**Original Research Article**

**Assessment of Soil Health and Productivity of Chickpea (*Cicer arietinum* L.) as Influenced by FYM, Vermicompost and NPK Treatments under Semi-Arid Climate Condition**

**Abstract**

The present study was formulated during the Rabi season of 2024-2025 at Research Farm, Mewar University Gangrar, (Chittorgarh) Rajasthan, to study the **“**Assessment of Soil Health and Productivity of Chickpea (*Cicer arietinum* L.) Influenced by Ten treatments, i.e., T1;Control, T2; NPK 100% (20:40:20),T3, NPK 50% + FYM 50% T4; FYM 100% (10 t ha-1), T5; NPK 50% + VC 50%, T6; VC 100% (5 t ha-1), T7; FYM 50% +VC 50%, T8; NPK 50% + FYM 25% +VC 25%, T9; NPK 25% +FYM 50 % +VC 25%, T10; NPK 25% + FYM 25% + VC 50% under Semi-Arid Climate Condition**”**. The experiment was laid out in Randomized Block Design (RBD) with three replications. comprising of Experimental data was recorded at different days of interval that is 30, 60 and harvest.The treatments T6 (1.44 Mg m3)and T7 (1.47 Mg m3) having lower bulk densities. The steady increase from T2 (0.33%) to T6 (0.40), and then T7 (0.37), T10 (0.37%) and T9 (0.36%) indicates a progressive enhancement of additional mixture in the soil. The improvement was recorded for nitrogen availability in treatments T6, T4, T7 and T10 (above 240kg ha-1). The highest P and K were recorded in treatment T7 (27.64 kg ha-1) and T7 (365.53kg ha-1), respectively. The bacterial, fungi and actinomycetes counts were observed highest in T6 (34.50×10⁶ g-1 of soil), T7 (24.86×104 g-1 of soil) and T4 (29×10⁶ g-1 of soil), respectively.

**Keywords:** Soil health, FYM, Vermicompost, Bacteria, Fungi, Actinomycetes

**INTRODUCTION**

“Leguminous crops are considered as an important component of all types of farming systems in agriculture-based countries of the world and these considered an important food source for human and animal nutrition”. “Chickpea (*Cicer arietinum* L.) ranks third among leguminous crops after pea (*Pisum sativum* L.) and beans (*Phaseolus vulgaris* L.) and it is an important legume crop in many countries and considered a functional food source, mostly due to its high protein content (17–31% protein)”. “Nutritionally, chickpea is a good source of proteins and can serve as an alternative to meat. Nitrogen nutrient plays important role in synthesis of chlorophyll, amino acids and other organic compounds of physiological significance in plant system. Rhizobium plays an important role in increasing the availability of nitrogen to the plants and helps in boosting the production through nitrogen fixation. Chickpea plays a significant role in improving soil fertility by fixing the atmospheric nitrogen. Due to continuous use of unbalanced chemical fertilizers and decreased use of organic manures, most of the soils are getting depleted with nutrient availability and degraded. Inorganic fertilizers alone cannot sustain the soil productivity and their large-scale use as a source of nutrients has less efficiency (Kumar *et al*., 2013 or 2019?). In this region, the soil is having low organic carbon content, which may be due to the extreme climate conditions and low use of organic manures. In order to boost and maintain crop yield and sustain productivity, use of organics is one of the methods that has become more popular among the scientists and farming community which includes the use of bulky organic manures like farmyard manure (FYM), and vermicompost. Vermicompost is made of worm castings, undigested organic waste, microorganisms with a neutral pH and higher ion exchange capacity and high buffering capacity (Baliah and Muthulakshmi, 2017 not in reference list). It has less soluble salts like nitrates (NO3 -), calcium (Ca+2), magnesium (Mg+2), and humic acid but higher amount of nutrients which makes the macro- and micro-nutrients available for plant uptake (Rekha *et al*., 2018 not in reference list). Application of vermicompost increases total porosity of soil, soil aeration, infiltration and water holding capacity of soil (Aksakal *et al*., 2015 not in reference list; Munnoli and Bhosle, 2011 not in reference list). There is a scope to improve the productivity of pulses by enhancing the soil fertility and its productivity through increasing soil organic carbon, soil moisture storage capacity and adopting integrated nutrient and pest management practices. ~~Chickpea (~~*~~Cicer arietinum~~* ~~L~~*~~.~~*~~)~~ Integrating organic and inorganic sources of nutrients can reduce environmental pollution along with increased crop production and soil health and also to minimize nutrient losses, and ensure sustainable productivity. This combination will favour soil carbon accretion and correction of secondary and micronutrient deficiency and long-term enhancement of soil quality (Padbhushan *et al*., 2015 not in reference list). This integration proved to be beneficial for maintaining soil nutrient balance, aggregation, moisture retention capacity and fertility (Saha *et al*., 2007 not in reference list; Dunjana *et al.,* 2012 not in reference list). The availability of primary nutrients (N, P, and K) depends mainly on the nutrient composition of the organic sources but the efficiency of organic sources of nutrients is less as compared to mineral fertilizers. In addition to providing those nutrients, organic manures often make the scarce elemental N available, solubilization of phosphates and micronutrients, and helps in the decomposition of crop residues to promote the absorption of nutrients by plants (Lalrintluangi *et al*., 2019 not in reference list). Furthermore, organic sources of nutrients promote the activity of beneficial microorganisms and, therefore, ultimately improve crop productivity and soil health.

**MATERIALS AND METHODS**

The present study was conducted during the Rabi season of 2024-2025 at Research Farm, Mewar University Gangrar, (Chittorgarh) Rajasthan, to study the **“**Assessment of Soil Health and Productivity of Chickpea (*Cicer arietinum* L.) Influenced by Different Treatments of FYM, Vermicompost and NPK nutrient sources under Semi-Arid Climate Condition**”**. The experiment was laid out in Randomized Block Design (RBD) with three replications comprising of Ten treatments. The texture of the soil is sandy loam soil. The standard methods were followed as follow:

**TABLE 1. Initial properties of the soil: Physical, chemical and biological**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Values** | **Analysis method** | **References** |
| Textural class | Sandy loam | Hydrometer method | Bouyoucos, 1962 not in reference list |
| Bulk density (Mg m3) | 1.77 | Core sampling method | Blake,1965 not in reference list |

**TABLE 2. Chemical properties of soil:**

|  |  |  |  |
| --- | --- | --- | --- |
| Organic Carbon (%) | 0.2 | Wet digestion method | Walkley and Black 1973 not in reference list |
| EC (dSm-1) | 1.7 | Soil- water suspension method | Jackson, 1967 not in reference list |
| Soil pH  | 7.3 | Soil- water suspension method | Jackson, 1967 not in reference list |
|  Available-N (kg ha-1) | 177.0 | Kjeldahl method | Subbiah $ Asijia,1956 not in reference list |
| Phosphorus (kg ha-1) | 13 | Olsen method | Olsen et al. 1954 not in reference list |
| Potassium (kg ha-1) | 319.0 | Ammonium Acetate | Blake,1965 not in reference list |
| Calcium (kg ha-1) | 11.0 | Ammonium Acetate | Blake,1965 not in reference list |
| Sulphur (kg ha-1) | 9.5 | Heat soluble sulphur | Cottenie *et al.,* 1979 not in reference list |
| Magnesium (kg ha-1) | 7.8 | Ammonium Acetate | Blake, 1965 not in reference list |

**Biological properties**

**Bacteria:** Thorton’ s medium was used for the total bacterial count (Thornton, 1992 not in reference list).

**Actinomycetes:** Ken-knight and munaier’s medium was used for the counts of actinomycetes

**Fungi:** Fungi was counts by Martin’s Rose-Bengal medium (Martin, 1950 not in reference list).

**RESULTS AND DISCUSSION**

**3.1.1 Physical properties of the soil**

**3.1.1.1 Bulk density**

From the present study and analysis as shown in **Table 3.**, values of bulk density ranged from treatment T6 (1.44 Mg m 3) to T1 (1.67 Mg m3). The treatments like T1 and T2 which values are (1.67 Mg m3) and (1.67 Mg m3) are considerably categorized as high bulk densities, suggest as compacted soil with limited porosity. While the treatments T6 (1.44 Mg m3)and T7 (1.47 Mg m3) having lower bulk densities. Due to application of organic source of nutrients which help in soil aggregation improvement. The untreated treatment T1 recorded the highest bulk density (1.67 Mg m3), while treatment T6 exhibited the lowest value (1.44 Mg m3). Treatments T5, T3 and T8 showed same values. Lower bulk density values also suggest improved soil porosity and increased in clay and slit fractions. Finer particles generally lead to greater total pore space when well-aggregated. Greater porosity enhances water infiltration and storage, promotes gas exchange and provides optimal environmental for root and microbial activities.

**3.1.1.2 Porosity**

From the present study and analysis as shown in **Table 3**, pore space values ranged from treatment T2 (44.20%) to T6 (46.0%). The treatments like T6 (46.0%), and T4 (45.85%) are considerably categorized as high porosity. Greater porosity generally improves soil health by enhancing structure, drainage, root conditions. and **better aeration** helps roots and beneficial microbes get more oxygen, which supports healthy plant growth. While T2 (44.20%) and T1 (44.46%) has lowest porosity. Lowest porosity **restricts water and air movement**, which can hurt plant health in most cases, but they may be beneficial in **very sandy or excessively porous soils** by improving water retention. **Lowest porosity treatments** generally harm soil health by causing compaction, poor drainage, and low biological activity.

The treatment T6 has high value of porosity and T2 has lowest value of porosity.

**Table:3. Influence of organic and inorganic treatments on soil physical properties:**

|  |  |  |
| --- | --- | --- |
| **Treatments** | **Bulk density (Mg m3)** | **Porosity (%)** |
| **T1 -** Control | 1.67 | 44.46 |
| **T2** - NPK 100% | 1.65 | 44.20 |
| **T3** - NPK 50% + FYM 50% | 1.62 | 45.02 |
| **T4**- FYM 100% | 1.48 | 45.85 |
| **T5**- NPK 50% + VC 50% | 1.63 | 45.11 |
| **T6**-VC 100% | 1.44 | 46.0 |
| **T7**- FYM 50% +VC 50% | 1.47 | 45.72 |
| **T8**- NPK 50% + FYM 25% +VC 25% | 1.63 | 45.17 |
| **T9** - NPK 25% +FYM 50 % +VC 25% | 1.52 | 45.45 |
| **T10**- NPK 25% + FYM 25% + VC 50% | 1.47 | 45.32 |
| **S. Em. ± (P=0.05)** | 0.005 | 0.10 |
| **C.D** | 0.01 | 0.30 |

**Chemical properties of the soil**

**Organic carbon (%)**

Organic carbon content showed a clear increasing trend across treatments, as shown in **Table 4** In the study, organic values increased progressively from treatment T1 (0.32%) to treatment T6 (0.40%), indicating the significant impact of treatments in improving soil organic matter. The lowest organic carbon was recorded in treatment T1 (0.32%) and highest was observed in treatment T6 (0.40%). T1, which had the lowest organic value is an absolute control, leading to lower organic matter accumulation in the soil. The steady increase from T2 (0.33%) to T6 (0.40), and then T7 (0.37), T10 (0.37%) and T9 (0.36%) indicates a progressive enhancement of additional mixture in the soil. Organic carbon contributes indirectly to other soil properties, particularly CEC and nutrient availability that ultimately helps in crop growth, higher yield and soil health enrichment.

**Electrical Conductivity (EC)**

Electrical conductivity was observed lowest in treatment T1 (1.71 dSm-1) and highest was found in treatment T2 (1.83 dSm-1). Slight increases in electrical conductivity values corresponded to higher nutrient concentrations but did not show salinity risks. Though after analyzing the soil electrical conductivity, all the values are within the safe range for the most crops (<2.0 dSm-1), the increasing trend suggests an accumulation of salts through external inputs in soil. The treatments T2 and T8, had higher nutrient values. Despite that, moderate increases in electrical conductivity also reflects enhanced nutrient concentration. The lowest electrical conductivity in treatment T1 and T7 reflects nutrient poor conditions, while the moderate electrical conductivity in treatment T5 (1.78) T3 (1.77) and T10 (1.76 dSm-1).

**pH**

Soil pH value T2 remains 6.90. remaining treatments remains within the neutral acidic range 7.1 to 7.24. However, no treatment induced extreme acidity or alkalinity. It is worth noting that a stable and near-neutral pH observed in treatments T4 to T10, creates an ideal environment for most crops, ensuring maximum nutrient availability. Thus, pH declined slightly, the trend is not alarming and over-all soil healthy. It is worth noting that a stable and near-neutral pH observed in treatments T4 to T10, creates an ideal environment for most crops, ensuring maximum nutrient availability. Thus, pH declined slightly, the trend is not alarming and over-all soil healthy.

**Nitrogen (kg ha-1)**

Available nitrogen was recoded lowest in treatment T1 (176.3 kg ha-1) and highest was seen in treatment T7(268.16 kg ha-1). Treatments from T6 to T10 demonstrated significantly higher nitrogen levels, all exceeding 240 kg ha-1. The increasing trend of available nitrogen from T2 to T10 shows that there is gradual increase in organic carbon, highlighting the correlation between organic matter content and nitrogen availability. The treatments with high organic carbon i.e., T6, T4, T7 and T10 consistently showed higher nitrogen levels, moreover improved nitrogen availability in treatments T6, T4, T7 and T10 (above 240kg ha-1). The relatively low nitrogen in treatment T1 (176.3 kg ha-1) is an absolute control.

**Phosphorus (kg ha-1)**

Phosphorus availability also increased notably with treatment intensity. The lowest value was found in T1 (13.20 kg ha-1), while the highest was recorded in treatment T7 (27.64 kg ha-1). Treatments from T6 to T10 had values above 20 kg ha-1, indicating improved phosphorus availability.

**Potassium (kg ha-1)**

Available potassium was significantly influenced by treatments. The lowest value was observed in T1 (321.23 kg ha-1), and the highest in T7 (365.53kg ha-1). All the treatments from T6 to T10 showed potassium values above 350 kg ha-1, highlighting the role of treatments in enhancing potassium release and retention. In the present study, there is significantly increased in values from treatment T1 to T10 as shown in **Table 4**

**Calcium (kg ha-1)**

Available calcium was recoded lowest in treatment T1 (12.16 kg ha-1) and highest was seen in treatment T7(17.96 kg ha-1). Treatments from T6 to T10 demonstrated significantly higher calcium levels, all exceeding (15 kg ha-1). Improved calcium availability in treatments T6 to T10 (above 15 kg ha-1). The relatively low calcium in treatment T1 (12.16 kg ha-1) is an absolute control.

**Magnesium (kg ha-1)**

Available Magnesium was significantly influenced by treatments. The lowest value was observed in T1 (7.40 kg ha-1), and the highest in T7 (15.20 kg ha-1). All the treatments from T6 to T10 showed magnesium values more than 10 kg ha-1, highlighting the role of treatments in enhancing magnesium content in the soil.

 In the present study, there is significantly increased in values from treatment T1 to T10 as shown in **Table 4**

**Sulphur (kg ha-1)**

Available sulphur was significantly influenced by treatments. The lowest value was observed in T1 (9.83 kg ha-1), and the highest in T7 (15.93 kg ha-1). All the treatments from T6 to T10 showed potassium values above 13 kg ha-1, highlighting the role of treatments in enhancing sulphur content in the soil.

**Table 4: Influence of organic and inorganic treatments on soil chemical properties**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **O.C****(%)** | **EC (dSm-1)** | **pH** | **Available N****(kg ha-1)** | **Available P2O5****(kg ha-1)** | **Available****K2O****(kg ha-1)** | **Available****Ca****(kg ha-1)** | **Available****Mg****(kg ha-1)** | **Available****S****(kg ha-1)** |
| **T1** | 0.32 | 1.71 | 7.14 | 176.33 | 13.20 | 321.23 | 12.16 | 7.40 | 9.83 |
| **T2** | 0.33 | 1.83 | 6.90 | 206.16 | 14.56 | 325.63 | 12.60 | 7.70 | 10.60 |
| **T3** | 0.34 | 1.77 | 7.10 | 213.60 | 16.20 | 330.63 | 14.20 | 9.25 | 10.86 |
| **T4** | 0.38 | 1.73 | 7.18 | 220.60 | 17.57 | 335.76 | 14.60 | 9.69 | 11.50 |
| **T5** | 0.35 | 1.78 | 7.11 | 226.33 | 18.66 | 350.10 | 15.16 | 11.42 | 11.83 |
| **T6** | 0.40 | 1.74 | 7.24 | 245.50 | 21.26 | 354.00 | 15.63 | 11.77 | 14.00 |
| **T7** | 0.37 | 1.72 | 7.22 | 268.16 | 27.64 | 365.53 | 17.96 | 15.20 | 15.93 |
| **T8** | 0.35 | 1.81 | 7.13 | 249.50 | 24.47 | 357.00 | 16.43 | 12.44 | 14.33 |
| **T9** | 0.36 | 1.75 | 7.16 | 256.83 | 24.76 | 363.00 | 16.86 | 13.85 | 15.33 |
| **T10** | 0.37 | 1.76 | 7.20 | 261.16 | 26.30 | 364.00 | 17.36 | 14.71 | 15.60 |
| **S. Em. ± (P=0.05)** | 0.004 | 0.004 | 0.003 | 0.71 | 0.14 | 0.92 | 0.06 | 0.1654 | 0.04 |
| **C.D** | 0.01 | 0.01 | 0.010 | 2.13 | 0.44 | 2.76 | 0.18 | 0.0384 | 0.12 |

**Biological properties of the soil**

**3.1.3.1 Bacteria (\*10-6 cfu g-1 of soil)**

 The **Table 5.** showed that the total bacterial populations ranged from (27.06 ×10⁶ cfu/g ) of soil in treatment T1 to (37.13 ×10⁶ cfu/g) of soil in T6. Treatments T6 (37.13 ×10⁶ cfu/g of soil), T7 (35.60 ×10⁶ cfu/g of soil), and T4 (34.50×10⁶ cfu/g of soil) showed the highest bacterial counts, suggesting a favorable microbial environment. In contrast, T1 (27.06 ×10⁶ cfu/g soil) and T2 (27.50×10⁶ cfu/g soil) had the lowest bacterial Counts. Treatments T6 and T7 with the highest bacterial populations, improves soil structure and overall soil fertility.

**3.1.3.2 Actinomycetes (\*106 cfu g-1 of soil)**

The actinomycetes population was observed lowest in treatment T1 (19.06 x 106 cfu g-1 soil) and highest was in treatment T4 (29 x 106 cfu g-1 soil). Treatments T7 (27.50 x 106), T6 (26.16 x 106) and T9 (25.13 x 106) also showed relatively high present of actinomycetes populations may due to application of different combination of organic and inorganic nutrient sources that provide energy in those treatments.

As shown in **Table 5.** the lower values were found in treatment T1 (19.06 x 106 cfu g-1 soil), T2 (20.20 x 106 cfu g-1 soil) and T5 (20.50 x 106 cfu g-1 soil) indicate unfavourable conditions for actinomycetes development. The treatments T7 (27.50), T6(26.16 x 106) and T9 (25.13 x 106) also supported strong actinomycetes populations. Actinomycetes prefer slightly alkaline conditions and a stable supply of organic matter. There has been found to be moderate levels in treatment T4 (24.90)and T5 (24.26) of actinomycetes.

**3.1.3.3 Fungi (\*104 cfu g-1 of soil)**

In terms of fungal population, highest was observed in T4 (25.66 ×10⁴ cfu/g soil) and followed by T7 (24.86 ×10⁴ cfu/g soil), T6 (24.00 ×10⁴ cfu/g soil) and T9 (23.36 ×10⁴ cfu/g soil). Indicating that T4 had the most conducive conditions for fungal growth. Other treatments with moderate fungal counts included T10 (21.46 ×10⁴ cfu/g soil) and T8 (21.10 ×10⁴ cfu/g soil). At the other side, lowest was observed in T1 (17.50 ×10⁴ cfu/g soil) and T2 (17.86 ×10⁴ cfu/g soil).

 The treatments T6 (24 ×10⁴ cfu/g soil) and T7 (24.86 ×10⁴ cfu/g soil) demonstrated high fungal populations as these treatments include T6-100% vermicompost and T7-50%vermicompost + 50% FYM. The treatments T3 (19×10⁴ cfu/g soil) and T5 (18.90×10⁴ cfu/g soil) also showed relatively lower fungal values. The positive impact of organic treatments on fungal communities improved the soil aggregation and moderated pH and create ideal conditions for fungal colonization.

**Table 5: Influence of organic and inorganic treatments on soil biological properties**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Total Bacteria****(\*10-6 cfu g-1 of soil)** | **Fungi****(\*10-6 cfu g-1 of soil)** | **Actinomycetes****(\*cfu g-1 of soil)** |
| T1 - Control | 27.06 | 17.50 | 19.06 |
| T2 - NPK 100% | 27.50 | 17.86 | 20.20 |
| T3 - NPK 50% + FYM 50% | 28.06 | 19.00 | 22.20 |
| T4 - FYM 100% | 34.50 | 25.66 | 29.00 |
| T5 - NPK 50% + VC 50% | 28.50 | 18.90 | 20.50 |
| T6 - VC 100% | 37.13 | 24.00 | 26.16 |
| T7 - FYM 50% +VC 50% | 35.60 | 24.86 | 27.50 |
| T8 - NPK 50% + FYM 25% +VC 25% | 30.00 | 21.10 | 24.26 |
| T9 - NPK 25% +FYM 50 % +VC 25% | 31.56 | 23.36 | 25.13 |
| T10 - NPK 25% + FYM 25% + VC 50% | 32.70 | 21.46 | 24.90 |
| **S. Em. ± (P=0.05)** | 0.045 | 0.05 | 0.01 |
| **C.D** | 0.13 | 0.17 | 0.05 |

**Growth parameters**

**Plant height (cm)**

Data pertaining to influence of organic and inorganic nutrient sources on plant height presented in **Table 6**.The organic and inorganic nutrient sources showed significant influence on plant height. Plant height was recorded at 30 days and 60 days of intervals. It is evident from the data that height of plant was maximum in **T7 -** FYM 50% +VC 50% that is 46 then **T10**- NPK 25% + FYM 25% + VC 50% (41.3) followed by **T9**- NPK 25% +FYM 50 % +VC 25% (41) and **T8**- NPK 50% + FYM 25% +VC 25% (40.16) were recorded. And minimum plant height was recorded with T1 (23.5 cm), followed by T2 (28 cm), and T3 (30 cm) were recorded. Further, it was noted that height of plant increases with the advancement of age of plant up to 90 DAS and subsequently it slightly reduced at harvest of crop over previous stage.

**Nodules count per plant**

Data pertaining to influence of organic and inorganic nutrient sources on nodules count per plant presented in **Table 6**. The organic and inorganic sources of nutrient were showed significant influence on nodules count. Data revealed that the maximum nodules count per plant with **T7**-FYM 50% +VC 50% (21.50) followed by T10-NPK 25% + FYM 25% + VC 50% (20.66), T9-NPK 25% +FYM 50 % +VC 25% (18.76) and T8-NPK 50% + FYM 25% +VC 25% (17.33). The minimum number of nodules count per plant recorded with T1-Control (10.5). Higher number of nodules per plant were observed in treatments which received combination of FYM and vermicompost and this might be due to the fact that Rhizobium inoculation increased the root nodulation through better root development and more nutrient availability resulting in significant increase in number of nodules per plant.

**Dry matter accumulation per plant (g)**

Dry matter accumulation per plant (g) were recorded from different treatments after harvesting were presented in **Table 7.** Maximum dry matter accumulation recorded with **T7**-FYM 50% +VC 50% (5.16) followed by T10-NPK 25% + FYM 25% + VC 50% (5.03), T9-NPK 25% +FYM 50 % +VC 25% (4.90), and T8-NPK 50% + FYM 25% +VC 25% (4.76).

High dry matter accumulation was recorded in treatment which were supplied with organics which include 100%FYM + 100%VC. This might be due to slowly and steadily release of nutrients in soil which matches the crop’s nutrient uptake pattern over time to make them available for plant absorption. Also effect on soil chemical processes to make unavailable forms of nutrients into available forms. The high dry matter accumulation obtained with organic manure treated plots might be due to more moisture conservation and additional availability of nutrients. These findings were in conformity with Yadav et al. (2004 not in reference list) and Bodamwad and Rajput (2006 not in reference list).

**Table: 7 Influence of organic and inorganic treatments on plant height(cm), Dry matter accumulation (g), and nodules count plant-1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **Plant height (cm)** | **Nodules count per plant at 90 days** | **Dry matter accumulation per plant (g)** |
| **30 DAS** | **60 DAS** |
| **T1** | 5.633 | 23.5 | 10.50 | 1.93 |
| **T2** | 6.033 | 28 | 11.50 | 2.13 |
| **T3** | 6.567 | 30 | 12.50 | 2.36 |
| **T4** | 6.733 | 33.83 | 14.83 | 2.60 |
| **T5** | 6.6 | 36 | 16.00 | 3.30 |
| **T6** | 6.967 | 38.33 | 17.16 | 3.80 |
| **T7** | 8.367 | 46 | 21.50 | 5.16 |
| **T8** | 7.167 | 40.16 | 17.33 | 4.76 |
| **T9** | 7.867 | 41 | 18.76 | 4.90 |
| **T10** | 7.733 | 41.3 | 20.66 | 5.03 |
| **S. Em. ± (P=0.05)** | 0.565 | 0.34 | 0.40 | 0.04 |
| **C.D** | O.78 | 1.03 | 1.20 | 0.14 |
| **C.V%** | 14.036 | 1.66 | 4.32 | 2.32 |

**Yield parameters**

**Grain yield (kg ha-1)**

Data pertaining to influence of organic and inorganic nutrient sources on grain yield presented in **Table 8.** The organic and inorganic sources of nutrient were showed significant influence on grain yield. Data revealed that the maximum grain yield with **T7**-FYM 50% +VC 50% (1,030.0 kg ha-1) followed by T10-NPK 25% + FYM 25% + VC 50% (890.0 kg ha-1), T9-NPK 25% +FYM 50 % +VC 25% (826.66 kg ha-1) and T8-NPK 50% + FYM 25% +VC 25% (765.00 kg ha-1). The minimum grain yield recorded with T1-Control (163.33 kg ha-1).

It was observed from the data that highest grain yield was recorded in treatment which received organics compared to inorganics and combination of organics and inorganics. This might be due to the fact that organics application to the chickpea crop enhance soil fertility, leading to improved nutrient availability and higher chickpea productivity.

**Straw yield (kg ha-1)**

Data pertaining to influence of organic and inorganic nutrient sources on straw yield kg ha-1presented in **Table 8** The organic and inorganic sources of nutrient were showed significant influence on straw yield. Data revealed that the maximum straw yield with **T10**- NPK 25% + FYM 25% + VC 50% (2390.66 kg ha-1) followed by T9- NPK 25% +FYM 50 % +VC 25% (2223.33 kg ha-1) and T8- NPK 50% + FYM 25% +VC 25% (2013.66 kg ha-1kg ha-1). The minimum grain yield recorded with T1-Control (616.66 kg ha-1). This might be due to the fact that organics application to the chickpea crop attributed to improved soil health, enhance nutrient availability, and greater root development, all of which contribute to stronger plant growth and biomass production.

**Fig: 1. Influence of organic and inorganic treatments on Grain yield (kg ha-1), Straw yield (kg ha-1)**

(T1;Control, T2; NPK 100% (20:40:20),T3, NPK 50% + FYM 50% T4; FYM 100% (10 t ha-1), T5; NPK 50% + VC 50%, T6; VC 100% (5 t ha-1), T7; FYM 50% +VC 50%, T8; NPK 50% + FYM 25% +VC 25%, T9; NPK 25% +FYM 50 % +VC 25%, T10; NPK 25% + FYM 25% + VC 50%)

**Conclusion**

**Where is the conclusion? Conclusion is missing.**

**References**

Akrawi, H. (2019). *Journal of Applied and Pure Science and Agriculture*, *3(7): 64-68.* Effect of organic and inorganic fertilizer on availability of Potassium in soil and yield of Chickpea (*Cicer arietinum L*.). *Iraqi Journal of Agricultural Sciences*, *49(2).*

Bochalya, R. S., Gupta, A. K., Thakur, N. P., Puniya, R., Kumar, P., Kumar, D. and Mehta, S. (2020). Residual Effect of Fertility Levels, Biofertilizer and Foliar Nutrition on Yield and Yield Attributes of Summer Blackgram (*Vigna mungo L*.) in Wheat-blackgram Cropping System under Subtropical Conditions in Jammu. Legume Research- *An International Journal,45(7): 860-86.*

Chala and Obsa, (2019). Effect of Organic and Inorganic Fertilizers on Growth and Yield of ChickPea (*Cicer arietinum*) on Vertisols. *Ethiopian Journal of Crop* *Science, (6)1*.

[Dangmei](https://www.researchgate.net/profile/Gaigongthui-Dangmei?_tp=eyJjb250ZXh0Ijp7InBhZ2UiOiJwdWJsaWNhdGlvbiIsInByZXZpb3VzUGFnZSI6bnVsbH19), kumar.S., Ankur.S., and Kamlesh.J. (2023). Effect of organic source of nutrients on growth, yield and quality of Chickpea (*Cicer arietinum L*). *The Pharma Innovation Journal,* *12(6), 2216-2219*.

Divya, G., Vani, K. P., Babu, S. P. and Suneetha, K. P. (2017). Impact of cultivars and integrated nutrient management on growth, yield and economics of summer pearl-millet. *International.*

Elis, S.S, Fatma. B., and M.T. (2019). the effects of different fertilizer forms on yield and yield components of some chickpea varieties. *International Journal of Agriculture, Environment and Food Sciences, 4(2), 209-215.*

Jadhav SS, Jadhav AS, Karpe PJ and Chalak AM. (2021). *The Pharma Innovation Journal, 10(12), 1577-157.*

Jagadeesha1, Srinivasulu, Rathnakar M., Umesh, Kustagi, B. Ravikumar, L. Madhu and V.C.Reddy. (2019). Effect of Organic Manures on Physical, Chemical and Biological Properties of Soil and Crop Yield in Fingermillet-Redgram Intercropping System. *International Journal of Current Microbiology and Applied Sciences 8(5): 1378-1386.*

Kantwa, C.R., vyas, K. G., Patel, S. A. and Patel, B. J. 2021. Residual Effect of Wheat Varieties and Integrated Nutrient Management on Productivity and Profitability of Green Gram under North Gujarat Agro-climatic Condition. Legume Research-*An International Journal,1(8).*

Khan, N.A. Kirmani and Shafiq Wani. (2017). Effect of INM on Soil Carbon Pools, Soil Quality and Sustainability in Rice Brown Sarson Cropping System of Kashmir Valley. *International Journal of Current Microbiology and Applied Sciences, 6(7), pp. 785-809.*

*Khalid, haq, Y Lan, L Zhang. (2023*) Effect of vermicompost along with rhizobium incoluation potential, growth and yielding attributes of Lentil. *Biosci., Biotech. Res. Asia, Vol. 20(2), 735-744 .*

Kumar. S, Ankur. S and A.B., (2019). Response of Manures and Inorganic Sources of Nutrient on Growth, Yield and Quality of Chickpea *(Cicer arietinum L*.). *The Journal of Economics, Environment and Conversation,* *29, (S79-S84).*

Margal (2020). Long term effect of FYM and vermicompost on soil physical and chemical properties under pearl millet-chickpea cropping sequence. *International Journal of Chemical Studies,* 9(1), *1189-1193*.

Meena, R.B, A. A, T. T, N. T., and Kumar. (2023). *International Journal of Plant & Soil Science*, *35(17), 2320-7035*.

Meena, Swaroop, Thomas and Kumar Singh. (2023). Effect of different levels of organic manures on physico-chemical properties of soil under cowpea crop in an inceptisol. *International Journal of Plant soil science, 35(17),109-116*.

Mishra, Singh, Singh Bais and Mishra. (2022). Effect of Phosphorus and Vermicompost on Growth Characteristics and Yield of Chickpea *(Cicer arietinum L.*). *International Journal of Plant and Soil Science,* *(35)9, 58-64.*

Nawaz, Khan and Ali Shah (2015). Yield and yield components of chickpea as affected by various levels of FYM and rhizobium inoculation. *Pure and Applied Biology*, *(6)1, 346-351*.

Pagar, P. A., Pawar, S. B., Asewar, B. V. and Patil, D. K. (2022). Effect of spacing and nutrient management practices on growth yield and economics of sweet corn-chickpea under sequence cropping. *The Pharma Innovation Journal, 11(7),280-286.*

Raut, Nagrare and Kusumb. (2021). Effect of foliar application water soluble fertilizers on yield and economics of chickpea. *International Journal of Research in Agronomy*, *7(8), 298-300.*

Sahu, Narendra. S., Arun A. D.,and T. T. (2020). Effect of Different Levels of NPK and Zinc on Soil Health Growth and Yield of Chickpea (*Cicer arietinum L.*). *International Journal of Current Microbiology and Applied Sciences, 9(10), 591-597*.

shah, R. A. and Sandeep, K. (2014). Direct and residual effect of integrated nutrient management and economics in hybrid rice wheat cropping system. *American-Eurasian Journal of Agricultural and Environmental Sciences*,*14(5): 455-458*.

Singh, Sekhon and kaur. (2012). Effect of Farmyard manure, vermicompost and chemical nutrients on growth and yield of chickpea. *International Journal of Agriculture Research, 7(2): 93-99, 2012.*

Shokrollah, M. Reza and F. Abbas. (2013). The Effects of Four Organic Soil Conditioners on Aggregate Stability, Pore Size Distribution, and Respiration Activity in a Sandy Loam Soil. *Turk Journal of Agriculture, 47-55*.

 Sarkar, Dhar, Dey, Chatterjee, Mukherjee, Chakraborty, Chatterjee, Ravisankar and Mainuddin (2024). Natural and Organic Input-Based Integrated Nutrient-Management Practices Enhance the Productivity and Soil Quality Index of Rice–Mustard–Green Gram Cropping System. *Land 2024, 13, 1933.*

Thorhate, Misal and Chormul. (2018). Response of organic and inorganic fertilizers on nutrient content and uptake in Chickpea (*Cicer Arietinum L*.). *Plant Archives*, 19(1), *861-864.*

 Upadhyay, Kulhare, Dixit, Tagore, Gupta, Singh and Sharma (2024). Impact of FYM and NPK levels on nitrogen, protein content and yield of chickpea in vertisols*. International Journal of Advanced Biochemistry Research 2024; 8(12): 113-117.*

Verma, S., Singh b and Kushuwaha. (2024). Effect of Organic Manure on Different Soil Properties: *A Review. 36(5): 182-187.*

Yasodha, M. and Chinnusamy, C. (2019). Direct and residual effect of organic manures and inorganic fertilizer application in brinjal+onion-cowpea-sunnhemp cropping system. *Journal of Pharmacognosy and Phytochemistry,8(3): 2335-2339.*

C. Zhang, Zhanhui Z., Fang L, and J. Zhang. (2022). Effects of Organic and Inorganic Fertilization on Soil Organic Carbon and Enzymatic Activities. *Agronomy 2022, 12, 3125.*