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Management of Weeds in Faba Bean (*Vicia faba* L.) through Hoeing and Hand Weeding Frequency at Dagam District, North Shewa Zone, Oromia

Shelema Feyissa Lalisa, and Adisu Regasa

Oromia Agricultural Research Institute (OARI), Fitche Agricultural Research Center, P.O. Box 109, Fitche, Oromia, Ethiopia

Abstract: Weeds are the major production constraint for faba bean production in North Shewa Zone, Oromia Region. Its management is quite important to increase the production and productivity of the crop. Due to such gaps, the experiment was conducted in Dagam District on farmers' fields during 2022 and 2023 during the main cropping seasons to evaluate the effect of hoeing with hand-weeding frequencies on the yield of faba bean. The treatments were consisted of ten weed management options i.e. Weedy check, Weed free check, one times Hand weeding at three weeks after emergence, one times Hoeing at three weeks after emergence, one times Hoeing at three weeks after emergence and one times Hand weeding at five weeks after emergence, one times Hoeing at three weeks after emergence and one times Hand weeding at six weeks after emergence, one times Hoeing at three weeks after emergence and two times Hand weeding at five weeks after emergence and seven weeks after emergence, two times Hoeing at three Weeks After Emergence and five Weeks After Emergence, two times Hand Weeding at three Weeks After Emergence and five Weeks After Emergence and Weed harvesting at 50% pod setting stage. It was laid out in a randomized complete block design (RCBD) with three replications. Results indicated that the faba bean plant flowered and matured earlier when infested with weeds as compared to well weed-controlled treatments. The growth and yield attributes of faba bean were significantly reduced when the crop was left unweeded. The result also showed that there was about 48.15% and 39.89% yield reduction occurred due to total weed infestation and Weed harvesting at 50% pod setting stage of faba bean as compared to the recommended one time hoeing at three Weeks After Emergence + one time Hand Weeding at six Weeks after Emergence and one time hoeing at three Weeks After Emergence + one times Hand Weeding at five Weeks After Emergence. one time hoeing at three Weeks After Emergence + one time Hand Weeding at six Weeks after Emergence gave a yield advantage of 91.8% and one time hoeing at three Weeks After Emergence +one times Hand Weeding at five Weeks After gave a yield advantage of 88.8% compared to weed control. Thus, it was concluded that the use of weed management options as of one time hoeing at three Weeks After Emergence + one time Hand Weeding at six Weeks after Emergence and one time hoeing at three Weeks After Emergence + onetime Hand Weeding at five Weeks After Emergence was more economically profitable and has an acceptable marginal rate of return.

Key words: Hand weeding, week after emergence, Hoeing, Faba bean.

1. Introduction

Faba bean (Vicia faba L.) is one of the most important pulse crops worldwide. It is used as a nitrogen-fixing plant, capable of returning atmospheric nitrogen into the soil, and as a source of high-quality protein [1]. Ethiopia is one of the largest producers of major pulse crops [2]. However, its productivity is very low compared to its potential productivity; according to CSA, it is 2.12 tons ha^{-1}, which is relatively low when compared to the crop's potential yield of 4.4 tons ha^{-1} [3].

The yield and productivity of faba bean are influenced by various production constraints such as biotic and abiotic factors. Weeds are a challenging problem for pulse crops in general and for faba bean production in particular. Since the crop is poorly competitive with both broadleaf and grass weed species from early establishment to the flowering stage, it requires control measures during this critical period. Weeds affect growth, yield, and quality of

Corresponding author: Shelema Feyissa Lalisa, M.Sc., researcher, research fields: weed science, crop protection, and integrated weed management.

crop plants adversely and reduce soil fertility, compete with the crop plants for soil moisture, available nutrients, space, and sunlight, etc. leads to the low yield of crop [4].

Since the herbicides for most pulse crops are not locally available or are very limited in availability, most small-scale farmers cannot access and use the chemicals for weed control. Due to such reasons, hand weeding is the common cultural practice to remove weeds from pulse crop fields. This calls for the introduction of improved weed control techniques that are economically and agronomically feasible, such as a combination of hoeing and hand weeding can be considered in faba bean growing areas of Northern Oromia. Therefore, the objective of this study was to evaluate the effect of hoeing with hand-weeding frequencies on the yield of faba bean for weed control in Faba bean (Vicia faba) in Northern Oromia.

2. Materials and Methods

2.1 Description of Study Area

The experiment was conducted on farmers' fields in Dagam District, North Shewa Zone, Oromia, under rain-fed conditions during the main cropping seasons of 2022 and 2023. Dagam district located 125 km to the North direction of Addis Ababa, the capital city of the country.

2.2 Treatments and Experimental Design

The experiment includes ten (10) treatments arranged in a randomized complete block design (RCBD) with three replications, with a plot size of 3 m x 1.6 m. Each plot consisted of 3 meters long, with 4 rows spaced 40 cm apart. The distance between plants was 10 cm. The distance between adjacent replications (blocks) and plots was 1 m and 0.5 m, respectively. The net central unit area of each plot consisted of 2 rows of sample measurements, leaving aside plants in the two outer rows and those at both ends of each of the rows to avoid border effects. Treatment details includes: Weedy check, Weed free check, one times Hand weeding at three weeks after emergence, one times Hoeing at three weeks after emergence, one times Hoeing at three weeks after emergence and one times Hand weeding at five weeks after emergence, one times Hoeing at three weeks after emergence and one times Hand weeding at six weeks after emergence, one times Hoeing at three weeks after emergence and two times Hand weeding at five weeks after emergence and seven weeks after emergence, two times Hoeing at three Weeks After Emergence and five Weeks After Emergence, two times Hand Weeding at three Weeks After Emergence and five Weeks After Emergence and Weed harvesting at 50% pod setting stage. The recommended seed rate of 125 kg ha^{-1} and 100 kg ha^{-1} NPS fertilizer were uniformly supplied for each treatment at planting.

2.3 Data Collection

Important yield and yield components, percentage of yield increment and loss, production cost, and benefit were collected to assess the profitability difference of the treatments. Yield from the experimental plot was adjusted downward by 10% to reflect the difference between the experimental yield and the yield farmers could expect from the same treatment. Accordingly, the mean grain yield of weed-free and weedy cheek plots were subjected to a discrete economic analysis using the procedure recommended by [5] to estimate economic parameters; faba bean yield was valued at an average open market price of 100 birr kg^{-1}; labor was valued at 300 birr per person per day and used for the determination of the variable cost.

2.4 Data Analysis

The agronomic data were analyzed using R software and descriptive statistical techniques such as percentages. Economic analysis was made using partial budget to determine the economic feasibility of the Different management practices.

3. Results and Discussion

This experiment was conducted for two years (2022 and 2023 cropping seasons) in Dagam District on Farmers' fields. In the 2022 and 2023 cropping seasons, the experiment was conducted at the same locations, and all the required field data were collected. Therefore, the current results were summarized from the two years' data of Dagam District from farmers' fields.

3.1 Weed Data

3.1.1 Weed Community

The experimental field was found to be infested with different types of grasses and broad-leaved weeds (Table 1). The most dominant broad-leaved weeds include Polygonum nepalensis, Corrigiola capensis, Plantago lanceolata, Caylusea abyssinica, Spergula arvensis, Raphanus rephanistrum, Bidens pilosa, Galinsoga parviflora, Oxalis latifolia, and Guizotia scabra. Among the grass weeds Snowdenia polystachya, Setaria pumlia, Phalaris paradoxa and Avena fatua were dominant.

Weed density (m^{-2}) was significantly affected by different weed management practices, which reduced the weed population from 70.42 to 100% (Table 2). The highest number (235.17 m^{-2}) was recorded in the weedy check, followed by one-time hand weeding at three weeks after emergence (80.93 m^{-2}). This might be due to weed infestation from poor weed management practices. This result is in line with [6], who reported that uncontrolled weed infestation resulted in significantly higher weed density in cowpea.

The lowest weed density (0, 11, 17 and 27) m^{-2} was detected from weed-free treatment, one-time hoeing at three weeks after emergence + two times hand weeding at five weeks after emergence and seven weeks after emergence, one-time hoeing at three weeks after emergence + one time hand weeding at six weeks after emergence, and one-time hoeing at three weeks after emergence + one times Hand weeding at five weeks after emergence (Table 2). This might be due to the competitive advantage of the crop over weeds; the later-emerging weeds were suppressed by taller crop plants more under best weed management practices, thus resulting in reduced total weed density.

Weed biomass dry weight: From the analysis of above-ground weed biomass dry weight data, it was noted that there was a significant difference among the treatments at $p \leqslant 0.05$. At harvest, the highest weed biomass dry weight (392.8 g m^{-2}) was observed from the weedy check, followed by hand weeding once at three weeks after emergence (385.3 g m^{-2}). This finding corroborates the findings of [7], where they observed that weed management significantly influenced weed biomass dry weight in faba bean. According to their results, weed management practices significantly lowered weed biomass dry weight in comparison with the weedy check. Likewise, [7] reported that the higher weed dry weight in the weedy check was due to higher weed density, which provided an opportunity for weeds to compete vigorously for nutrients, space, light, water, and carbon dioxide, resulting in higher biomass production.

While the lowest weed biomass (0.00 g m^{-2}, 180.4 g m^{-2}, and 218.5 g m^{-2}) was observed from weed-free treatments, one times Hoeing at three weeks after emergence + two times hand weeding at five weeks after

Table 1 The major problematic weeds in the experimental fields during the 2022 and 2023 cropping season.

Botanical name	Family
Bidens pilosa L. Galinsoga parviflora, Guzotia scabra	Composite Composite Composite
Raphanus raphanistrum	Brassicaceae
Corrigiola capensis, Spergula arvensis	Caryophyllaceae Caryophyllaceae
Oxalis latifolia	Oxalidaceae
Plantago lanceolata L.	Plntaginaceae
Snowdenia polystachya, Setaria pumlia, Phalaris paradoxa L., Avena fatua	Poaceae Poaceae Poaceae Poaceae
Polygonum nepalensis	Polygonaceae
Caylusea abyssinica(Fressen.)Fisch.& May	Resedaceae

Table 2 Weed flora parameters as influenced by weed control treatment at Dagam District during the 2022/2023 main cropping season.

Treatments	WD (m^2)	WDB (gm^2)	WCE (%)
Weedy check	235.17^{f}	392.8^{f}	0
Weed free check	0^{a}	0^{a}	100
1HW at 3WAE	80.93^{e}	385.3^{e}	70.42
1Hoieng at 3WAE	59.63^{e}	370.2^{de}	71.58
1H at 3WAE + 1HW at 5WAE	27.62^{c}	218.5^{bc}	83.22
1H at 3WAE + 1HW at 6WAE	17.17^{ac}	219.6^{bc}	83.14
1H at 3WAE+ 2HW at 5WAE and 7WAE	11^{abc}	180.4^{b}	86.15
2H at 3WAE and 5WAE	44.9^{d}	249.2^{bcd}	80.87
2HW at 3WAE and 5WAE	55.1^{d}	339.8^{cde}	73.91
Weed harvesting at 50% pod setting stage	0^{a}	0^{a}	100
Mean	54.8	327	71.913
LSD (5%)	16.26	17.5	-
CV (%)	17.3	21.0	-

WD: weed density; WDB: weed dry biomass; WCE: weed control efficacy.

emergence and seven weeks after emergence, and one time hoeing at three weeks after emergence + one time hand weeding at five weeks after emergence. In line with this result, [8] reported that minimum weed dry weight in different weed management treatments with weed-free conditions might be due to effective weed control obtained under hand hoeing at early crop growth stage, which resulted in the lowest weed counts and finally reduced the total dry weight of weeds at harvest. This reduction of weed dry weight might be due to lower weed dry biomass than the other treatments (Table 2).

Weed Control Efficiency: Weed control efficiency (%) was affected significantly by different weed management practices. The maximum weed control efficiency was recorded in the weed-free check plot (100%), followed by one-time hoeing at three weeks after emergence + two times hand weeding at five weeks after emergence and seven weeks after emergence (86.15%) and one-time hoeing at three weeks after emergence + one time hand weeding at five weeks after emergence treatments (83.22%). The lowest weed control efficiency was recorded in the weedy check (0.00%). The result is in agreement with the findings of [8], who reported that hoeing early gave higher weed control efficiency by reducing the weed density and dry weight significantly as compared to the weedy check (Table 2). This might be due to more competition offered by Faba bean for growth resources and early space covering.

3.2 Crop Parameters

3.2.1 Phenology and Growth

Days to 50% plant flowering. Table 3: Showed weed management practices had a significant effect on flowering date. The result indicated that the weed-free check (73.67 days), one-time hand weeding at three weeks after emergence (72.33 days,) one time Hoeing at three weeks after emergence, and one-time hand weeding at five weeks after emergence (71.67 days) flowered later compared to other treatments, respectively. While weedy check (69.67 days) plots flowered and matured early. A similar result was reported by [8]; this may be due to resource competition caused by narrow leaves, which fix the lowest amount of nitrogen and have less translocation of photosynthesis from source to sink, which resulted in early flower formation. These results disagreed with [9], which identified that the plants in non-weeded plots took the longest time to reach 50% flowering in

cowpea, and similarly, [7] also reported that delayed days to flowering in faba bean were recorded under the weedy check than the other treatments.

Days to 90% physiological maturity: The highest days to 90% physiological maturity (151.7 days) was recorded under weedy free check, followed with one time Hoeing at three weeks after emergence and one time Hand weeding at five weeks after emergence (151 days) days to 90% physiological maturity than the other treatments. While Plots, which were kept weedy throughout the season, had the lowest (147.7 days), followed by weed harvesting at 50% pod setting stage (148 days) to 90% physiological maturity (Table 3). Regarding maturity, weeds in the faba bean field may compete heavily for resources, which can force early maturity. A similar result was reported by [8] that the weedy check treatment flowered and matured earlier compared to the intensive weed management treatments due to resource competition in the weedy check, which caused forced phenological growth of the crop. These results disagreed with [10], which reported that with an increase in the density of Parthenium, the duration required by the common bean plants to reach physiological maturity was prolonged.

Plant Height: Different weeding management practices had a significant effect on plant height. The highest plant height (149.27 cm) was recorded from weed-check plots, followed by one-time hand weeding at three weeks after emergence (140.62 cm). The shortest plant height was recorded when one-time hoeing at three Weeks After Emergence + two times Hand Weeding at five Weeks After Emergence and seven weeks After Emergence (117.40 cm) followed by, one time Hoeing at three Weeks After Emergence + one time Hand weeding at five Weeks After Emergence (130.13 cm). This result is in agreement with the report of [6], who observed that the increase in plant height of cowpea in the presence of severe weed interference can be due to intense competition between weeds and crop plants and their desire to get light energy. [7] Also reported that the plants in weedy check plots attained significantly higher height than others weed management practices.

3.2.2 Yield and Yield Components

3.2.2.1 Number of Pods per Plant (No): Weed management practices significantly affected the number of pods per plant. The highest number of pods per plant was recorded in one-time hoeing at three Weeks After Emergence + one-time hand weeding at six Weeks after Emergence (27.73), followed by weed-free treatments (26.67). The minimum value was observed in the weedy check (15.13) and weed removal at the 50% pod-setting stage (17.07).

The results indicated that the number of pods per plant increased as weed infestation decreased. The higher number of pods per plant in the weed-free check might be due to the absence of competition for moisture, nutrients, and light from weeds, as the plots were kept weed-free throughout the cropping season. Similar results were reported by [11], who observed that increasing the number of weedings significantly increased the number of pods per plant. [12] also reported that a higher number of pods per plant was found in the three-stage weeding treatment than in the no-weeding treatment.

3.2.2.2 Number of Seeds per Pods (No): Weed control methods showed a significant effect on the number of seeds per pod. The data revealed that they had shown highest number of seeds per pod (3.46) was recorded by one-time hoeing at three Weeks After Emergence + one-time hand weeding at six Weeks after Emergence, followed by weed-free treatments (3.45). The lowest Number of seeds per pod was recorded from Weed harvesting at the 50% pod-setting stage treatments (3.04), followed by weed control treatments (3.1). The highest number of seeds per pod under treatments kept weed-free throughout the season was due to the absence of competition for nutrients, moisture, and light from the weeds, and the vigorous leaves of faba bean might have helped to improve the photosynthetic efficiency of the crop that supported a large number of seeds per pod. This result

was in line with the current result; [11] reported the highest number of seeds per pod under weed-free treatment, while the lowest was obtained under weed-infested treatment. This might be attributed to effective weed control during the early growth stage of the crop helped in the better development of the plant infrastructure and reduced competition for nutrients, radiation, and water from weeds, facilitating better growth and development of the crop.

3.2.2.3 Number of Branches per Plant (No): Different weed management practices significantly affected the Number of branches per plant. The highest Number of branches per plant was recorded from Weed free check (5.33), followed by one time Hoeing at three Weeks After Emergence + Two times Hand Weeding at five Weeks After Emergence + seven Weeks After Emergence (4.63) and one time Hoeing at three Weeks After Emergence + one time Hand Weeding at six Weeks after Emergence (4.5). This might be due to the weed-free period during life cycle of the crop life cycle. The lowest Number of branches per plant was recorded from weed control treatments (3.00), followed by one-time hoeing at three Weeks after Emergence (3.11) (Table 3). This might be due to being weed-free during life cycle of the crop life cycle.

3.2.2.4 Hundred Seed Weight: Different weed management practices significantly affected 100 seed weight in Dagam Districts. The data revealed that the highest 100 seed weight was recorded when weed-free throughout the life cycle of the crop (67.38), followed by one-time hoeing at three Weeks After Emergence + one-time hand weeding at six Weeks after Emergence (65.67). The increment in thousand seed weight in weed-free treatments might be due to reduced competition between weeds and crop for growth resources, which might have enhanced the availability of nutrients and better translocation of photosynthesis from source to sink, and resulted in higher accumulation of photosynthesis in the seeds. These results were in line with the results of [12], who stated that increasing the number of weedings significantly increased 1000 seed weight. Also reported [13] that thousand seed weight of Faba bean was increased as frequency of weeding was increased.

Table 3 Phonological and growth components of Faba bean as influenced by weed control treatment at Dagam District during the 2022/2023 main cropping season.

Treatments	DF	DM	PH	NPPP	NSPP	NB
Weedy check	69.67^{a}	147.7^{a}	149.27^{a}	15.13^{ab}	3.1^{ab}	3.00 ^{c}
Weed free check	73.67^{d}	151.7^{e}	138.00^{bc}	26.67^{a}	3.45^{ab}	5.33^{a}
1HW at 3WAE	72.33^{c}	150.7^{cde}	140.62^{b}	20.87^{ab}	3.197^{ab}	3.67^{bc}
1Hoieng at 3WAE	70.67^{ab}	149a^{bcd}	130.67^{d}	20.47^{ab}	3.31^{ab}	3.11^{c}
1H at 3WAE + 1HW at 5WAE	71.67^{bc}	151de	130.27d	22.14^{ab}	3.38^{ab}	4.23^{b}
1H at 3WAE + 1HW at 6WAE	70.67^{ab}	148.7^{abc}	131.60^{d}	27.73^{ab}	3.46^{ab}	4.5bc
1H at 3WAE+ 2HW at 5WAE and 7WAE	71^{abc}	149^{abcd}	117.40e	20.29^{b}	3.44^{a}	4.63^{ab}
2H at 3WAE and 5WAE	70.67^{ab}	149^{abcd}	130.13^{d}	19.93^{ab}	3.047^{b}	4b^{c}
2HW at 3WAE and 5WAE	71.67^{bc}	150^{bcde}	132.93^{cd}	18.4^{ab}	3.243^{ab}	3.44^{bc}
Weed harvesting at 50% pod setting stage	69.67^{a}	148.3^{ab}	138.40^{b}	17.07^{ab}	3.04^{ab}	3.55^{bc}
Mean	71.17	149.50	133.93	20.4	3.2	3.9
LSD (5%)	1.287	1.61	5.12	9.91	0.53	0.94
CV (%)	10.1	1.86	12.25	28.4	9.5	14.2

DF: Days to 50% flowering; DM: Days to 90% maturity; PH: Plant height in centimeters; NPPP: Number of pods per plant; NB: Number of branches.

Table 4 Yield and yield-contributing traits of Faba bean as influenced by weed control treatment at Dagam District during the 2022/2023 main cropping season.

Treatments	HSW(g)	GY (kg ha^{-1})	HI (%)
Weedy check	53.23^{bc}	3700^{c}	35.15
Weed free check	67.38^{a}	7136^{a}	42.6
1HW at 3WAE	64.68^{ab}	4338^{abc}	40.22
1Hoieng at 3WAE	63.75^{bc}	4800^{bc}	39
1H at 3WAE + 1HW at 5WAE	65.65^{bc}	6044^{ab}	43.51
1H at 3WAE + 1HW at 6WAE	60.72^{abc}	6178^{abc}	40.73
1H at 3WAE+ 2HW at 5WAE and 7WAE	62.37^{abc}	5400^{ab}	41.47
2H at 3WAE and 5WAE	62.2^{abc}	5622^{ab}	41.63
2HW at 3WAE and 5WAE	56.58^{bc}	5098^{ab}	41
Weed harvesting at 50% pod setting stage	59.02^{abc}	5098^{bc}	39.94
Mean	59.9	5341.4	40.53
LSD (5%)	8.50	17.75	ns
CV (%)	9.3	19	11.012

HSW: Hundred seed weight in grams; GY (kg ha^{-1}): Grain Yield in kilograms per hectare; HI: Harvest Index in percentage.

The lowest hundred seed weight was recorded from weed control treatments (53.23), followed by weed harvesting at the 50% pod setting stage (59.02). The reason for the lower seed weight might be due to competition between weeds and crops. In agreement with these findings, [14] observed the lowest number of hundred seed weights of soybean in weedy check plots.

3.2.2.5 Grain Yield: The difference in growth and grain yield was observed to be highly significant due to different weed management. The highest seed yield (7136 kg ha^{-1}) was obtained from weed-free treatments, followed by one-time hoeing at three weeks after emergence and one-time hand weeding at six weeks after emergence (6178 kg ha^{-1}) and one-time hoeing at three weeks after emergence and one-time hand weeding at five weeks after emergence (6044 kg ha^{-1}). The possible reason for higher yields under these treatments was that higher weed control efficiency resulted in better growth and development, leading to higher yield components. Therefore, the higher number of pods per plant, seeds per pod, and thousand seed weight (Tables 3 and 4) might have contributed to the significantly higher grain yield in these treatments. Similar results were obtained by [15], who reported an increase in grain yield with an increase in weeding frequency of green gram.

[16] also reported that two hand weedings at 20 and 40 days after sowing resulted in higher weed-control efficiency and grain yield compared with the weedy check. The improvement in grain yield under effective weed management could be attributed to reduced competition between weeds and the crop for essential resources such as nutrients, moisture, light, and space, which promoted better crop growth and yield formation.

On the other hand, plants that were not weeded throughout the season had the lowest grain yield (3700 kg ha^{-1}), followed by weed harvesting at the pod-setting stage (4289 kg ha^{-1}), compared with all other treatments. The lowest grain yield in the weedy check was a result of intense weed competition that resulted in a lower number of pods per plant, seeds per pod, and lower thousand seed weight finally reduced the yields. The higher weed dry biomass and lower weed control efficiency also resulted in yield reduction of faba bean in these treatments.

3.2.2.6 Yield Loss (%): When comparing weed management practices with each other, the highest yield loss (48.15%) was observed in weedy check plots over weed-free check than the other treatments, which was followed by Weed harvesting at 50% pod setting stage and one-time hoeing at three weeks after emergence (39.21%). The highest yield loss observed in the weedy check was due to weed infestation throughout the season in these treatments. These results were in line

with the results of [6], who reported that higher yield reduction was recorded in weedy checks than the other treatments due to weed infestation. These indicate that faba bean production without weeding until pod setting significantly affected yield performance. Although farmers use the weed as animal feed when the feed shortage is critical. Similar to this finding, [16] and [7] found that effective weed management significantly reduced weed infestation and improved the grain yield of faba bean compared with the weedy check. The improvement in crop performance under effective weed control was attributed to reduced competition between weeds and faba bean for essential resources such as nutrients, moisture, light, and space.

The lowest yield loss (0.00%) was recorded from weed-free treatments, followed by one-time hoeing at three Weeks After Emergence + one time Hand Weeding done six weeks after the emergence of crops resulted in a decreased weed infestation rate (13.42%). This is due to the fact that weeds had been well removed from the field during the process of growth of the crops. Similar findings were reported by [4] reported that there was an increased yield of faba bean seeds by 25% when hand weeding was done six weeks after the emergence of crops.

Partial Budget Analysis: The partial budget analysis result using the partial budget procedure [5] was done because grain yield was significantly influenced by Hoeing and Hand weeding frequency. Economic analysis of different weed control in faba bean by the use of weed-free and one-time hoeing at three Weeks After Emergence + one-time hand weeding at six Weeks after Emergence gave different economic returns as compared to the weedy check, weed removal at 50% pod setting stage, and hand weeding frequency (Table 5). Thus, weed-free and one-time hoeing at three Weeks After Emergence + one-time hand weeding at six Weeks after Emergence gave the highest net benefit (567,240 and 485,468), followed by one-time hoeing at three Weeks After Emergence + one times Hand Weeding at five Weeks After Emergence with net benefits of (478,408 birr). The lowest net benefits were recorded from Weed control and Weed harvesting at 50% pod-setting stage treatments (333,000 and 373,010 birr), respectively.

Similarly, [4] found that two hand-hoeing and weeding at two and five weeks after crop emergence were the most economically feasible alternatives for faba bean production. Thus, it was concluded that the use of weed management options such as of one time Hoeing at three Weeks After Emergence + one-time hand weeding at six Weeks after Emergence and one-time hoeing at three Weeks After Emergence + one-time hand weeding at five Weeks After Emergence are economically profitable and have an acceptable marginal rate of return.

Table 5 Economic and marginal analysis of weed control practices at Dagam districts, highlands of north Shewa, during 2022 and 2023 main cropping seasons.

Treatments	GY(kg/ha^{-1})	AdY (kg/ha)	GI (Birr)	VC (Birr)	NB (Birr)	MRR (%)
	3700	3330	333,000	0	333,000	307.77
Weed harvesting at 50% pod setting stage	4289	3860.1	386,010	13,000	373,010	D
1HW at 3WAE	4338	3904.2	390,420	20,500	369,920	66.32
1Hoieng at 3WAE	4800	4320	432,000	45,500	386,500	387.64
2HW at 3WAE and 5WAE	5098	4588.2	458,820	51,000	407,820	386.94
2H at 3WAE and 5WAE	5622	5059.8	505,980	60,685	445,295	D
1H at 3WAE+ 2HW at 5WAE and 7WAE	5400	4860	486,000	65,800	420,200	D
1H at 3WAE + 1HW at 5WAE	6044	5439.6	543,960	65,552	478,408	141.20
1H at 3WAE + 1HW at 6WAE	6178	5560.2	556,020	70,552	485,468	1838.40
Weed free check	7136	6422.4	642,240	75,000	567,240	756.32

4. Conclusion and Recommendations

Weed pressure is the main driving factor that influences the production and productivity of faba bean. Even though cultural weed management approaches are the best option for effective and sustainable weed control, cultural practices are one of the best strategies for the control of weeds, particularly in areas where access to post- or pre-emergence herbicides is very limited. Among different cultural practices, hoeing and hand weeding frequencies are some of them. The result of this experiment, which focused on different cultural practices, revealed that one-time hoeing at three Weeks After Emergence + one-time hand weeding at six Weeks after Emergence and one-time hoeing at three Weeks After Emergence + one-time hand weeding at five Weeks After Emergence gave optimum yield advantage compared to other treatments and hence recommended for the study area.

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