17.26		
Ambar. Baraka	18.23	16.70	15.70	15.52	17.25	16.68		
Furat 1	23.50	22.65	17.15	17.72	18.08	19.82		
Average	22.54	19.94	15.87	16.17	17.09			
LSD 0.05	Cultivar harvest dates interaction							
	1.49 1.49 3.32							
	Harvest date at or after physiological maturity for the 2021 season							
Cultivars	At physiological maturity	days later 7	days later 14	days later 21	days later 28	averag		
Ambar 33	18.90	17.90	15.70	15.52	17.25	17.05		
Yasmin	19.72	18.45	16.62	17.47	18.02	18.06		
Dijlah	18.40	16.40	15.52	16.15	16.83	16.66		
Ambar. Baraka	20.20	16.20	15.80	16.30	16.88	17.07		
Furat 1	19.55	18.35	16.52	17.02	18.48	17.98		
Average	19.36	17.46	16.04	16.50	17.49			
LSD 0.05	Cultivar harvest dates interaction							
	1.06	1.06		2.38				

Table 10: The effect of cultivars, harvest dates and their interaction on electrical conductivity (microsiemens.cm-1.gm-1test) for seeds resulting from field experience for the 2020 and 2021 seasons.

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Discussion

This result agrees with ^{1,7,19,20} in increasing the germination percentage with a delay in time of harvest, and then then it tends to stabilize or decrease slightly. The cultivar Amber AL Baraka was registered at the third harvest date. The highest mean of the trait was 56.0% for both seasons. These results also agree with findings ^{2,17} in that cultivars differed significantly in the percentage of standard germination. The seeds resulting from the third harvest date (14 days after physiological maturity) gave the highest average for the trait 92.9 and 93.9% for the two seasons, respectively, compared with the harvest date at physiological maturity, which came last in both seasons, with the lowest mean of the trait reached 77.3 and 77.6%, respectively. These results agree with ^{1,9,20} in the significant effect of harvest dates on germination percentage.

These findings agree with what was found ¹⁵ in the different seedlings of rice cultivars in the trait of root length, also with ^{2,17} that their results indicated the rice seedlings that excelled in germination speed and plumule length gave vigorous seedlings superior in radical length.

This agrees with ¹¹ different harvest dates in the radical length trait. The cultivar Amber al-Baraka at the third harvest also recorded the highest average of 11.7 and 12 cm for the two seasons respectively. The results are in agreement with the findings ^{15,20} In the occurrence of a significant variation in the characteristics of seedlings of cultivars of rice in the average dry weight of seedlings; also, these results are in agreement with the results of study ^{2,17}, in that the seeds of the rice cultivars that excelled in the speed and percentage of germination and gave their seedlings the highest average dry weight of the seedling.

Moreover, these results agree with ⁷ that the rate of the dry weight of the seedling increased with the increase in the harvest time and then tended to stabilize or decrease slightly. It also agrees with ^{4,20} in the effect of harvest dates significantly on the dry weight of seedlings.

These results agree with ^{15,20} in the harmful effects of seed aging, including a decrease in germination. It also agrees with ^{8,15} in the difference between several varieties of rice seeds in the germination percentage after being subjected to the accelerated aging test. This agrees with ⁹ that the potent seeds are resistant to severe stress conditions and deteriorate less than those that do not have the strength.

These results agree with ^{2,16} In the presence of a significant difference between the rice varieties in the characteristics of seedling growth, including the characteristic of seedling vigor, and there was a significant positive correlation between germination percentage, radical length, dry seedling weight and seedling vigor index.

These results agree with ¹⁸ that the seeds of five rice cultivars differed in the electrical conductivity test.

Finally, changes in seed membrane systems occur during the seed development period to physiological maturity and drying before harvest and safety of seed membranes. The amount of imbalance determines the biochemical changes and physical rupture, which are the main reasons for the variation in seed vegore, and this affects the number of electrolytes leaked during the electrical conductivity test ¹⁴. These results agree with ²⁰ in the significance of the effect of harvest dates on electrical conductivity.

Conclusions

We conclude that the seeds of the Amber AL-Baraka cultivar showed the best performance in the germination tests. By judging the studied indicators and their results, the Dijlah variety, with the superiority of this variety in the characteristics of stress (accelerated aging and cold test) and date of harvest 14 days after physiological maturity, is suitable for obtaining the highest figure of the seeds. We recommend planting the seeds of the cultivar Amber Baraka or Dijlah and harvesting them after 14 days of physiological maturity to obtain the highest strength and vitality of these seeds.

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