LRF-855
[1-5]

RESEARCH ARTICLE Legume Research- An International Journal

Effects of Staking and Weeding Frequencies on the Germination, Growth, Yield and Harvest Duration of Black Beans (*Phaseolus vulgaris* L.)

Lilian U. Ekenta[1], Cajethan U. Ugwuoke[1], Ijeoma S. Oha[1], Benedicta A. Omeje[1], Godwin E. Eze[1], Chinyere R. Okwo[1], Scholastica U. Ekwueme[1]

10.18805/LRF-855

ABSTRACT

Background: The performance and yield of black beans are declining greatly to the extent that it is considered as one of the endangered species of crops. This was mainly due to poor crop management practices. Hence, this study determined the effects of staking and weeding frequencies on the performance of black beans (*Phaseolus vulgaris*).

Methods: The randomized complete block design (RCBD) which was replicated thrice was adopted to conduct the study during 2023 and 2024 planting seasons. Eighteen plots each measuring 1.5 m × 1 m with 0.5 m alley between were made and randomly assigned to six treatment groups with the corresponding replicates as followed: T1 = staked and weeded every 2 weeks, T2 = staked and weeded every 4 weeks, T3 = not staked but weeded every 2 weeks, T4 = not staked but weeded every 4 weeks, T5 = staked and not weeded and T6 = not staked and not weeded. Data collected were analysed using mean and ANOVA at 0.05 level of probability and separation of significant differences between means was done using LSD.

Result: Germination rate, germination percentage and germination index were recorded highest in black beans staked and weeded every 2 weeks. Number of leaves/plant and vine length were best in black beans staked and weeded every 2 weeks which were statistically significant from other groups. Number of pods/plant, pods weight and number of seeds/pod were highest in black beans staked and weeded every 2 weeks and also statistically significant from other treatments.

Key words: Agronomic practices, Black beans, Germination index, Number of pods, Plant height.

INTRODUCTION

Black bean (*Phaseolus vulgaris* L.) is a special type of beans, locally known as *Akidi* in Igbo. It is relished as a native delicacy and contributes significantly to the meals in most of the tropical communities. The black bean (*Phaseolus vulgaris* L.) is a nutrient-dense food that is high in proteins, minerals, vitamins, carbohydrates and fiber, all of which are needed for human health. Black beans have sufficient quantities of essential and non-essential amino acids to meet daily nutritional demands (Kotue *et al*., 2018). In addition to being an excellent source of protein, Fernandes *et al.* (2016) stated that black beans are rich in minerals, such as calcium, potassium, phosphorus, iron, copper, zinc and magnesium. Black beans contain soluble and insoluble dietary fibre that give them a great sense of satiety which is a desirable effect for weight loss (Ikezu *et al*., 2015). Regular consumption of black beans is linked to reduced cholesterol and coronary heart disease, beneficial effects against cancer, reduction of diabetes and obesity, high antioxidant capacity, anti-mutagenic and anti-proliferative activities (Nwadike *et al*., 2018).

Black beans have become the fastest growing market class of beans, which means people are eating a lot of black beans. However, the performance and yield of black beans is declining greatly to the extent that it is considered as one of the endangered species of crops (Ntukamazina *et al*., 2014). This was mainly due to poor agronomic practices where inadequate attention were paid to improve the production. Poor adoption of correct agronomic practises like inadequate spacing and poor seed rate leads to decline in egusi melon growth and yield (Ugwuoke *et al.,* 2021). With improved agronomic practices like staking, climbing brown bean variety was reported to have produced up to 4 metric tonnes per hectare, while bush beans produced between 1 and 2 tonnes per hectare (Ntukamazina *et al*., 2014). Climbing beans grow vertically and thus need support by staking which help the plants to grow faster, healthier, reduce disease attack especially anthracnose, access enough light and produce higher

[1]Department of Agricultural Education, University of Nigeria, Nsukka, Nigeria.

Corresponding Author: Benedicta A. Omeje, Department of Agricultural Education, University of Nigeria, Nsukka, Nigeria.
Email: benedicta.omeje@unn.edu.ng
ORCIDs: https://orcid.org/0000-0003-2424-6200, https://orcid.org/0000-0002-6666-6660, https://orcid.org/0000-0000-0000-0000.

How to cite this article: Ekenta, L.U., Ugwuoke, C.U., Oha, I.S., Omeje, B.A., Eze, G.E., Okwo, C.R., Ekwueme, S.U. (2025). Effects of Staking and Weeding Frequencies on the Germination, Growth, Yield and Harvest Duration of Black Beans (*Phaseolus vulgaris* L.). *Legume Research*. **1-5.** doi: 10.18805/LRF-855.

Submitted: 25-01-2025 **Accepted:** 03-08-2025 **Online**: 15-09-2025

yields. Staked beans have extra advantage of being harvested over a prolonged period compared to bush beans. Staking and weeding are essential agronomic practices in black beans that promote healthy crop growth and production. Weeds compete with crops for natural and applied resources, thereby causing reduction in quantity and quality of productivity (Rao and Chanuhan, 2015). Beans, being low-growing plants, struggle to compete with weeds for minerals, light and moisture especially during the early stage of crop growth. Some weeds are alternative hosts of pests and diseases. The weed seeds and shoots also reduce the quality and market value of harvested grains (MAAIF, 2019). Unfortunately, many bean farmers have not fully grasped the importance of staking and frequent weeding in black beans production. Hence, this study determined the effects of staking and weeding frequencies on the performance of black beans (*Phaseolus vulgaris*).

MATERIALS AND METHODS

Experimental procedure

The study was conducted in 2023 and 2024 planting seasons at the Department of Agricultural Education demonstration farm, University of Nigeria, Nsukka located at 6.84°N, 7.37°E (Ugwuoke *et al*., 2020). The study adopted experimental research based on randomized complete block design (RCBD) which was replicated thrice. Land preparation was carried out according to the procedure described in Uguru (2011). Eighteen plots each measuring 1.5 m × 1 m with 0.5 m alley between were made and randomly assigned to six treatment groups with each replicating three times. The treatment groups were represented as T1 = staked and weeded every 2 weeks, T2 = staked and weeded every 4 weeks, T3 = not staked but weeded every 2 weeks, T4 = not staked but weeded every 4 weeks, T5 = staked and not weeded and T6 = not staked and not weeded (Control). Healthy and viable black bean seeds were purchased from the Department of Crop Science, University of Nigeria, Nsukka. The Black bean seeds were sown at a planting distance of 50 cm × 20 cm and two seeds per hole. Poultry manure was applied at 4t/ha and worked into the soil two weeks before planting to allow for decomposition, mineralization and nutrient release into the soil. Agronomic practices were done according to the recommendations of Duncan and Ewing, (2015).

Data analysis

The data collected from the 2023 and 2024 planting seasons were pooled and statistically analysed using mean and analysis of variance (ANOVA) at 0.05 level of significance while the separation of means for significant effects was carried out using least significant differences (LSD).

RESULTS AND DISCUSSION

Effect of staking and weeding frequencies on the germination

Table 1 shows that the germination rate, germination percentage and germination index were recorded highest in black beans staked and weeded every 2 weeks (T1). The germination rate of T1 was found to be statistically significant ($p<0.05$) when compared to others (Table 1). The least germination rate, germination percentage and germination index were found in control (T6). The poor gemination parameters of black beans in control might be attributed to the harmful effects of weeds on crops. Some weeds exude chemical substances that have allelopathic effects on germination of some crops (Kadioôlu and Kanar, 2004).

Table 1: Mean and ANOVA analysis of the effect of staking and weeding frequencies on the germination rate, percentage and index of black beans.

Treatments	3 DAP	4 DAP	5 DAP	6 DAP	7 DAP	Mean	SEM	p-value
				Germination rate				
T1	16.0	19.0	22.0	22.0	22.0	20.2[a]	2.43	0.02
T2	9.00	11.0	14.0	14.0	15.0	12.6[d]	1.62	0.04
T3	12.0	14.0	17.0	17.0	17.0	15.4[c]	0.94	0.03
T4	12.0	14.0	17.0	17.0	17.0	15.4[c]	1.05	0.03
T5	15.0	17.0	19.0	19.0	20.0	18.0[b]	1.16	0.04
T6	8.00	10.0	13.0	13.0	13.0	11.4[d]	0.57	0.01
		Germination %		**Germination Index**				
T1		91.7%		21.3				
T2		62.5%		13.0				
T3		70.8%		16.1				
T4		70.8%		16.1				
T5		83.3%		19.2				
T6		54.2%		11.9				

Key: Means followed by the same alphabetic superscript are statistically similar (LSD 5%), T1: staked and weeded every 2 weeks, T2: staked and weeded every 4 weeks, T3: not staked but weeded every 2 weeks, T4: not staked but weeded every 4 weeks, T5: staked and not weeded, T6: Not staked 7 not weeded (Control), DAP: days after planting.

The germination percentage and seedling growth were found to be significantly affected by the extracts of *Eleusine indica, Cyperus rotundus and Cynodon dactylon* (Afrin *et al*., 2016). Early germinated black bean seedlings are usually strong, resistant to biotic and abiotic conditions that might attack the seedlings (Dugesar *et al.,* 2025) thereby enhancing the growth and yield of black beans.

Effect of staking and weeding frequencies on the growth of black beans

Number of leaves/plant and vine length were best in black beans staked and weeded every 2 weeks (T1) which were statistically significant different ($p<0.05$) from other groups (Table 2). Number of leaves/plant and vine length were statistically lower in control (T6) when compared with other treatments. The results might be attributed to the staking which expose their leaves to sunlight for increased photosynthesis and faster growth. Plant height was found to be significantly higher in staked tomato than the un-staked group (Falodun and Bakare, 2023). Delay in weed removal was found to decrease growth and decline yield performance of soybeans (Daramola *et al*., 2020). The number of branches/plant of black beans were highest in the treatment group not staked and weeded every 4 weeks (T4) and least in control but not statistically significant ($p>0.05$) when compared to others. In another study, the dry bean height, number of leaves/plant and chlorophyll content were found to be lowest under no weeding control and increased as the weeding frequencies increase (Baker *et al*., 2021).

Effect of staking and weeding frequencies on the yields of black beans

Production of pods in black beans generally started at the 8WAP which coincides with 2 months after planting. Table 3 showed that the number of pods/plant, pod weight and number of seeds/pod were highest in black beans staked and weeded every 2 weeks and statistically significant different ($p<0.05$) from other treatments. The lowest number of pods/plant, pod weight and number of seeds/pod were obtained in control group (Table 3). The weight of pods decreased progressively from T1 to T6. Pradhan *et al.* (2021) reported that fruit yield and marketable fruits can be achieved by exposing the plant to adequate sunlight and ventilation following proper staking. Staking increased fruit diameter, fruit length and marketable size of tomato when compared to the control (Lamptey and Koomson, 2021). The increase in yield parameters in black beans staked and weeded every 2 weeks could also be attributed to the constant weeding practice. Tomatos weeded every 2 weeks were found to produce more fruits yield and better shelf-life than other treatments (Babatola and Olaniyi, 2007). Poor weed control in cowpea was detrimental to the yield resulting to a loss ranging from 25%-76% (Manibharathi *et al.,* 2024).

Table 2: Mean and ANOVA analysis of the effect of staking and weeding frequencies on the growth of black beans.

Treatment	3 WAP	6 WAP	9 WAP	12 WAP	Mean	SEM	p-value
Number of leaves/plant							
T1	22.385	142	216.5	240	155.22^{a}	9.10	0.01
T2	15.685	79.0	185	228	126.92^{c}	7.55	0.02
T3	17.725	97.1	152.5	187	113.58^{d}	7.01	0.01
T4	19.84	94.7	197.5	230	135.51^{b}	10.47	0.01
T5	18.49	48.4	111	113	72.72^{e}	4.14	0.11
T6	17.4	80.7	67.5	63.3	57.23^{f}	3.89	0.52
Vine length (cm)							
T1	30.315	170	267.5	300	191.95^{a}	11.82	0.01
T2	17.94	162	251	277	176.99^{b}	10.90	0.02
T3	16.43	137	213	230	149.11^{d}	9.26	0.03
T4	27.71	149	228	234	159.68^{c}	10.43	0.01
T5	18.43	166	194	200	144.61^{d}	8.72	0.06
T6	27.915	100	190	198	128.98^{e}	9.11	0.15
Number of branches/plant							
T1	2.97	6.29	8.865	10	7.03^{a}	1.09	0.22
T2	1.69	5.94	7.095	6.67	5.35^{b}	0.74	0.14
T3	1.78	6.08	8.67	9.67	6.55^{b}	0.95	0.18
T4	2.5	5.33	9.835	11	7.17^{a}	0.48	0.30
T5	2.05	4.04	5.33	5.33	4.19^{b}	0.12	0.09
T6	1.40	4.80	4.80	5	4.00^{b}	0.20	0.11

Key: Means followed by the same alphabetic superscript are statistically similar (LSD 5%), T1: staked and weeded every 2 weeks, T2: staked and weeded every 4 weeks, T3: not staked but weeded every 2 weeks, T4: not staked but weeded every 4 weeks, T5: staked and not weeded, T6: not staked and not weeded (Control), WAP: Weeks after planting.

Table 3: Mean and ANOVA analysis of the effect of staking and weeding frequencies on the yields of black beans.

Treatments	8 WAP	10 WAP	12 WAP	Mean	SEM	p-value
Number of pods/Plant						
T1	14.0	32.3	12.0	19.43[a]	4.15	0.03
T2	8.83	17.3	14.3	13.48[c]	3.07	0.18
T3	8.33	15.3	23.3	15.64[b]	3.44	0.03
T4	6.33	15.7	15.3	12.44[c]	2.91	0.21
T5	10.0	7.00	2.33	6.44[d]	0.30	0.36
T6	5.00	6.33	3.00	4.78[d]	0.41	0.28
Weight of pods (g)						
T1	0	17.1	45.7	31.40[a]	4.13	0.01
T2	0	8.60	27.0	17.80[b]	5.92	0.04
T3	0	9.00	23.5	16.25[b]	4.54	0.04
T4	0	7.50	19.0	13.25[c]	3.00	0.09
T5	0	14.0	7.50	10.75[c]	1.98	0.15
T6	0	6.00	6.33	6.17[d]	0.43	0.11
Number of seeds/pod						
T1	0	17.0	16.7	16.85[a]	4.18	0.03
T2	0	16.0	15.7	15.85[b]	3.36	0.01
T3	0	17.0	16.7	16.85[a]	3.94	0.03
T4	0	14.0	14.0	14.00[b]	3.19	0.10
T5	0	11.0	11.7	11.35[c]	2.58	0.21
T6	0	8.00	8.33	8.165[d]	0.67	0.72

Table 4: Effect of staking and weeding frequencies on harvest duration of black beans.

Treatment	Time of first harvest	Time of last harvest	Duration of harvest
T1	6 WAP	15 WAP	9
T2	7 WAP	14 WAP	7
T3	6 WAP	13 WAP	6
T4	8 WAP	13 WAP	5
T5	7 WAP	12 WAP	5
T6	8 WAP	12 WAP	4

Effect of staking and weeding frequencies on harvest duration of black beans

Table 4 showed that the duration of black beans harvest decreased progressively from T1-T6. The duration of harvest was highest in black beans staked and weeded every 2 weeks which was followed by the black beans staked and weeded every 4 weeks (Table 4). The shortest harvest duration was recorded in control. The shortest harvest period in the control might be the smothering effect of weed that overshadowed the black bean plants, particularly as they were not staked. Black beans being creeping plant is susceptible to weed attack. Iderawumi and Friday, (2018) reported a total suppression and early death of maize plant when weeding was delayed. Weeding every 2 weeks was discovered to reduce the incidence of pest associated with weed infestation in crops which progressively increased as the weeding was delayed and became disastrous in control where weeding was not done (Iledun and Durojaye, 2020). Delayed weeding in rice farm was found to have irreversible effects on growth pattern and death of plants before maturity (Kolo *et al.* 2021).

CONCLUSION

Black bean is a weak stemmed plant that cannot stand erect. It creeps on soil when not staked. Weeds attack black beans by covering and smothering the plant, inhabit pests and diseases that attack black beans, exude chemical substances that affect the growth and production and early death of the plant. Staking and weeding every two weeks increased the plant height, number of leaves and branches, number of pods, pods weight, number of seeds/ pod and harvest duration.

Conflict of interest

All authors declare that they have no conflict of interest.

REFERENCES

Afrin, M.S.T.F., Pramanik, M.H.R., Rhaman, M.S. and Awal, M.A. (2016). Effects of weed extracts on germination and seedling growth of some vegetable crops. *Fundamental and Applied Agriculture*. **1(2):** 87-91.

Babatola, L.A. and Olaniyi, J.O. (2007). Effects of weeding frequency on the yield and shelf-life performance of tomato [*Lycopersicon Lycopersicum* (L.) *Mill.*]. *International Journal of Applied Agricultural and Apicultural Research* (C). **4(1 and 2):** 42-49.

Baker, C. Modi, A.T. and Nciizah, A.D. (2021). Weeding frequency effects on growth and yield of dry bean intercropped with sweet sorghum and cowpea under a dryland area. *Sustainability*. **13:** 1-15. https://doi.org/10.3390/su1321 12328.

Daramola, O.S., Adeyemi, O.R., Adigun, J.A., Adejuyigbe, C.O. and Olorunmaiye, P.M. (2020). The Effect of the period of weed interference on the growth and yield of Soybean (*Glycine Max L. Merrill*). *Journal of Agricultural Sciences (Belgrade).* **65(3):** 225-237.

Dugesar, V., Chaurasia, A.K., Bara, B.M. and Sahi, V.P. (2025). Enhancement of seed germination and seedling vigour through different seed priming treatments in Blackgram (*Vigna mungo L.*). *Legume Research*. **48(4):** 652-657. doi: 10.18805/LR-4938.

Duncan, J. and Ewing, J. (2015). Specialty melon production for small and direct-market growers. ATTRA Sustainable Agriculture.

Falodun, E.J. and Bakare, T. (2023). Effect of staking on growth and yield of tomato (*Lycopersicon esculentum Mill*) varieties in Edo humid forest Zone, Nigeria. *Journal of Applied Science and Environmental Management*. **27(10):** 2337-2342.

Fernandes, S.B., Abreu, A.F.B. and Ramalho, M.A.P. (2016). Genotype x environment interaction and its implication in identification of common bean populations with high calcium content. *Genetics Molecule Research*. **15(2):** 1-9.

Iderawumi, A.M. and Friday, C.E. (2018). Characteristics effects of weed on growth performance and yield of maize (*Zea mays*). *Biomedical Journal of Scientific and Technical Research*. **7(3):** 1-4.

Ikezu, U.J.M., Udeozo, I.P. and Egbe, D.E. (2015). Phytochemical and proximate analysis of black turtle beans *(Phaseolus vulgaris). African Journal of Basic and Applied Sciences*. **7(2):** 88-90

Iledun, O.C. and Durojaye, O.O. (2020). Effect of weeding regime on pest infestation, growth and yield of okra [*Abelmoschus esculentus* (L.) moench] in Anyigba, Kogi State, Nigeria. *GSC Biological and Pharmaceutical Sciences*. **11(01):** 106-112. doi: https://doi.org/10.30574/gscbps.2020.11. 1.0083.

Kadioôlu, I. and Kanar, Y. (2004). Allelopathic effects of plant extracts against seed germination of some weeds. *Asian Journal of Plant Sciences.* **3(4):** 472-475.

Kolo, E., Adigun, J.A., Adeyemi, O.R., Daramola, O.S. and Bodunde, G.J. (2021). The effect of weed control timing on the growth and yield of upland rice (*Oryza sativa L.*). *Journal of Agricultural Sciences (Belgrade)*. **66(1):** 27-38.

Kotue, T.C., Jayamurthy, P., Nisha, P., Pieme, A.C., Kansci, G., Fokou, E. and Ashok, P. (2018). Proximate analysis and minerals of black bean seeds (*Phaseolus vulgaris* L.) used to manage sickle cell disease in West Region of Cameroon. *Asian Food Science Journal*. **1(4):** 1-8.

Lamptey, S. and Koomson, E. (2021). The role of staking and pruning methods on yield and profitability of tomato (*Solanum lycopersicum* L.) production in the Guinea Savanna zone of ghana. *Advances in Agriculture*. 1-7. https://doi.org/ 10.1155/2021/5570567.

Manibharathi, S., Swaminathan, C., Somasundaram, S., Kathirvelan, P. and Kannan, P. (2024). Weed management practices in cowpea (*Vigna unguiculata* L.): A review. *Legume Research*. **47(12):** 2019-2027. doi: 10.18805/LR-5306.

Ministry of Agriculture, Animal, Industry and Fisheries (MAAIF), (2019). Beans training manual for extension workers in Uganda. Retrieved from https://www.agriculture. go.ug/wp-content/uploads/2019/09/Beans-training-manual for-extension-workers-in-uganda.pdf.

Ntukamazina, N., Ruraduma, C. and Ntibashirwa, S. (2014). Relative performance of staking techniques on yield of climbing bean in highlands of Burundi. *African Crop Science Journal*. **22:** 997-1001

Nwadike, C., Okere, A., Nwosu, D., Okoye, C., Vange, T. and Apuyor, B. (2018). Proximate and nutrient composition of some common bean (*Phaseolus vulgaris* L.) and cowpea [*Vigna unguiculata* (L.) Walp.] accessions of jos- plateau, Nigeria. *Journal of Agriculture and Ecology Research International*. **15(1):** 1-9.

Pradhan, R., Nayak, D.A., Rao, K.M. and Mohapatra, P. (2021). A critical review on effect of trailing and staking on growth and yield of cucurbitaceous crops. *Journal of Pharmacognosy and Phytochemistry*. **10(1):** 2151-2154.

Rao, A.N. and Chauhan, B.S. (2015). Weeds and weed management in India-A review. In: Weed Science in the Asian Pacific Region. Hyderabad: Indian Society of Weed Science.

Uguru, M.I. (2011). Crop production: Tools, techniques and practice. Nsukka: Fulladu Publishing Company.

Ugwuoke, C.U., Asogwa, A.A., Okwo, C.R., Onu, F.M., Eze, G.E. and Onah, F.C. (2021). Effects of planting distance and seed rate on the growth and yield of egusi melon (*Citrullus colocynthis*). *Legume Research*. **44(3):** 328-333. doi: 10. 18805/LR-566.

Ugwuoke, C.U., Eze, G.E., Mgbenka, R.N., Omeje, B.A., Osinem, E.C. and Machebe, N.S. (2020). Effects of dietary intake of *Moringa oleifera* leaf meal on the growth performance of pullet chicks. *Agricultural Science Digest*. **40(2):** 194-198. doi: 10.18805/ag.D-189.