

Effect of Inorganic Fertilizers and Organic Manures on Growth and Yield

Parameters under Wheat-Maize Cropping Sequence Grown on Normal and Saline-Sodic Inceptisol

Abstract

The present study entitled "Effect of inorganic fertilizers and organic manures on physical properties of soils under wheat-maize cropping sequence grown on normal and saline-sodic Inceptisol" was conducted at PGI Research farm, Department of Soil Science and Agriculture Chemistry, Post Graduate Institute, MPKV., Rahuri during *Rabi-2021* and *Summer-2022*. The experiment consist of eight treatments in wheat crop viz., T₁: RDN (50% N) + 50% N through FYM, T₂: RDN (50%N) + 50% N through vermicompost, T₃: RDN (50% N) + 50% N through poultry manure, T₄: (50% N) + 50% N through press mud compost, T₅: (50% N) + 50% N through goat manure, T₆: (50% N) + 50% N through urban compost T₇: GRDF (120:60:40 N:P₂O₅:K₂O kg ha⁻¹) + 10 t FYM ha⁻¹ and T₈: absolute control. Whereas, in maize crop treatment from T₁ to T₆ RDN (50% N) is applied with residual N applied to wheat through FYM, vermicompost, poultry manure, goat manure and urban compost, respectively and T₇: GRDF (120:60:40 N: P₂O₅:K₂O kg ha⁻¹) + 5 t FYM ha⁻¹ and T₈: Absolute control. These treatments replicated thrice in Randomized Block Design.. In wheat crop, the grain yield, straw yield, test weight, plant height and spike length recorded higher in treatment T₇ (GRDF 120:60:40 N: P₂O₅:K₂O kg ha⁻¹ + 10 t FYM ha⁻¹) under both normal and saline-sodic Inceptisol (27.87 q ha⁻¹, 41.00 q ha⁻¹, 43.72 g, 92 cm and 9.92 cm) and (34.43 q ha⁻¹, 44.02 q ha⁻¹, 42.40 g, 91 cm and 9.82 cm), respectively. Whereas, in succeeding maize crop, the treatment T₇ (GRDF 120:60:40 N: P₂O₅:K₂O kg ha⁻¹ + 5 t FYM ha⁻¹) recorded highest grain yield, stover yield, test weight, plant height, length of cob and no. of grains per cob in both normal and saline-sodic Inceptisol (64.11 q ha⁻¹, 74.23 q ha⁻¹, 40.34 g, 237.82 cm, 19.99 cm and 633.02 g) and (52.52 q ha⁻¹, 61.82 q ha⁻¹, 38.63 g, 226.24 cm, 18.74 cm and 579.48 g), respectively. In wheat crop application of treatment T₇ (GRDF 120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t ha⁻¹ FYM) recorded highest total uptake of nitrogen, phosphorous and potassium in both normal and saline-sodic Inceptisol (88.00, 16.00 and 100 N, P and K kg ha⁻¹) and (99.36, 17.20 and 103 N, P and K kg ha⁻¹), respectively. Whereas in succeeding maize crop, total uptake of nitrogen, phosphorous and potassium recorded highest in treatment T₇ (GRDF (120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 5 t ha⁻¹ FYM) in both normal and saline-sodic Inceptisol (107.69, 10.77 and 94.67 N, P and K kg ha⁻¹) and (85.85, 8.58 and 75.47 N, P and K kg ha⁻¹), respectively.

Comment [a1]: Effect of Inorganic Fertilizers and Organic Manures on Growth and Yield of Wheat-Maize Cropping Sequence Grown on Saline-Sodic Inceptisol

Comment [a2]: 1. Describe 1 or 2 sentences related to the research problem.
2. Describe 1 sentence related to the research objective
3. Describe 1 or 2 sentences related to research methods
4. Describe 1 - 3 sentences related to the results
5. Describe 1 sentence related to findings and suggestions given to further research (optional)
6. Word abbreviations need to be explained e.g. MPKV, RDN, FYM, GRDF

1. Introduction

The maize-wheat cropping system holds significant importance in addressing local food requirements and ensuring food security for India's ever-growing population. This system, featuring the cultivation of maize (*Zea mays L.*) and wheat (*Triticum aestivum*), is widely recognized as the primary and popular double cropping approach, especially in the irrigated regions of northwestern India [1]. Although maize is traditionally grown during the monsoon season, the maize-wheat combination remains the prevailing maize-based system, covering approximately 1.8 million hectares. This system ranks as the third major crop rotation in India and plays a vital role, contributing 3.0% to the nation's overall food production [2]. Additionally, it serves as a crucial factor in sustaining the country's food supply.

Chemical fertilizers have the advantage of rapidly restoring soil fertility, as the nutrients they contain become readily available to plants once the fertilizers dissolve in the soil [3]. Consequently,

Comment [a3]: The references used in the introduction need to be updated for the last 5 years (2020-2024) for GAP research on the effect of inorganic and organic fertilizers on the growth and yield of Wheat-Maize Cropping Sequence Grown on Saline-Sodic Inceptisol.

farmers have placed a strong emphasis on the use of chemical fertilizers to boost agricultural productivity [4]. Inorganic fertilizers, being water-soluble and containing all the essential nutrients in readily usable forms, are particularly effective for promoting rapid plant growth. Their quick and efficient action is attributed to their high nutrient content, requiring only small quantities to enhance productivity [5].

Organic fertilizers encompass natural materials derived from both plant and animal sources, such as livestock manure, green manures, crop residues, household waste, compost, and other organic matter. These materials function directly as sources of essential plant nutrients while also exerting indirect effects on the physical, chemical, and biological characteristics of the soil [4]. Organic manures like farmyard manure (FYM), compost, vermicompost, poultry manure, and goat manure, among others, represent natural products that serve as valuable reservoirs of nutrients and moisture in the soil. Organic manures contribute to the improvement of soil structure and foster the growth and proliferation of beneficial soil microorganisms. This, in turn, increases the availability of nutrients for crop growth and aids in the detoxification of harmful chemicals present in the soil [6]; [7]; [8].

A well-balanced approach involving the combined use of fertilizers and manure stands as a highly effective strategy for preventing the depletion of organic matter and the rapid deterioration of soil's physical attributes, particularly its structure [9]; [10]. Integrated nutrient management practices have been developed as efficient methods to rejuvenate both soil's physical properties and chemical fertility while enhancing soil organic matter levels. The introduction of organic matter into the soil leads to an increase in its organic carbon content, which, whether directly or indirectly, impacts on growth and yield parameters of crops [11].

2. Material and Method

The research trials took place at the PGI Research Farm within the Department of Soil Science and Agricultural Chemistry at Mahatma Phule Krishi Vidyapeeth, Rahuri. The experimental plot selected was characterized as a level and uniform area with moderate soil depth, classified as an Inceptisol. Geographically, the experimental site was situated at a latitude of 19.034° N and a longitude of 74.064° E, with an elevation of 513 meters above sea level. This region is positioned on the Eastern side of the Western Ghats in Maharashtra. The climate in this area is categorized as a regional steppe climate, characteristic of a semiarid tropical region. It features dry and hot summers, along with cool winters, and falls within the agro-climatic zone known as the "Scarcity zone. The initial status of both normal and saline-sodic Inceptisol described in table 1.

Table 1. Initial Soil properties of normal and saline-sodic Inceptisol Initial soil chemistry of normal and saline-sodic Inceptisol

| Sr.-No. | Soil chemical properties | Values Inceptisol | |
|---------|---|-------------------|-------------------|
| | | Normal soil | Saline-sodic soil |
| A | Chemical properties | | |
| 1 | pH (1:2.5) | 8.32 | 8.41 |
| 2 | EC (dS m ⁻¹) | 0.29 | 2.1 |
| 3 | Organic carbon (%) | 0.42 | 0.46 |
| 4 | Calcium Carbonate (%) | 8.77 | 11.68 |
| 5 | Available nitrogen (kg ha ⁻¹) | 182.6 | 187.1 |

Comment [a4]: Explain the condition of Saline-sodic Inceptisols, whether as an experiment or a sample taken from a specific area?

Comment [a5]: 1. explanation is needed regarding changes in initial soil chemical properties in normal and saline-sodic Inceptisols.

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Comment [a6]: Explain the condition of Saline-sodic Inceptisols, whether as an experiment or a sample taken from a specific area?

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| | | | |
|--------------|---|-------------------|-------------------|
| 6 | Available phosphorus (kg ha ⁻¹) | 14.16 | 13.11 |
| 7 | Available potassium (kg ha ⁻¹) | 389.6 | 361.3 |
| 8 | DTPA extractable Fe (mg kg ⁻¹) | 4.09 | 4.01 |
| 9 | DTPA extractable Mn (mg kg ⁻¹) | 10.90 | 10.64 |
| 10 | DTPA extractable Zn (mg kg ⁻¹) | 0.323 | 0.307 |
| 11 | DTPA extractable Cu (mg kg ⁻¹) | 0.724 | 2.12 |
| 12 | CEC (cmol(p ⁺) kg ⁻¹) | 57 | 52 |
| 12 | ESP (%) | 0.25 | 17.69 |
| B | Heavy metals (Traces) | | |
| 1 | Pb (mg kg⁻¹) | Traces | Traces |
| 2 | Cd (mg kg⁻¹) | Traces | Traces |
| 3 | Cr (mg kg⁻¹) | Traces | Traces |
| 4 | Ni (mg kg⁻¹) | Traces | Traces |
| C | Saturation paste extract analysis | | |
| 1 | pHs | 8.26 | 8.37 |
| 2 | ECe | 1.33 | 5.76 |
| 3 | Ca ²⁺ (meL ⁻¹) | 7.19 | 24.92 |
| 4 | Mg ²⁺ (meL ⁻¹) | 6.80 | 19.41 |
| 5 | Na ⁺ (meL ⁻¹) | 0.11 | 11.28 |
| 6 | K ⁺ (meL ⁻¹) | 0.15 | 0.16 |
| 7 | CO₃²⁻ (meL⁻¹) | - | - |
| 8 | HCO ₃ ⁻ (meL ⁻¹) | 5.6 | 9.4 |
| 9 | Cl ⁻ (meL ⁻¹) | 5.8 | 24.6 |
| 10 | SO ₄ ²⁻ (meL ⁻¹) | 2.2 | 22.3 |

The experiment consist of eight treatments in wheat crop viz., T₁: RDN (50% N) + 50% N through FYM, T₂: RDN (50%N) + 50% N through vermicompost, T₃: RDN (50% N) + 50% N through poultry manure, T₄: (50% N) + 50% N through press mud compost, T₅: (50% N) + 50% N through goat manure, T₆: (50% N) + 50% N through urban compost T₇: GRDF (120:60:40 N:P₂O₅:K₂O kg ha⁻¹) + 10 t FYM ha⁻¹ and T₈: absolute control. Whereas, in maize crop treatment from T₁ to T₆ RDN (50% N) is applied with residual N applied to wheat through FYM, vermicompost, poultry manure, goat manure and urban compost, respectively and T₇: GRDF (120:60:40 N: P₂O₅:K₂O kg ha⁻¹) + 5 t FYM ha⁻¹ and T₈: Absolute control. The observations were recorded such as plant height, spike length, grain yield, straw yield and test weight in wheat crop under both normal and saline-sodic Inceptisol and plant height, length of cob and no. of grains per cob, grain yield, stover yield and test weight in maize crop under both normal and saline-sodic Inceptisol. The data were analysed statistically and results were interpreted by using methods suggested by [12] Panse and Sukhatme.

3. Result and Discussion

3.1 Effect of inorganic fertilizers and organic manures on yield and plant growth

parameters of wheat crop in normal and saline-sodic inceptisol

Data pertaining to the significant results were observed for growth and yield of wheat by the application of various organic manures with inorganic fertilizers and presented in table 2 and 3 for normal and saline-sodic soil, respectively.

The treatment T₇, GRDF 120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t FYM ha⁻¹ for normal soil was recorded significantly the highest value in term of grain yield, straw yield, test weight, plant height and spike length (27.87 q ha⁻¹, 41.00 q ha⁻¹, 43.72 g, 92 cm and 9.92 cm), respectively.. For grain and straw

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Comment [a11]: This experiment uses a design or not, if so, please explain e.g. type of design (RCD or RCBD, other), how many replicates?

Comment [a12]: 1. sub-section needs to explain the preparation process of the inorganic and organic fertilizers used in detail, such as the type of fertilizer, the composting process and its composition, and the essentials of both. 2. sub-section is needed to explain how the cultivation process of the Wheat-Corn Intercropping was carried out by describing (Experimental Plot Figure) the planting distance, plot size, number of plants, planting process, maintenance, and harvesting.

3. because cultivation is carried out by Wheat-Maize Cropping Sequence Grown? need special explanation in the sub-chapter in the cultivation process.

4. Sub-section soil and plant analysis

5. need to explain in the relevant sub-section the analysis method used in each parameter such as EC and others.

Comment [a13]: The results and discussion should be reorganized as follows:

a. Plant height

b. Plant Nutrients

c. Crop yield e.g. Grain yield, Straw, number and weight of grains, cob length etc.

This needs to be considered so that the research results look systematic

Comment [a14]: The discussion carried out is very lacking, so it is necessary to increase and improve the discussion in each section.

yield treatment T₃ and T₆ were at par with treatment T₇ and for the test weight and plant height treatments T₃, T₄ and T₆ while, for spike length treatment T₆ was found to be at par with treatment T₇.

Table 2. Effect of inorganic fertilizers and organic manures on yield and plant growth parameters of wheat in normal Inceptisol

| Tr. No. Code | Treatments | Yield and plant growth parameters | | | | |
|----------------|---|-----------------------------------|-----------------------------------|-----------------|-------------------|-------------------|
| | | Normal soil | | | | |
| | | Grain yield (q ha ⁻¹) | Straw yield (q ha ⁻¹) | Test weight (g) | Plant height (cm) | Spike length (cm) |
| T ₁ | RDN (50% N) + 50% N through FYM | 24.34 | 27.61 | 39.44 | 78 | 6.67 |
| T ₂ | RDN (50% N) + 50% N through Vermicompost | 24.33 | 32.05 | 40.67 | 85 | 7.17 |
| T ₃ | RDN (50% N) + 50% N through Poultry manure | 26.33 | 40.23 | 41.88 | 85.7 | 7.33 |
| T ₄ | RDN (50% N) + 50% N through Press mud compost | 24.34 | 28.62 | 42.34 | 86 | 7.50 |
| T ₅ | RDN (50% N) + 50% N through Goat manure | 23.00 | 29.65 | 40.97 | 84 | 6.75 |
| T ₆ | RDN (50% N) + 50% N through urban compost | 27.81 | 40.00 | 42.56 | 89 | 9.47 |
| T ₇ | GRDF (120:60:40 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹ + 10 t ha ⁻¹ FYM | 27.87 | 41.00 | 43.72 | 92 | 9.92 |
| T ₈ | Absolute Control | 11.00 | 18.07 | 31.5 | 65 | 4.33 |
| | SE (m)± | 0.66 | 1.81 | 0.64 | 2.14 | 0.18 |
| | CD at 5% | 2.03 | 5.45 | 1.93 | 6.4 | 0.55 |

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In saline-sodic soil the treatment T₇, GRDF (120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t FYM ha⁻¹) was also recorded significantly the highest value in term of grain yield, straw yield, Test weight, plant height and spike length (34.43 q ha⁻¹, 44.02 q ha⁻¹, 42.40 g, 91 cm and 9.82 cm), respectively. For grain yield and straw yield, treatments T₂, T₃ and T₆ were found to be at par with treatment T₇ and for the test weight treatment T₄ and T₆ and for spike length treatment T₃ was found to be at par with treatment T₇.

Table 3. Effect of inorganic fertilizers and organic manures on yield and plant growth parameters of wheat in saline-sodic Inceptisol

| Tr. No. Code | Treatments | Yield and plant growth parameters | | | | |
|----------------|--|-----------------------------------|-----------------------------------|-----------------|-------------------|-------------------|
| | | Saline sodic soil | | | | |
| | | Grain yield (q ha ⁻¹) | Straw yield (q ha ⁻¹) | Test weight (g) | Plant height (cm) | Spike length (cm) |
| T ₁ | RDN (50% N) + 50% N through FYM | 25.61 | 39.04 | 37.82 | 80 | 6.8 |
| T ₂ | RDN (50% N) + 50% N through Vermicompost | 31.69 | 40.67 | 38.97 | 87 | 7.19 |

Comment [a15]: It is strongly recommended to change the data display to graphical for each parameter against normal and saline-sodic conditions in order to be informative of the results obtained and the discussion is focused.

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| | | | | | | |
|----------------|---|-------|-------|-------|------|------|
| T ₃ | RDN (50% N) + 50% N through Poultry manure | 34.17 | 42.12 | 40.61 | 86 | 9.40 |
| T ₄ | RDN (50% N) + 50% N through Press mud compost | 30.00 | 38.67 | 40.96 | 88 | 7.50 |
| T ₅ | RDN (50% N) + 50% N through Goat manure | 29.78 | 40.02 | 39.57 | 86 | 6.75 |
| T ₆ | RDN (50% N) + 50% N through urban compost | 30.99 | 42.53 | 40.94 | 89 | 8.17 |
| T ₇ | GRDF (120:60:40 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹ + 10 t FYM ha ⁻¹) | 34.43 | 44.02 | 42.40 | 91 | 9.82 |
| T ₈ | Absolute Control | 16.63 | 28.81 | 32.62 | 68 | 5.31 |
| | SE (m)± | 1.22 | 1.23 | 0.47 | 0.15 | 0.19 |
| | CD at 5% | 3.63 | 3.68 | 1.47 | 0.45 | 0.57 |

Wheat is moderately salt tolerant crop and tolerate salt upto much level and takes nutrients even after high salt concentration it might be one of the reason for high grain and straw yield of wheat crop in saline-sodic soil.

3.2 Effect of Inorganic Fertilizers and Organic Manures on Yield and Plant Growth

Parameters of Maize crop in Normal and Saline-Sodic Inceptisol

The significant results were observed for total yield of maize by the application inorganic fertilizers and residual effect of organic manures and presented in table 4 and 5 for normal and saline-sodic soil, respectively.

In normal soil, the treatment T₇, GRDF (120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t FYM ha⁻¹) was recorded significantly the highest value in term of grain yield, stover yield, test weight, plant height, length of cob and no. of grain per cob (64.11 q ha⁻¹, 74.23 q ha⁻¹, 40.34 g, 237.82 cm, 19.99 cm and 633.02 g), respectively. For grain yield, stover yield, plant height, length of cob and no. of grain per cob treatment T₂ and T₃ were at par with treatment T₇ and for the test weight treatments T₂, T₃, T₄ and T₆ were found to be at par with treatment T₇.

Table 4. Effect of inorganic fertilizers and organic manures on yield and plant growth parameters of maize in normal Inceptisol

| Tr. No. Code | Treatments | Yield and plant growth parameters | | | | | |
|----------------|-------------|-----------------------------------|------------------------------------|-----------------|-------------------|--------------------|--------------------------|
| | | Normal soil | | | | | |
| | | Grain yield (q ha ⁻¹) | Stover yield (q ha ⁻¹) | Test weight (g) | Plant height (cm) | Length of cob (cm) | No. of grain per cob (g) |
| T ₁ | RDN (50% N) | 58.41 | 67.72 | 36.83 | 188.45 | 17.32 | 520.33 |
| T ₂ | RDN (50% N) | 62.28 | 70.44 | 39.72 | 224.85 | 18.93 | 596.33 |
| T ₃ | RDN (50% N) | 60.34 | 69.89 | 39.16 | 216.71 | 18.72 | 586.78 |
| T ₄ | RDN (50% N) | 58.66 | 67.64 | 37.92 | 198.32 | 17.74 | 533.63 |

Comment [a16]: add visualization (figure) of Wheat-Maize Cropping Sequence Grown on Normal and Saline-Sodic Inceptisol

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Comment [a17]: 1.same as the other tables and the experiments conducted
2.why is it different from the experiment in the table 2 and 3

| | | | | | | | |
|----------------|---|-------|-------|-------|--------|-------|--------|
| T ₅ | RDN (50% N) | 57.42 | 66.22 | 36.14 | 186.45 | 17.25 | 515.36 |
| T ₆ | RDN (50% N) | 59.36 | 68.44 | 38.72 | 208.32 | 18.03 | 543.78 |
| T ₇ | GRDF 120:60:40 + 5 t ha ⁻¹ FYM | 64.11 | 74.23 | 40.34 | 237.82 | 19.99 | 633.02 |
| T ₈ | Absolute control | 48.83 | 58.52 | 29.84 | 176.35 | 15.79 | 491.19 |
| | SE (m)± | 1.45 | 1.72 | 1.13 | 6.96 | 0.47 | 16.07 |
| | CD at 5% | 4.39 | 5.22 | 3.42 | 21.13 | 1.44 | 48.76 |

Table 5. Effect of inorganic fertilizers and organic manures on yield and plant growth parameters of maize in saline-sodic Inceptisol

| Tr. No. Code | Treatments | Yield and plant growth parameters | | | | | |
|----------------|---|-----------------------------------|------------------------------------|-----------------|-------------------|--------------------|--------------------------|
| | | Saline-sodic soil | | | | | |
| | | Grain yield (q ha ⁻¹) | Stover yield (q ha ⁻¹) | Test weight (g) | Plant height (cm) | Length of cob (cm) | No. of grain per cob (g) |
| T ₁ | RDN (50% N) | 47.18 | 56.43 | 34.96 | 184.68 | 16.31 | 476.85 |
| T ₂ | RDN (50% N) | 50.76 | 59.52 | 36.82 | 213.75 | 17.42 | 551.78 |
| T ₃ | RDN (50% N) | 49.28 | 58.77 | 36.23 | 206.23 | 17.33 | 533.63 |
| T ₄ | RDN (50% N) | 47.54 | 57.12 | 35.58 | 197.75 | 16.78 | 496.13 |
| T ₅ | RDN (50% N) | 46.64 | 55.53 | 34.37 | 179.46 | 16.08 | 468.86 |
| T ₆ | RDN (50% N) | 49.08 | 57.28 | 35.86 | 197.71 | 17.12 | 517.6 |
| T ₇ | GRDF 120:60:40 + 5 t ha ⁻¹ FYM | 52.52 | 61.82 | 38.63 | 226.24 | 18.74 | 579.48 |
| T ₈ | Absolute control | 38.47 | 49.35 | 26.49 | 168.45 | 14.23 | 393.74 |
| | SE (m)± | 1.12 | 1.39 | 1.05 | 6.97 | 0.48 | 16.07 |
| | CD at 5% | 3.40 | 4.21 | 3.18 | 21.14 | 1.44 | 48.76 |

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Comment [a18]: adapted to others

In saline-sodic soil, the treatment T₇, GRDF (120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t FYM ha⁻¹) was recorded significantly the highest value in term of grain yield, stover yield, test weight, plant height, length of cob and no. of grain per cob (52.52 q ha⁻¹, 61.82 q ha⁻¹, 38.63 g, 226.24 cm, 18.74 cm and 579.48 g), respectively. For grain yield, stover yield, plant height, length of cob and no. of grain per cob treatment T₂ and T₃ were at par with treatment T₇ and for the test weight treatments T₂, T₃, T₄ and T₆ were found to be at par with treatment T₇.

The highest yield in maize crop was observed in treatment T₇, GRDF (120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t FYM ha⁻¹) for both normal and saline-sodic Inceptisol which is might be due to improvement of physical and chemical properties of soils that resulted in increased productivity by increasing availability of plant nutrients [13]. Further, the organic matter might have supplied macro and

micro nutrients and resulted as chelating agent for enhancing the availability of nutrients in soil. These results are in conformity with the finding of [14] Urkurkar et al.; [15] Thakur et al..

Comment [a19]: Explain fully how the difference in results between normal and saline-sodic conditions occurs.

3.3 Effect of inorganic fertilizers and organic manures on uptake of nutrients by wheat in normal and saline-Sodic Inceptisol

The data for the uptake of NPK by wheat by the application of various organic manures with inorganic manures is presented in table 6. In wheat crop application of treatment T₇ (GRDF 120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t ha⁻¹ FYM) recorded highest total uptake of nitrogen, phosphorous and potassium in both normal and saline-sodic Inceptisol *i.e.* (88.00, 16.00 and 100 N, P and K kg ha⁻¹) and (99.36, 17.20 and 103 N, P and K kg ha⁻¹), respectively.

Table 6. Effect of inorganic fertilizers and organic manures on nutrients uptake by wheat in normal and saline-sodic Inceptisol

| Tr. No. | Treatments | Total uptake (kg ha ⁻¹) | | | | | |
|----------------|---|-------------------------------------|-------|-------|-------------------|-------|-------|
| | | Normal soil | | | Saline-sodic soil | | |
| | | N | P | K | N | P | K |
| T ₁ | RDN (50% N) + 50% N through FYM | 74.44 | 9.24 | 80.81 | 95.88 | 10.90 | 86 |
| T ₂ | RDN (50% N) + 50% N through Vermicompost | 63.85 | 10.46 | 84.06 | 77.13 | 15.68 | 88 |
| T ₃ | RDN (50% N) + 50% N through Poultry manure | 86.48 | 14.00 | 94.10 | 97.59 | 15.39 | 96 |
| T ₄ | RDN (50% N) + 50% N through Press mud compost | 68.01 | 11.70 | 91.61 | 74.31 | 14.92 | 93 |
| T ₅ | RDN (50% N) + 50% N through Goat manure | 55.68 | 10.66 | 79.51 | 59.56 | 10.04 | 87 |
| T ₆ | RDN (50% N) + 50% N through urban compost | 85.92 | 10.40 | 94.7 | 73.20 | 13.41 | 100 |
| T ₇ | GRDF (120:60:40 N: P ₂ O ₅ : K ₂ O kg ha ⁻¹ + 10 t FYM ha ⁻¹) | 88.00 | 16.00 | 100 | 99.36 | 17.20 | 103 |
| T ₈ | Absolute Control | 33.06 | 4.45 | 41.25 | 38.50 | 5.88 | 69.31 |
| | SE(m)± | 0.94 | 0.66 | 2.21 | 1.1 | 1.14 | 3.05 |
| | CD at 5% | 2.82 | 2.03 | 6.63 | 3.3 | 3.52 | 9.16 |

In normal soil treatment T₃ and T₆ were found to be at par with treatment T₇ for the uptake of total nitrogen and potassium while, for the uptake of phosphorus treatment T₃ was at par with treatment T₇. In saline-sodic soil for total nitrogen uptake treatment T₃ was at par with treatment T₇ and for total phosphorus treatments T₂, T₃ and T₄ while, for total potassium uptake treatments T₃ and T₆ were found to be at par with T₇.

The significant increase in the uptake of total N, P and K might be due to combined application of organic and inorganic fertilizers due to which availability of nutrients increased during crop growth. The findings are accordance with those reported by [16] Bahadur et al..

Comment [a20]: a detailed explanation is needed regarding why nutrients can be found in saline-sodic and normal conditions.

3.4 Effect of inorganic fertilizers and organic manures on uptake of nutrients by maize in normal and saline-sodic Inceptisol

The data for the uptake of NPK by maize by the application of inorganic fertilizers and residual effect of organic manures is presented in table 7.

Table 7. Effect of inorganic fertilizers and organic manures on nutrients uptake by maize in normal and saline-sodic Inceptisol

| Tr. No. | Treatments | Total uptake (kg ha ⁻¹) | | | | | |
|----------------|---|-------------------------------------|-------|-------|-------------------|------|-------|
| | | Normal soil | | | Saline-sodic soil | | |
| | | N | P | K | N | P | K |
| T ₁ | RDN (50% N) | 96.58 | 9.66 | 84.90 | 76.09 | 7.61 | 66.89 |
| T ₂ | RDN (50% N) | 102.58 | 10.26 | 90.18 | 82.15 | 8.22 | 72.22 |
| T ₃ | RDN (50% N) | 100.31 | 10.03 | 88.18 | 78.98 | 7.96 | 70.26 |
| T ₄ | RDN (50% N) | 98.28 | 9.83 | 86.40 | 77.04 | 7.70 | 67.73 |
| T ₅ | RDN (50% N) | 96.13 | 9.61 | 84.51 | 74.77 | 7.48 | 65.74 |
| T ₆ | RDN (50% N) | 99.33 | 9.93 | 87.32 | 80.01 | 8.00 | 70.34 |
| T ₇ | GRDF 120/60/40 + 5 t FYM ha ⁻¹ | 107.69 | 10.77 | 94.67 | 85.85 | 8.58 | 75.47 |
| T ₈ | Absolute control | 79.49 | 7.95 | 69.88 | 61.72 | 6.17 | 54.26 |
| | SE(m)± | 2.88 | 0.29 | 2.54 | 2.28 | 0.23 | 2.01 |
| | CD at 5% | 8.75 | 0.87 | 7.69 | 6.93 | 0.69 | 6.09 |

In both normal and saline-sodic Inceptisol, in succeeding maize crop, total uptake of nitrogen, phosphorous and potassium recorded highest in treatment T₇ (GRDF (120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 5 t ha⁻¹ FYM) (107.69, 10.77 and 94.67 N, P and K kg ha⁻¹) and (85.85, 8.58 and 75.47 N, P and K kg ha⁻¹), respectively and the lowest value for the uptake of NPK was recorded for treatment T₈ (Absolute control).

In normal soil treatment T₂, T₃ and T₆ were found to be at par with treatment T₇ for the uptake of total nitrogen, phosphorus and potassium. In saline-sodic soil for total nitrogen, phosphorus and potassium uptake treatment T₂, T₃ and T₆ were found to be at par with treatment T₇.

The significant increase in the uptake of total N, P and K might be due to releasing nutrients from sources and biological activity which resulted in more nutrient uptake. The findings are accordance with those reported by [17] Prajapati et al..

4. Conclusion

The growth parameters viz. plant height, spike length, test weight, grain and straw yield and total uptake of N, P and K were found to be significantly higher in the treatment GRDF 120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t ha⁻¹ FYM under wheat crop in both normal and saline-sodic Inceptisol. The yield in GRDF 120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 10 t ha⁻¹ FYM is increased by 23.53 % in saline-sodic soil compared to normal Inceptisol.

Comment [a21]: add and explain the interpretation of the data obtained and the discussion of how the best treatment can increase plant growth and yield and the supporting theory.

Application of GRDF 120:60:40 N: P₂O₅: K₂O kg ha⁻¹ + 5 t ha⁻¹ FYM was found significantly higher under succeeding maize crop in both normal and saline-sodic Inceptisol in term of plant height, length of cob, No. of grains per cob, test weight, grain yield, stover yield and total uptake of N, P and K. The treatment RDN 50% N + Residual N is applied to wheat through vermicompost and RDN 50% N + Residual N is applied to wheat through poultry manure were found at par for maize crop characteristics such as plant height, cob length, grain count, test weight, grain and stover yield, and nutrient uptake in both types of soils.

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Comment [a22]: 1.The references used are too few and need to be updated for the last 5 years.
2.Need to check the writing of references based on the templete used

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