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Effect of Integrated Nutrient Management of Chickpea (*Cicer arietinum* L.) under Teak (*Tectona grandis*) Based on Agroforestry

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

At the research field of the College of Forestry, SHUATS, Prayagraj, UP, a field experiment was carried out in the Rabi season from November 2022 to March 2023 to determine the impact of integrated nutrition management on Chickpea (*Cicer arietinum* L.). The experiment is set up using a randomized block design (RBD), with seven treatments that are duplicated three times using different treatments. The results showed that the highest plant height was 19.80 cm at the 30 DAS (days after sowing) interval, 46.43 cm at the 60 DAS interval, and 52.51 cm at the 90 DAS interval. At 30 DAS maximum number of branches (4.33), 60 DAS maximum number of branches (8.67), and 90 DAS maximum number of branches (12.33), maximum test weight (100 seed, hundred seed weight) (gm) (28.00), greatest grain output q/ha (14.51), highest DAS to flowering (79.14), highest number of pods per plant (no.) (32.27), and highest number of seeds per pod (no.) (2.23). Following

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the best straw yield per hectare (18.33), the highest harvest index percentage (44.18) and the highest benefit-cost ratio (2:91) were harvested. Maximum net return of 115,255 and maximum gross return of 154,855 respectively. The Treatment T7 outcome with the highest recorded result was 100%VERMICOMPOST + 0%FYM + 0%NPK.

Keywords: Chickpea; NPK; FYM; vermicompost; growth; yield; economics.

1. INTRODUCTION

The Green Revolution in India started in the 1950s with enhanced monoculture productivity, but it did not address the indigenous people's issue of food security, which prompted them to pursue sustainable development in order to guarantee food security. In order to become more resilient and self-sufficient, and to protect biodiversity, traditional communities began implementing agroforestry techniques [1]. Furthermore, the word "agroforestry" originated from outdated methods in which growing food, not growing trees, was the main goal of the farming system [2]. In these methods, trees were merely a necessary component. Agroforestry is the practice of growing forest trees alongside livestock, crops, or both with the goal of preserving the ecosystem. Sustainable farming methods are made possible by the increased pressure on food security brought about by population growth. Agroforestry emerged in response to the awareness that higher revenue might be obtained through agricultural land use management [3]. Subsequently, small landholders began to reevaluate agroforestry as a dynamic, ecological, and cost-effective technique with the goal of advancing sustainability, increasing farm output, and improving the welfare of their rural community [4].

1.1 OBJECTIVES

1. To study the effect of different nutrient management in the growth of Chickpea under teak based on agroforestry system.

2. To evaluate the economics of Chickpea under Teak based on agroforestry system.

2. MATERIALS AND METHODS

The study was conducted at the Crop Research Farm, Department of Silviculture & Agroforestry, College of Forestry SHUATS, Prayagraj (U.P.) during the Rabi season of 2022 (November 2022–March 2023) at a height of 98 meters above mean sea level and at a latitude of 250 24' 42" N and a longitude of 810 50' 56" E. This region is located next to Prayagraj on the Yamuna River's right bank. It is located 98 meters above mean sea level at an elevation of 25.26° N, 81.54° E. Its tropical to subtropical climate, with harsh summer and winter temperatures, is found in the southeast of Uttar Pradesh. Temperatures can drop as low as 5°C during the winter, especially in December and January, while summer temperatures can rise as high as 45°C. While there may occasionally be frost in the winter, hot, sweltering winds—also referred to as "Loo"—are a constant feature in the summer. The monsoon autumn, which runs from July to November, receives the most of the region's annual rainfall of 1,100 mm, with a few isolated showers throughout the winter.

Table 1. Treatment combination details

Treatment	Treatment Combination
T1	Absolute control
T2	@ 0%NPK+50%FYM+50%VERMICOMPOST
T3	@ 50%NPK+ 50%FYM+0% VERMICOMPOST
T4	@50%NPK+ 0%FYM+50% VERMICOMPOST
T5	@100%NPK+0%FYM+0% VERMICOMPOST
T6	@0%NPK+100%FYM+0% VERMICOMPOST
T7	@ 0%NPK+0%FYM+100% VERMICOMPOST

3. RESULTS AND DISCUSSION

At the Forest Nursery and Research Centre, College of Forestry, Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj (UP) during Rabi during 2022–2023, the current study, "Effect of Integrated Nutrient Management of Chickpea (*Cicer arietinum* L.) Under a Teak-based Agroforestry System," was conducted. The seven treatments in the experiment were duplicated three times and were arranged in a randomized block pattern. The experiment's key findings are outlined below according to the goals that were set.

- ♣ A significant increase in plant height (52.51 cm) was seen when the INM treatment combination of 0% NPK, 0% FYM, and 100% Vermicompost was applied.

- ♣ The number of branches per plant (12.33) was found to be considerably larger in the organic treatment group (0% NPK+0% FYM+100% VERMICOMPOST) as well as in the organic treatment alone.

- ♣ A substantially greater day to 50% flowering (75.14) was seen when the organic and inorganic treatment combination of 0% NPK, 0% FYM, and 100% Vermicompost was applied.

- ♣ A considerable increase in the number of pods per plant (32.27) was seen when the organic and inorganic treatment combination of 0% NPK, 0% FYM, and 100% Vermiculite was applied.

- ♣ The combination of organic and inorganic treatments (0% NPK, 0% FYM, and 100% Vermicompost) resulted in a significantly larger number of seeds per pod (2.23).

- ♣ With an organic and inorganic treatment combination of 0% NPK, 0% FYM, and 100% Vermicompost, the test weight (28.00) was much greater.

- ♣ With an organic and inorganic treatment combination of (0% NPK+0% FYM+100% Vermicompost), grain yield (14.51) was significantly greater.

- ♣ The application of 0% NPK+0% FYM+100% VERMICOMPOST in both organic and inorganic forms resulted in a considerably greater straw yield (18.33).

- ♣ The Harvest Index percentage of 44.18 was found to be non-significant. • Greater net return (115255 ha), gross return (154855 ha), and benefit cost ratio (2.91) were attained when the treatment combination of 100% VERMICOMPOST + 0% FYM + 0% NPK was used.

3.1 Plant Height (cm)

There was a noticeable variation in plant height at 30, 60, and 90 days after the data on plant height was taken and analyzed. T7 (19.80) recorded the highest plant height at 30DAS, followed by T6 (19.52) in a similar manner. T4 (17.81) recorded the minimum plant height at 60DAS. The minimal plant height was recorded in T1 (41.76), noteworthy and at 90DAS, and the minimum was reported in T7 (46.43), followed by T3 (45.96) in a similar manner. The data from T7 (52.51) and T6 (52.01) showed the highest plant height, respectively, while the data from T1 (48.10) showed the minimum plant height, which was also significant.

3.2 Number of Branches

Information about the number of branches is displayed. Data analysis showed that there were notable differences in the number of branches at 30, 60, and 90 DAS. The lowest number of branches was recorded in T1 (2.34) and at 60 DAS, while the largest number of branches at 30 DAS was recorded in T7 (4.33) and T6 (4.01) in a similar manner. The highest number of branches was noted in T7 (8.67), which was followed in a similar manner by T6 (8.34). The lowest number of branches was noted in T1 (5.33) and at 90DAS. The data from T7 (12.33) showed the highest number of branches, followed by T6 (12.20) in a similar manner. The data from T1 (9.33) showed the lowest number of branches, which was also significant.

3.3 Number of Days to Flowering

Data on the number of days before flowering were recorded, and an examination of the data showed that a substantial difference had been identified. The minimal number of days to flowering was recorded in T5 (76.59) data, similarly noteworthy, and the highest number of days to flowering was recorded in T7 (79.14) data, followed by T2 (79.03) in a similar manner.

3.4 Pod Count for Each Plant

The study of the data pertaining to the number of pods per plant at 70 DAS showed that there was a substantial variation in the number of pods per plant. T7 (32.27) recorded the highest number of pods per plant, which was then lowered by T6 (30.80) in a similar manner. T_1 (26.34) recorded the lowest number of pods per plant, which was also a remarkable finding.

3.5 Count of Seeds in Each Pod

The study of the data pertaining to the number of seeds per pod showed that there was a substantial difference in the number of seeds per

pod. The highest recorded number of seeds per pod (T7, 2.23), followed in a similar manner by T6 (1.91), and the lowest recorded number of seeds per pod (T1, 1.03), both of which were statistically significant.

3.6 Test Weight (100 seed, hundred seed weight) (No)

Following harvesting, the data on test weight (100 seed, hundred seed weight) (no) were recorded. Data analysis showed that a substantial difference in test weight (100 seed, hundred seed weight) (no) was discovered. The highest test weight (100 seeds, hundred-seed weight) (No) was recorded in T7 (28.00), while the lowest test weight (100 seeds, hundred-seed weight) (No) was recorded in T1 (22.00), both of which were statistically significant. These results were followed by (27.40) in a similar manner.

3.7 Grain Yield. q/ha

Data collected on grain yield (q/ha following harvesting has been provided. Data analysis showed that there was a notable variation in grain yield. a. The highest grain yield, or q/ha, was recorded in T7 (14.51), followed in a similar manner by T6 (13.76), and the lowest grain yield, or kg/ha, was recorded in T1 (9.38), with a comparable significant record.

3.8 Straw Yield. q/ha

Following harvesting, data on q/ha was obtained. Data analysis showed that a notable variation in straw yield was discovered. The highest reported straw yield, or q/ha, was found in T7 (18.33), and the lowest, or minimum, was found in T1 (12.00), both of which had statistically significant results.

3.9 Harvest Index %

The statistics on Harvest Index% that were provided and analyzed showed that there was no discernible difference in Harvest Index%. The minimum Harvest Index% was recorded in T4 (42.24) data, which was similarly non-significant, and the maximum Harvest Index% was recorded in T7 (44.18) data, followed by T6 (44.05) data in a similar manner.

Table 2. Plant height of Chickpea (*Cicer arietinum*) under Teak (*Tectona grandis*) based agroforestry system at 30 DAS, 60DAS and 90 DAS

Treatment	Plant height(cm)30 DAS	Plant height (cm) 60 DAS	Plant height (cm) 90 DAS
T1	17.91	41.76	48.10
T2	18.80	43.76	49.72
T3	19.63	45.96	50.51
T_4	17.81	43.83	50.11
T_5	19.11	42.73	51.10
T_6	19.52	43.40	52.01
T_7	19.80	46.43	52.51
Significant	**S**	**S**	**S**
C.D.	**0.89**	**2.46**	**1.92**
SE(m)	**0.28**	**0.79**	**0.62**
SE(d)	**0.40**	**1.12**	**0.88**
C.V.	**2.64**	**3.14**	**2.13**

Table 3. Number of branches of Chickpea (*Cicer arietinum*) under Teak (*Tectona grandis*) based agroforestry system at 30 DAS, 60DAS and 90 DAS

Treatment	Number of branches 30 DAS	Number of branches 60 DAS	Number of branches 90 DAS
T1	2.34	5.33	9.33
T2	2.67	6.33	9.64
T3	3.63	6.66	10.33
T_4	3.01	7.01	11.33
T_5	3.33	7.33	12.01
T_6	4.01	8.34	12.20
T_7	4.33	8.67	12.33
Significant	**S**	**S**	**S**
C.D.	**1.17**	**0.19**	**0.55**
SE(m)	**0.38**	**0.06**	**0.17**
SE(d)	**0.53**	**0.09**	**0.25**
C.V.	**20.68**	**1.55**	**2.81**

Table 4. Number of days to flowering, Number of pods per plant and Number of seeds per pod of chickpea under teak

Treatment	Days to Flowering	Pod count for each plant	Count of Seeds in Each Pod
T1	78.57	26.34	1.03
T2	79.03	27.65	1.11
T3	77.63	29.27	1.23
T4	78.03	27.87	1.64
T5	76.59	25.60	1.76
T6	77.05	30.80	1.91
T7	79.14	32.27	2.23
Significant	**S**	**S**	**S**
C.D.	**3.87**	**19.25**	**0.25**
SE(m)	**1.25**	**6.24**	**0.08**
SE(d)	**1.77**	**8.83**	**0.11**
C.V.	**2.81**	**35.11**	**9.32**

Table 5. Test weight (100 seed) (gm) after harvesting, Grain yield q/ha, Straw yield q/ha and Harvest index % of chickpea under teak

Treatment	Test Weight (100 seed, hundred seed weight) (gm) after harvesting	Grain Yield. q/ha. After harvesting	Straw Yield. q/ha. After harvesting	Harvest Index %
T1	22.20	9.38	12.00	43.87
T2	23.10	10.36	13.33	43.73
T3	25.46	11.02	14.00	44.04
T4	26.33	11.32	15.67	42.24
T5	24.63	12.66	16.00	44.17
T6	27.40	13.76	17.33	44.05
T7	28.00	14.51	18.33	44.18
Significant	**S**	**S**	**S**	**NS**
C.D.	**0.97**	**2.44**	**2.20**	**5.93**
SE(m)	**0.31**	**0.81**	**0.73**	**1.98**
SE(d)	**0.44**	**1.15**	**1.04**	**2.80**
C.V.	**2.16**	**8.81**	**7.28**	**7.14**

3.10 Post-Harvest Observations

3.10.1 Grain yield. q/ha

Data analysis showed that there was a notable variation in grain yield. Minimum grain yield of q/ha was recorded in T1 (9.38), similarly significant, and maximum grain yield of q/ha was recorded in T7 (14.51), followed by T6 (13.76) in a similar manner.

3.10.2 Straw yield. q/ha

Data analysis showed that there was a notable variation in straw yield, or q/ha. The results from T7 (18.33) and T6 (17.33) showed the largest and minimum straw yields, respectively, and were both statistically significant. The data from T1 (12.00) showed the lowest straw yield, q/ha.

3.10.3 Harvest index %

The data analysis showed that the harvest index did not differ significantly. The minimum Harvest Index % was recorded in T6 (44.05), and the maximum Harvest Index % was recorded in T7 (44.18). The data in T4 (41.72) is likewise non-significant.

4. CONCLUSION

The treatment combination T7 (0% NPK+0% FYM+100% VERMICOMPOST) was determined to be the best in terms of growth and yield, with significantly greater gross return (ha) and grain yield (kg/ha). It might be suggested for the profitable production of chickpeas.

Since these results are based on a single season, more research may be necessary to corroborate them.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Gonçalves CDBQ, Schlindwein MM, Martinelli GDC. Agroforestry systems: A systematic review focusing on traditional indigenous practices, food and nutrition security, economic viability, and the role of women. Sustainability. 2021;13(20): 11397.
2. Nair PR. An introduction to agroforestry. Springer Science and Business Media; 1993.
3. Rigueiro-Rodríguez A, McAdam J, Mosquera-Losada MR. (Eds.). Agroforestry in Europe: Current status and future prospects; 2008.
4. MacDicken KG, Vergara NT. Agroforestry: Classification and management. John Wiley & Sons; 1990.
5. Abebe TN, Beyene S, Hawassa E. Growth Limiting Nutrient (s) and Their Effects on the Yield and Nutrient Uptake of Chickpea (*Cicer arietinum* L.) in Nitisols, Southern Ethiopia. Growth. 2021; 11(12).
6. Ali M, Kumar S. Chickpea (*Cicer arietinum*) research in India: Accomplishments and future strategies. Indian Journal of Agricultural Sciences. 2005;75(3): 125-133.
7. Aslam M, Afzal M. Effect of integrated nutrient management on growth and yield of chickpea (*Cicer arietinum* L.) under teak-based agroforestry system. Journal of Plant Nutrition. 2019;42(1): 113-125.
8. Balasubramanian A, Anjali KS, Hari-Prasath CN, Swathiga G, Radhakrishnan S, Sivaprakash M, Manimaran V. Linear forecasting nutrient uptake model for teak (*Tectona grandis*) in early developmental stages (seedling stages) under fertigation system. Journal of Tropical Forest Science. 2023;35(2) :211-220.
9. Bana RS, Punia V, Choudhary AK, Rana KS, Tyagi VK. Influence of organic nutrient resources and moisture management on productivity, biofortification and soil health in pearl millet and cluster bean intercropping system of semi-arid India. Indian Journal of Agriculture Science. 2016;86(11):1418-1422.
10. CaK MaK I. Role of mineral nutrients in tolerance of crop plants to environmental stress factors. Pp35–48 in Ima's P & Price MR (eds)Proceedings from the International Symposium on Fertigation – Optimizing the Utilization of Water and Nutrients. Beijing; 20–24 September 2005.
11. Chtouki M, Laaziz F, Naciri R, Garré S, Nguyen F, Oukarroum A. Interactive effect of soil moisture content and phosphorus fertilizer form on chickpea growth, photosynthesis, and nutrient uptake. Scientific Reports. 2022;12(1): 6671.
12. Cowan BD, Nagel WP. Predators of the Douglas-Fir Beetle in Western Oregon. Agricultural Experiment Station, Oregon State University, Oregon; 1965.
13. Dhyani SK, Newaj R, Sharma AR. Agroforestry: Its relation with agronomy, challenges and opportunities. Indian Journal of Agronomy. 2009;54(3): 249-266.
14. Dotaniya CK, Lakaria BL, Sharma Y, Meena BP, Aher SB, Shirale AO, Lata M. Performance of chickpea (*Cicer arietinum* L.) in maize-chickpea sequence under various integrated nutrient modules in a Vertisol of Central India. Plos One. 2022; 17(2):e0262652.
15. Fahad S, Chavan SB, Chichaghare AR, Uthappa AR, Kumar M, Kakade V, Poczai P. Agroforestry systems for soil health improvement and maintenance. Sustainability. 2022;14(22):14877.
16. FAO. Food and Agriculture organization, Rome, Italy. Journal of statistical. 2017; 567.
17. Fernandez-Moya J, Murillo R, Portuguez E, Fallas JL, Ríos V, Kottman F, Alvarado A. Nutrient accumulation and export in teak (*Tectona grandis* Lf) plantations of Central America. IForest-Biogeosciences and Forestry. 2015;8(1): 33.
18. Gadi Parvati, Dawson J, Shankar M. Effect of different organic manures, inorganic fertilizers and growth regulator on yield attributes and yield of green gram (*Vigna radiata* L.). Int. J. Curr. Res. 2017; 12:1567-1572.

19. Gaur AC. Phosphate solubilizing Micro-organisms as Bio-fertilizers. Omega Scientific publishers, New Delhi. 1990: 63-90.

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