



زانكۆی سه لاهه دین - ههولنير

Salahaddin University – Erbil

The Effect of Different Levels of Charcoal and NPK Fertilizer on Growth and Yield Parameters of Faba Bean (*Vicia faba* L.)

Research Project submitted to the department of (Field Crops & Medicinal
Plants) in partial fulfillment of the requirements for the degree of BSc in
(Field Crops Production)

By:

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Certificate

This project has been written under my supervision and has been submitted for the award of the degree of BSc of Agriculture Science in Field Crops and Medicinal Plants with my approval as supervisor.

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Lecturer

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Date: 3/4/2024

I confirm that all requirements have been fulfilled.

S. B. Shakir

Signature

Dedication

We dedicate this project to:

Our prophet Muhammad (peace be upon him)

Our beloved Fathers and Mothers

Our Brothers and Sisters

All our friends who supported us.

Students Name:

***Maliha Amirxan Youns
Narmin Awdal Wasman***

Acknowledgement

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Abstract

This research was conducted during the growing season 2023 - 2024 at Grdarsha field, College of Agricultural Engineering Sciences, Salahaddin University, Erbil with GPS reading of (36.10116 °N, longitude 44.00925° E and elevation of 415.8) meters above sea level .The experiment was conducted to study the influence of three levels of local charcoal (CH1, CH2 and CH3) which equivalent to (1.5, 3 and 4.5) t ha⁻¹ , with 0.1 t ha⁻¹ on growth and yield of faba bean using randomized complete block design (RCBD) with three replicate. The results indicated to the significant effect of Charcoal treatments in high rate on the studied growth traits. The highest value of leaf numbers and brunch number per plant was recorded in CH3 treatments (15.3) and (3.82) respectively, and the lowest value of brunches number plant-1 was (3.41) recorded in control. Its concludes that the natural carbon source such as charcoal has effective impacts on growth parameters of faba bean crops when used in high rates.

Keywords: Charcoal, NPK fertilizer, Faba bean yield.

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1. Introduction

Faba bean (*Vicia faba* L.) is the primary vital legume crop, where it is utilized for human consumption as an excellent source of vegetarian protein which contain (28-36%) (Mostafa and Shaban.,2019).

It may be eaten raw or canned. it is also utilized as a break crop in grain rotations and as a crop for soil development (Köpke and Nemecek., 2010), to maintain the land healthy due to high nitrogen fixation (200 kg ha⁻¹), then improving soil productivity (Mona,et al ., 2011).

Charcoal improves the soil's ability to hold onto nutrients, increasing its nutrient content (Shakir,2019). this improves plant nutrition and decreases the leaching of nutrients (Glaser et al., 2002). if an additional fertilizer source is offered, charcoal addition to the soil will stabilize soil fertility. the release and availability of (P, K, Ca, Mg, and N) did not decrease in the soil fertilized with charcoal compared to soil treated with a mineral nutrient (Steiner et al., 2007).

Inorganic fertilizer such as NPK when applied to the soil, adds nutrients, improves the soil chemical properties and enhances crop growth, development and yield (Negasa et al., 2019). Capacity of the soils often exacerbate losses of nutrients considering the importance of soil plant relationships.

The application of bio-organic fertilizers such as organic manure, biofertilizers and biogas manure as well as carbon resource such as charcoal, sawdust and sugar and

its derivatives could resolve these issues and make our ecosystem healthier (Shakir and Mahmood, 2023). Thus, it is important to develop credible and usable alternatives to overcome the limitation of chemical inputs.

The aim of the current study was investigating the effects of different levels of charcoal and NPK fertilizer on growth and yield parameters of faba bean (*Vicia faba* L.).

2. Material and Method

2.1 Location of Experiment:

The experiment was conducted at Grdarasha Agriculture Research Station, College of Agricultural Engineering Sciences, Salahaddin University – Erbil, Kurdistan region.

Field Experiment:

The field experiment was placed out in Randomized Complete Block Design (RCBD) with three replicates.

Seeds of faba bean (Franchi Sementi, dal 1783), used as plant material from this current study. Three different levels of charcoal (CH1 =150 g /m², CH2 =300 g /m² and CH3 =450 g /m²) that equalized (1.5, 3 and 4.5 t ha⁻¹), while NPK was 10 g /m² (0.1t ha⁻¹) represent as a powder and control which was zero. All levels of charcoal were added and mixed with soil before planted.

Seeds were planted on November 15th, 2023 at a soil depth of 3 - 5 cm in the plot with the size of 1m². The distance between plants was 20 cm and 25 cm were between rows which was totally four rows in each plot. Charcoal was mixed with the soil.

2.2 Land preparation

Before implementing the field experiment a rectangular area of (10*8m) was demarcated on a nearly uniform soil. The soil texture at the investigated site is silty clay loam. The field was flooded with water and allowed to soak on.

14/11/2023 After several days when the soil became plow able, the experimental field was chisel-plowed to 30 cm depth and harrow disked 48 h prior to seeding.

2.3 Statistical Analysis

All data were collected from this present study statistically analyzed according to the technique of analysis of variance (ANOVA) for randomized complete block design, (RCBD) using Minitab 19 (Minitab, 2014) the mean comparison was fulfilled according to Tukey multiple range test at the level of significant 0.05.

3. Results and Discussion

3.1 Plant Heights (cm)

Figure (1) shows the effects of three different levels of charcoal and NPK on the plant height of faba bean. The results obtained that there were no significant differences (P-value ≤ 0.05) between the treatments and the control. The highest plant heights were recorded CH2 (81.87 cm), while the lowest plant height in CH3 and control (71.43 and 73.27 cm) respectively. The results were in garments with study of (Shakir and Mahmood, 2023) that used three different resources of natural carbons (Charcoal, sugar and sawdust) to enhance the germination and growth parameters of tow (*Sorghum bicolor* L.) varieties.

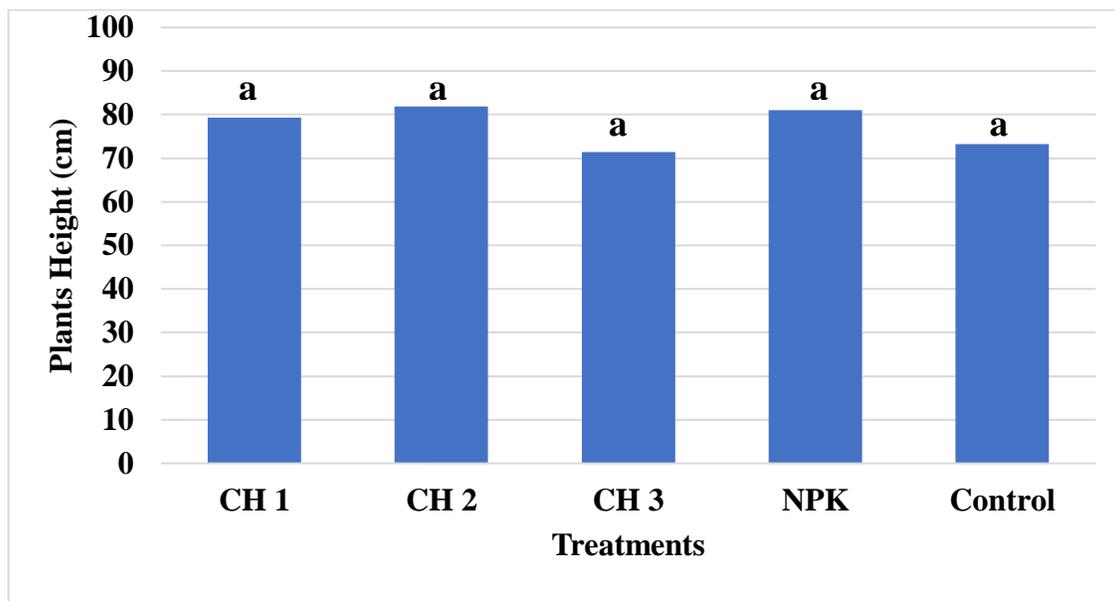


Figure (1) The effect of three different of charcoal (CH1, CH2 and CH3) and NPK fertilizer on plant height of (*Vicia faba* L.).

3.2 Number of Leaves Plant⁻¹:

The results of the effects of three different levels of charcoal and NPK treatments on number of leaves per plant were shown in figure (2). The results indicated that there was significant difference ($P\text{-value} \geq 0.05$) between CH3 and control in addition to CH1. However, there were no significant differences CH3, NPK and Ch2 treatments. The highest leaf numbers plant ⁻¹ was recorded in CH3 treatments (15.3) and the lowest leaf numbers plant⁻¹ was presented in control (13.66). It was observed that the highest numbers of leaves per plant were recorded when using higher rate of charcoal. Our finding overwhelmingly imply that different wood species have inherent differences in their charcoals, which could have a significant impact on ecological processes. This is due to the fact that wood from different species can have drastically different physical and chemical characteristics, and even though the pyrolysis process may change these characteristics to some extent (Downie and Schudson, 2009).

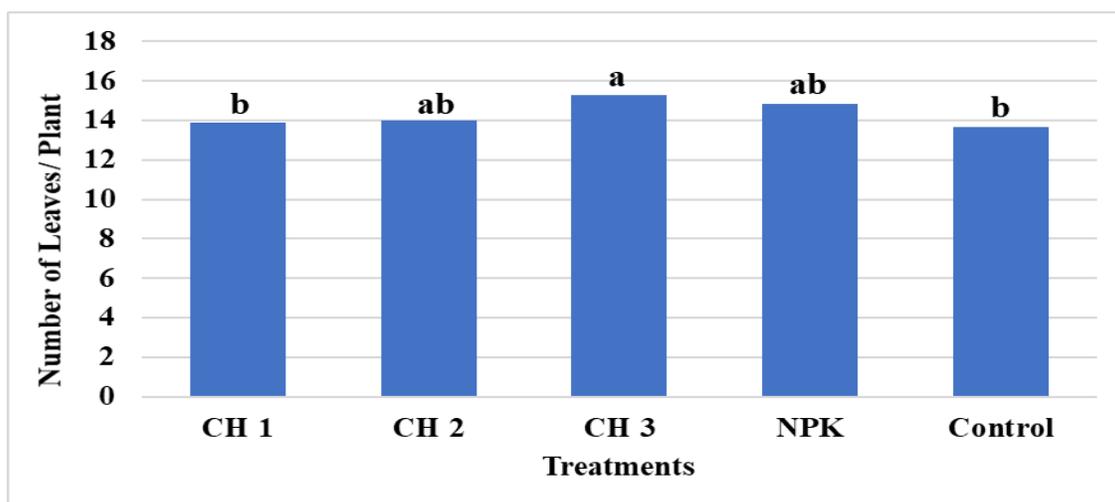


Figure (2) The effect of three different of charcoal (CH1, CH2 and CH3) and NPK fertilizer on number of leaves plant⁻¹ of (*Vicia faba* L.).

3.3 Number of Branches plant⁻¹:

Figure (3) shows the effect of three different levels of charcoal and NPK fertilizer on number of branches plant⁻¹ of faba bean crops. As indicated from the letters on each bar in the figure, there was significant differences ($P\text{-value} \geq 0.05$) between CH3 treatments and other two level of charcoal CH1 and CH2 in addition to control. However, there was no significant differences between CH3 and NPK. The highest value of brunch number per plant was (3.82) in CH3 treatment and the lowest value was (3.41) recorded in control.

However, it is less known how charcoal affects soil characteristics and plant growth. Dibenzofurans, polychlorinated dibenzo-p-dioxins, and polynuclear aromatic hydrocarbons are just a few of the toxic compounds that can be produced during the combustion of woody materials (Kim et al., 2003). It discovered that the addition of charcoal had a beneficial effect on plant growth, which agree with the findings of the study of Salih et al, (2019) which showed that, charcoal was caused to significantly improve some growth and yield parameters such as plant height, technical stem length, total fresh yield, and dry stem yield. The effects of adding charcoal to plant biomass were always beneficial and were usually tied to specific characteristics of the charcoal, supporting our initial hypothesis.

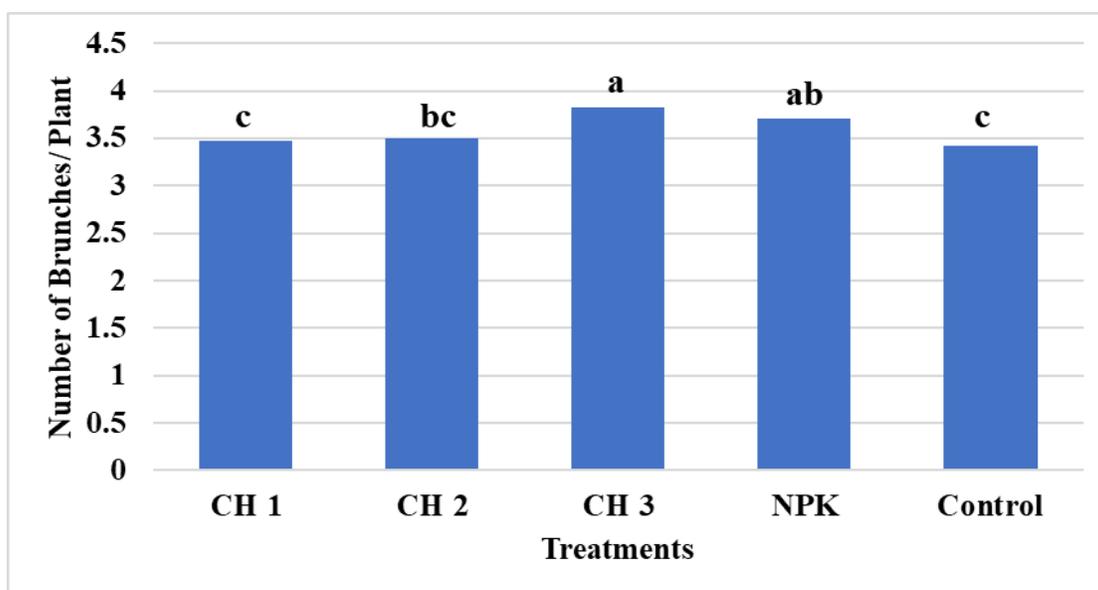


Figure (3) The effect of three different of charcoal (CH1, CH2 and CH3) and NPK fertilizer on number of brunches plant-1 of (*Vicia faba* L.).

3.4 Number of Flowers plant⁻¹:

Figure (4) shows the effects of three different levels of charcoal and NPK on the number of flowers per plant of faba bean. The results attained that there were no significant differences ($P\text{-value} \leq 0.05$) between the treatments and the control. The highest value of number of flower plant ⁻¹ were recorded CH1 (20.7), while the lowest value of number of flower plant ⁻¹ were recorded in CH3 treatments (14.8). Bahar et al. (2021), study. Interaction effect of different concentrations of nano-fertilizer (NPK) and sources of charcoal on growth and yield parameters of Faba bean shows similar results.

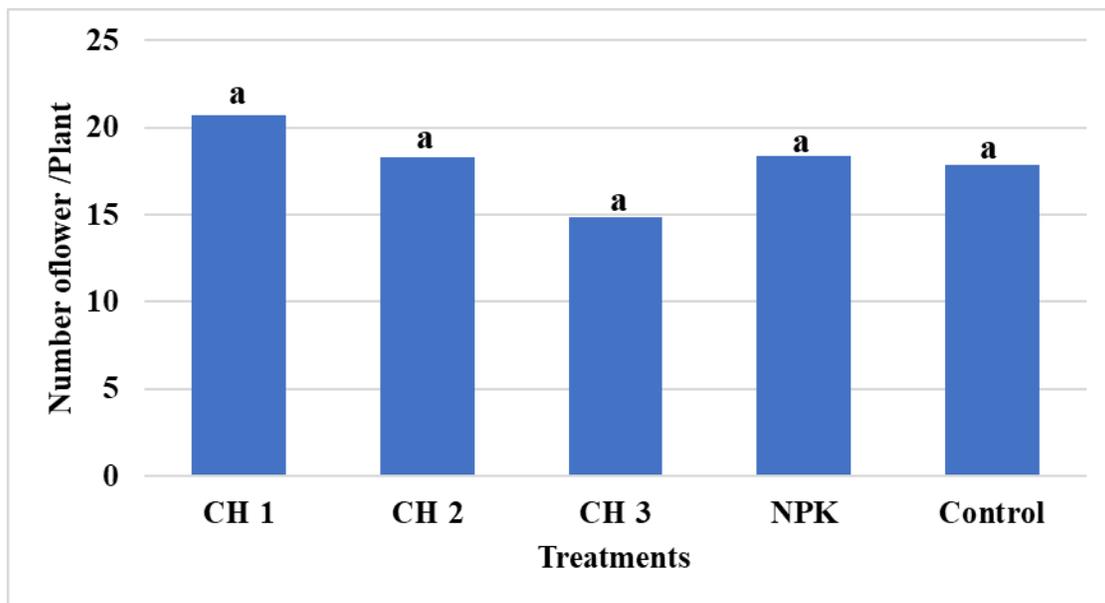


Figure (4) The effect of three different of charcoal (CH1, CH2 and CH3) and NPK fertilizer on number of flowers plant⁻¹ of (*Vicia faba* L.).

4. Conclusion:

Different levels of charcoal and NPK fertilizers were assets the growth parameter of faba bean plants. Its concludes that the natural carbon source such as charcoal has effective impacts on growth parameters of faba bean crops when used in high rates. Although, NPK fertilizer has good effects on faba bean growth and yields, it has also negative impact on environment and human health. So, it is suggested minimize the chemical fertilizer rate and cooperated with natural fertilizer resources such as charcoal, biochar and other natural resources in field crops production.

5. References

1. Bahar, J.M., Rabar, F.S., Solin, I.H. and Chra, A.F., 2021, May. Interaction Effect of different concentrations of nano-fertilizer (NPK) and sources of charcoal on growth and yield parameters of Faba bean (*Vicia faba* L.). In *IOP Conference Series: Earth and Environmental Science* (Vol. 761, No. 1, p. 012082). IOP Publishing
2. Downie Jr, L. and Schudson, M., 2009. The reconstruction of American journalism (Vol. 20). *New York: Columbia University Graduate School of Journalism*.
3. Kim, E.J., Oh, J.E. and Chang, Y.S., 2003. Effects of forest fire on the level and distribution of PCDD/Fs and PAHs in soil. *Science of the Total Environment*, 311(1-3), pp.177-189.
4. Köpke, U. and Nemecek, T., 2010. Ecological services of faba bean. *Field crops research*, 115(3), pp.217-233.
5. Minitab, I. (2014). MINITAB release 19: statistical software for windows. Minitab Inc, USA.
6. Mona, A. M., Sabah, M. A., & Rehab, A. M. 2011. Influence of potassium sulfate on faba bean yield and quality. *Australian Journal of Basic and Applied Sciences*, 5(3), 87-95.
7. Mostafa, F., & Shaban, K. 2019. Effect of different types of biochar on soil chemical properties, microbial community, pathogenic fungi and faba bean productivity. *Scientific Journal of Agricultural Sciences*, 1(2), 72-86. 5.

8. Negasa, G., Bedadi, B., & Abera, T. 2019. Influence of phosphorus fertilizer rates on yield and yield components of faba bean (*Vicia faba* L.) varieties in Lemu Bilbilo District of Arsi Zone, Southeastern Ethiopia. *International Journal of Plant & Soil Science*, 28(3), 1-11.
9. Salih, R.F., Osman, G.A. and Aziz, L.H., 2019. Growth and yield response of flax (*linum usitatissimum* l.) to different rates of charcoal and potassium fertilizer in Erbil, Kurdistan region-Iraq. *Journal of Duhok University*, 22(2), pp.71-80.
10. Shakir, S.B. and Mahmood, A.H., 2023. Using Different Carbon Resources to Enhance Germination and Growth Components of Two Varieties of (*Sorghum bicolor* L). *Zanco Journal of Pure and Applied Sciences*, 35(5), pp.181-189.
11. Shakir, S.B., 2019. Investigating factors affecting restoration of native grassland in ex cropland (*Doctoral dissertation, Federation University Australia*).
12. Steiner, C., Teixeira, W.G., Lehmann, J., Nehls, T., de Macêdo, J.L.V., Blum, W.E. and Zech, W., 2007. Long term effects of manure, charcoal and mineral fertilization on crop production and fertility on a highly weathered Central Amazonian upland soil. *Plant and soil*, 291, pp.275-290.
13. Glaser, B., Lehmann, J., Steiner, C., Nehls, T., Yousaf, M. and Zech, W., 2002, May. Potential of pyrolyzed organic matter in soil amelioration. In *12th ISCO conference*. Beijing (Vol. 421, p. 427).

6. Appendices



Figure (5) Shows the application of charcoals.



Figure (6) Shows the planting of faba bean seeds.



Figure (7) Shows the general situation of experiment field and germination of the seeds.



Figure (8) Shows the flowering of faba bean plants.



Figure (9) Shows the data collection of the experiment study.