Response of Faba Bean yield, its components and companion weeds to planting dates and weed control treatments under rainy area conditions

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Abstract

A field experiment was conducted during the 2024–2025 winter season at the College of Agricultural Engineering Sciences, University of Duhok (Sumel), Kurdistan Region, Iraq, to investigate the response of faba bean (Vicia faba L.) yield, yield components, and weed populations to different sowing dates and weed management practices under rainfed conditions. The experimental design was a randomized complete block with three sowing dates (5th November, 20th November, and 5th December) and five weed control treatments (Control, Blast, Axial, Haloxyfop, and Hand Weeding), totaling 15 treatments with three replications. Results indicated that sowing date significantly influenced weed density, biomass, and crop performance. Early sowing (5th November) resulted in the highest weed pressure but achieved competitive yields, while the mid-sowing date (20th November) provided the most favorable crop growth and productivity with relatively lower weed infestation. Hand weeding was consistently the most effective for weed suppression, yielding the tallest plants (85.10 cm), the highest number of pods per plant (30.85), and the greatest seed dry weight per plant (33.71 g). Among herbicides, Haloxyfop and Blast were the most effective in reducing both narrow- and broad-leaved weed densities, significantly improving crop performance compared to the untreated control. This study highlights the critical role of appropriate sowing dates and effective weed management practices in maximizing faba bean productivity under rainfed conditions, suggesting that early sowing may increase weed pressure but also allows for competitive yields, while mid-season sowing optimizes growth with less weed competition.

Keywords: Herbicides, Sowing Dates, Weeds, Faba Bean

Introduction

Faba bean (Vicia faba L.), also known as fava bean, broad bean, horse bean, or windsor bean, is a leguminous crop used as food, feed, forage, or cover crop in various parts of the world. It is an important source of nourishment for millions of people, notably in underdeveloped countries in East and North Africa and portions of Asia [25] It is a unique legume crop due to its high nutrient content, which also makes it an excellent source of proteins, complex carbohydrates, dietary fiber, choline, lecithin, and minerals [32] .Furthermore, this crop contributes significantly to soil quality improvement by assisting in the fixation of atmospheric nitrogen in the soil through root nodules in collaboration with Rhizobium bacteria [10.[

Faba bean is currently grown in over 66 nations [28], and its cultivation is distributed in Iraq's governorates of Nineveh, Al-Tamim, Babel, and Baghdad [29]. Iraq's planted area has reached (9382) dunums, and total production amounted to (4947) thousand tons of seeds, with a productivity rate of 527.4 kg/dunum [12.[

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The faba bean crop in Iraq is deteriorating in productivity and quality due to a failure to use modern scientific techniques and methods in crop service and management during its various stages of growth, such as weed control and planting at appropriate densities [23], bean productivity is considered low in Iraq and accounts for a small percentage of total domestic consumption [24.[

In 2022, the global production of faba beans was approximately 1,810,000 tons for green beans and 6,770,000 tons for dried beans, with a total area harvested of around 640,000 and 6,630,000 acres, respectively. Asia and Africa have the largest faba bean production and harvested area worldwide. [18.[

The weeds are considered one of the main problems facing the agricultural sector in terms of quantity and quality in the world, as the percentage of crop losses caused by the weed ranges approximately from (40-60%) of the economic outcome according to the type of crop grown as well as environmental conditions through competition for light, moisture, nutrients and the space, [37] Weeds also harbor pests that harm crop plants, increasing production costs and lowering crop quality. [19] Winter weeds, which come in two varieties, narrow-leaved and broad-leaved weeds, are the most serious challenges that farmers confront around the world, as the crop fights for nutrients and water [33.[

The sowing date has a considerable impact on the timing and duration of the vegetative and reproductive stages, as well as the quantity and quality of seed. Because environmental elements, such as temperature and light, vary according to sowing dates [40] .and sowing dates are closely related to the yield and its components, as there was a loss in the yield amounting to 50-62% when sowing at late dates [39].Therefore, planting the crop at the ideal time is necessary to achieve the highest outcome because the planting date depends on environmental conditions and is considered an important agricultural management factor that farmers must control depending on the prevailing environmental conditions, [38]. Early planting dates produce weak plants with a weak root system because the temperature is higher than the optimal limit leads to irregular germination due to the death of the embryo after germination. As for late planting dates, the growth of plants is slow due to lower temperatures than the optimal limit, either when choosing the date, The ideal for cultivation gives better growth and thus the fullness of the grains is better, and this is reflected positively on the final yield, [30[

Chemical control is represented by the use of herbicides, which is one of the most important means in control programs, and it is ranked first because of the quick and positive results that can be obtained when compared to other control methods, as three million tons of herbicides are produced annually in the world in various agricultural systems to limit the spread of weeds [6.[

Manual weeding is the oldest and most basic technique for treating faba beans. Manual weed control begins with farmers picking weeds by hand, which results in good weed management [14.[

The Aims of The Study :

.1To study the effect of different sowing dates on Faba bean yield and companion weeds at the Sumel.

.2Determine the effectiveness of applied herbicides for control of common weeds in Faba bean.

.3Evaluate the studied herbicides on Faba bean yield and associated weeds .

Materials and Methods

The field experiment was carried out during the winter season 2024- 2025 at Collage of Agricultural Engineering Sciences University of Duhok (Sumel) Kurdistan Region, Iraq

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respectively. The experiment was applied by Randomized Complete Block Designing, the soil texture at Sumel was silty clay and PH (7.75), the soil was plowed, then smoothed, and divided into lines, distance between plants to plant 20cm and line to line 40cm, each plot has 5 lines, 65 plants per experimental units, and the area of one treatment was 4.8 m^2 .

Table 1: The average rate of humidity, temperature and rainfall during the experiment period.

Sumel				
Month	**Relative humidity %average**	**Temperature (ºC)**		**Rainfall (mm)average**
		Max.	**Min.**	
November 2024	65	20.3	9.5	37.9
December2024	60	15.9	5.2	11.3
January 2025	56	15.8	4.2	9.3
February 2025	56	12.4	2.6	45.9
March 2025	46	22.3	10.2	15.3
April 2025	45	25.5	14.9	57.7
May 2025	32	34.4	20.1	9.9
Total Rainfall(mm)				**187.3**

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Experiment factors, the first factor, three planting dates for the crop of legumes and second factor was five treatments of herbicides. The experiment included 15 treatments with 3 replications, giving 45 experimental in the location. The first factor when the Seeds of broad bean (Vicia faba L. 'Aguadulce') were sown manually were sown for the first date (D1 (5/11/2024), D2 (20/11/2024) and D3 (5/12/2024)). placing two seeds per hole, later thinned to one. and the second factor was five treatments of herbicides (Control, Blast 450 mL in 150 L of water per hectare, Axial 510 mL in 150 L of water per hectare, Haloxyfop 500 mL in 200 L of water per hectare and Hand Weeding). And Spray herbicides on each planting date. (25/12/2024, 10/1/2025 and 25/1/2025) at the stage of 4-6 leaves of weed plants in both locations according to the recommended concentrations. The height of the plant when spraying is approximately 20 cm, while avoiding the spray reaching the neighboring treatments, by creating barriers between the treatments. The field was irrigated five times until the plants germinate, one time in December, two time in January and two time in March.

Table 2: weeds type found in the field

a-Broad Leaf Weed		
Botanical name	**English name**	**Family**
Silybum marianum L.	Milk thistle	Asteraceae
Lactuca serriola L.	Prickly lettuce	Asteraceae
Sonchus oleraceus L.	Sowthistle	Asteraceae
Sinapis arvensis L.	Wild mustard	Brassicaceae
Gallium aparine L.	Catchweed bedstraw	Rubiaceae
Medicago orbicularis L.	Round-fruited medic	Fabaceae
Convolvulus arvensis L.	Field bindweed	Convolvulaceae
Astragalus ssp.	*Montpellier milkvetch*	Fabaceae.
Pisum sativum L.	Garden pea	Fabaceae

b-Narrow Leaf Weed		
Botanical name	**English name**	**Family**
Phalaris minor L.	Lesser canary grass	Poaceae
Hordeum glaucum L.	Parley grasses	Poaceae
Avena fatua	Common wild oat	Poaceae

The weeds data were taken at the of February and March (D1(17/2/2025), D2(5/3/2025) and D3(20/3/2025)) using the wooden square with an area of (0.5 x 0.5) m. Then the narrow leaved weeds were isolated from the broad ones, and then they were dried in oven for 72 hours on the 70°. Then the data for the crop were taken after its maturity at the beginning of the month of May. The studied qualities. The following characteristics were studied and that is by taking five random plants from each experimental unit and according to the rate, they have the following characteristics: (weed number for both narrow and broad-leaved weeds and their dry weight). the data of crop recorded that includes (plant height, number of pods per plant, number of seeds per pod, seed dry weight per plant and seed yield per hectare). The data was analyzed statistically after collecting, arranging and classifying the data for all the studied characteristics according by the Randomized Complete Block Designing RCBD .

Table 3: Common, trad and chemical name with some information of herbicides used.

Common Name	**Trade name**	**Formulation**	**Chemical Name**	**Weed control**	**Group**
Pinoxaden	Axial	50 % EC	8-(2,6-diethyl-p-tolyl)-1,2,4,5-tetrahydro-7- oxo-7H-pyrazolo[1,2-d] [1,4,5] oxadiazepin-9- yl 2,2-dimethylpropionate	Narrow weeds	Phenylpyrazolin
Bentazone	Blast	44.1% EC	1*H*-2,1,3-Benzothiadiazin-4(3*H*)-one,3-(1-methylethyl)-2,2-dioxide	Broad weeds	Benzothiadiazole

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Haloxyfop	Haloxyfop-R Methyl Ester.	10.8% EC	M ethyl 2-(4-{[3-chloro-5-(trifluoromethyl) pyridin-2-yl] oxy} phenoxy) propanoate is the methyl ester of 2-(4-{[3-chloro-5-(trifluoromethyl) pyridin-2-yl] oxy} phenoxy) propanoic acid	Narrow weeds	Aryloxyphenoxypropionates

Result and Desiccation

Characteristics weeds:

.1Effect of sowing date and herbicides treatment on the number of Narrow leaf weeds:

The data in table (4) indicate that sowing date had a significant impact on the number of narrow-leaf weeds at the Sumel location. Early sowing (Date 1) resulted in the highest weed density, with an average of 27.20 weeds/m², whereas late sowing (Date 3) showed the lowest weed density (14.47 weeds/m²). This decreasing trend in weed density with delayed sowing suggests that early sowing provides favorable environmental conditions—such as optimal temperature, moisture, and light—for early weed emergence and growth. This reduction could be attributed to less favorable conditions for weed germination at later planting dates, or increased crop competitiveness due to better synchronization of crop emergence with weed emergence. This is consistent with what was concluded by [17]. and [5] Studied the planting date (7 November, 7 December, and 7 January) were investigated, as well as the four dosages of Basgran herbicide (control, 187.5, 375, 750 ml.h-1). Planting dates had a substantial effect on the quantity of narrow weeds; the number of narrow weeds reduced by 28.1 and 30.65% on the second and third dates, respectively, compared to the first date.

The results of table (5) indicate that there are Significant differences were also observed among herbicide treatments. The control plots, which received no weed management, had the highest weed densities (36.00 weeds/m²), demonstrating the necessity of active weed control interventions in narrow-leaf weed-infested fields. Among the chemical treatments, Haloxyfop (14.56 weeds/m²) and Axial (15.22 weeds/m²) showed the highest efficacy in suppressing narrow-leaf weed populations. These herbicides target grassy weeds specifically and appear to have been well-suited for the weed flora present in the experimental field. And when using the Blast herbicide, while effective to a degree, was less successful in reducing weed numbers (23.00 weeds/m²), possibly due to lower efficacy against the dominant narrow-leaf species or due to differences in application timing or active ingredient formulation. Hand weeding, although not a chemical method, resulted in the lowest overall weed densities (10.11 weeds/m²), highlighting its effectiveness in physical weed removal. This result is consistent with what was reached by [31]. The decrease in the number of narrow-leaved weeds increases as the concentration of the herbicides increases. Field studies have reported significant reductions in grass weed

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biomass and population following the use of Pinoxaden [35.[

The results in Table (6) show that are significant interaction effect between sowing date and herbicide treatment was observed, emphasizing the importance of integrating these two management strategies. The highest weed densities were recorded in plots that were both early sown (Date 1) and left untreated (Control), averaging 54.33 weeds/m². Conversely, the lowest weed densities were found in plots sown late (Date 3) and treated with Haloxyfop or subjected to hand weeding, with values as low as 10.33 and 7.67 weeds/m², respectively. This interaction reveals that the effectiveness of herbicide treatments can be enhanced by adjusting the sowing date. In early sowing, the weed pressure may be too high for herbicides to be fully effective, potentially leading to weed escapes or increased competition with the crop .

.2Effect of sowing date and herbicides treatment on the dry weight of Narrow leaf weeds:

The data in table (4) indicate that sowing date had a significant effect on crop yield. The earliest sowing date (Date 1) resulted in the highest overall yield average (93.96), followed by Date 2 (85.98), while Date 3 (83.62) recorded the lowest yield among the three dates. This trend suggests that early sowing is favorable for maximizing crop productivity in the Sumel location, likely due to a longer growing period, better soil moisture conditions, and more favorable temperatures during early crop establishment and reproductive stages. While earlier sowing (Date 1) was associated with higher weed pressure, the crop still managed to outperform later sowing dates in yield, possibly due to better resource use efficiency and stronger early vigor. This implies that the benefit of a longer growing season may outweigh the negative effects of increased weed competition, especially when effective weed control strategies are applied [3] found that delaying the sowing date reduced total weed density and biomass. This reduction is due to the fact that later planting dates are typically associated with lower soil moisture levels and less favorable weed germination conditions. These findings underscore the necessity of choosing the right sowing dates to effectively manage weed populations in faba bean fields .

The results in the table (5) Herbicide treatments significantly influenced yield performance. The control treatment (no weed control) produced the lowest yield (114.68), confirming that weed competition reduces crop growth and productivity. Conversely, the highest yields were recorded in hand-weeding (71.14), followed closely by Haloxyfop (80.74) and Axial (81.01) treatments, indicating that effective weed management enhances yield potential. While Haloxyfop and Axial showed similar efficacy in reducing weed numbers, their effect on yield was slightly different. Hand weeding consistently outperformed all chemical treatments, reaffirming that complete weed removal leads to better crop performance, although at a higher labor cost.

The results in Table (6) show that was a noticeable interaction effect between sowing date and herbicide treatment. The highest individual yield (137.48) was obtained from Date 1 + Control, which is unusual since weed control was not applied. This may reflect experimental variability or perhaps an unmeasured factor (e.g., lower weed density in that specific replicate or high early crop vigor). However, in general, Date 1 + hand weeding (71.77), Date 2 + Haloxyfop (80.52), and Date 3 + hand weeding (68.23.(

.3Effect of sowing date and herbicides treatment on the number of broad leaf weeds:

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The results in the table (4)a significant decrease in weed biomass with delayed sowing. The highest average weed biomass was recorded at Date 1 (42.13 g/m²), followed by Date 2 (19.67 g/m²), and the lowest at Date 3 (16.73 g/m²). These results are consistent with earlier findings where weed density also declined with delayed sowing. This trend indicates that early sowing promotes more vigorous weed growth, likely due to favorable germination conditions such as higher soil moisture and temperature early in the season. In contrast, delayed sowing allows time for initial weed flushes to be controlled before crop planting and may shift the sowing window beyond the peak emergence period of dominant weed species. [5[

The effect of herbicide treatment on weed biomass was also highly significant.in the table (5) The control treatment showed the highest average biomass (56.00 g/m²), demonstrating the strong competitive advantage weeds maintain when left unchecked. Among the herbicide treatments: when using the Blast (16.56 g/m²), Axial (23.56 g/m²), and Haloxyfop (22.78 g/m²) significantly reduced weed biomass. And hand weeding was the most effective method, reducing biomass to 12.00 g/m². Although Axial and Haloxyfop showed similar performance, Blast appeared more effective in reducing weed biomass than in reducing weed density. Hand weeding consistently provided the lowest biomass values, confirming that complete physical removal is the most reliable method of reducing the actual competition load from weeds, though it is labor-intensive. [36] confirmed that the use of chemical herbicides gives effective and efficient results in combating weeds, especially broad-leaved weeds. Also, [34] explained that application of herbicide Bentazone to the bean crop led to a decrease in the number of broad-leaved weeds, and the percentage decrease in their numbers was 63.54%.

The results in Table (6) show that are interaction between sowing date and herbicide treatment reveals important trends in how weed biomass is influenced by management combinations. Date 1 + Control resulted in the highest weed biomass (102.67 g/m²), reinforcing the idea that early sowing without weed control leads to severe infestation and growth. Date 3 + Hand weeding recorded the lowest weed biomass (9.00 g/m²), indicating that delayed sowing combined with manual weed control is the most effective approach in minimizing total weed growth. And Axial and Haloxyfop treatments were more effective in Dates 2 and 3, suggesting that herbicide efficiency improves under lower weed pressure, which is more common in later sowing dates .

.4Effect of sowing date and herbicides treatment on the dry weight of broad leaf weeds:

The data in table (4)a clear and statistically significant reduction in total weed biomass with delayed sowing. The earliest sowing date (Date 1) recorded the highest average total weed biomass (170.74 g/m²), while Date 2 and Date 3 showed progressively lower averages (109.58 g/m² and 97.17 g/m², respectively). These results reinforce earlier findings (Tables 1 and 3), confirming that early sowing provides a favorable environment for weed emergence and growth, leading to higher seasonal biomass accumulation. Delaying sowing reduces the time window for weed establishment, possibly due to cooler temperatures, lower soil moisture, or earlier weed control opportunities before planting. Thus, delayed sowing is an effective cultural practice that suppresses weed growth and reduces competition, particularly in weed-dense environments like Sumel. This may be attributed to the short lifespan of the shrubs on the third planting date until the harvest date, which resulted in a reduction in the accumulation of dry matter in the shrub plants. Agriculture is affected by environmental conditions, which are considered among the most important factors affecting the physiological processes taking place within

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the plant. High temperatures and a long period of light increase the acceleration of physiological processes within the plant, while a short growth period means that the products of photosynthesis become insufficient to meet the plant's requirements to complete the growth stages, which negatively affects the accumulation of dry matter in the plant. This is completely consistent with what was indicated by [4.[

The results in table (5) Herbicide treatments also significantly influenced total weed biomass: Control plots exhibited the highest biomass accumulation (202.92 g/m²), confirming the lack of weed suppression in untreated plots. The most effective treatments in reducing biomass were: Hand weeding (81.54 g/m²) and the Blast herbicide (86.43 g/m²) and when using the Axial (134.20 g/m²) and Haloxyfop herbicide (124.05 g/m²) provided moderate weed suppression, though less than Blast in this case.Hand weeding again proved to be the most reliable method for reducing weed biomass. [15] demonstrated that the use of Clethodim herbicide at a concentration of 2.38 liters. ha-1 led to a reduction in the dry matter of the weeds growing in the bean fields and this is line with findings, [20 and 21]. that the reason for reducing the number of broadleaf weeds is due to the effectiveness of pesticides and their positive effects in reducing weed density .

The results in Table (6) show that are interaction of sowing date and herbicide treatment had a significant impact on total weed biomass the highest biomass occurred in Date 1 + Control (329.40 g/m²), reflecting unchecked weed growth under optimal early-season conditions. And the lowest biomass was seen in combinations like Date 3 + Hand weeding (79.64 g/m²) and Date 2 + Hand weeding (80.84 g/m²). All herbicide treatments performed better under Date 2 and Date 3, showing that herbicide efficacy improves when weed pressure is reduced through delayed sowing.

.5Effect of sowing date and herbicides treatment on the plant height(cm:(

These results in the table (4) indicate that Date 2 (mid-sowing) led to the tallest average plant height (82.67 cm), suggesting it provided the most favorable environmental conditions for crop development. This could be due to optimal temperature, moisture, and solar radiation aligning with early vegetative growth stages. Date 1 (early sowing) resulted in slightly lower plant height (81.21 cm), possibly due to higher weed pressure, which could limit access to growth resources. Date 3 (late sowing) had the shortest plants (79.44 cm), likely because of heat stress and shortened vegetative periods, this is consistent with what they found [9 and 13] who confirmed that plant height decreased. Gradually, due to the late planting date. They explained this by saying that late planting exposes plants to the negative effects of high temperatures during the elongation stages, which leads to plants accelerating the cessation of vegetative growth and moving towards flowering. This leads to a reduction in the elongation period and, consequently, a decrease in plant height.

The results in the table (5) The herbicide treatments had a highly significant effect on plant height, Among the treatments, hand weeding consistently led to the tallest plants, averaging 85.10 cm, confirming its efficacy in reducing weed competition without introducing chemical stress. This was closely followed by haloxfop (83.49 cm), aixal (82.99 cm), and blast (82.75 cm), suggesting all three herbicides were relatively effective in weed control, but possibly exerted some effects or stress on the crop compared to manual weeding.The control plots, where no herbicides were applied, had the lowest average plant height at 71.22 cm, indicating the significant negative impact of unchecked weed competition on crop growth. These findings reinforce the importance of weed

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management in maximizing crop height and, by extension, potentially improving yield. [27] noted that herbicides significantly affect the height of the plant by increasing. [16] when spraying the herbicide Oxadiargyl on the bean crop to control the accompanying weed; it increased the height of the crop plant (92.03) cm in relation to the spraying treatment, while the control treatment reached the height of 44.77 cm. As [4] mentioned when using four types of herbicides (Basgran, Traflan, Topek, and illoxan), it led to the superiority of all treatments in terms of plant height over the control treatment (without herbicide(

The results in Table (6) show that are interaction between sowing date and herbicide treatment across all sowing dates, similar trends in herbicide performance were observed. Hand weeding remained superior in promoting plant height, while control treatments lagged behind. The consistency of these results highlights that, regardless of sowing date, effective weed management is critical for optimal plant growth. Overall, the study underscores that both the timing of sowing and the choice of weed management strategy significantly influence plant height in the Sumel location. Manual weeding, though labor-intensive, was the most effective, while chemical herbicides provided a viable alternative with slightly lower growth outcomes. Future studies may further explore the economic trade-offs between manual and chemical weed control, as well as examine additional growth and yield parameters.

.6Effect of sowing date and herbicides treatment on the number of pods per plant:

The results in the table (4) clearly shows that sowing date had a statistically significant effect on the number of pods per plant. The number of pods per plant was highest on Date 2 (25.91 pods), followed closely by Date 1 (24.05 pods). The lowest pod count occurred on Date 3 (21.79 pods). These results suggest that sowing in the middle window (Date 2) was slightly more favorable for pod development, possibly due to better synchronization of vegetative and reproductive phases with climatic conditions.

However, the gradual decline from Date 2 to Date 3 also suggests that delayed sowing may negatively affect pod formation, likely due to higher weed pressure, reduced vegetative vigor, or suboptimal environmental conditions during the pod-setting stage. And [1] who indicated that early planting leads to an increase in the number of pods per plant due to the suitability of environmental conditions.While the [40] found a substantial effect of planting date on the quantity of pods per plant and [11] found that delayed planting reduces the number of seeds per pod in the pea plant.

The results in the table (5) Herbicide treatments also significantly impacted pod number per plant Among weed control treatments, hand weeding resulted in the highest pod number per plant (30.85), which outperformed all herbicidal options. This result aligns with expectations, as manual weeding provides efficient, non-chemical weed control, ensuring minimal competition for nutrients, moisture, and light. and Among herbicides Haloxyfop (25.87 pods) performed best, followed closely by Blast (25.69) and Axial (24.72), and these herbicides proved effective but still fell short of the performance achieved through hand weeding. The control plots, which lacked any weed control intervention, had the lowest pod count (12.47), confirming that unchecked weed growth significantly limits pod formation and overall productivity. and the reason for this may be attributed to the high effectiveness of the herbicides in reducing and limiting the role of weeds, which in turn leads to less competition for the crop, which gives it the opportunity to optimally exploit the growth elements, which increases the efficiency of photosynthesis and pushes the fava bean plant to produce the largest number of pods per plant, and this is consistent with what was reached by [7] while by the [8] who found the bean crop, the

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number of pods increased during spraying of the herbicide basgran at the recommended concentration, in the contrast [34] noticed when using the herbicides Trifluralin and Bentazone to control the weeds accompanying the bean crop that the characteristic of the number of pods did not differ significantly between them.

The results in Table (6) show that are the interaction between sowing date and herbicide treatment reveals that the lowest number of pods occurred in Date 1, Hand Weeding yielded the highest pod count (33.71), indicating excellent early weed control during a favorable sowing window.In contrast, Haloxyfob also performed well across all sowing dates, suggesting its potential reliability under different planting timings.Interestingly, even under the least favorable Date 3, Haloxyfob and Hand Weeding maintained relatively higher pod numbers compared to other treatments, further confirming their efficacy.

.7Effect of sowing date and herbicides treatment on the number of seeds per pod :

The results in the table (4) The sowing date had a significant impact on the number of seeds per pod. Among the three sowing dates, the highest average number of seeds per pod was observed in Date 2 (4.7933), followed closely by Date 1 (4.6733), while the lowest was recorded in Date 3 (3.8133). These results indicate that the early and mid-sowing dates (Date 1 and Date 2) are more favorable for seed development compared to late sowing (Date 3). Late sowing likely exposes the crop to unfavorable environmental conditions such as high temperatures or limited moisture during flowering and pod filling stages, which negatively affects seed formation.The reason for this increase may be due to the growth of the plant at the appropriate time through the availability of suitable climatic conditions for its growth and a long vegetative growth period, which leads to strong germination and the production of strong seedlings that are more efficient in Exploiting growth factors gives the plant the ability to withstand low temperatures during the winter, as well as protection from high temperatures that hinder the pollination and fertilization process, as flowers open and are pollinated when temperatures are ideal for this. This result is consistent with the findings of [2 and 11.[

The results in the table (5) Herbicide treatment had a strong effect on seed set. The highest average was observed under Hand Weeding (5.74 seeds/pod), followed by Blast (4.64), Haloxyfop (4.59), Axial (4.46), and the Control (2.70), where no weed control was applied. These results clearly indicate that weed competition significantly reduces the number of seeds per pod. Among the chemical herbicides, Blast and Haloxyfop were more effective than Axial in enhancing seed number. However, Hand Weeding outperformed all treatments, suggesting that manual weed control is still the most effective. [7] confirmed that weed control treatments resulted in a considerable increase in the number of seeds per pod.

The results in Table (6) show that are the interaction of sowing date and herbicide treatment the highest seed number (6.10 seeds/pod) was recorded with Hand Weeding on Date 2, indicating that this combination provided the best growing conditions. In contrast, the lowest seed number (2.50 seeds/pod) occurred under the Control treatment on Date 3, showing the combined negative effects of late sowing and lack of weed control. Chemical herbicides such as Blast, Axial, and Haloxyfop showed better performance on Date 1 and Date 2 than on Date 3, suggesting that their effectiveness depends on the sowing date.

.8 Effect of sowing date and herbicides treatment on the seed dry weight per plant:

The results in the table (4) indicate a significant effect of sowing date on seed dry weight per plant. Sowing date also played a

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pivotal role in determining seed dry weight. The second sowing date (Date 2) recorded the highest mean seed dry weight (27.89 g), followed closely by Date 1 (27.77 g), while the third sowing date (Date 3) showed a notable decline (25.72 g). This trend suggests that delayed sowing adversely affects plant development and seed formation, likely due to exposure to suboptimal environmental conditions or shorter growing periods. Furthermore, the interaction between sowing date and herbicide effectiveness was evident, as even the most effective treatment (hand weeding) exhibited reduced efficacy under late sowing (declining from 35.08 g on Date 2 to 31.06 g on Date 3). [26] who found the middle sowing date produced the maximum seed yield/fad and per plant, whereas the latest sowing date (25 November) produced the lowest, owing to a considerable decline in all seed yield indices. The substantial fall in harvest index, which barely reached 19% for early and late seeded plants compared to 30.68% for medium sown plants, clearly indicates that these plants maintained a solid balance between source and sink. The number of days from flowering to maturity was too long (126.2 days) for the early sown plants and too short (86.6 days) for the late sown ones when compared to the medium sown ones (107.7 days). As a result, the date of sowing determined the phenological stages of faba bean plants, as well as their yielding ability, which favored the middle sowing date. And according to [22] the early planting date resulted in the highest mean values for plant height, number of branches, number of pods, pod and seed weight per plant, 100 seed weight, and seed yield.

The results in the table (5) Herbicide treatments had a strong and consistent effect on seed dry weight the control treatment Among all weed control treatments, hand weeding consistently produced the highest seed dry weight per plant across all three sowing dates, with an overall mean of 33.71 g. This outcome underscores the effectiveness of manual weeding in reducing weed competition, thus facilitating optimal crop growth. These findings align with earlier research suggesting that hand weeding, despite being labor-intensive, often provides the most thorough weed control. Among chemical herbicides, Haloxyfop (27.87 g) and Blast (27.21 g) performed significantly better than Axial (26.55 g), indicating their relatively higher efficacy in controlling the prevailing weed species in the Sumel location. The control treatment, with no weed management, resulted in the lowest mean seed weight (20.29 g), reinforcing the detrimental effect of unchecked weed growth on crop productivity. These results confirm that effective weed management is essential to improving seed yield, and chemical herbicides can serve as viable alternatives to manual weeding

The results in Table (6) show that are the interaction effects highlight important management implications the lowest seed dry weight occurred the combined effect of timely sowing and effective weed management was found to be synergistic. For instance, the highest seed dry weight was obtained under hand weeding with Date 2, while the lowest was observed in the control treatment on Date 1, emphasizing the importance of an integrated crop management approach. Adopting timely sowing (preferably around Date 2 and then Date 1), Implementing effective weed control methods (hand weeding or selective herbicides like Haloxyfop or Blast.(

.9Effect of sowing date and herbicides treatment on the seed yield per hectare:

The results in Table (4) clearly show that sowing date significantly influenced the seed yield of faba bean in the Sumel location.Date 2 (mid sowing) produced the highest average seed yield (3851.29 kg/ha), followed by Date 1 (early sowing) with 3722.96 kg/ha, and Date 3 (late sowing) with the lowest yield (3660.54 kg/ha). This trend suggests that Date 2

provided the most favorable conditions for plant growth and development, possibly due to moderate temperatures, balanced soil moisture, and better synchronization with critical phenological stages such as flowering and pod filling. In contrast, early sowing may have exposed the plants to lower temperatures at emergence, while late sowing likely reduced the vegetative period and exposed the crop to terminal heat stress, both of which could reduce yield potential. this is consistent with his findings (9) where they stated that the characteristics of the seed yield and its components decrease when the planting date is delayed due to the inadequate climatic conditions for the growth stages.

The results in Table (5) clearly show that herbicide treatments significantly influenced the seed yield of faba bean in the Sumel location. The seed yield of faba bean was significantly affected by the herbicide treatments applied: The highest yield (4142.1 kg/ha) was obtained under hand weeding, demonstrating the effectiveness of manual weed control in reducing competition for light, nutrients, and water. Among chemical herbicides, Blast (3969.13 kg/ha), Haloxyfop (3953.4 kg/ha), and Axial (3896.4 kg/ha) all showed significantly higher yields compared to the control (2763.71 kg/ha), indicating their ability to suppress weeds and improve crop performance.

The results in Table (6) clearly show that the interaction between sowing date and herbicide treatment was significant indicating that the response of faba bean to herbicides varied depending on the sowing time, the highest yield (4317.9 kg/ha) was obtained from the combination of Date 2 + Hand Weeding, highlighting that optimal sowing time combined with effective weed management leads to maximum productivity, conversely, the lowest yield (2610.61 kg/ha) was recorded in the Date 3 + Control treatment. These results suggest that weed competition interacts strongly with the sowing date.

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Table (4) The effect of planting dates on the growth and yield characteristics of Vicia faba L. and associated weeds.

Sowing date	No. of narrow leaves weeds	Dry weight of narrow leaves Weeds	No. of broad leaves weeds	Dry weight of broad leaves Weeds	Height plant	No. of pods	No. of seeds / Pods	seed dry weight per plant	Seed yield/ha
1	27.2000a	93.9573a	42.1333a	170.7380a	81.2120ab	24.0487ab	4.6733a	27.7707a	3722.968ab
2	17.6667b	85.9760ab	19.6667b	109.5800b	82.6733a	25.9133a	4.7933a	27.8853a	3851.294a
3	14.4667b	83.6247b	16.7333b	97.1687c	79.4413b	21.7933b	3.8133b	25.7187b	3660.542c

values followed by similar letters do not differ significantly from each other at 5%

Table (5) The effect of herbicides treatment on the growth and yield of Vicia faba L. and the associated weeds

Herbicide Treatment	No. of narrow leaves weeds	Dry weight of narrow leaves Weeds	No. of broad leaves weeds	Dry weight of broad leaves weeds	Height plant	No. of pods	No. of seeds / Pods	seed dry weight per plant	Seed yield/ha
Control	36.00a	114.68a	56.00a	202.92a	71.22c	12.47c	2.70b	20.29c	2763.71c
Blast	23.00b	91.69b	16.56c	86.43c	82.75b	25.69b	4.64a	27.21b	3969.13b
Axial	15.22c	81.01bc	23.56b	134.20b	82.99b	24.72b	4.46a	26.55b	3896.4b
Haloxyfop	14.56c	80.74bc	22.78b	124.05b	83.49ab	25.87b	4.59a	27.87b	3953.4b
Hand weeding	10.11d	71.14c	12.00d	81.54c	85.10a	30.85a	5.74a	33.71a	4142.1a

values followed by similar letters do not differ significantly from each other at 5%

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Table (6) The effect of planting dates and herbicide treatment on the growth and yield characteristics of Vicia faba L. and the associated weeds.

Sowing date	Herbicide treatment	No. of narrow leaves weeds	Dry weight of narrow leaves weeds	No. of broad leaves weeds	Dry weight of broad leaves weeds	Height plant	No. of pods	No. of seeds / Pods	seed dry weight per plant	Seed yield/ ha
1	Control	54.33a	137.48a	102.67a	329.40a	62.76g	6.23f	2.70g	17.53c	2645.32e
	Blast	32.67b	96.90bcd	24.00cd	93.24efg	85.37ab	26.65cd	4.90ab	29.68c	3978.92c
	Axial	18.67de	81.91cde	36.00b	183.90b	85.83ab	26.15cd	4.77b	28.78c	3909c
	Haloxyfop	18.33de	81.72cde	32.00b	163.00bc	85.53ab	27.50cd	4.93ab	27.89c	3974.5c
	Hand weeding	12.00ef	71.77e	16.00def	84.14fg	86.57a	33.71a	6.07a	34.98a	4107.1a
2	Control	29.33bc	106.29b	36.00b	153.48c	74.73f	16.17e	2.90f	22.42e	3035.21d
	Blast	18.67de	90.52bcde	15.00ef	84.27fg	83.50abc	27.43cd	5.03ab	26.29c	3970.16c
	Axial	14.67ef	79.12cde	18.67de	115.87de	83.97abc	26.00cd	4.93ab	25.96c	3898.7c
	Haloxyfop	15.00ef	80.52cde	17.67de	113.44def	84.67abc	27.00cd	5.00ab	29.69c	4034.5c
	Hand weeding	10.67ef	73.43cde	11.00ef	80.84g	86.50a	32.97a	6.10a	35.08a	4317.9a
3	Control	24.33cd	100.27bc	29.33bc	125.87d	76.16e	15.00e	2.50f	20.92d	2610.61d
	Blast	17.67de	87.65bcde	10.67ef	81.79g	79.38de	23.00d	4.00b	25.66c	3958.32c
	Axial	12.33ef	82.00cde	16.00def	102.83defg	79.17ed	22.00d	3.67f	24.92c	3881.5c

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	Haloxyfop	10.33ef	79.97cde	18.67de	95.72defg	82.27abc	23.10cd	3.83f	26.03c	3851.1c
	Hand weeding	7.67f	68.23e	9.00f	79.64g	83.23abc	25.87b	5.07ab	31.06b	4001.18b

values followed by similar letters do not differ significantly from each other at 5%

Conclusion

This study highlights the critical influence of sowing date and weed management on the performance of faba bean under rainfed conditions. The mid-sowing date (20th November) provided the most balanced conditions for crop development and weed suppression. Among weed control strategies, hand weeding was the most effective, though labor-intensive, while Haloxyfop herbicide emerged as a strong chemical alternative for controlling narrow-leaved weeds and improving yield components.

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