Prime Scholars Library

Advances in Agriculture, Food Science and Forestry

Research Article

Vol. 10 (4), pp.01 - 05, December, 2022

Available online at
https://primescholarslibrary.org/

Determining optimum inter and intra -Row spacing for faba bean (*Vicia Faba L.*) in mirab azernet and Alicho wuriro Highlands, Ethiopia

Bezabih Woldekiros*

Department of Crop Research, South Agricultural Research Institute, Worabe Agricultural Research Center, Worabe, Ethiopia.

Received: 13-Sep-2022, Manuscript No. AAFSF-22-74530; **Editor assigned:** 16-Sep-2022, Pre QCNo. AAFSF-22-74530 (PQ); **Reviewed:** 30-Sep-2022, QC No. AAFSF-22-74530; **Revised:** 07-Oct-2022, Manuscript No. AAFSF-22-74530 (R); **Published:** 14-Oct-2022, DOI: 10.51268/2736-1799.22.10.085.

ABSTRACT

In the highlands of Ethiopia, faba bean is one of the major pulse crops widely produced. It is an annual crop grown during the main rainy season (June to September). Despite its range of benefits, both national and regional productivity is still low compared to its attainable yield. Alicho wurio and Mirab azernet highlands are ideal places for the growth of faba bean. However, the yield is below the national and regional average yield. Plant density determines the number of plants per area, which determines the available area for an individual plant. The field experiment was conducted in 2019 and 2020 at Alicho wuriro and Mirab azernet highlands, Siltie zone, Southern Nations Nationalities and Peoples' Regional State of Ethiopia to determine optimum plant density for faba bean. The factorial combination of three levels of inter-row spacing (30 cm, 40 cm and 50 cm) and four levels of intra-row spacing (5 cm, 10 cm, 15 cm and 20 cm) was laid out in a randomized complete block design with three replications. Plant height, number of pods per plant and grain yield was significantly affected by plant density. The highest grain yield was recorded due to 40 cm inter and 10 cm intra-row spacing. Therefore, it can be concluded that the previous national recommendation of inter and intra-row spacing is effective to obtain a high yield of faba bean in the experimental areas.

Keywords: Faba bean, Individual plant, Inter row spacing, Plant population.

INTRODUCTION

Faba bean is the most important annual edible legume crop in Ethiopia (Mulualem et al., 2012). It is an annual crop grown by subsistence farmers during the main monsoon season (June to September). Faba bean accounts for 29.84 percent of the country's legume crop acreage (CSA, 2020). Of the total area under legume crop production in the southern region, 31.29% is covered by faba bean (CSA, 2020).Crop density affects canopy formation, the efficiency of light conversion, crop growth, dry matter production, seed yield and crop production (Lopez et al., 2005). Furthermore, the contribution capacity of the yield components to the final seed yield is related to the number of plants per unit area. Variations in plant density in different climates affect faba bean productivity (Khalil et al., 2011).The faba bean is a crop with various advantages in Ethiopia's highlands farming

community. It is a valuable and low-cost source of protein, as well as a food and feed source. The fixation of atmospheric nitrogen by the faba bean contributes to soil fertility restoration in crop rotation (Degago, 2000). It is mostly used as a substitute for peas in the preparation of flour, which is used to produce a stew popular in Ethiopian cuisine. In Ethiopia, the boiling broad bean is also popular. It's also a highly profitable crop (Jensen et al., 2010).Despite its numerous advantages, faba bean productivity, both national and regional productivity (2.15 t/ha), has remained low as compared to the attainable yield of 3.7 t/ha (FAOSTAT, 2017) (CSA, 2020).
Climate, idiopathic, biotic (diseases, pests, and weeds) factors, and bad farming techniques are the main reasons for low faba bean yields in Ethiopia (Ademe et al., 2018).Alicho wurio and Mirab azernet are two prospective faba bean growing sites. However, this crop's production is significantly lower than the national and regional averages. Poor farming practices, such as incorrect plant density, fertilizer management, and the usage of local cultivars, are to blame. As previously stated, plant density has a significant impact on crop productivity. Due to the difficulty of cultivating manually, farmers are not adhering to the previously specified inter and intra-row spacing. Consequently, the yields are very poor. Hence, the goal of this study was to determine the best faba bean plant density and structure in the Alicho wuriro and Mirab azernet highlands.

MATERIALS AND METHODS

Study areas

The field experiment was conducted in 2019 and 2020 in the Alicho wuriro and Mirab Azernet districts, Siltie zone, Southern Nation Nationalities and People's Regional State of Ethiopia. Alicho wuriro is located at 07°56'96"N and 038°09'39"E, at an elevation of 2814 meters above sea level. Mirab azernet lies at 07°44'43"N, 038°54'41"E, and 2625 meters above sea level. With an average annual rainfall of 1008 mm, these locations have dual-model rainfall. The rainy season is divided into two parts: short rainy season (March to April) and main rainy season (June to September). The rainfall pattern, on the other hand, is quite diversified with a high variability. Clay loam is the predominant soil type in the areas. Agriculture is the most important economic activity in rural areas, with rain-fed agricultural production dominating (Figure 1).

Experimental design and approaches

There were three inter-row levels (30 cm, 40 cm, and 50 cm) and four intra-row levels (5 cm, 10 cm, 15 cm, and 20 cm). In a randomized complete block design with three replications, factorial combinations of spacing are evaluated. Table 1 lists the treatment combinations and plant density information. The experimental farms are ploughed four times with local ploughs pulled by oxen using traditional farming techniques. Plots are drawn according to the arrangement, with levelling and treatments assigned at random. The Tumisa faba bean variety was used as the test type. At sowing 121 kg, NPS was applied as band application and 50 kg urea per hectare during mid-growth. After the crop had matured, plot-by-plot harvesting was carried out.

RESULTS AND DISCUSSION

Plant height

At both experimental sites, plant density demonstrated a significant ($p<0.05$) effect on plant height. Because of the dense plant population, high plant heights were reported at the Mirab azernet and Alicho wuriro locations (Tables 2 and 3). As a result, the highest plant heights (127.07 cm and 124.90 cm) were attained in Mirab azernet and Alicho wuriro, respectively, due to 30 cm × 5 cm. These findings correspond with those of Gezahegn (Gezahegn et al., 2016), who discovered that plants with the tightest inter and intra-row spacing developed to be significantly taller than those with broader spacing. Similarly, Singh (Singh, 2002) found that dense plant populations lead to increased plant height. This is most likely due to high-density plants competing for light, resulting in taller plants. According to Baye (Baye et al., 2020), plant height changed greatly depending on plant density. The largest plant height was found when seeds were planted at a shorter spacing, while the lowest was observed when seeds were put at a wider spacing, according to their findings.

The number of pods per plant

Plant density had a major impact on the number of pods per plant in two places. The plant population dwindled as the population grew denser. As a result of the maximum plant density in the two testing sites, the lowest number of pods per plant was produced (Tables 2 and 3). According to many studies, the number of pods per plant increases when plant density drops (inter and intra-row separation increases). For example, increasing inter and intra-row spacing resulted in a considerable increase in the number of pods per plant (Gezahegn, 2017), with the maximum number of pods/plant achieved from the widest inter and intra-row spacing. These findings are in line with Bakry (Bakry, 2011), who found that as plant density increased, pod numbers fell. Due to increased competition in dense plant density, this decrease in pod quantity could be linked to branch number.

Hundred seed weight

Plant density did not have a significant effect on one hundred seed weight in two locations (Tables 2 and 3). This agrees with previous papers

showing that 1000-seed weight was not significantly affected by plant density (O'Donovan, 1994). In contrast, Khalil (Khalil et al., 2011) reported that plant concentrations that are lower than those that produce lighter grains produce heavier grains.

Grain yield

The effect of plant density on seed yield is significant in both locations. According to the seed yield data of faba bean, the highest seed yield with 40 cm inter-row and 10 intra-row spacing was obtained from both Alicho wuriro and Mirab azernet. Grain yield decreased due to a decrease in plant density. However, an increase in plant density increased grain yield, and higher plant density did not significantly increase grain yield. This is because the contribution capacity of the yield components to the final seed yield is related to the number of plants per unit area. Accordingly, the highest grain yields were recorded at two locations (Tables 2 and 3) with a plant density of 40 cm and an inter-row space of 10 cm. This result is in agreement with Khalil (Khalil et al., 2011) and Dahmardeh (Dahmardeh et al., 2010), who reported higher yields of faba bean at higher planting density. From an economic point of view, a further increase in plant population leads to additional input costs, while an increase in plant density does not increase seed yield. Inter and intra-row spacing have a substantial impact on seed production (kg/ha). The smallest spacing yielded the highest seed output, while the wide spacing yielded the lowest mean seed yield (Gezahegn, 2017).

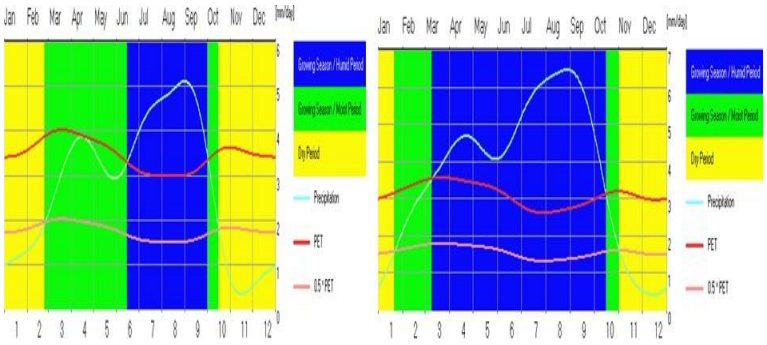

Figure 1. Vegetation period of the experimental sites (Alicho wuriro at left and Mihrab azernet at right). **Note:** ( ): Growing season/Humid period;( ) : Growing season/Moist period; ( ): Dry period; ( ): Precipitation; ( ): PET :05'PET.

Table 1. Treatment, combination and corresponding plant population.

Inter row (cm)	Intra row (cm)	Number of plants/ha	Treatment
	5	666667	T1
30	10	333333	T2
	15	222222	T3
	20	166667	T4
	5	500000	T5
	10	250000	T6
40	15	166667	T7
	20	125000	T8
	5	400000	T9
	10	200000	T10
50	15	133333	T11
	20	100000	T12

Table 2. Effect of plant density on yield and yield components of faba bean in Mirab azernet

Treatment			Ph (cm)	NBPP	NPPP	HSW (g)	Gy (kg/ha)
Inter row (cm)	Intra row (cm)	Number of plants/ha					
	5	###	127	2.43	13.3	77.1	1994
	10	###	126	3.68	14.5	74.4	1756
30	15	###	110	3.48	16.6	78.1	1626
	20	###	113	4.54	17.3	77	1453
	5	###	131	2.71	15.8	76.4	1539
40	10	###	122	4.4	16.8	73.8	2077
	15	###	115	4.67	17.4	73.6	2000
	20	###	112	4.82	18	73	1320
	5	###	127	2.47	14.5	74	1763
	10	###	113	3.23	16.6	74.2	2035
50	15	###	114	4.33	18.9	78.1	1597
	20	###	104	4.46	17.5	75.2	1315
LSD (p<0.05)			9.2	0.35	3.13		464.4
CV (%)			7.47	18	16	7.76	25.01
Note: PH=Plant Height, NPPP=Number of Pods Per Plant, NBPP=Number of Branches Per Plant, HSW=Hundred Seed Weight, Gy=Grain yield.							

Table 3. Effect of plant density on yield and yield components of faba bean in Alicho wuriro.

Treatment			Ph (cm)	NBPP	NPPP	HSW (g)	Gy (kg/ha)
Inter row (cm)	Intra row (cm)	Number of plants/ha					
30	5	###	127	2.43	13.3	77.1	###
	10	###	126	3.68	14.5	74.4	###
	15	###	110	3.48	16.6	78.1	###
	20	###	113	4.54	17.3	77	###
40	5	###	131	2.71	15.8	76.4	###
	10	###	122	4.4	16.8	73.8	###
	15	###	115	4.67	17.4	73.6	###
	20	###	112	4.82	18	73	###
50	5	###	127	2.47	14.5	74	###
	10	###	113	3.23	16.6	74.2	###
	15	###	114	4.33	18.9	78.1	###
	20	###	104	4.46	17.5	75.2	###
LSD (p<0.05)			9.2	0.35	3.13		464
CV (%)			7.5	18	16	7.76	25
Note: PH=Plant Height, NPPP=Number of Pods Per Plant, NBPP=Number of Branches Per Plant, HSW=Hundred Seed Weight, Gy=Grain yield.							

CONCLUSION

According to the findings, plant density had a substantial impact on faba bean growth, yield, and yield fraction at both experimental sites. Since 40 cm inter and 10 cm inter-row spacing resulted in the best grain yield, it can be concluded that the national suggestion of earlier spacing is successful in achieving a high yield of faba bean in the Alicho wuriro and Mirab azernet highlands. Hence, faba bean producer should use the previously

recommended 40 cm inter and 10 cm inter row spacing.

AUTHOR CONTRIBUTIONS

Conceptualization, Proposal preparation, Methodol ogy, Data collection, Data analysis, Report writing, Writing and Editing manuscript.

FUNDING

The Southern Agricultural Research Institute provided funding for this study.

ACKNOWLEDGMENT

For funding this study and providing the necessary resources, the author thanks Worabe Agricultural Research Center and Southern Agricultural Research Institute (SARI). The author would also like to thank all the groups and people who contributed to this study.

CONFLICTS OF INTEREST

No conflicts of interest are disclosed by the author. The funders played no part in the planning of the study, gathering, analyzing, or interpreting the data, writing the report, or choosing to publish the findings.

AUTHOR'S STATEMENTS

The goal of this research project is to boost the productivity of faba beans for both commercial and agricultural producers. Researchers who wish to do additional faba bean research will also benefit from the study's findings.

REFERENCES

Gezahegn AM, Tesfaye K, Sharma JJ, Belel MD. Determination of optimum plant density for faba bean *(Vicia faba L.)* on vertisols at Haramaya, Eastern Ethiopia. Cogent Food & Agriculture. 2016;2(1):1224485.

Ademe A, Ebabuye Y, Gelaye M, Gezachew S, Telahun G. Survey of faba bean *(Vicia faba L.)* diseases in major faba bean growing districts of North Gondar. Afric J Plant Sci. 2018;12(2):32-36.

Bakry BA, Elewa TA, El-Karamany MF, Zeidan MS, Tawfik MM. Effect of row spacing on yield and its components of some faba bean varieties under newly reclaimed sandy soil conditions. World J of Agri Sci. 2011;7(1):68-72.

Baye E, Ebirahim Z, Kasahun N, Wasyihun N, Siyum K, Yachiso D. Effects of planting depth on germination and growth of faba bean *(Vicia faba L.)* at fitche, oromia national regional state, Central Ethiopia. Am J Agric Forest. 2020;8(3):58-63.

CSA (Central Statistical Agency of the Federal Democratic Republic of Ethiopia). Report on Area and production of major crops (Private Peasant Holdings, Meher season). Agricultural Sample Survey. 2020.

Dahmardeh M, Ramroodi M, Valizadeh J. Effect of plant density and cultivars on growth, yield and yield components of faba bean (*Vicia faba L.*). Afric J Biotechnol. 2010;9(50):8643-8647.

FAOSTAT. Crops. Statistics Division, Food and Agriculture Organization of the United Nations, Rome. 2017.

Gezahegn AM. Optimum inter and intra row spacing for faba bean production under Fluvisols. MAYFEB J Agric Sci. 2017;4:10-19.

Jensen ES, Peoples MB, Hauggaard-Nielsen H. Faba bean in cropping systems. Field crops research. 2010;115(3):203-216.

Khalil SK, Wahab A, Amanulla A, Khan AZ. Variation in leaf traits, yield and yield components of faba bean in response to planting dates and densities. Egyptian Aca J Biol Sci. H. Botany. 2011;2(1):35-43.

López-Bellido FJ, Lopez-Bellido LO, López-Bellido RJ. Competition, growth and yield of faba bean *(Vicia faba L.*). European J Agronom. 2005;23(4):359-378.

O'Donovan JT. Canola (*Brassica rapa*) plant density influences tartary buckwheat (*Fagopyrum tataricum*) interference, biomass, and seed yield. Weed Sci. 1994;42(3):385-389.

SAS (Statistical Analysis System) Institute. SAS/STAT user's guide. Proprietary software version 9.00. SAS Institute, Inc., Cary, NC, USA. 2004.

Singh NP, Singh RA. Scientific crop production. Press Graphics, Delhi-28, India. 2002.

Mulualem T, Dessalegn T, Dessalegn Y. Participatory varietal selection of faba bean (*Vicia faba L.)* for yield and yield components in Dabat district, Ethiopia. Wudpecker J Agric Res. 2012;7:270-274.

Degago Y. Faba bean (*Vicia faba*) in Ethiopia. IBCR. 2000.