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Effect of some agricultural operations on the growth and yield of chickpea (*Cicer aritenium* L.)

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ABSTRACT: The study was carried out in the years 2022/2023 and included a field experiment in two locations (Rashidia and Alqosh districts in Iraq); each study contained 12 treatments resulting from combinations between two planting and harvest dates and three seeding rates for chickpea seeds: plantings in autumn and spring, with harvests on 5/15 and 6/1/2023; the sowing rates were based on different densities and the distance between the sowing lines (20-15-10 cm) was changed to obtain (150, 100 and 75) plants m^{-2}. A randomized block design was used in a factorial arrangement with three replications. The results of the individual factors for the autumn planting dates and harvest date on 05/15 indicated significant superiority of these two dates in all the characteristics studied; From the results of the sowing rates, the average superiority of 75 plants m^{-2} in the characteristics of the number of pods plant^{-1} and the seed index is noted. In contrast, seeding rates exceeded 75 and 100 plants m^{-2} in the seed pod^{-1} number trait, while seeding rates exceeded 150 plants m^{-2} in plant height, lowest pod height, seed yield and biological characteristics, for both experimental locations.
Keywords: plant-climate interactions; harvest dates; planting date; seeding rates.

Efeito de algumas operações agrícolas no crescimento e rendimento do grão-de-bico (*Cicer aritenium* L.)

RESUMO: O estudo foi realizado nos anos 2022/2023 e incluiu um experimento de campo em duas localidades (distritos de Rashidia e Alqosh no Iraque); cada estudo continha 12 tratamentos resultantes de combinações entre duas datas de plantio e colheita e três taxas de semeadura para sementes de grão de bico,: plantios no outono e primavera, com colheitas em 15/5 e 1/6/2023; as taxas de semeadura foram baseadas em diferentes densidades e a distância entre as linhas de semeadura (20-15-10 cm) foi alterada para obtenção de (150, 100 e 75) plantas plantas m^{-2}. Utilizou-se delineamento em blocos casualizados, em arranjo fatorial, com três repetições. Os resultados dos fatores individuais para as datas de plantio de outono e data de colheita em 15/05, indicaram superioridade significativa dessas duas datas em todas as características estudadas; a partir dos resultados das taxas de semeadura, nota-se a superioridade média de 75 plantas m^{-2} nas características do número de vagens planta^{-1} e o índice de sementes. Em contrapartida, as taxas de semeadura ultrapassaram 75 e 100 plantas m^{-2} na característica do número de sementes vagem^{-1}, enquanto a taxa de semeadura ultrapassou 150 plantas m^{-2} na altura da planta, altura da vagem mais baixa, rendimento de sementes e características biológicas, para ambos os locais experimentais.
Palavras-chave: interações planta-clima; datas de colheita; datas de plantio; taxas de semeadura.

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is One of the major crops that are legumes adapted to the conditions of the world's semi-arid and arid locations because of the crop's ability to absorb water from the soil with high efficiency because it has an in-depth root system that can reach water in the depths of the soil (Gan et al., 2012), the nutritional importance of chickpeas is due to the high percentage of protein digestion in it compared to other legumes, as well as the high rate of essential amino acids and low and nutrients, and the % protein in its seeds can reach (22%), Chickpea seeds are high in carbohydrates (52-70%) and fats (4-10%) as well as fiber, oils, calcium, and phosphorus (Qasim et al., 2010) and chickpeas are of great importance in agricultural rotations due to improved soil fertility through atmospheric nitrogen fixation by streptococcus bacteria (ALI et al., 2021; ALI et al., 2023). Planting seasons greatly affect the characteristics of leguminous crops, including chickpeas, because the variation of planting seasons leads to the variation of synchronization of appropriate or inappropriate environmental conditions that the crop goes through in its different stages of growth according to the dates chosen for planting (ABDULQADER et al., 2021).

The impact of appointments increases, especially in dry areas with low moisture content, due to the varying amount of rain that the crop exploits during its growth, and this effect is exacerbated by the sharp rise in temperatures, especially in the later stages of plant life, the increase in consequences of global warming, the scarcity of water resources, and the increase in drought and desertification (ALI, 2021; ALI et al., 2023; ALI et al., 2024).

The production of chickpeas is affected a lot by the growing seasons, so the appropriate date must be determined for planting the crop accurately because of the sensitivity of the crop to frost and the possibility of infection with leaf spot disease (Askokaita), which is active during frost periods, and the crop is grown during the winter in the Indian subcontinent and Latin America and during the spring in the Mediterranean basin. Since the seventies of the last century, there have been attempts to introduce winter agriculture to the areas where the crop is grown during the spring by developing varieties that bear grades Low heat and resist blight (associate spot). Studies (Lopez et al., 2008) in this area indicated that the yield of the winter planting season is almost twice as high as the spring planting season.

In Iran, Sadeghipour; Aghaei (2012) studied the effect of three winter dates (12/10, 2/11, and 22/11) and two spring dates (16/3 and 6/4) on chickpea yield. They noted that the second winter date significantly outperformed the biological yield (g m^{-2}), the number of seeds in every pod, the number of pods in every plant, and the seed yield per m^2. Sikdar (2015) observed a significant superiority of the winter over the spring season in most studied qualities. Thombre et al. (2019) noted that winter dates excelled in plant height, 100 seed weight, number of pods, biological yield and seed yield. Getachew; Abraham (2021), when studying four planting dates (4, 14, 24 September, and 5 October) for some chickpea varieties (Dube, Dalota, Teji, and Ejere), noted a high significant superiority for the date of September 14 in most of the studied traits. Sandeep et al. (2023) found significant differences between most of the studied traits of the chickpea crop when planted with different planting dates.

The main reason for the low yield of leguminous crops in general and chickpeas is the fall of flowering before maturity or the occurrence of the breakup of the pods at maturity and the scattering of seeds, reducing the breakup will lead to an increase in the yield of leguminous crops in general, including the chickpea crop. There is a lot of controversy about whether the yield of legumes is determined by the size and number of pods, the size and number of seeds, or the number of leaves formed early and their ability to carry out photosynthesis.

Many studies are in favor of the size and number of pods and the size and number of seeds as the pods that are formed early as a result of the activity of the vegetative part of the plant are heavier than those that form late and that these pods and seeds will be prone to breakup Early and thus the loss of large amounts of yield as a result of the seeds breaking from the pods. Many signs of crop maturity include plant discoloration to yellow, corns, or browning and low humidity below 20% (BEGUM et al., 2007).

One method to reduce breakup is to use different harvest dates. Yang (2012) stated that early harvesting, when the color of the pods changed from green to yellow, resulted in obtaining the highest number of pods/plants, the number of seeds/pods, the weight of 1000 seeds, the seed yield, and the biofield, but the delay in harvesting led to a decrease in all these qualities. Enaiat; Sharafizadeh (2013) found that in early harvesting, when the color of the pods changed from green to yellow or brown, it was possible to obtain the maximum seed yield and vital yield, but the delay in harvesting led to a decrease in seed yield due to the breakdown of the pods and the scattering of seeds. Saini; Thakur (2014) found that early harvesting after ten days of ripening and yellowing of the pods led to a significant increase in the characteristics of the number of pods/plants, number of seeds/pods, and weight of 1000 seeds compared to late harvesting after thirty days of maturity and yellowing of the pods. In their study, Rahman; Akter (2015) deduced the nominal effect of the first harvest when most of the pods are colored yellow and the second most of the pods are colored brown. As the two dates differed, the date of the first harvest exceeded the second in the traits of the number of seeds/pods, the number of pods/plants, the weight of (1000) seeds, the biological yield, and the seed yield.

Seeding rates are defined as the ideal number of seeds for sowing plants, which will result in the required number of plants per unit area to give the highest production at the lowest production costs (seeds + fertilizers + pesticides, etc.). Seeding rates and, thus, plant density vary according to the crop, soil fertility and prevailing environmental conditions.

Plant density is determined by the amount of seeding, seed size, degree of vitality, and purity of Studies in this field showed that the study of Cokkizg (2012) showed the superiority of plant height and the height of the lowest pod in high seeding rates (50 and 60 plants m^{-2}). The average plant height (46.10 – 45.50 cm) and the average height of the lowest pod (30.70 – 33.00 cm) in these two qualities, respectively), and the number of branches.$plant^{-1}$ increased significantly at low seeding rates (30 plant m^{-2}) and the number of branches (2.75 branches $plant^{-1}$). Then, it decreased to (2.40-2.43-2.17 branches $plant^{-1}$) when seeding rates were increased to 40, 50, and 60 plants m^{-2}, respectively. Gan et al. (2012) found that growing seeding rates from 20 to 30, 40, and 50 plants m^{-2} led to a significant in seed yield kg ha^{-1} and a significant decrease in pods and seeds/pods. Ray et al. (2017) noted that the average of 50 kg ha^{-1} was substantially superior in seed yield, weight of 100 seeds, and seeding rate of 60 kg e^{-1} was significantly higher than 100 seeds and biological yield. Choudhary et al. (2022) confirmed an increase in seed yield and biological yield by increasing seeding rates to 80 kg ha^{-1}, but the number of pods $plants^{-1}$ increased with lower rates.

The study aims to determine the impact of planting seasons, seeding rates, and harvest dates on the development and output of local chickpeas (*Cicer arietinum* L.).

2. MATERIAL AND METHODS

The study was carried out in the years 2022/2023 and included a field experiment in two sites (Rashidiya and Alqosh district); each study included 12 worker treatments resulting from combinations between two dates for planting and harvesting and three seeding rates for local chickpea seeds grown in Nineveh Governorate and the factors were implemented as follows: Planting dates autumn 1/11 spring 15/2. The second factor was the number of plants in every area. The area was 4.5 m^2 and included five lines, each measuring three meters in length and spaced thirty centimeters apart; the experimental unit contained (150,100,75) plants, and the distance between the holes (20-15-10 cm) was changed to obtain the required numbers for each experimental unit. The third factor is two harvest dates, 15/5 and 1/6/2023.

The (R.C.B.D) was used according to the system of factor experiments with three replicates, the design chosen for analyzing the data, and the differences between the averages were tested according to the Dunkin' multi-range method. The land was plowed on two perpendicular plows with the dump plow and then smoothed with the awl.

The parameters in the experimental units of each repeater were randomly distributed, and the seeds were planted at a depth of approximately 5 cm. Fertilizer with nitrogen was added at a rate of (40 kg nitrogen ha^{-1}) at once at the planting of each appointment in the form of urea $CO(NH_2)2$ 45-46% N as a booster dose. Superphosphate fertilizer (P_2O_5) was included at 46% at a rate of (40 kg ha^{-1}) when planting according to the scheduled dates for all experimental units, and the bush was controlled manually twice in both sites. The harvesting process was carried out manually or according to the ripening periods. The following characteristics were studied: plant height (cm) and number of primary branching $plant^{-1}$, height of the first pod above ground (cm), number of pods $plant^{-1}$, and number of seeds pod^{-1}, seed index (g), seed yield (g m^{-2}), and biological yield (ton ha^{-1}).

3. RESULTS

3.1. Plant height (cm)

The results obtained in Table 1 show a significant superiority in the height of plants planted on the autumn date (45.74 and 38.88 cm) compared to the spring date (40.16 and 34.33 cm). The rationale behind plants' superior height in the autumn date compared to the spring date is the result of the prolonged crop time growth and the availability of appropriate environmental conditions of heat and humidity during the period of plant elongation, and this was reflected in the height of the plants planted on the autumn date. This outcome was comparable to the result of Sikdar (2015), Thombre et al. (2019), Getachew; Abraham (2021) and Sandeep et al. (2023).

The height of the harvested plants on the date 15/5 morally exceeded the average recording of (43.20 cm) on the harvest date 1/6 and reached an average of (42.98 cm) at site one because the more the plant height in the high seeding rates is due to the elongation of plants due to the effect of shading plants for each other and thus increasing their lighting competition. In site 2, the plants harvested on 15/5 and 1/6 did not record significant differences, and the height was (36.47 and 36.73 cm) for the two harvest dates, respectively (Islam et al., 2010).

It reached a significant superiority of plant heights when planting at a rate of 150 plants m^{-2}, where a height of (52.75 and 42.90 cm) was obtained, while the plant height rate decreased significantly to (33.70 and 29.94 cm) when planting 75 plants m^{-2}. The superiority of the height of plants at high seeding rates is due to shading due to crowding between plants. It thus activates auxin in shading places, which encourages cell division and, therefore, increases the height of plants to obtain the largest amount of light, which agrees with the study of Cokkizg (2012).

Table 1. Effect of some agricultural operations on plant height (cm).
Tabela 1. Efeito de algumas operações agrícolas na altura das plantas (cm).

Planting dates	Harvest time	Seed rate			Planting dates * Harvest time
		75 plants m^{-2}	100 plants m^{-2}	150 plants m^{-2}	
		Site 1			
Autumn	15/5	37.37 d	43.25 c	58.05 a	55.64 a
	1/6	35.08 d	44.21 c	56.47 a	56.25 a
Spring	15/5	32.31 e	41.11 cd	47.14 b	44.36 b
	1/6	30.02 e	41.02 cd	49.33 b	40.19 c
Seed rate averages		33.70 c	42.40 b	52.75 a	
		Planting dates * Seed rate			Planting dates average
Autumn		51.75 b	52.74 b	57.35 a	45.74 a
Spring		37.37 d	40.25 c	43.11 c	40.16 b
		Harvest time * Seed rate			Harvest time average
15/5		50.14 ab	53.64 a	54.36 a	43.20 a
1/6		47.58 b	50.25 ab	52.34 a	42.98 a
		Site 2			
Autumn	15/5	33.77 de	37.36 c	43.69 a	44.52 a
	1/6	31.95 de	39.99 bc	46.52 a	43.65 a
Spring	15/5	28.07 e	35.58 d	40.40 b	32.58 b
	1/6	25.98 e	34.96 d	41.00 b	35.96 b
Seed rate averages		29.94 c	36.97 b	42.90 a	
		Planting dates * Seed rate			Planting dates average
Autumn		40.22 b	40.95 b	45.65 a	38.88 a
Spring		34.65 c	35.69 c	38.69 bc	34.33 b
		Harvest time * Seed rate			Harvest time average
15/5		40.69 ab	43.30 a	42.69 a	36.47 a
1/6		38.52 b	40.22 ab	42.36 a	36.73 a

3.2. Number of branches $plant^{-1}$

The data in Table 2 indicate significant differences in the number of branches $plant^{-1}$ by different planting dates in the two study sites, where the number of branches $plant^{-1}$ increased significantly on the autumn planting date compared to the spring. The number of branches on the first date reached (2.53 and 2.75 branches $plant^{-1}$) for the two study sites, respectively.

The number of branches for the spring date decreased to (2.15 -1.66 branches $plant^{-1}$) respectively. The increase in branching at the first date may be due to the longer vegetative growth period compared to the late dates, which is reflected positively in this trait. These results agreed with what was found by those who recorded a significant increase in the number of branches at early dates compared to late dates. This result agreed with Sikdar (2015), Thombre et al. (2019), Getachew; Abraham (2021). As for the harvest dates, a significant superiority is observed for the harvest date on 1/6 in the first site (2.47 branches plant^{-1}), while the harvest date on 5/15 in the second site (2.34 branches plant^{-1}) in the number of branches is significantly superior, and this may be due to the large variation between the environmental conditions between the two sites, and this was reflected in this trait more clearly than the other characteristics study conducted by Yang (2012).

Seeding rates significantly impacted the number of branches in the two study sites. The number of branches in the first site ranged from (3.00 branches plant^{-1}) at the rate of the third seeding, while the lowest average number of branches reached (1.72 branches plant^{-1}) at the rate of the third sowing. In contrast, at site 2, there were significant differences from the first site. A considerable superiority was recorded for the number of branches in the rate of first seeding, as the number of branches increased to (2.84 branches plant^{-1}), which significantly outperformed the rest of the seeding rates and the number of branches plant^{-1} decreased substantially below the rates of the third sowing (1,60 branch plant^{-1}).

The variation in the number of branches with different seeding rates is due to competition between plants for lighting and other sources of growth in the soil. The largest number of branches indicates perhaps the preference of the seeding rates used for each site in receiving an appropriate amount of lighting and stimulating the largest number of shoots to produce plant branches, and the result agreed with the results of Islam et al. (2010) and Cokkizg (2012).

Table 2. Effect of some agricultural operations on several branches plant^{-1}.
Tabela 2. Efeito de algumas operações agrícolas em diversas perfilhos planta^{-1}.

Planting dates	Harvest time	Seed rate			Planting dates * Harvest time
		75 plants m^{-2}	100 plants m^{-2}	150 plants m^{-2}	
Site 1					
Autumn	15/5	1.25 d	2.51 b	3.54 a	3.25 a
	1/6	1.99 c	2.21 b	3.65 a	2.54 b
Spring	15/5	1.65 cd	2.02 bc	2.25 b	2.01 c
	1/6	1.98 c	2.44 b	2.55 b	1.65 d
Seed rate averages		1.72 c	2.30 b	3.00 a	
		Planting dates * Seed rate			Planting dates average
Autumn		2.20 b	2.42 ab	3.06 a	2.53 a
Spring		1.54 c	1.87 c	2.02 bc	2.15 b
		Harvest time * Seed rate			Harvest time average
15/5		3.01 ab	3.30 a	3.33 a	2.20 b
1/6		1.58 c	2.20 bc	2.75 b	2.47 a
Site 2					
Autumn	15/5	2.97 a	3.41 a	2.15 b	3.22 a
	1/6	3.65 a	2.33 ab	1.96 b	3.11 a
Spring	15/5	2.65 ab	1.66 c	1.20 e	2.54 b
	1/6	2.08 b	1.28 d	1.10 e	2.41 b
Seed rate averages		2.84 a	2.17 b	1.60 c	
		Planting dates * Seed rate			Planting dates average
Autumn		2.34 ab	2.47 ab	2.98 a	2.75 a
Spring		1.42 c	1.87 bc	2.10 b	1.66 b
		Harvest time * Seed rate			Harvest time average
15/5		2.11 a	2.44 a	2.58 a	2.34 a
1/6		1.42 b	1.51 b	1.65 b	2.07 b

3.3. The height of the lowest pod (cm)

The results obtained showed a significant decrease in the height of the lowest pod for plants planted in the spring date compared to its height in the autumn date at sites 1 and 2 (Table 3), as the height of the lowest pod increased significantly in the autumn date to its maximum and reached (12.38 and 11.82 cm). In contrast, the height of the lowest pod decreased considerably in the spring date to (9.30 and 8.76 cm) for sites 1 and 2, respectively.

The increase in the height of the lowest pod in the autumn may be due to the coincidence of the high temperatures with planting on the spring date, especially during the flowering period. Thus, the high temperature of the soil may lead to the fall of flowering close to the soil surface or the failure of the fertilization process, and the result agreed with Thombre et al. (2019), Getachew; Abraham (2021) and Abdulqader et al. (2021).

The harvest dates significantly affected the lowest pod's height in the two study sites. A significant superiority was observed for the height of the lowest pod in site one at harvest on the first date and reached an average of (11.20 cm). In contrast, site 2 data violated the first site, and the second harvest date (10.09 cm) exceeded the first date for this capacity (ALI et al., 2021; ALI et al., 2023).

Seeding rates affected the height of the lowest pod in both sites. A significant superiority was observed for the height of the lowest pod in the two study sites at the planting rate at the rate of the third seeding of 150 plants m^{-2} amounted to (11.82 and 10.93 cm). In contrast, the lowest height of the lowest pod was recorded at planting at a seeding rate of 75 plants m^{-2} (9.94 and 9.55 cm) for the two sites, respectively, and in the Cokkizg (2012) study, they noticed an increase in the height of the lowest pod with increased seeding rates.

3.4. Number of pods plant^{-1}

The number of pods increased at the earliest planting dates, as the autumn date significantly exceeded the spring date at the two study sites (Table 4). The number of pods on the autumn date reached (10.70 – 7.98 pods plant^{-1}) in sites 1 and 2, respectively, and the number of pods on the spring date decreased to (4.74 – 4.03 pods plant^{-1}) in the two locations, respectively, the increase in the number of pods on time Al-Khorifi is due to the availability of sufficient time for plant growth and the increase in net photosynthesis to process plants with food and thus the formation of a larger number of pods due to the availability of appropriate environmental conditions to increase the percentage of nodes. These results agreed with Sadeghipour; Aghaei (2012), Sikdar (2015), Thombre et al. (2019) and Getachew; Abraham (2021).

Table 3. Effect of some agricultural operations of the height of the lowest pod (cm).
Tabela 3. Efeito de algumas operações agrícolas na altura da primeira vagem (cm).

Planting dates	Harvest time	Seed rate			Planting dates * Harvest time
		75 plants m-2	100 plants m-2	150 plants m-2	
Site 1					
Autumn	15/5	12.54 b	12.20 b	13.89 a	12.50 a
	1/6	10.52 cd	11.35 c	13.77 a	11.25 b
Spring	15/5	8.69 e	9.47 d	10.36 cd	9.86 c
	1/6	8.02 e	9.99 d	9.25 d	8.67 d
Seed rate averages		9.94 c	10.75 b	11.82 a	
		Planting dates * Seed rate			Planting dates average
Autumn		11.55 b	11.95 b	13.02 a	12.38 a
Spring		8.56 e	9.45 d	10.10 c	9.30 b
		Harvest time * Seed rate			Harvest time average
15/5		10.52 b	11.01 b	12.42 a	11.20 a
1/6		8.55 d	9.77 c	9.68 c	10.49 b
Site 2					
Autumn	15/5	10.65 c	11.99 b	12.97 ab	11.65 a
	1/6	10.00 c	11.63 b	13.65 a	11.99 a
Spring	15/5	9.02 d	9.25 d	9.00 d	9.12 b
	1/6	8.52 de	8.66 de	8.08 e	8.36 c
Seed rate averages		9.55 b	10.38 ab	10.93 a	
		Planting dates * Seed rate			Planting dates average
Autumn		10.34 b	11.79 ab	12.54 a	11.82 a
Spring		8.27 c	8.42 c	8.04 c	8.76 b
		Harvest time * Seed rate			Harvest time average
15/5		10.95 a	11.02 a	11.47 a	9.09 b
1/6		7.36 d	8.47 c	9.25 b	10.09 a

Table 4. Effect of some agricultural operations on the number of pods plant-1.
Tabela 4. Efeito de algumas operações agrícolas no número de vagens planta-1.

Planting dates	Harvest time	Seed rate			Planting dates * Harvest time
		75 plants m-2	100 plants m-2	150 plants m-2	
Site 1					
Autumn	15/5	11.76 a	11.31 a	10.85 ab	11.23 a
	1/6	10.35 a-c	10.05 a-c	9.88 a-c	10.21 ab
Spring	15/5	6.22 bc	5.94 bc	5.02 c	5.98 b
	1/6	4.22 d	4.02 de	3.02 e	3.75 c
Seed rate averages		8.14 a	7.83 b	7.19 b	
		Planting dates * Seed rate			Planting dates average
Autumn		10.64 a	10.54 a	9.64 a	10.70 a
Spring		5.64 b	4.86 b	4.65 b	4.74 b
		Harvest time * Seed rate			Harvest time average
15/5		10.20 a	9.24 ab	10.64 a	8.52 a
1/6		4.95 d	4.52 d	6.34 c	6.92 b
Site 2					
Autumn	15/5	9.40 a	8.36 a	8.02 a	9.57 a
	1/6	7.25 ab	7.65 ab	7.22 ab	7.65 b
Spring	15/5	5.76 b-d	6.47 a-c	4.96 de	5.85 c
	1/6	3.044 fg	2.41 fg	1.54 g	2.67 d
Seed rate averages		6.36 a	6.22 a	5.44 b	
		Planting dates * Seed rate			Planting dates average
Autumn		9.47 a	8.85 a	8.47 a	7.98 a
Spring		4.32 d	6.87 b	5.52 c	4.03 b
		Harvest time * Seed rate			Harvest time average
15/5		7.25 b	9.42 a	8.64 ab	7.16 a
1/6		3.25 d	4.68 cd	5.54 c	4.85 b

At site 1, the number of pods at harvest increased significantly on 15/5, and the average was (8.52 and 7.98 pods plant-1) for sites 1 and 2, respectively. The number of pods ranged (6.92 and 4.85 pods plant-1) at harvest by date 1/6, respectively, for sites 1 and 2. These results agreed with the results of Enaiat; Sharafizadeh (2013), Saini; Thakur (2014) and Rahman; Akter (2015). In legumes, many inflorescences are produced. Still, for the decade phase, only a few of them, and through the number of flowers, it is possible to predict the seed yield early by knowing the number of flowers produced, which will make the number of pods and the number of seeds and the weight of the seeds if the environmental conditions are favorable. At the same time, negative changes in ecological conditions lead to a decrease in yield Islam et al. (2010).

On the other hand, the number of pods significantly outperformed the decrease in seeding rates at site one. The number of pods at the rate of the first seeding (8.14 pods plant^{-1}) and the second site followed the same behavior with the superiority of the first and second seed rates, as they did not differ from each other morally. The rate reached (6.36 and 6.22 pods plant^{-1}), while the highest seeding rate wired 150 plants m$^{-2.}$ The lowest moral average for this trait amounted to (7.19 and 5.44 pods plant^{-1}) for sites 1 and 2, respectively. The cause of the rise in the number of pods in low seeding rates is due to the preference of the growth rate of plants and the availability of needs better at low seeding rates compared to high rates, and thus the low competition between plants at the seeding rate of 75 plants compared to other rates. In contrast, the decrease in pods at high rates is due to increased competition between plants. These findings are consistent with those of Gan et al. (2012) and Choudhary et al. (2022).

3.5. Number of seeds pod^{-1}

The planting dates at the study sites in Table 5 significantly impacted the number of seeds planted in autumn for sites 1 and 2, ranging between (1.21 and 1.07 seeds pod^{-1}), while the spring date ranged from seed number pod^{-1} (0.85 and 0.83 seeds pod^{-1}), and respectively these results agreed with Sadeghipour; Aghaei (2012), Thombre et al. (2019) and Getachew; Abraham (2021) and Sandeep et al. (2023) who found a significant effect of planting dates in this capacity. Harvest dates showed substantial differences in the number of seeds. They recorded a considerable superiority for the harvest date 15/5 in the number of seeds and for sites 1 and 2 where the number of seeds (1.09 seeds pod^{-1}) respectively and the number of seeds decreased significantly to (0.98 and 0.81 seeds pod^{-1}) at harvest on 1/6, and this was agreed with Saini; Thakur (2014) and Rahman; Akter (2015).

The variation in the number of seeds is due to the incompatibility of the appropriate environmental conditions of heat and humidity with the fertilization period of eggs in flower ovaries. The nature of the factors used in the study, such as dates and seeding rates, may also have an additional role in reducing or increasing the fertilization rate. In any case, the high number of seeds demonstrates a high fertilization rate, and vice versa, as shown by Enaiat; Sharafizadeh (2013).

The seeding rates significantly affected the number of seeds at the two sites. The number of seeds at site 1 (1.09 and 1.05 seeds pod^{-1}) for the seeding rates of 75 and 100 plants m^{-2} and recorded superiority of the same rates at site two and reached (1.02 and 0.99 seeds pod^{-1}) compared to the seeding rate of 150 plants m^{-2} which recorded the greatest values of (0.95 and 0.84 seeds pod^{-1}) for sites 1 and 2, respectively. These results agreed with Gan et al. (2012), who observed a significant effect of seeding rates on seed count trait pod$^{-1.}$ The decrease is due to heterogeneous seed distribution, increased number of plants, and poor seed contact with soil.

Table 5. Effect of some agricultural operations on several seeds pod^{-1}.
Tabela 5. Efeito de algumas operações agrícolas em diversas sementes vagem^{-1}.

Planting dates	Harvest time	Seed rate			Planting dates * Harvest time
		75 plants m^{-2}	100 plants m^{-2}	150 plants m^{-2}	
Site 1					
Autumn	15/5	1.45 a	1.26 ab	1.10 ab	1.25 a
	1/6	1.07 ab	1.35 ab	1.04 ab	1.10 a
Spring	15/5	1.00 b	0.80 bc	0.90 b	0.94 b
	1/6	0.84 bc	0.80 bc	0.77 c	0.80 b
Seed rate averages		1.09 a	1.05 a	0.95 b	
		Planting dates * Seed rate			Planting dates average
Autumn		1.24 a	1.30 a	1.07 ab	1.21 a
Spring		0.93 c	0.80 c	0.86 c	0.85 b
		Harvest time * Seed rate			Harvest time average
15/5		0.96 ab	1.09 a	1.00 a	1.09 a
1/6		0.80 b	0.94 ab	0.82 b	0.98 b
Site 2					
Autumn	15/5	1.33 a	1.35 a	1.00 ab	1.21 a
	1/6	0.92 b	0.94 b	0.88 b	0.96 b
Spring	15/5	0.99 b	0.95 b	0.88 b	0.90 b
	1/6	0.83 b	0.70 bc	0.61 c	0.70 c
Seed rate averages		1.02 a	0.99 a	0.84 b	
		Planting dates * Seed rate			Planting dates average
Autumn		1.44 a	1.24 ab	1.09 b	1.07 a
Spring		0.94 c	0.84 c	0.71 d	0.83 b
		Harvest time * Seed rate			Harvest time average
15/5		1.47 a	1.04 b	1.02 b	1.09 a
1/6		0.91 c	0.81 d	0.79 d	0.81 b

3.6. Seed index (g)

The results in Table 6 indicate the superiority of the autumn date significantly in the recipe of the seed guide and for both sites, where the seed index rose significantly on this date to (30.26 and 26.63 g) respectively. At the same time, spring planting recorded the lowest moral values for this attribute and amounted to the two sites (25.33 and 24.65 g). The result agreed with Sadeghipour; Aghaei (2012), Getachew; Abraham (2021), and Sandeep et al. (2023). The high value of the seed guide in early dates is because there is sufficient opportunity to complete the stages of plant growth and increase vegetative growth, which is reflected in the increased rate of photosynthesis and better seed fullness. They noticed an increase in seed evidence at early planting time (ALI, 2021; ALI et al., 2023).

Harvest dates influenced the seed guide at both study sites. A significant superiority of the seed index at early harvest was 15/5. The average was (28.90 g) for site one and (26.33 g) for site 2, and the seed index decreased at late harvest compared to early harvest and reached (26.69 and 24.95 g) for sites 1 and 2, respectively. The decrease in seed index at the second date is an expected result of prolonged duration and stages of growth due to delayed harvest date, increased competition and respiration, and pause or slow photosynthesis, all of which negatively affect Saini; Thakur (2014) and Rahman; Akter (2015).

The seeding rates showed significant variances in the seed index at the two study sites, and the seed index ranged (28.73 and 26.50 g) when planting 75 plants m^{-2} for sites 1 and 2, respectively. In contrast, the lowest seed index ranged significantly (26.61 and 24.86 g) at sites 1 and 2, respectively, due to the advantage of low seeding rates, as it reduces competition for nutrients per unit area. Thus, plants take the largest amount of nutrients compared to those with high seeding rates. Results were consistent with studies by Ray et al. (2017), who observed significant variation in the weight trait of 100 seeds with different seed rates.

Table 6. Effect of some agricultural operations of seed index (g).
Tabela 6. Efeito de algumas operações agrícolas do índice de sementes (g).

Planting dates	Harvest time	Seed rate			Planting dates * Harvest time
		75 plants m^{-2}	100 plants m^{-2}	150 plants m^{-2}	
Site 1					
Autumn	15/5	33.21 a	32.42 ab	30.35 bc	31.94 a
	1/6	29.75 c	28.74 c	27.10 cd	28.27 b
Spring	15/5	26.45 de	25.99 de	25.00 e	25.95 c
	1/6	25.52 de	25.01 e	f 24.00	24.57 d
Seed rate averages		28.73 a	28.04 a	26.61 b	
		Planting dates * Seed rate			Planting dates average
Autumn		32.65 a	30.54 b	28.42 c	30.26 a
Spring		26.14 d	26.41 d	25.21 e	25.33 b
		Harvest time * Seed rate			Harvest time average
15/5		30.31 a	28.31 b	27.42 bc	a 28.90
1/6		27.64 bc	27.01 bc	25.10 c	26.69 b
Site 2					
Autumn	15/5	29.54 a	27.35 b	26.14 bc	26.64 a
	1/6	26.35 bc	25.74 c	24.63 c	25.14 b
Spring	15/5	26.01 bc	24.36 c	24.55 c	25.01 b
	1/6	24.11 c	24.78 c	24.11 c	24.31 c
Seed rate averages		26.50 a	25.56 ab	24.86 b	
		Planting dates * Seed rate			Planting dates average
Autumn		28.20 a	26.01 b	25.54 bc	26.63 a
Spring		25.04 c	24.52 d	24.35 d	24.65 b
		Harvest time * Seed rate			Harvest time average
15/5		28.65 a	26.54 b	25.24 bc	26.33 a
1/6		26.54 b	24.65 c	24.50 c	24.95 b

3.7. Seed yield m^{-2} (g)

The seed yield is a summary of the overall biological activities in the plant, the environmental conditions surrounding the plant, and the various agricultural processes that affect the determination of the final yield of seeds. The results indicate a significant effect of planting dates in most of the components of Tables (4, 5, and 6) that led to an increase in seed yield in these treatments (Table 7). The first date showed significant superiority in the rate of seed yield, amounting to (63.63 and 82.52 g m^{-2}) compared to the second date, which decreased the seed yield significantly by recording (36.46 and 43.43 g m^{-2}) for the two study sites, respectively.

The decrease in the late date is due to the shortening of the growth stages in the plants at the late date due to the high temperatures and low humidity, especially during the flowering period during April. This led to decreased fertilization and the number of seeds formed, observed in sites 1 and 2. These results agreed with Sadeghipour, Aghaei (2012), Sikdar (2015), Getachew, Abraham (2021) and Sandeep et al. (2023).

Seed yield variation increased significantly when different harvest dates were used in both sites, where the seed yield rose dramatically in the two research sites at harvest on 15/5. This date achieved a significant superiority with the seed yield of (55.66 and 72.26 g m^{-2}) and the seed yield decreased significantly to below at harvest on 1/6 as the yield reached (44.44 and 53.69 g m^{-2}); in general, we note the decrease in seed yield in sites 1 and 2 whenever the harvest date is delayed, and this is due to the nature of leguminous crops By breaking the pods and falling seeds due to delayed harvest dates and thus low yield (Saini; Thakur, 2014; Rahman; Akter, 2015). The delay of harvesting until the seed moisture reached (12%) led to an increase in seed loss and the number of broken seeds, and the longer the harvest was delayed in reducing moisture, the higher the seed loss due to disintegration. The delay in the harvesting process causes the pods to dry out, increasing their fission, thus increasing seed loss and reducing yield.

The seed yield varied considerably at the two experimental sites, with different seeding rates at the two experiment sites. The seed yield significantly exceeded when using the third seeding rate, and the average was (53.43 and 69.65 g m^{-2}) for sites 1 and 2, respectively. The seed yield decreased significantly with the decrease in the first seeding rate (46.98 and 56.00 g m^{-2}); the cause of the yield increase in high seeding rates is attributed thanks to the rise in the number of plants, which made up for the drop in the number of pods. High Seeder, these results agreed with Gan et al. (2012), Ray et al. (2017) and Choudhary et al. (2022).

3.8. Biological yield (ton ha^{-1})

The variation of planting dates (autumn and spring) led to significant variation in the biological yield in both sites (Table 8). The biological yield decreased significantly when the planting date was delayed. The spring date gave the lowest significant biological yield, decreasing to 1.03 and 1.05 tons ha^{-1}.

In comparison, the biological yield exceeded significantly on the first date and recorded (1.72 and 1.81 ton ha^{-1}) for sites 1 and 2, respectively; the decrease in biological yield in the spring date is due to the small growth period during this season compared to the autumn season, which led to a reduction in net photosynthesis and thus a decrease in biological yield per unit area. These results, in their entirety, agreed with Sadeghip; Aghaei (2012), Sikdar (2015), Getachew; Abraham (2021) and Sandeep et al. (2023).

Table 7. Effect of some agricultural operations on seed yield (g m^{-2}).
Table 7. Effect of some agricultural operations on seed yield (g m^{-2}).

Planting dates	Harvest time	Seed rate			Planting dates * Harvest time
		75 plants m^{-2}	100 plants m^{-2}	150 plants m^{-2}	
		Site 1			
Autumn	15/5	65.33 ab	71.02 ab	75.58 a	72.15 a
	1/6	53.94 c	56.57 bc	59.34 b	56.95 b
Spring	15/5	37.65 cd	39.11 cd	45.24 b-d	40.68 c
	1/6	30.98 e	32.22 de	33.54 de	32.95 d
Seed rate averages		46.98 c	49.73 b	53.43 a	
		Planting dates * Seed rate			Planting dates average
Autumn		59.68 b	65.25 ab	68.57 a	63.63 a
Spring		35.41 d	36.25 cd	39.52 c	36.46 b
		Harvest time * Seed rate			Harvest time average
15/5		60.36 ab	66.25 a	67.41 a	55.66 a
1/6		35.44 d	35.95 d	37.52 c	44.44 b
		Site 2			
Autumn	15/5	80.87 bc	91.35 b	107.36 a	93.25 a
	1/6	61.67 e	70.22 d	83.65 bc	72.51 b
Spring	15/5	47.94 f	55.54 of	50.47 of	52.69 c
	1/6	33.52 g	35.98 g	37.10 g	35.84 d
Seed rate averages		56.00 c	63.27 b	69.65 a	
		Planting dates * Seed rate			Planting dates average
Autumn		71.69 c	80.67 b	95.86 a	82.52 a
Spring		40.95 e	45.67 d	44.69 de	43.43 b
		Harvest time * Seed rate			Harvest time average
15/5		64.95 b	73.69 ab	78.25 a	72.26 a
1/6		47.95 c	53.98 c	60.24 b	53.69 b

Table 8. Effect of some agricultural operations of seed biological (tons ha^{-1}).
Tabela 8. Efeito de algumas operações agrícolas de sementes biológicas (toneladas ha^{-1}).

Planting dates	Harvest time	Seed rate			Planting dates * Harvest time
		75 plants m^{-2}	100 plants m^{-2}	150 plants m^{-2}	
		Site 1			
Autumn	15/5	1.75 ab	1.87 a	2.01 a	1.86 a
	1/6	1.42 b	1.55 b	1.66 ab	1.52 b
Spring	15/5	1.06 cd	1.24 c	1.32 bc	1.14 c
	1/6	0.75 e	0.85 de	0.95 d	0.86 d
Seed rate averages		1.25 c	1.385 b	1.49 a	
		Planting dates * Seed rate			Planting dates average
Autumn		1.57 b	1.75 ab	1.84 a	1.72 a
Spring		0.86 d	1.05 c	1.15 c	1.03 b
		Harvest time * Seed rate			Harvest time average
15/5		1.37 ab	1.56 a	1.64 a	1.55 a
1/6		1.09 c	1.24 b	1.34 ab	1.20 b
		Site 2			
Autumn	15/5	1.85 b	2.20 a	2.21 a	2.10 a
	1/6	1.35 cd	1.46 c	1.75 b	1.54 b
Spring	15/5	1.06 of	1.16 de	1.25 d	1.17 c
	1/6	0.88 g	0.95 f	0.94 f	0.94 d
Seed rate averages		1.29 b	1.45 ab	1.54 a	
		Planting dates * Seed rate			Planting dates average
Autumn		1.53 b	1.87 ab	1.95 a	1.81 a
Spring		0.96 d	1.09 c	1.10 c	1.05 b
		Harvest time * Seed rate			Harvest time average
15/5		1.63 ab	1.72 a	1.75 a	1.63 a
1/6		1.05 c	1.19 bc	1.36 b	1.23 b

The results of the harvest dates (15/5 and 1/6) showed significant differences in this characteristic in the two sites; in site 1, the biological yield increased significantly at harvest with all early dates and recorded a biological yield of (1.55 and 1.63 tons ha^{-1}). The late harvest dates 1/6 led to a decrease in the biological yield to (1.20 and 1.23 tons ha^{-1}) for sites 1 and 2, respectively. The result aligned with Saini and Thakur (2014) and Rahman; Akter (2015). Through the effect of seeding rates on this trait, It was observed that there was a steady, notable rise in the biological yield by increasing the seeding rates and a significant superiority of the biological yield was recorded when planting 150 plants m^{-2} and the rate reached (1.49 and 1.54 tons ha^{-1}). In comparison, the biological yield decreased significantly in the low seeding rates of 75 plants m^{-2} and the lowest significant biological yield was recorded (1.25 and 1.29 tons ha^{-1}) for the two sites, respectively; the cause of the rise in biological yield observed with the increase the rise in the number of plants per unit area is the cause of the variation in seeding rates. Therefore, the dry matter yield will increase. These results show consistency with those of Ray et al. (2017) and Choudhary et al. (2022).

Most bilateral and triple interventions, especially those with an autumnal planting date and a harvest date of 5/15 and when planting 150 plants m$^{-2,}$ recorded significant superiority compared to other interventions for both sites.

4. DISCUSSION

The reason for the superiority of the autumn date in characteristics compared to the spring date may be due to the length of the crop's growth period (3 months) and the availability of appropriate environmental conditions of temperature, humidity, lighting, etc. during the vegetative growth period, and each stage of the crop's growth achieved its needs better. Especially plant elongation, providing sufficient time for plant growth, increasing net photosynthesis to provide plants with food, and increasing the percentage of sets were reflected in the traits studied in the fall date. In contrast to the spring period, vegetative and fruitful growth periods were shortened.

The decrease in yields in the spring period resulted from the shortening of the growth stages in plants later. This was also accompanied by high temperatures and low humidity, especially during the flowering period in April, which decreased growth characteristics, fertilization rate, and yield. It was observed. This is clearly stated in sites 1 and 2, Sikdar (2015) Thombre et al. (2019); based on the above, farmers resort to fall agriculture in the absence of a competing crop for growing chickpeas, the availability of suitable conditions, and the absence of fear of disease or fungal infections, while the farmer resorts to spring agriculture in the event of one or more of the obstacles. This is like the result of Getachew; Abraham (2021) and Sandeep et al. (2023).

The decline of most traits at the second date is an expected result of prolonging the duration and stages of growth due to the delay in the harvest date and the increase in competition and respiration. The cessation or slowdown of the photosynthesis process leads to a negative impact on these traits. Saini and Thakur (2014), Rahman; Akter (2015). In legumes, including the chickpea crop, a large number of flowers are produced, but only a small number of them reach the contract stage. From the number of flowers, it is possible to predict seed yield early by knowing the number of flowers produced that will be produced, the number of pods plant^{-1}, the number of seeds/pod, and the weight of the seeds if they are. Environmental conditions are favorable, usually occurring at the early harvest (the first date). In contrast, if there are negative changes in environmental conditions, this leads to a decrease in yield when the harvest is delayed, which happened on the second date ISLAM et al., (2010). The nature of the factors used in the study by appointment may have an additional role in reducing or increasing the fertilization rate. In any case, the number of seeds increases indicates a high fertilization rate and vice versa Enaiat and Sharafizadeh (2013). Delaying harvest until the seed moisture reached (12%) led to increased seed loss and the number of broken seeds. The more the harvest was delayed, reducing the moisture, the more seed loss increased because of overcooking. Delaying the harvesting process causes the pods to dry out and increase their splitting, thus increasing seed loss and lower yields.

The superior seed rates (150 plants m^{-2}) in vegetative traits (plant height, number of branches, and lowest pod) may be due to shading caused by crowding between plants. Thus, auxin is activated in shady places, which encourages cell division. Thus, these traits increase to obtain the largest amount of lighting and other growth elements in the soil.

Perhaps the largest number of branches indicates the superiority of the seed rates used for each site in receiving the appropriate amount of lighting and stimulating the largest number of buds to produce plant branches. The result agreed with Islam et al. (2010) and Cokkizg (2012). This was reflected positively by compensating for the decreased number of pods plant^{-1}, and the number of seeds pod^{-1} occurred at high seeding rates and led to an increase in seed and biological yields. These results agreed with Gan et al. (2012), Ray et al. (2017) and Choudhary et al. (2022). The biological yield increased with the increase in seed rates due to the increase in the number of plants and, thus, an increase in the dry matter yield. These results are consistent with the findings of Ray et al. (2017) and Choudhary et al. (2022).

The characteristics of the yield components behaved opposite to the vegetative traits. Low seeding rates gave these traits an advantage due to better availability of needs at low seeding rates compared to high rates. Thus, there was reduced competition between plants for nutrients per unit area; thus, plants took the largest amount of nutrients. At a seed rate of 75 plants compared to other rates, these results agreed with the findings of Gan et al. (2012) and Choudhary et al. (2022).

5. CONCLUSIONS

The autumn planting of the chickpea crop is morally superior to the spring planting. Still, the spring planting of this crop is preferred in the event of an emergency circumstance such as (a short growing season, injury, lack of moisture, or because of global warming) in this loop, it is possible to obtain a good yield. However, it is relatively low compared to the autumn loop.

Harvest dates have a clear impact, especially when harvesting early, 15/5, which had an advantage and reflected positively on most chickpea characteristics. This closely correlates with the seeding rates used, where the effect of seeding rates varied according to the studied characteristic. All of this helps improve the productivity of chickpeas.

6. REFERENCES

ALI, M. A.; Response selection and path analysis in naked barley. **Plant Cell Biotechnology and Molecular Biology**, v. 22, n. 11, p. 8-15, 2021.

ALI, M. A.; ABDULQADER, O. A. l; AZIZ, M. M. l Influence of seed size and planting depth on some growth and quality characters of local broad bean (Vicia Faba L.). **International Journal of Agricultural and Statistical Sciences**, v. 16, p. 1815-1819, 2021. https://connectjournals.com/03899.2020.16.1815

ALI, M. A.; KHALEEL A, TH.; AL-CHALABI, A. M.; AL-BARWARY, A.S., Effect of jelly and planting depths on the traits of two barley verities. **IOP Conference Series: Environmental Earth Science**, v. 1214, n. 1, e012041, 2023.

ALI, M. A.; AL-KIKANI, K. I.; AL-MASHHADANY, A. M.; AL-OBAIDI, A. H. Response of field crop seeds to stimulators improve germination and growth. **Tikrit Journal for Agricultural Sciences**, v. 23, n. 3, p. 103-111, 2023. https://doi.org/10.25130/tjas.23.3.12

ALI, M. A.; AL-KIKANI, K. I.; YAHYA, S. I.; AL-OBAIDI, A. H. Response of wheat cultivars to bread yeast with different concentrations and application time. **SABRAO Journal of Breeding and Genetics**, v. 56, n. 2, p.761-770, 2024. http://doi.org/10.54910/sabrao2024.56.2.27

ABDULQADER, O. A.; ALI, M. A.; AZIZ, M. M. Effect of volcanic rock dust and Fe-EDTA on the root nodule bacteria and the growth and yield of broad bean plants. **Agronomia Colombiana**, v. 39, n. 2, p. 243-251, 2021. https://doi.org/10.15446/agron.colomb.v39n2.92541

BEGUM, S.; ISLAM, M. A.; PRODHAN, A. Anatomy of rachis of the inflorescence in pigeon pea. **International Journal of Botany**, v. 3, p. 85-90, 2007. https://doi.org/10.3923/ijb.2007.85.90

CHOUDHARY, A.; SHEKHAWAT, P. S.; SINGH, S. P.; GODARA, A. S. Effect of seed rate and nipping on growth and yield of different chickpea (Cicer arietinum L.) varieties in arid irrigated western plain zone. **The Pharma Innovation Journal**, v. 11, n. 2, p. 840-842, 2022.

COKKIZGIN, A. Botanical characteristics of chickpea genotypes (*Cicer arieitinum* L.) under different plant densities in organic farming. **Scientific Research and Essays**, v. 7, n. 4, p. 498-503, 2012. http://dx.doi.org/10.5897/SRE11.1921

ENAIAT, M. R.; SHARAFIZADEH, M. Effect of sowing date and genotype on yield and yield components of mung bean conditions of Dezful. **Journal of Crops Physiology**, v. 1, n. 2, p. 11-20, 2013.

GAN, Y. T.; MILLER, P. R.; MCCONKEY, B. G.; ZERTNER, R. P.; LIU, P. H.; MCDONALD C. L. Optimum plant population density for chickpea and dry pea in semiarid environment. **Canadian Journal of Plant Science**, v. 83, p. 1-9, 2012. http://dx.doi.org/10.4141/P02-012

GETACHEW, A.; ABRAHAM, T. Effect of Sowing Dates on Yield and Yield Components of Some Selected Chickpea (*Cicer arietinum* L.) Varieties. **Asian Journal of Advances in Agricultural Research**, v. 15, n. 3, p. 9-15, 2021. https://doi.org/10.9734/ajaar/2021/v15i330152

ISLAM, M. O.; RAHIM, M. A.; PRODHAN, A. K. M. A. Flowering pattern, floral abscission and yield attributes in soybean influenced by GABA. **Journal of Bangladesh Agriculture University**, v. 8, n. 1, p. 29-33, 2010. http://dx.doi.org/10.3329/jbau.v8i1.6394

LOPEZ-BELLIDO, F. J.; LOPEZ-BELLIDO, R. J.; KHALIL, S. H. K.; LOPEZ-BELLIDO, L. Effect of planting date on winter kabuli Chickpea growth and yield under rainfed Mediterranean conditions. **Agronomy Journal**, v. 100, p. 957-964, 2008. http://dx.doi.org/10.2134/agronj2007.0274

QASIM, G.; MALIK, A. U.; SARFRAZE, M.; ALIAS, M. A.; BUKHSH, H. A.; ISHAQUE, M. Relationships between Laboratory seed quality tests, field emergence and yield of chickpea. **Journal of Crop and Environment**, v. 1, n. 1, p 31-34, 2010.

RAHMAN, M. A.; AKTER, M. B. Flower production and yield in mung bean. **Bangladesh Journal of Crop Science**, v. 2, n. 2, p. 58-63, 2015.

RAY, K.; SINGH, D.; JAT, B. L. Effect of sowing time and seed rate on growth and yield of chickpea cultivars. **Journal of Crop Improvement**, v. 1, p. 1-16, 2017. http://dx.doi.org/10.15740/HAS/ARJCI/8.1/1-16

SADEGHIPOUR, O.; AGHAEI, P. Comparison of autumn and spring sowing on performance of chickpea (*Cicer arieitinum* L.) Varieties. **International Journal of Biosciences**, v. 2, n. 6, p. 49-58, 2012.

SAINI, J. P.; THAKUR, S. R. Effect time of harvest on yield and quality of mung bean (*Vigna radiate* L). **Journal of Plant Sciences**, v. 4, n. 4, p. 523-524, 2014.

SANDEEP, G. S.; UMESHA, C.; UDAY, K. V. Effect of dates of sowing on growth and yield of chickpea varieties. **International Journal of Environment and Climate Change**, v. 13, n. 10, p. 834-838, 2023. https://doi.org/10.9734/ijecc/2023/v13i 102723

SIKDAR S.; ABUYUSUF, M.; AHMED, S.; TAZMIN, M. F.; SIKDAR, M. M. H. Variety and Sowing Time on the Growth and yield of Chickpea (Cicer arietinum L.) in Southern Region of Bangladesh. **European Academic Research**, v. 3, n. 6, p. 236-244, 2015.

THOMBRE, S. V.; GOUD, V. V.; JAYBHAYE, J. N.; HODOLE, S. S.; TUPE, A. R. Effect of sowing dates and varieties on nutrient uptake and yield of chickpea. **Journal of Pharmacognosy and Phytochemistry**, v. 8, n. 5, p. 806-808, 2019.

YANG, W. M. Effect of harvest methods on grain quality and losses in mung bean harvest. **International Journal of Agriculture and Biology**, v. 6, n. 1, p. 108-109, 2012.

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