



# Yield and quality of the Indian mustard (*Brassica juncea L.*) under the effect of planting dates and nitrogen fertilizer levels in southern Iraq.

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## Abstract.

Two field experiments were conducted in winter season 2021-2022 at two different locations namely, Al-Hartha Agricultural Research Station / College of Agriculture, and the second in the Al-Zubair district to study the effect of three planting dates (15<sup>th</sup> October, 1<sup>st</sup> November and 15<sup>th</sup> November) and four levels of nitrogen fertilizer (0, 80, 160, 240 kg N ha<sup>-1</sup>) on yield and quality of Indian mustard. Factorial experiment according to Randomized complete block design (R.C.B.D) was used with three replicates. The results showed that the date of 15<sup>th</sup> October was superior and achieved the highest mean of seed yield and oil percentage of 8.851 µg ha<sup>-1</sup>, 42.26 % for Al-Hartha location and 4.925 µg ha<sup>-1</sup>, 39.95% for Al-Zubair respectively. The level of 240 kg N ha<sup>-1</sup> gave the highest seed yield of 8.308 and 3.850 µg ha<sup>-1</sup> for the two locations respectively. Whereas, the control gave the highest percentage of oil, reached 42.42 and 39.956 %, respectively. When planting at 15<sup>th</sup> October with application of 240 kg N ha<sup>-1</sup> level gave the highest seed yield of 11.770 and 6.453 µg ha<sup>-1</sup> for the two locations respectively, while planting at 15<sup>th</sup> October with control had the highest oil percentage of 45.4 and 40.7%, for the two locations respectively.

**Keywords:** Mustard, Planting date, Nitrogen, Yield. Protein

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## 1-Introduction

Mustard is one of the important crops belonging to the family Brassicaceae, and is considered a weed, but it is cultivated for the purpose of its green edible leaves, as well as to obtain oil from its seeds, as it is an economically important crop among the oil crops due to its high productivity of oil and protein[1]. It has a variety of medicinal uses. The date of planting is one of the most important and controllable

agricultural processes that affect the quality and productivity of agricultural crops[2], as the different planting dates contribute to providing a different environment of temperature and light duration that affects plant growth[3]. Therefore, there is a possibility to increase the production of oil crops by relying on good management in agriculture, such as choosing the date of planting[4]. With the different planting date, changes occur to climatic



conditions that may affect most of the vital activities that take place in the soil and plants, and that the performance of the mustard plant is closely related to climatic changes [5,6]. It was found [7] that the plants of the date of 1<sup>st</sup> October gave the highest number of seeds, weight of 1000 seeds, seed yield and percentage of oil, [8] In a study of the effect of three planting dates (5<sup>th</sup> October, 15<sup>th</sup> October and 30<sup>th</sup> November), he indicated that the highest average of the number of pods per plant, the number of seeds per pod, the weight of the seeds per plant and the plant yield of mustard was obtained from the plants of the date 15<sup>th</sup> October, On the other hand, the date of November 30<sup>th</sup> gave the lowest seed yield. Nitrogen is one of the most important nutrients, the main component of protoplasm, protein, and is involved in many metabolic processes that affect growth, productivity and quality. It was found [9] that the highest number of pods per plant, number of seeds per pod, plant yield, 1000-seed weight, seed yield, and percentage of protein and oil were obtained at the level of fertilization 120 kg ha<sup>-1</sup>, [10] when fertilizing mustard with four levels of nitrogen fertilizer (0, 40, 80 and 120 kg N ha<sup>-1</sup>) the level of 120 kg N ha<sup>-1</sup> was superior and gave the highest seed yield, It was noted [11] that the level of 120 kg N ha<sup>-1</sup> gave the highest seed yield. Due to the few studies on this crop, the research aims to determine the appropriate date for planting in the conditions of southern Iraq, as well as the optimum nitrogen level, These two factors are important in determining the first steps of producing any crop.

## 2-Materials and Methods

Two field experiments were conducted in winter season 2021-2022 at two locations namely: Al-Hartha Agricultural research station /

College of Agriculture, north of Basrah Governorate in clay loam soil (30.66°N latitude and 47.75°E longitude), the second: in the Al-Zubair district, located in the southwest of Iraq, in sandy loam soil (latitudes 29° and 31.30° north and longitudes 46.30° and 48.30° ) to study the effect of three planting dates (15<sup>th</sup> October, 1<sup>st</sup> November and 15<sup>th</sup> November) and four levels of nitrogen fertilizer (0, 80, 160, 240 kg N ha<sup>-1</sup>) on yield and quality of Indian mustard. Factorial experiment according to Randomized complete block design (R.C.B.D) was used with three replicates. Physical and chemical properties of the soil were presented in Table 1. To prepare for planting the field plowed with cultivator and divided with plot with an area of 3 \* 2 m<sup>2</sup>, contained 4 lines with a distance of 50 cm between one line and another and 20 cm between plants. Urea fertilizer (46% N) was added as a source of nitrogen in two doses, the first after 21 days of planting and the second after 30 days of the first adding. Phosphate fertilizer was added for each plot before planting as a calcium superphosphate at a rate of 100 kg P ha<sup>-1</sup> [12], Irrigation was carried out at Al-Hartha location with river water, while Al-Zubair location was irrigated with well water, their properties are shown in Table 1. The average temperature, thermal accumulation and monthly total solar radiation are shown in Table 2, when the plants reached the maturity, ten plants were selected from the middle lines and the following traits were measured: Number of pods, number of seeds per pod, weight of 1000 seeds, seed yield per plant, total seed yield, percentage of protein and oil. The data were statistically analyzed using the statistical program GenStat . using the least significant difference (L.S.D) test at the level of significance 0.05 [13].

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**Table (1) Some Physical and chemical properties of soil**

Properties	pH	E.C (ds m <sup>-1</sup> )	E. C Irrigation water	Available nutrients (mg kg <sup>-1</sup> )			Soil Texture
				N	P	K	
Hartha	7.45	7.16	3.00	69.40	30.70	139.70	Clay loam
Zubair	7.68	12.04	10.35	60.00	2.89	111.37	Sandy loam



**Table (2) Monthly average temp. , thermal assembly and monthly solar radiation during the season 2021- 2022**

Months	Average temp. (C) °		Thermal assembly (C) °		Monthly solar radiation Mj m <sup>-2</sup> DAY <sup>-1</sup>	
	Al- Hartha	Al-Zubair	Al- Hartha	Al-Zubair	Al- Hartha	Al-Zubair
Oct.	28.23	28.75	634.54	650.23	16.13	15.13
Nov	20.48	20.17	464.90	457.86	14.78	13.45
Dec	14.17	14.04	315.60	310.70	8.77	11.01
Jan	12.83	11.94	242.45	225.72	10.25	10.34
Feb.	16.73	15.68	328.50	307.88	10.55	9.43
Mar.	19.64	18.15	458.65	423.58	15.12	11.90
Apr.	27.75	26.40	341.35	324.74	16.56	16.13

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### 3- Results and Discussion

#### 3.1. Yield Components

The results of Table 3 indicate that the date of 15<sup>th</sup> October, gave the highest average of the yield components for both locations, at Al-Harthalocation, the number of pods, the number of seeds in the pod, and the weight of 1000 seeds was 916.60 pod plant<sup>-1</sup>, 17.12 seed pod<sup>-1</sup>, and 5.677 g, As for the Zubair location, it gave 553.1 pod plant<sup>-1</sup>, 15.86 seed pods<sup>-1</sup>, and 5.499 gm respectively.On the other hand, the date of 15<sup>th</sup> November gave the lowest averages for both locations, except for the number of seeds per pod, which gave the lowest value of 15,664 seed pod<sup>-1</sup> at the date of 1<sup>st</sup>November at Al-Hartha location.This may be due to the appropriate environmental conditions that accompanied germination and growth, especially temperatures and thermal and solar collection (Table 2).which gave the plant sufficient opportunity during this date to continue to grow, increase the effectiveness and efficiency of the photosynthesis process, and increase the production of dry matter, which led to an increase in food manufactured

within the plant and distributed to the various consumption parts (flowers and fruits).As for the effect of nitrogen fertilization, the results of Table (3) indicate that the fertilizer level 240 kg N ha<sup>-1</sup> was superior to the average number of pods per plant and the number of seeds per pod for both locationsexcept for the weight of 1000 seeds, which was not significant for the two locations,The Al-Hartha location recorded 956.40 pod plant<sup>-1</sup> and 16,787 seed pod<sup>-1</sup> for the two traits, respectively, At the Zubair location, it reached 487.7 pod plant<sup>-1</sup> and 15.56 seed pod<sup>-1</sup>, respectively,While the comparison treatment recorded the lowest average of 551.00 pod plant<sup>-1</sup> and 16,300 seed pod<sup>-1</sup> at Al-Hartha location, and 230.10 pod plant<sup>-1</sup> and 13.33 seed pod<sup>-1</sup>, respectively, at the Zubair location.The increase in the components of the yield by increasing the level of nitrogen fertilization is due to the important physiological role of nitrogen in the molecular structure of biomolecules such as Porphyrin, which is found in important metabolic compounds such as chlorophyll pigments and cytochromes, which are essential in the



processes of photosynthesis and respiration, In addition to its role in the manufacture of enzymes and their coenzymes and the production of essential amino acids in building protein [14].

### 3.2. Seed yield

The yield of a mustard plant is produced from three components: the number of pods in the plant, the number of seeds in the pod, and the weight of the seed. It is clear from the results of Table (3) the significant effect of planting dates on seed yield, as the first date 15<sup>th</sup> October outperformed the other dates, recording the highest plant seed yield and total seed yield of mustard for both locations reached 87.45 and 47.19 gm plant<sup>-1</sup>, 8.851 and 4.925 µg ha<sup>-1</sup> for the Al-Hartha and Al-Zubair locations respectively, While the third date 15<sup>th</sup> November recorded the lowest average of 40.73 and 16.82 gm plant<sup>-1</sup>, 4.165 and 1.673 µg ha<sup>-1</sup> for the two locations respectively. The increase in yield on the date of 15<sup>th</sup> October may be attributed to the increase in the number of pods in the plant and the number of seeds in the pod, and the late planting led to a decrease in the number of pods in the plant a result of the coincidence of the formation of flower buds with high temperatures, Planting at a later date leads to an acceleration of the growth and development of buds at the expense of the number of buds that develop into pods, and then the number of pods formed in the plant decreased, This is consistent with [7, 3, 15, 16]. The results of Table 3 show that the level of 240 kg N ha<sup>-1</sup> was superior to the plant seed yield and total plant yields for both locations, and it gave 83.39 and 38.11 gm plant<sup>-1</sup>, 8.308 and 3.850 µg ha<sup>-1</sup> for the two locations respectively, while the control treatment gave the lowest average of 48.39 and 16.01 gm plant<sup>-1</sup>, 4.873 and 1.579 µg ha<sup>-1</sup> for the two locations respectively. The increase in plant production of

seeds by increasing the level of nitrogen is a natural result of the effect of nitrogen on expansion and cell division, which leads to an increase in the growth of the vegetative growth and the resulting increase in the number of pods per plant and the number of seeds per pod (Table 3), which leads to a higher plant yield. This result agrees with [10, 11, 17].

### 3.3. Protein and Oil %

The results of Table 3 show that the date of 15<sup>th</sup> October gave the highest percentage of seeds protein and oil. Al-Hartha location recorded 24.87 and 42.26%, while the Zubair location gave 21.59% and 39.96% for respectively, while the third date gave the lowest of 20.05 and 36.55% at Al-Hartha location, and 19.76 and 35.46% at Al-Zubair location for the two traits, respectively, Table 3 shows the superiority of the level of 240 kg N ha<sup>-1</sup> in the percentage of protein, which gave 23.67 and 21.83% for the two locations respectively with a par with 160 kg N ha<sup>-1</sup>, While the control recorded the lowest of 20.75 and 19.61% for the two locations respectively. Table 3 also shows that the control treatment gave the highest percentage of oil of 42.42 and 39.02% for the two locations respectively. This decrease in the percentage of seed oil with the increase in the level of nitrogen may be attributed to the fact that the element is the main component of the structural tissue units of the plant, and the increase in the level of the element has led to support the construction of these tissues at the expense of the percentage of seed oil according to inverse relationship, Also, the increase in the number of seeds per plant resulting from the increase in the level of nitrogen may be a reason for the decrease in the percentage of oil in the seeds because there is a negative relationship between the number of seeds per plant and the percentage of oil in the seeds [18]

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**Table (3) Effect of Sowing Dates and nitrogen fertilizer level on Components of yield, yield and quality of Indian mustard for Al-Hartha and Al-Zubair locations**

Treatments	Pods Plant <sup>-1</sup>	Seeds Pod <sup>-1</sup>	1000 seed weight (g)	Seed yield g plant <sup>-1</sup>	Seed yield µg ha <sup>-1</sup>	Protein %	Oil %
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Al-Hartha								
Planting Dates	15 <sup>th</sup> October	916.60	17.120	5.677	87.45	8.851	24.87	42.26
	1 <sup>st</sup> November	794.90	15.664	4.996	61.60	6.032	21.23	40.76
	15 <sup>th</sup> November	531.60	16.102	4.950	40.73	4.165	20.05	36.55
LSD( $p \geq 0.05$ )		22.34	0.3642	0.3124	2.653	0.2359	0.4445	0.553
N level (kg h <sup>-1</sup> )	0	0551.0	16.300	5.311	48.39	4.873	20.75	42.42
	80	690.10	15.741	5.239	55.50	5.549	21.28	41.42
	160	793.20	16.353	5.064	65.76	6.667	22.51	37.62
	240	956.40	16.787	5.217	83.39	8.308	23.67	37.97
LSD( $p \geq 0.05$ )		25.80	0.4205	N. S	3.064	0.2723	0.5133	0.639
Al-Zubair								
Planting Dates	15 <sup>th</sup> October	553.1	15.86	5.499	47.19	4.925	21.59	39.96
	1 <sup>st</sup> November	366.7	14.5	4.443	24.87	2.398	20.93	38.63
	15 <sup>th</sup> November	244.6	14.26	4.558	16.82	1.673	19.76	35.46
LSD( $p \geq 0.05$ )		11.800	0.572	0.210	1.914	0.1546	0.607	0.398
N level (kg h <sup>-1</sup> )	0	230.1	13.33	4.849	16.01	1.579	19.61	39.02
	80	393.5	14.88	4.833	29.06	2.993	20.32	38.70
	160	441.4	15.79	4.994	35.33	3.571	21.29	36.77
	240	487.7	15.56	4.658	38.11	3.850	21.83	37.58
LSD( $p \geq 0.05$ )		13.63	0.661	N. S	2.210	0.1785	0.701	0.4595

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### 3. 4. Effect of interaction

Table 4 shows the significant effect of the interaction between the factors, as the combination between the planting date 15<sup>th</sup> October and the fertilizer level 240 kg N ha<sup>-1</sup> achieved a significant superiority over the other combinations., the highest averages of the number of pods, the number of pod seeds, plant yield and total plant yield were 1157.50 and 726.1 pods plant<sup>-1</sup>, 18,447, 16.31 seed pods<sup>-1</sup>, 117.92, 58.96 gm plant<sup>-1</sup>, 11.77 and 6.453 µg ha<sup>-1</sup> for the two locations, respectively. While the third date with the control treatment gave the lowest values. The interaction did not have a significant effect on the weight of 1000 seeds and the percentage of protein in the Zubair location only, The date of 15<sup>th</sup> October with the control treatment was superior in the percentage of oil in the seeds reached 45.4 and 40.7% for the two locations respectively.

**Table (4) Effect of interaction between Sowing Dates and nitrogen fertilizer level on Components of yield, yield and quality of Indian mustard for Al-Hartha and Al-Zubair locations**



Planting Dates	Nitrogen levels (kg h <sup>-1</sup> )	Pods Plant <sup>-1</sup>	Seeds Pod <sup>-1</sup>	1000 seed weight (g)	Seed yield g plant <sup>-1</sup>	Seed yield µg ha <sup>-1</sup>	Protein %	Oil %
<b>Al-Hartha</b>								
15 <sup>th</sup> October	0	623.20	16.733	5.850	61.02	6.133	23.063	45.40
	80	783.90	16.657	5.900	76.24	7.733	23.470	45.33
	160	1101.70	16.643	5.317	94.62	9.767	24.927	39.20
	240	1157.50	18.447	5.642	117.92	11.770	28.020	39.09
1 <sup>st</sup> November	0	567.90	16.333	5.417	50.35	5.013	20.120	43.39
	80	760.00	14.847	5.000	57.14	5.480	21.150	43.33
	160	714.00	15.700	5.283	59.54	5.880	21.617	37.11
	240	1137.8	15.777	4.283	79.35	7.753	22.040	39.20
15 <sup>th</sup> November	0	462.00	15.833	4.667	33.80	3.473	19.067	38.47
	80	526.30	15.720	4.817	33.13	3.433	19.207	35.59
	160	563.90	16.717	4.592	43.11	4.353	20.983	36.53
	240	574.00	16.137	5.725	52.89	5.400	20.937	35.60
LSD (p≥0.05)		44.69	0.7284	0.6247	5.307	0.4717	0.8890	1.107
<b>Al-Zubair</b>								
15 <sup>th</sup> October	0	333.9	15.23	5.553	27.93	2.793	20.54	40.703
	80	567.9	15.67	5.733	50.20	5.160	21.38	40.410
	160	584.6	16.24	5.510	51.68	5.293	21.61	39.437
	240	726.1	16.31	5.200	58.96	6.453	22.83	39.273
1 <sup>st</sup> November	0	197.4	13.13	4.377	11.41	1.117	20.11	38.203
	80	394.6	14.44	4.493	23.73	2.493	20.25	39.130
	160	437.3	15.53	4.750	32.22	3.150	21.35	38.177
	240	437.6	15.06	4.153	32.12	2.830	22.02	39.000
15 <sup>th</sup> November	0	158.9	11.62	4.617	8.69	0.827	18.17	38.147
	80	217.9	14.53	4.273	13.25	1.327	19.34	36.543
	160	302.4	15.59	4.723	22.09	2.270	20.92	32.690
	240	299.3	15.30	4.620	23.26	2.267	20.63	34.467
LSD (p≥0.05)		23.60	1.144	N. S.	3.829	0.3091	N. S.	0.7959

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## Conclusions

The environmental conditions when planting mustard seeds early (15<sup>th</sup> October) were suitable for mustard growth in the two locations, which was positively reflected in the seed yield. Also, the fertilizer level of 240 kg ha<sup>-1</sup> significantly exceeded the yield components and was positively reflected in the seed yield. Planting on time (15<sup>th</sup> October) with the use of a fertilizer level of 240 kg ha<sup>-1</sup> is appropriate to obtain a high yield of seeds per unit area.

## References

- [1] Collett, M.G.; Stegelmeier, B.L and Tapper, B.A. 2014. Could nitrile derivatives of turnip (*Brassica rapa*) glucosinolates be hepato- or cholangiotoxic in cattle? J. Agric. Food Chem. 62, 7370–7375. [CrossRef] [PubMed].
- [2] Wang, S., Wang, E., Wang, F. and Tang, L. (2012) Phenological Development and Grain Yield of Canola as Affected by Sowing Date and Climate Variation in the Yangtze River Basin of China. Crop & Pasture Science, 63, 478-488.
- [3] Monfared, N. S. ; G. N. Mohammadl ; A. H. S. Rad and E. M. Heravan (2020). Effects of sowing





date and glycine betaine application on yield components and oil yield in canola (*Brassica napus L.*). Turkish Journal Of Field Crops, 25(1), 32-40.

- [4] Al-Obady R. F. A. and Shaker A. T. (2021). Effect of Sowing Dates and Compound Fertilizer NPK on Growth and Yield of Flax (*Linum usitatissimum L.*). Basrah J. Agric. Sci., 34(4), 2021.
- [5] Gupta, M., Sharma, C., Sharma. R., Gupta V, Khushu MK., 2017. Effect of Sowing Time on Productivity and Thermal Utilization of Mustard (*Brassica juncea L.*) Under SubTropical Irrigated Conditions of Jammu. Journal of Agrometeorology, 19 (2): 137-141.
- [6] Kumar, A., Lal, M., Mohan, N., Kumar, M., Kumar, N., 2018. Effect of different sowing dates on yield and yield attributes of Indian mustard (*Brassica juncea L.*) genotypes. Int. J. Pure App. Biosci. 6(2): 848-853.
- [7] Matroad, S. A.. 2012. Effect of planting date, spacing and spray with salicylic acid on growth and yield of indian mustard (*Brassica juncea L.*) Czern. and Coss and its biochemical activities. PhD thesis, Department of Horticulture and Landscaping. college of Agriculture. Al-Basrah university.
- [8] Kumar. P. Yadav. A. (2022). To study the effect of different sowing date and sea weed extract on production and productivity of Indian mustard (*Brassica juncea L.*). The Pharma Innovation Journal. 11(7): 1688-1692.
- [9] Kumar, V., Nath, p. Kumar, R. Kumar, V., Verma, J. K. and Naresh, R.K. (2016). Interaction effect of Sulphur and Nitrogen on growth, Yield and Quality of Indian mustard (*Brassica Juncea L.*) I.J.S.N., 7 (1): 57-61.
- [10] Yadav, M. S. and Dhanai, C. S. (2018). Effect of fertilizers on yield and yield attributing characters of mustard (*Brassica juncea L.* Czern&Coss). Journal of Pharmacognosy and Phytochemistry, 7(2), 2300- 2303.
- [11] Al-Hamdaoui, Shakir Mutlaq Jassim. 2020. Effect of cultivar, nitrogen and sulfur fertilizers on growth and yield of mustard plant and seed content of Glucosinolate and Glutathione. Master's thesis. Field Crops Division. college of Agriculture. Al-Qasim Green University.
- [12] Ministry of Agriculture, (2000). Guidance leaflet on the cultivation of rapeseed, the General Authority for Agricultural Cooperation and Extension. Baghdad. Iraq.
- [13] Al-Rawi, K.M. & Khalaf Allah, A.M. 2000. Design and Analysis of Agricultural Experiments. Min. High. Educ. Sci. Res. Univ. Baghdad: 360pp. (In Arabic).
- [14] Espinosa, M., Turner, B. L. and Haygarth, P.M. (1999). Preconcentration and separation of trace phosphorus compounds in soil leachate. Journal of Environmental Quality, 28(5), 1497-1504.
- [15] Hashim. J. J. and Mahmood. B. J. (2021). Effect of Sowing Dates, Seeding Rates on Growth, Yield and its Component of Some Rapeseed (*Brassica napus L.*) Genotypes. Agricultural and Environmental Researches. 33(1).
- [16] Al-Rikabe, S. K. R. and Al-Doghachi, K. A. R. (2022). Effect of Planting Dates and Plant Densities on the Growth and Yield in Rapeseed in Southern Region of Iraq. Indian Journal of Ecology. 49(18): 52-56.
- [17] Shorna, S. I., Polash, M. A. S., Sakil, M. A., Mou, M. A., Hakim, M. A., Biswas, A. and Hossain, M. A. (2020). Effects of nitrogenous fertilizer on growth and yield of Mustard Green. The Journal of the Society for Tropical Plant Research, 7(1), 30-36.
- [18] Nigussie, Alemayehu, T. Adefris and T. Zerihum. (1996). Effect of agronomic practices on seed and oil yield of Ethiopian mustard (*Brassica carinata A. Braum*) and rape seed (*B. napus L.*) Trop. Agric. (Trinidad) vol. 73, No. 2, April (1996). p. 94-99.

