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# EFFECT OF CROP MANAGEMENT ON PERFORMANCE OF RABI MAIZE AND SOIL PHYSICO-CHEMICAL PROPERTIES

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## ABSTRACT

A field experiment was carried out during the Rabi season of 2023-24 at the experimental farm of the All India Coordinated Research Project on Soybean, School of Agricultural Sciences, Nagaland University, Medziphema campus. The objective was to assess how various crop management practices influence maize growth, yield, quality, nutrient composition, uptake, and soil characteristics. The study included two maize varieties, M1 (RCM 76) and M2 (VLQMH 45) as main-plot factors, along with three sub-plot management systems: Organic Farming (OF; application of well-decomposed FYM @ 10 t ha$^{-1}$), Natural Farming (NF; seed treatment using Beejamrit @ 50–100 mL kg$^{-1}$ and Jeevamrit @ 500 ha$^{-1}$ applied at 15, 30, and 45 DAS), and Integrated Crop Management (ICM; 50% of recommended nitrogen supplied through urea and 50% through FYM), with four replications. The findings showed that VLQMH 45 surpassed RCM 76 in major growth and yield indicators, such as plant height, dry matter accumulation, number of green leaves, cobs per plant, grains per cob, grain yield, and harvest index. Among the management practices, ICM achieved the highest grain productivity, exceeding OF by 62.5% and NF by 82.5%. Maize cultivated under ICM also demonstrated superior grain quality, higher nutrient levels, and greater nutrient uptake, followed by OF, while NF consistently recorded the lowest values. Though soil physical properties were not significantly affected, ICM markedly improved soil organic carbon and the availability of N, P, K, S, as well as exchangeable Ca and Mg. It also showed higher exchangeable acidity and aluminum than NF. No significant variation was noted in exchangeable hydrogen or total potential acidity among the treatments.

***Keywords* :** Integrated Crop Management, Natural Farming, Organic Farming, Rabi Maize, Soil fertility.

## Introduction

The agricultural sector stands at a critical juncture as it seeks to increase food production to meet the needs of a projected global population of 9.7 billion by 2050, requiring nearly 60% higher food output than current levels (FAO, 2017). This goal is increasingly difficult to achieve due to declining soil fertility, inefficient nutrient use, and the deterioration of soil structure caused by compaction, erosion, and loss of organic matter (Gruhn *et al*., 2000). Soil attributes such as water-holding capacity, pH, bulk density, and depth strongly influence root development and nutrient absorption, and any deterioration in these properties directly affects crop productivity and farm profitability. Maize (*Zea mays* L.), known as the "queen of cereals" due to its high genetic yield potential, is a major global food, feed, and industrial crop. In India, it ranks third among cereals after rice and wheat, with cultivation expanding from 4.4 million hectares producing 4.1

MMT in 1960–61 to 9.5 million hectares producing 18.7 MMT by 2016–17 (Sharma *et al*., 2018). By 2025, national maize demand is projected to reach 50 MMT, with substantial requirements from the livestock, industrial, food, and seed sectors (Yadav *et al*., 2016). Meeting this demand poses both significant challenges and opportunities for Indian agriculture, especially against the backdrop of rising input costs, fluctuating crop prices, and potential food insecurity affecting nearly 60% of India's population by 2050.

These challenges have accelerated the adoption of sustainable and low-input agricultural approaches. Zero Budget Natural Farming (ZBNF) has gained prominence, with more than 523,000 farmers adopting it across 13% of the cultivated area in Andhra Pradesh (Smith *et al*., 2020). Integrated Crop Management (ICM) has also shown strong potential, as studies in Karnataka report substantial improvements in soil health, crop yields, and farm profitability under ICM practices (Wani *et al*., 2017). Within India's cropping systems, rabi maize grown under irrigated winter conditions have emerged as a promising option due to its higher productivity and more stable environmental conditions compared with kharif maize (Kumari *et al*., 2020). However, the long-term sustainability of rabi maize cultivation depends heavily on soil physical, chemical, and biological health. Conventional monoculture systems reliant on synthetic fertilizers and pesticides have contributed to soil degradation, nutrient leaching, and environmental pollution (Swaney *et al*., 2015; Chen *et al*., 2021). Globally, one-third of arable land is already degraded (FAO, 2015), and in India, nearly 97.85 million hectares were classified as degraded during 2018–19 (ISRO, 2021). These issues highlight the urgent need for sustainable soil and nutrient management strategies. Therefore, the present study aims to assess the effects of different crop management practices on the growth, yield, quality, nutrient uptake, and soil properties of rabi maize, with the goal of identifying ecologically sustainable and economically viable production practices.

## Materials and Methods

The field experiment was carried out during Rabi 2023-24 at the Experimental Farm of AICRP on Soybean, School of Agricultural Sciences, Nagaland University, Medziphema Campus. The site lies in the sub-humid tropical foothills of Nagaland at 310 m altitude, between 25°43.923'–25°50.569' N and 93°37.645'–93°55.202' E. The region receives 2000–2500 mm annual rainfall with temperatures ranging from 21–32°C. The experiment was laid out in a Split Plot Design with six treatments and four replications, consisting of two maize varieties in main plots (M1: RCM 76 and M2: VLQMH 45) and three crop management practices in sub-plots (Organic farming, Natural farming, and Integrated Crop Management).

Maize was sown on 25 November 2023 at 60 cm × 20 cm spacing with a seed rate of 20 kg $ha^{-1}$ and fertilizer dose of 120:60:60 NPK kg $ha^{-1}$. NF seeds were treated with Beejamrit (@50–100 mL $kg^{-1}$) and Jeevamrit (@500 $ha^{-1}$) was applied at 15, 30, and 45 DAS. FYM (@10 t $ha^{-1}$) was applied in OF and ICM, with ICM plots receiving 50% N through urea and 50% through FYM. Intercultural operations included thinning and weeding at 30 and 45 DAS, and irrigation was provided during early stages and as life-saving irrigation at tasseling and silking.

Observations on plant height, leaf number, fresh and dry biomass, number of cobs $plant^{-1}$, grains $cob^{-1}$, grain yield, stover yield, and harvest index were recorded using standard procedures. Plant samples were oven-dried, ground, and analyzed for nitrogen, phosphorus, potassium, and sulphur content and nutrient uptake was computed accordingly. Soil samples were analyzed for pH, EC, organic carbon, available N, P, K, S, bulk density, particle density, porosity, water holding capacity, and soil acidity parameters (exchangeable acidity, $Al^{3+}$, $H^{+}$, total potential acidity) using methods described by Jackson (1973), Walkley and Black (1934), Subbiah and Asija (1956), and Baruah and Barthakur (1997). All recorded data were statistically analyzed using ANOVA following Cochran and Cox (1957), and treatment means were compared using the F-test at 5% significance.

## Result and Discussion

### Growth and yield parameters

The readings for growth and yield parameters are presented in Table 1. Significant variability was observed among maize varieties and crop management practices across the recorded growth and yield parameters. Plant height at 60 DAS recorded greater height in VLQMH 45 than RCM 76. Crop management practices significantly influenced plant height at all stages, with ICM producing the tallest plants, followed by OF and NF. Fresh and dry weights showed a similar trend: varietal effects were found to be significant at 60 DAS, with VLQMH 45 outperforming RCM 76. ICM produced the highest fresh and dry biomass at all stages, OF ranked next, and NF consistently recorded the lowest values. The number of green leaves was significantly higher in VLQMH 45, while ICM consistently produced more leaves compared to OF and NF. The number of cobs $plant^{-1}$ did not vary significantly between varieties or treatment combinations, but ICM showed the highest numerical values. Grain count cob$^{-1}$ differed significantly, with VLQMH 45 and ICM recording the highest values. Grain yield followed the same pattern, where VLQMH 45 and ICM recorded significantly higher yields than RCM 76, OF and NF. Stover yield also showed significant differences among crop management practices, with ICM being superior to OF and NF. Harvest index was significantly higher in VLQMH 45 and under ICM treatment, with OF and NF showing lower values.

Across all growth and yield parameters, hybrid VLQMH 45 consistently outperformed the composite variety, particularly at later growth stages, likely due to its stronger genetic potential for biomass accumulation and grain formation, as similarly reported by Vinay *et al*. (2020). The superior performance of ICM over OF and NF reflects the positive influence of combined organic and inorganic nutrient sources on plant growth. The quick-release nature of inorganic fertilizers supports early growth, while FYM ensures a steady nutrient supply at later stages, resulting in improved vegetative and reproductive development (Pramesh *et al*., 2023). The significantly higher plant height, biomass accumulation, grain count and yield under ICM aligns with findings of Veeranna *et al*. (2023), Vinay *et al*. (2020), and Ksiezak *et al*. (2017), who reported improved performance of maize under integrated nutrient management. The poor performance under NF can be attributed to the limited nutrient availability, as Jeevamrit acts primarily as a microbial stimulant rather than a nutrient source, insufficient to meet crop demands, especially under dry early-season conditions (Sudhanshu *et al*., 2015). Reduced cob formation, lower grain count, and overall diminished productivity under NF reflect the nutrient-deficient environment described by Paramesh *et al*. (2023). The higher harvest index under ICM is consistent with Sudhakar *et al*. (2018), who found that FYM combined with fertilizers enhances biological yield and improves partitioning of assimilates towards grain. Overall, the results confirm that ICM provides the most balanced nutrient environment, enabling superior growth, biomass accumulation and yield components, while OF provides moderate improvement and NF remains insufficient for achieving optimum productivity.

### Effect of treatments on nutrient content and uptake

Nutrient content and uptake in maize were influenced variably by varieties, crop management practices, and their interactions, as shown in Tables 1, 2 and 3. Nitrogen, phosphorus, potassium and sulphur contents in both grain and stover showed either non-significant or marginal varietal differences, except for phosphorus and sulphur, where VLQMH 45 (M2) consistently recorded higher concentrations. Crop management practices exerted clear effects on nutrient accumulation, with ICM producing the highest contents of N, P, K and S across grain and stover, followed by OF, while NF showed the lowest values. This trend was also reflected in nutrient uptake, where ICM achieved markedly greater uptake of all nutrients due to its superior yield and higher nutrient concentration, whereas NF recorded the minimum uptake. Interaction effects were significant for several parameters, particularly phosphorus and potassium uptake, where M2ICM consistently outperformed other combinations, registering the highest uptake values across grain, stover and total. In general, the data demonstrate that integrated nutrient supply through ICM results in substantial improvement in nutrient content and uptake, while nutrient-limited conditions under NF restrict nutrient accumulation and removal.

The consistent superiority of ICM in enhancing nutrient content and uptake across nutrients can be attributed to the combined effect of mineral fertilizers and organic inputs, which together provide both immediate and sustained nutrient availability (Immanuel *et al*., 2021). The improved nutrient acquisition under ICM is also supported by the greater biomass and yield associated with integrated nutrition, aligning with the observations of Veeranna *et al*. (2023). The lower nutrient content and uptake under NF reflect limited availability of readily accessible nutrients, particularly nitrogen, which is essential for root growth and metabolic activity. This agrees with findings indicating that Jeevamrit acts primarily as a microbial stimulant rather than a substantial nutrient source. Higher uptake of P, K and S in the ICM treatment may also be linked to greater root proliferation under adequate nitrogen supply, as well as the enhanced phosphorus pool resulting from organic amendments (Zhang *et al*., 2023). Elevated uptake values in M2ICM for most nutrients further highlight genotype × management interactions, suggesting that VLQMH 45 responds more favorably to integrated nutrient management. Overall, the results emphasize that integrated nutrient strategies optimize nutrient availability, improve plant uptake efficiency, and consequently enhance nutrient accumulation in grain and stover.

### Protein content

Protein content was unaffected by varietal differences, although the hybrid VLQMH 45 consistently showed a marginally higher value than RCM 76 (Table 3 and 4). Crop management practices, however, exerted a clear influence, with ICM producing the highest protein content (7.89%), statistically comparable to OF (7.47), while NF resulted in the lowest levels, reflecting its limited nitrogen supply. Interaction effects between variety and management practice were non-significant. The superior protein content observed under ICM and OF may be attributed to the sustained nutrient release provided by organic inputs, which enhance nutrient availability throughout the growing period as reported by Abid *et al*. (2020).

### Effect of treatments on post-harvest soil properties

Post-harvest soil analysis showed that pH, EC, bulk density, particle density, porosity and water-holding capacity were unaffected by maize varieties or their interaction with crop management practices, although minor shifts were noted (Table 5 and 6). NF slightly increased soil pH, while ICM and OF produced marginal reductions, consistent with observations by Veeranna *et al*. (2023) and Abid *et al*. (2020). In contrast, significant differences emerged for soil organic carbon and available nutrients. ICM consistently recorded the highest organic carbon content, likely due to greater residue addition and FYM-derived humic substances (Lu *et al*., 2009; Bajpai *et al*., 2006). Available N, P, K and S were also highest under ICM, followed by OF, with NF showing the lowest levels, aligning with earlier reports on the benefits of integrated fertilization (Abid *et al*., 2020; Toppo *et al*., 2024). Exchangeable Ca and Mg were significantly elevated under ICM, attributed to nutrient inputs from fertilizers and organic amendments (Wong *et al*., 2001). Exchangeable acidity and aluminium were also higher in ICM, while OF showed the lowest acidity, likely due to the buffering effect of organic matter (Wong *et al*., 2001; Prakash *et al*., 2002). Exchangeable hydrogen and total potential acidity showed no significant variation across treatments. Overall, ICM improved soil nutrient status without markedly altering basic soil physical properties.

## Conclusion

The study demonstrated that integrated crop management (ICM) consistently produced superior growth, yield and nutrient uptake compared to organic farming (OF) and natural farming (NF), with VLQMH 45 performing better than RCM 76. While soil physical properties remained largely unchanged across treatments, ICM improved critical soil chemical attributes particularly organic carbon and nutrient availability. Under the rabi conditions of Nagaland, NF performed poorly, likely due to reduced microbial activity in colder temperatures, whereas ICM emerged as the most effective and sustainable approach for maize production. Nevertheless, long-term trials are recommended to validate these trends and better understand their implications for soil health and crop.

**Table 1 :** Growth, yield and nutrient content parameters on the effect of crop management practices on the performance of rabi maize

| | Plant height plant$^{-1}$ (cm) | Fresh weight plant$^{-1}$ (g) | Dry weight plant$^{-1}$ (g) | Green leaves plant$^{-1}$ | Cobs plant$^{-1}$ | Grains cob$^{-1}$ | Grain yield (q ha$^{-1}$) | Stover yield (q ha$^{-1}$) | Harvest index | N content (%) | | P content (%) | | K content (%) | | S content (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Grain | Stover | Grain | Stover | Grain | Stover | Grain | Stover |
| *Variety* | | | | | | | | | | | | | | | | | |
| M1 | 41.51 | 39.12 | 3.39 | 7.92 | 0.84 | 63.11 | 2.01 | 13.90 | 12.42 | 1.14 | 0.68 | 0.49 | 0.25 | 0.47 | 0.79 | 0.47 | 0.17 |
| M2 | 41.67 | 53.05 | 4.32 | 9.42 | 0.92 | 99.11 | 4.76 | 12.39 | 34.20 | 1.19 | 0.67 | 0.56 | 0.30 | 0.62 | 0.88 | 0.59 | 0.22 |
| Sem± | 0.57 | 1.75 | 0.10 | 0.14 | 0.02 | 4.89 | 0.04 | 0.31 | 0.55 | 0.02 | 0.02 | 0.01 | 0.01 | 0.03 | 0.02 | 0.02 | 0.02 |
| CD at 5% | NS | 7.89 | 0.46 | 0.62 | NS | 22.00 | 0.19 | NS | 2.49 | NS | NS | 0.03 | 0.03 | NS | NS | 0.08 | NS |
| *Crop Management Practices* | | | | | | | | | | | | | | | | | |
| OF | 38.27 | 34.10 | 2.77 | 8.26 | 0.85 | 68.93 | 2.45 | 13.78 | 19.23 | 1.23 | 0.61 | 0.46 | 0.25 | 0.49 | 0.82 | 0.52 | 0.19 |
| NF | 29.05 | 18.95 | 1.64 | 7.91 | 0.79 | 45.00 | 1.14 | 7.56 | 13.80 | 1.00 | 0.63 | 0.36 | 0.17 | 0.43 | 0.66 | 0.39 | 0.16 |
| ICM | 57.45 | 85.21 | 7.15 | 9.83 | 1.00 | 129.40 | 6.56 | 18.09 | 36.90 | 1.26 | 0.79 | 0.76 | 0.41 | 0.71 | 1.03 | 0.68 | 0.25 |
| Sem± | 1.34 | 3.12 | 0.17 | 0.30 | 0.04 | 4.88 | 0.09 | 0.63 | 1.33 | 0.03 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.03 | 0.02 |
| CD at 5% | 4.14 | 9.62 | 0.53 | 0.92 | 0.12 | 15.05 | 0.29 | 1.94 | 4.10 | 0.10 | 0.07 | 0.02 | 0.03 | 0.07 | 0.04 | 0.08 | 0.06 |

**Table 2 :** Interaction effect between maize varieties and crop management practices on growth, yield and nutrient content parameters

| Treatment combinations | Plant height plant$^{-1}$ (cm) | Fresh weight plant$^{-1}$ (g) | Dry weight plant$^{-1}$ (g) | Green leaves plant$^{-1}$ | Cobs plant$^{-1}$ | Grains cob$^{-1}$ | Grain yield (q ha$^{-1}$) | Stover yield (q ha$^{-1}$) | Harvest index | N content (%) | | P content (%) | | K content (%) | | S content (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Grain | Stover | Grain | Stover | Grain | Stover | Grain | Stover |
| M1OF | 39.47 | 40.83 | 2.94 | 7.56 | 0.78 | 57.87 | 2.00 | 16.46 | 12.22 | 1.21 | 0.64 | 0.86 | 3.85 | 0.43 | 0.77 | 0.49 | 0.16 |
| M1NF | 29.35 | 18.89 | 1.33 | 7.44 | 0.78 | 32.60 | 0.33 | 6.48 | 4.91 | 1.03 | 0.62 | 0.11 | 0.99 | 0.39 | 0.65 | 0.34 | 0.13 |
| M1ICM | 55.71 | 57.65 | 5.91 | 8.75 | 0.98 | 98.87 | 3.70 | 18.75 | 20.12 | 1.19 | 0.79 | 2.55 | 6.26 | 0.59 | 0.95 | 0.57 | 0.23 |
| M2OF | 37.06 | 27.36 | 2.61 | 8.96 | 0.93 | 80.00 | 2.90 | 11.10 | 26.24 | 1.26 | 0.58 | 1.39 | 2.97 | 0.56 | 0.86 | 0.55 | 0.21 |
| M2NF | 28.76 | 19.02 | 1.96 | 8.38 | 0.80 | 57.40 | 1.96 | 8.64 | 22.68 | 0.98 | 0.63 | 0.74 | 1.70 | 0.48 | 0.68 | 0.44 | 0.18 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M2ICM | 59.20 | 112.77 | 8.39 | 10.91 | 1.03 | 159.93 | 9.42 | 17.42 | 53.67 | 1.33 | 0.80 | 7.55 | 8.27 | 0.82 | 1.12 | 0.78 | 0.27 |
| *SEm±* | 1.90 | 4.42 | 0.24 | 0.42 | 0.06 | 6.91 | 0.13 | 0.89 | 1.88 | 0.05 | 0.03 | 0.12 | 0.26 | 0.03 | 0.02 | 0.04 | 0.03 |
| *CD at 5%* | NS | 13.61 | 0.75 | NS | NS | 21.29 | 0.41 | 2.75 | 5.80 | NS | NS | 0.36 | 0.79 | NS | 0.05 | NS | NS |

**Table 3.** Effect of crop management practices on nutrient uptake and protein content of rabi maize

| | N uptake (kg ha$^{-1}$) | | | Phosphorus uptake (kg ha$^{-1}$) | | | Potassium uptake (kg ha$^{-1}$) | | | Sulphur uptake (kg ha$^{-1}$) | | | Protein content (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grain | Straw | Total | Grain | Stover | Total | Grain | Stover | Total | Grain | Stover | Total | |
| *Variety* | | | | | | | | | | | | | |
| M1 | 2.37 | 9.75 | 12.13 | 1.17 | 3.70 | 4.87 | 1.06 | 11.53 | 12.59 | 1.08 | 2.55 | 3.63 | 7.13 |
| M2 | 5.97 | 8.69 | 14.58 | 3.23 | 4.31 | 7.54 | 3.54 | 11.68 | 15.21 | 3.26 | 2.72 | 5.99 | 7.29 |
| Sem± | 0.09 | 0.62 | 0.72 | 0.03 | 0.07 | 0.08 | 0.05 | 0.66 | 0.65 | 0.07 | 0.09 | 0.12 | 0.05 |
| CD at 5% | 0.42 | NS | NS | 0.14 | 0.32 | 0.37 | 0.23 | NS | NS | 0.32 | NS | 0.52 | NS |
| *Crop Management Practices* | | | | | | | | | | | | | |
| OF | 2.90 | 8.51 | 11.41 | 1.12 | 3.41 | 4.53 | 1.39 | 11.10 | 12.48 | 1.30 | 2.34 | 3.63 | 7.47 |
| NF | 1.13 | 4.73 | 5.85 | 0.42 | 1.34 | 1.76 | 0.54 | 5.02 | 5.55 | 0.49 | 0.93 | 1.42 | 6.27 |
| ICM | 8.49 | 14.43 | 22.80 | 5.05 | 7.27 | 12.32 | 4.96 | 18.71 | 23.67 | 4.73 | 4.65 | 9.38 | 7.89 |
| Sem± | 0.15 | 0.68 | 0.72 | 0.08 | 0.18 | 0.16 | 0.10 | 0.70 | 0.66 | 0.12 | 0.26 | 0.25 | 0.17 |
| CD at 5% | 0.45 | 2.09 | 2.22 | 0.26 | 0.56 | 0.50 | 0.31 | 2.15 | 2.04 | 0.37 | 0.81 | 0.78 | 0.52 |

**Table 4 :** Interaction effect between maize varieties and crop management practices on nutrient uptake and protein content.

| Treatment combinations | Nitrogen uptake (kg ha$^{-1}$) | | | Phosphorus uptake (kg ha$^{-1}$) | | | Potassium uptake (kg ha$^{-1}$) | | | Sulphur uptake (kg ha$^{-1}$) | | | Protein content (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grain | Straw | Total | Grain | Stover | Total | Grain | Stover | Total | Grain | Stover | Total | |
| M1OF | 2.39 | 10.63 | 13.02 | 0.86 | 3.85 | 4.71 | 0.85 | 12.70 | 13.55 | 0.99 | 2.54 | 3.53 | 7.53 |
| M1NF | 0.34 | 3.97 | 4.31 | 0.11 | 0.99 | 1.10 | 0.12 | 4.20 | 4.31 | 0.11 | 0.67 | 0.79 | 6.42 |
| M1ICM | 4.40 | 14.66 | 19.06 | 2.55 | 6.26 | 8.82 | 2.19 | 17.70 | 19.89 | 2.13 | 4.44 | 6.58 | 7.44 |
| M2OF | 3.42 | 6.39 | 9.81 | 1.39 | 2.97 | 4.36 | 1.92 | 9.50 | 11.40 | 1.60 | 2.13 | 3.73 | 7.41 |
| M2NF | 1.91 | 5.48 | 7.39 | 0.74 | 1.70 | 2.43 | 0.96 | 5.83 | 6.79 | 0.86 | 1.19 | 2.05 | 6.12 |
| M2ICM | 12.58 | 14.20 | 26.53 | 7.55 | 8.27 | 15.82 | 7.73 | 19.72 | 27.44 | 7.33 | 4.85 | 12.18 | 8.34 |
| *SEm±* | 0.21 | 0.96 | 1.02 | 0.12 | 0.26 | 0.23 | 0.14 | 0.98 | 0.94 | 0.17 | 0.37 | 0.36 | 0.24 |
| *CD at 5%* | 0.63 | 2.96 | 3.14 | 0.36 | 0.79 | 0.70 | 0.44 | NS | 2.89 | 0.52 | 1.15 | 1.10 | NS |

**Table 5 :** Effect of crop management practices on the post-harvest soil properties

| | pH | EC (dSm$^{-1}$) | Bulk Density (g cm$^{-3}$) | Particle Density (g cm$^{-3}$) | Porosity (%) | Water holding capacity (%) | OC (g kg$^{-1}$) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) | S (kg ha$^{-1}$) | Ca (cmol (p$^{+}$) kg$^{-1}$) | Mg (cmol (p$^{+}$) kg$^{-1}$) | E. acidity (cmol (p$^{+}$) kg$^{-1}$) | E. Al$^{+3}$ (cmol (p$^{+}$) kg$^{-1}$) | E. H$^{+3}$ (cmol (p$^{+}$) kg$^{-1}$) | Total Potential acidity cmol (p$^{+}$) kg$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Variety* | | | | | | | | | | | | | | | | | |
| M1 | 4.49 | 0.09 | 1.03 | 2.43 | 56.44 | 33.69 | 11.80 | 240.29 | 20.67 | 146.24 | 25.02 | 2.17 | 0.67 | 4.03 | 1.10 | 2.86 | 13.33 |
| M2 | 4.54 | 0.09 | 1.02 | 2.49 | 53.48 | 34.41 | 12.30 | 244.47 | 21.61 | 151.59 | 24.63 | 2.15 | 0.70 | 3.89 | 1.11 | 2.77 | 15.89 |
| Sem± | 0.03 | 0.01 | 0.02 | 0.05 | 3.33 | 0.16 | 0.15 | 5.26 | 0.30 | 1.07 | 0.45 | 0.13 | 0.04 | 0.12 | 0.01 | 0.09 | 0.54 |
| CD at 5% | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| *Crop Management Practices* | | | | | | | | | | | | | | | | | |
| OF | 4.49 | 0.09 | 1.03 | 2.43 | 58.53 | 34.02 | 11.65 | 245.86 | 21.43 | 148.96 | 24.51 | 2.20 | 0.60 | 3.55 | 0.95 | 2.60 | 14.52 |
| NF | 4.60 | 0.08 | 1.02 | 2.56 | 49.87 | 34.06 | 10.73 | 214.50 | 18.74 | 128.64 | 18.42 | 1.80 | 0.53 | 3.96 | 1.00 | 2.84 | 14.80 |
| ICM | 4.44 | 0.10 | 1.03 | 2.40 | 56.50 | 34.07 | 13.78 | 266.77 | 23.26 | 169.14 | 31.56 | 2.48 | 0.93 | 4.38 | 1.37 | 3.01 | 14.51 |
| Sem± | 0.05 | 0.01 | 0.02 | 0.04 | 3.79 | 0.30 | 0.29 | 6.04 | 0.34 | 1.85 | 0.44 | 0.07 | 0.07 | 0.13 | 0.06 | 0.15 | 0.41 |
| CD at 5% | NS | NS | NS | NS | NS | NS | 0.91 | 18.60 | 1.05 | 5.70 | 1.35 | 0.21 | 0.22 | 0.40 | 0.19 | NS | NS |

**Table 6 :** Interaction effect between maize varieties and crop management practices on post-harvest soil properties

| Treat-ment | pH | EC ($dSm^{-1}$) | Bulk Density ($g\ cm^{-3}$) | Particle Density ($g\ cm^{-3}$) | Porosity (%) | Water holding capacity (%) | OC ($g\ kg^{-1}$) | N ($kg\ ha^{-1}$) | P ($kg\ ha^{-1}$) | K ($kg\ ha^{-1}$) | S ($kg\ ha^{-1}$) | Ca (cmol ($p^+$) $kg^{-1}$) | Mg (cmol ($p^+$) $kg^{-1}$) | E. acidity (cmol ($p^+$) $kg^{-1}$) | E. $Al^{+3}$ (cmol ($p^+$) $kg^{-1}$) | E. $H^{+3}$ (cmol ($p^+$) $kg^{-1}$) | Total Potential acidity (cmol ($p^+$) $kg^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M1OF | 4.47 | 0.09 | 1.01 | 2.41 | 56.84 | 33.96 | 10.80 | 241.68 | 22.26 | 148.70 | 25.54 | 2.30 | 0.55 | 3.34 | 1.00 | 2.34 | 13.01 |
| M1NF | 4.60 | 0.09 | 1.04 | 2.59 | 58.03 | 33.35 | 10.05 | 216.59 | 18.15 | 121.42 | 18.39 | 1.80 | 0.55 | 4.17 | 1.03 | 2.93 | 13.21 |
| M1ICM | 4.40 | 0.10 | 1.04 | 2.31 | 54.47 | 33.76 | 14.55 | 262.59 | 21.59 | 168.59 | 31.14 | 2.40 | 0.90 | 4.59 | 1.27 | 3.32 | 13.77 |
| M2OF | 4.51 | 0.09 | 1.06 | 2.46 | 60.21 | 34.09 | 12.50 | 250.04 | 20.59 | 149.21 | 23.48 | 2.10 | 0.65 | 3.75 | 0.90 | 2.85 | 16.04 |
| M2NF | 4.61 | 0.07 | 1.00 | 2.52 | 41.71 | 34.77 | 11.40 | 212.41 | 19.32 | 135.86 | 18.45 | 1.80 | 0.50 | 3.75 | 0.97 | 2.75 | 16.39 |
| M2ICM | 4.49 | 0.10 | 1.01 | 2.50 | 58.52 | 34.37 | 13.00 | 270.95 | 24.92 | 169.69 | 31.97 | 2.55 | 0.95 | 4.17 | 1.47 | 2.70 | 15.24 |
| *SEm±* | 0.08 | 0.01 | 0.02 | 0.06 | 5.35 | 0.42 | 0.42 | 8.53 | 0.48 | 2.62 | 0.62 | 0.07 | 0.1 | 0.19 | 0.09 | 0.21 | 0.58 |
| *CD at 5%* | NS | NS | 0.07 | 0.17 | NS | NS | 1.28 | 26.30 | 1.49 | 8.06 | NS | NS | NS | NS | NS | NS | NS |

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## Conflict of interest

Authors have no conflict of interest to declare.

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