Original Research Article

Influence of magnesium in combination with organics on the yield and uptake of nutrients by cotton (*Gossypium hirustum* L.) crop in *Typic Ustropept*

ABSTRACT

A field experiment was conducted to evaluate the effects of mangesium and organic manures on yield and nutrient uptake of cotton (*Gossypium hirustum* L.) between Aug 2109 and Feb 2020 in a farmer's field located at Achchandavilthan village of Srivillipudhur block, Virudhunager district, Tamil nadu. This experiment comprised of fifteen treatment with three replication involving magnesium in combination with organics, The results revealed that the application of $MgSO_4$ @ 50 kg ha^{-1} along with 250 kg vermicompost for 30 days (1:5 ratio) at critical stages of crop growth along with the STCR based N,P_2O_5 and K_2O registered maximum nutrient uptake of major nutrients N (14.25, 23.60 and 43.50 kg ha^{-1}), P (6.25,7.80 and 10.34 kg ha^{-1}), K (20.35, 34.50 and 47.45 kg ha^{-1}) 40,70 DAS and harvest stage, secondary nutrient Ca (20.54, 33.21 and 69.21 kg ha^{-1}), Mg (4.65, 5.75 and 10.50 kg ha^{-1}) 40, 70 DAS and harvest stage and micro nutrient Fe (1185.6, 1975.6 and 4865.2 325.80g ha^{-1}), Mn (380.5, 530.2 and 792.3 325.80), Zn (90.65, 155.72 and 325.60 325.80), and Cu (90.62, 155.70 and 325.80 325.80) 40, 70 DAS and harvest stage of crop growth.

Key word: Cotton, FYM, Vermicompost, uptake

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1. INTRODUCTION

Magnesium (Mg) is the eighth most abundant element in the earth's crust, as well as the second most common cation in plants. It is a common element in many minerals; however, because to the slow weathering and releasing process, roughly 90–98% of Mg is integrated in the crystal lattice structure of minerals and hence not immediately available for plant absorption (Senbayram *et al.,* 2015). Plants absorb a smaller amount of Mg from the soil solution generated by soil minerals, therefore extra dose must be obtained from outside sources, such as fertilizers to meet the crop's nutritional requirements. Because Mg is a mobile nutrient in soil, Mg fertilizers, especially the soluble form of sulphate fertilizers, are easily leached off. Mg insufficiency is prevalent in crops, not only owing to leaching losses of Mg nutrient from the soil, but also due to antagonistic interactions of Mg with H^{+}, $Al^{3+,}$ NH^{4+}, and Mn^{2+} in acid soil (pH 7.0), Ca^{2+} and Na^{+} in alkaline soil (pH > 7.0), and K^{+} in high potassium (K) containing soil (Sankaranarayanan *et al.,* 2010) Despite the fact that 'Mg,' a secondary plant nutrient, is the only mineral in the central atom of chlorophyll and a mobile nutrient in plants, older leaves of Mg deficient plants show interveinal chlorosis, or chlorophyll breakdown between the veins.

Cotton, sometimes known as the "King of Fibre," is a key cash crop in India and one of the crops with a high Mg demand. It is also extremely sensitive to the Mg nutrient, which aids in their growth and development. Apart from the most important functions of Mg, which include photo phosphorylation (such as ATP formation in chloroplasts), enzyme activation [Ribulose-1,5-bisphosphate (RuBP) carboxylase involved in photosynthesis], photosynthetic carbon dioxide (CO_2) fixation, protein synthesis, chlorophyll formation, phloem loading, partitioning, and utilisation of photo assimilates, generation of reactive oxygen species, and photo oxidation in leaf (Cakmak and Kirkby 2007). Cotton is often cultivated on heavy clay soils with a high pH (>7.0), where Mg uptake is restricted due to increased calcium buildup and their antagonistic interaction effect (Fageria, 2001). Foliar feeding is an efficient approach to raise Mg content in different regions of the plant and boost yield when compared to soil application of Mg nutrients, and comparable results have been found in cotton by Mobarak et al., (2013) and Singh, Rathore, and Gumber (2015). However, there is a scarcity of studies on the usefulness of Mg in combination with organic manures on Mg-responsive crops such as cotton. Therefore, the present study was carried out to evaluate the effect of magnesium inconjoint with organic manures on the yield and uptake of nutrient by the cotton crop.

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2. MATERIALS AND METHOD

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2.1. Description of the study area

The experiment was conducted during kharif season (Aug-2019 to Feb 2020) in a farmer field at Achchandavilthan village, Srivillipudhur block, Virudhunagar district, Tamil nadu. The farm is located at 9.51'92'' North Latitude and 77.66'74" East Longitude. The soils of the experimental site was clay loam with soil pH (8.4), EC (0.32 dS m^{-1}) and OC (3.94 g kg^{-1}). The soil was low in available nitrogen (218.0 kg ha^{-1}), medium in available phosphorus (14.3 kg ha^{-1}) and medium in available potassium (356.0 kg ha^{-1}).

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2.2. Enrichment of organics fortified with Mg

The organic sources employed in the incubation of Mg are vermicompost and farmyard manure. The enrichment process include $MgSO_4$ @ 50 kg ha^{-1} incubated with 250 kg vermicompost for 30 days (1:5 ratio), $MgSO_4$ @ 50 kg ha^{-1} incubated with 500 kg FYM for 30 days (1:10 ratio), $MgSO_4$ @ 37.5 kg ha^{-1} incubated with 375 kg FYM for 30 days (1:10 ratio), $MgSO_4$ @ 25 kg ha^{-1} incubated with 250 kg FYM for 30 days (1:10 ratio), $MgSO_4$ @ 37.5 kg ha^{-1} incubated with 187.5 kg vermicompost for 30 days (1:5 ratio), $MgSO_4$ @ 25 kg ha^{-1} incubated with 125 kg vermicompost for 30 days (1:5 ratio).

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2.3. Experimental Design and Treatments

The field experiment was conducted in randomized block design with fifteen treatments and three replications, with a plot size 5 m x 4 m. The details of treatments are T_1 - Recommended N, P_2O_5 and K_2O @ 80:40:40 kg ha^{-1}, T_2 - N, P_2O_5 and K_2O on STCR basis, T_3 - T_2 + Basal application of $MgSO_4$ @ 37.5 kg ha^{-1}, T_4 - T_2 + $MgSO_4$ @ 37.5 kg ha^{-1} incubated with 375 kg FYM, T_5 - T_2 +$MgSO_4$ @ 25 kg ha^{-1} incubated with 250 kg FYM, T_6 - T_2+ $MgSO_4$ @ 37.5 kg ha^{-1} incubated with 187.5 kg vermicompost, T_7 - T_2 + $MgSO_4$ @ 25 kg ha^{-1} incubated with 125 kg vermicompost, T_8 - T_2 + Basal application of MgSO4 @ 50 kg ha^{-}1, T_9 - T_2 + $MgSO_4$ @ 50 kg ha^{-1} incubated with 500 kg FYM, T_{10} - T_2 + $MgSO_4$ @ 50 kg ha^{-1} incubated with 250 kg Vermicompost,T_{11} - T_2 + Foliar application of $MgSO_4$ @ 1 % on 20, 40, 60 DAS T_{12} - T_3 + Foliar application of

$MgSO_4$ @ 1 % on 20, 40,60 DAS T_{13} - T_8 + Foliar application of $MgSO_4$ @ 1 % on 20, 40,60 DAS, T_{14} - T_2 + Basal application of EDTA @ 2 kg ha^{-1} T_{15} - T_2 + Foliar application of Mg EDTA @0.5%on 20 40 60 DAS. The data was analysed with the help of a window-based computer package OPSTAT to calculate standard error of means SE(m), standard error of difference in mean SE(d), and critical difference between treatments mean CD.

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3. RESULTS AND DISCUSSION

3.1. Effect of magnesium and fortified organic nutrients on seed yield cotton

Incubated of magnesium with vermicompost showed a significant impact on the number of bolls $plant^{-1}$, boll weight (g), seed cotton yield. among the various treatment combination application of $MgSO_4$@ 50 kg ha^{-1} incubated with 250 kg vermicompost for 30 days (1:5 ratio) along with STCR based N, P_2O_5 and K_2O at was found to be effective in increasing seed cotton yield (26.2 q ha^{-1}), followed by $MgSO_4$ @ 50 kg ha^{-1} incubated with 500 kg FYM for 30 days (1:10 ratio) along with STCR based N, P_2O_5 and K_2O. The treatment T_{14}, T_4, T_5, T_6 statically on par with each other. The lowest seed cotton yield (17.5 q ha^{-1}) was recorded in the RDF treatment receiving (T_1).

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The influence of various nutrient management systems on seed cotton output is significant. When 100 percent RDF was combined with vermicompost, the seed cotton produced the maximum. This might be related to the cotton crop's mineralization and slow nutrient release, which results in improved nutrient absorption and increased seed cotton output when grown on vermicompost observed by Mohadeseh *et al.,* (2015).

Because of the delayed mineralization of nitrogen in vermicompost, it assists in the availability of nutrients to plants throughout their growth cycle, resulting in higher yields. Vermicompost promotes soil microbial activity, oxygen availability, soil temperature, soil porosity and water penetration, nutrient content, and plant development, yield, and quality (Arora *et al.,* 2011).

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The catalytic involvement of magnesium in various enzymatic pathways might explain the much greater seed cotton production in combination treatments of MgSO4 with organic manures. In the presence of organics, magnesium's positive impact was shown to be greater. Organics, on the other hand, improved the physical, chemical, and biological qualities of the soil as well as the delivery of nutrients throughout the crop's growth, resulting in better seed cotton yield in all organic treatments than in the other treatments. The usage of organic manures such as FYM boosts microbial activity, which aids in the transformation of nutrients and makes them more accessible to plants. Similar results were reported by Tayade *et al.,*(2011).

3.2. Effect of magnesium and fortified organic nutrients on nutrient uptake

Nitrogen uptake

The results showed that a significant influence of Mg with organic manures on N uptake. The N uptake was significantly higher while incorporating $MgSO_4$ in combination with organic manures along with N, P_2O_5 and K_2O on STCR basis in all the three growth stages of cotton crop. The N uptake ranged from 5.95 to 14.25 kg ha^{-1} at flowering stage, 9.35 to 23.60 kg ha^{-1} boll development and 20.24 to 43.50 kg ha^{-1} at harvest stages. The highest N uptake was recorded in the treatment T_{10} ($MgSO_4$ @ 50 kg ha^{-1} incubated with 250 kg vermicompost along with N, P_2O_5 and K_2O on STCR basis) with the values 14.25, 23.60, 43.50, at 40,70 DAS and at harvest stages respectively. Followed by the treatment $T_{9.}$ The treatment T_{14} which was statistically at par with T_4, T_5, T_6. The lowest uptake at 40 DAS (5.95 kg ha^{-1}), 70 DAS (9.35 kg ha^{-1}) and at harvest stage (20.24 kg ha^{-1}) were recorded in the treatment applied with recommended N, P_2O_5 and K_2O (T_1).

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Magnesium has a strong favourable effect on N uptake, which might be owing to its function in enzymatic process activation and increased N usage by plants (Marschner, 2011). Treatments that received organics exhibited higher nitrogen absorption than the other treatments. This might be due to integrated management of organic and inorganic sources, which would have generated a favourable effect in the

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rhiosphere, resulting in higher nitrogen content in cotton leaf (Nawlakhe and Mankar 2011).

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P uptake

The P uptake ranged from 1.19 to 6.25 kg ha^{-1} at 40 DAS, 2.90 to 7.80 kg ha^{-1} 70 DAS and 5.45 to 10.34 kg ha^{-1} at harvest stages of cotton crop. The highest P uptake of 6.25, 7.80 and 10.34 kg ha^{-1} at 40, 70 DAS and harvest stage respectively were registered in the treatment receiving $MgSO_4$ @ 50 kg ha^{-1} incubated with 250 kg vermicompost for 30 days (1:5 ratio) along with N, P_2O_5 and K_2O on STCR basis (T_{10}), followed by the treatment receiving $MgSO_4$ @ 50 kg ha^{-1} incubated with 500 kg FYM for 30 days (1:10 ratio) along with N, P_2O_5 and K_2O on STCR basis (T_9). The lowest P uptake of 1.19, 2.90 and 5.45 kg ha^{-1} at 40, 70 DAS and at harvest stage respectively were registered in the treatment T_1 (RDF alone).

Generally when the phosphorous (SSP) is applied to the alkaline soil, it reacts with $CaCO_3$ and form $Ca_3(PO_4)_2$ which is a sparingly soluble complex and the availability of P gets reduced in the rhizosphere. Due to the addition of $MgSO_4$ with organics or in synthetic chelated form, the organic acids released during the decomposition of organics might have been ionized and the organic anions formed during this reaction would have chelated the P and released to the labile pool and favoured for increased uptake .Such a positive effect of organic manures on P uptake was reported by several researchers (Pathak *et al.,* 2005; Thenmozhi and Paulraj, 2009).

K uptake

As observed in N and P uptakes, the uptake of potassium by cotton crop was also significantly influenced due to the applied treatments. Similar to N and P uptake, the treatment which had received $MgSO_4$ incubated with vermicompost along with N, P_2O_5 and K_2O on STCR basis registered significantly higher K uptake than other treatments. With regard to the K uptake of cotton grown in the soil, it varied from 12.15 to 20.35, 18.35 to 34.50 and 28.15 to 47.45 kg ha-1 at 40, 70 DAS and at harvest stages respectively. Among the various treatments imposed, the highest K uptake were

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recorded in the treatment T_{10} ($MgSO_4$ incubated with vermicompost along with N, P_2O_5 and K_2O on STCR basis) at all the three stages of crop growth. At all the three stages, the lowest K uptake (12.15, 18.35 and 28.15kg ha^{-1}) was noticed in T_1 which was fertilized with recommended dose of fertilizer alone.

Application of $MgSO_4$ with N, P_2O5 and K_2O on STCR basis registered decreased uptake of K than applying $MgSO_4$ along with organic manures and N, P_2O_5 and K_2O on STCR basis. This might be due to the competition between Mg and K in the absorption zone. Such an antagonistic effect of Mg on K was already reported by Ding (2006).

Increased uptake of K was noticed by the application of $MgSO_4$ along with organic manures which might be due to release of potassium from applied organic manures during decomposition and solubilisation and release of native and fixed forms of potassium, charging the soil solution with K^+ ions. The increase in uptake of K may be ascribed to split application of potassic fertilizers and the role of organics in increasing the use efficiency of applied K (Mahavishnan *et al*., 2007). Similarly, Adeniyan *et al.* (2011) reported that leaching of K was higher in the soil treated with the K fertilizer than with organic manures. The vermicompost performed better over FYM owing to its narrow C: N ratio and faster mineralization.

Calcium uptake

The effect of magnesium along with organic manures on Ca uptake by cotton at all the three stages of crop growth is presented in table. Among the treatments, T_{10} which received with $MgSO_4$ @ 50 kg ha^{-1} incubated with 250 kg vermicompost for 30 days (1:5 ratio) along with N, P_2O_5 and K_2O on STCR basis recorded the maximum Ca uptake of 20.54, 33.21 and 69.21 Kg ha^{-1}, followed by it, the treatment receiving $MgSO_4$ @ 50 kg ha^{-1} incubated with 500 kg FYM for 30 days (1:10 ratio) along with N, P_2O_5 and K_2O on STCR basis(T9) was found to be the best performing, However, the lowest Ca uptake of 12.35, 14.22, and 43.25 kg ha^{-1} at all the three stages of crop growth were recorded in the crop T_1 (RDF alone).

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Significant influence of treatments on Ca uptake by cotton crop was recorded at 30 DAS, 60 DAS and at harvest stages. This may due to the narrow C: N ratio of vermicompost which would have released the nutrients to the labile pool easily. These results are in conformity with the findings of Ghosh *et al.* (2014).

Magnesium uptake

The data pertaining to the Mg uptake of cotton grown in the soils was depicted in the Table. The Mg uptake ranged from 1.70 to 4.65, 2.05 to 5.75 and 5.23 to 10.50 kg ha^{-1}at 40,70 DAS and at harvest stage respectively. The maximum Mg uptake of 4.65, 5.75 and 10.50 kg ha^{-1} at 40,70 DAS and at harvest stage respectively were found in the treatment T_{10} which was applied with $MgSO_4$ @ 50 kg ha^{-1} incubated with 250 kg vermicompost for 30 days (1:5 ratio) along with N, P_2O_5 and K_2O on STCR basis. However, the minimum Mg uptake at all the three stages of crop growth (1.70, 2.05 and 5.23 kg ha^{-1} were recorded in the treatment T_1 (RDF alone). In calcareous soil, the Mg reacts with CO_3^{2-} and OH^- and form insoluble $MgCO_3$ and $Mg(OH)_2$. So that the availability of Mg to the labile pool get reduced. Application of $MgSO_4$ along with organic nutrient have released the organic acid and the organic anions which are formed during the decomposition of organic manures might have make coordinate bond with Mg supplied as $MgSO_4$ and the fixation of Mg as $MgCO_3$ and $Mg(OH)_2$ would have been reduced and the availability of Mg to the labile pool got increased and easily available to the plants. Such an increase in uptake of Mg with the conjoint incorporation of N, P_2O_5 and K_2O with FYM was already reported by Mohana Rao *et al.* (2012).

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Fe, Cu, Zn and Mn uptake

A close examination of the data pertaining to the micronutrient uptake of showed that application of Mg had a significant influence on uptake of Fe, Mn, Zn and Cu by the cotton crop. Among the various treatments, the treatment which had received $MgSO_4$ @ 50 kg ha^{-1} incubated with 250 kg vermicompost for 30 days (1:5 ratio) along with N, P_2O_5 and K_2O on STCR basis registered the highest Fe (1185.6, 1975.6 and 4865.2 g ha^{-1}), Mn (380.5, 530.2 and 792.3 g ha^{-1}), Zn (90.65, 155.72 and 325.60 g ha^{-1}) and Cu (90.62, 155.70 and 325.80 g ha^{-1}) uptakes at 40 DAS,70 DAS and harvesting stages of

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crop. Followed by the treatment receiving $MgSO_4$ @ 50 kg ha^{-1} incubated with 500 kg FYM for 30 days (1:10 ratio) along with N, P_2O_5 and K_2O on basis (T_9). The lowest micro nutrient uptake was registered in T_1 (RDF alone)

The uptake being the product of content and dry matter production, the increase in micronutrient uptake by the crop might be due to more availability and absorption of from the soil when applied along Mg with organics. The present findings are in conformity with the findings of Das *et al.* (2004) and Yadav *et al*. (2011).

Similarly application of vermicompost significantly increased the uptake Fe, Mn, Zn and Cu by the crop. Higher uptake of micronutrients by combined addition of Mg and organics might be due to the release of micronutrients on mineralization organics upon decomposition, which aids in solubilization of insoluble micronutrient compounds in soil or due to supply of natural chelating agents, which renders them more available. The chelating action of released organic compounds prevent the micronutrient cations from fixation, precipitation, oxidation and leaching and increase their availability and uptake by plants. This is in accordance with results of Devarajan *et al*. (1980) and Gogoi *et al*. (2010).

5. CONCLUSION

The results clearly showed that application of magnesium along with organic manures especially vermicompost followed by FYM can be recommended for cotton cultivation in at Virudhunagar district due to the highest nutrient uptake observed while applying of $MgSO_4$ @ 50 kg ha^{-1} incubated with 250 kg vermicompost for 30 days (1:5 ratio) along with N, P_2O_5 and K_2O on STCR basis.

Comment [K26]: Try to present the results in the conclusion in a way of synthesis

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Table: 1 Effect of magnesium inconjoint with organic manures on major nutrient uptake (kg ha^{-1}) different stages of crop growth in soil

Treatment	Nitrogen			Phosphorus			Potassium		
	40 DAS	70DAS	HS	40 DAS	70DAS	HS	40 DAS	70DAS	HS
T_1	5.95	9.35	20.24	1.19	2.90	5.45	12.15	18.35	28.15
T_2	8.05	14.25	30.35	2.25	3.20	6.05	16.25	22.20	30.32
T_3	9.12	17.30	32.13	3.02	3.60	7.54	17.80	24.25	32.30
T_4	12.55	22.05	40.12	5.70	6.65	9.05	18.50	31.52	43.30
T_5	12.13	21.55	39.25	5.20	6.18	8.35	18.10	31.12	42.70
T_6	12.20	21.86	3975	5.45	6.40	8.70	18.35	31.30	43.05
T_7	11.60	20.84	37.64	4.90	5.80	8.00	17.35	29.80	40.75
T_8	11.07	20.20	37.15	4.65	5.36	7.65	16.63	28.50	38.80
T_9	13.50	22.90	42.02	6.10	7.25	9.90	19.56	33.18	45.50
T_{10}	14.25	23.60	43.50	6.25	7.80	10.34	20.35	34.50	47.45
T_{11}	10.16	19.02	35.18	3.38	4.15	6.75	16.02	26.86	36.20
T_{12}	10.34	19.24	35.40	3.55	4.50	7.05	16.14	27.06	36.55
T_{13}	10.55	19.50	35.65	3.80	4.90	7.35	16.30	27.18	36.90
T_{14}	12.74	22.22	40.50	5.90	6.90	9.42	18.80	31.75	43.56
T_{15}	9.60	18.30	33.70	3.12	3.83	6.35	15.30	25.50	34.25
SEd±	**0.25**	**0.32**	**0.70**	**0.06**	**0.08**	**0.15**	**0.33**	**0.62**	**0.88**
CD(P=0.05)	**0.52**	**0.67**	**1.45**	**0.15**	**0.19**	**0.34**	**0.70**	**1.30**	**1.90**

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Table: 2 Effect of magnesium inconjoint with organic manures on secondary nutrient uptake (kg ha^{-1}) different stages of crop growth in soil

Treatment	Calcium uptake			Magnesium uptake		
	40 DAS	70DAS	HS	40 DAS	70DAS	HS
T_1	12.35	14.22	43.25	1.70	2.05	5.23
T_2	14.90	18.61	48.31	1.90	2.40	6.10
T_3	15.55	22.10	50.45	2.03	2.85	6.30
T_4	18.40	23.15	62.65	3.70	4.60	8.95
T_5	18.02	29.80	61.82	3.30	4.20	8.82
T_6	18.16	30.05	62.05	3.50	4.40	8.90
T_7	17.22	28.50	59.60	3.10	4.02	8.38
T_8	16.42	27.18	57.40	2.90	3.85	8.05
T_9	19.51	31.90	65.35	4.10	5.20	9.42
T_{10}	20.54	33.21	69.21	4.65	5.75	10.50
T_{11}	15.21	25.05	54.85	2.35	3.25	7.07
T_{12}	15.35	25.45	55.10	2.52	3.45	7.40
T_{13}	15.60	25.80	55.30	2.70	3.65	7.65
T_{14}	18.65	30.60	63.10	3.90	4.82	9.05
T_{15}	16.42	24.35	52.70	2.20	3.03	6.75
SEd±	**0.37**	**0.63**	**1.07**	**0.07**	**0.08**	**0.15**
CD(P=0.05)	**0.77**	**1.30**	**2.21**	**0.15**	**0.17**	**0.32**

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Table:3 Effect of magnesium inconjoint with organic manures on micro nutrient uptake (g ha^{-1}) different stages of crop growth in soil

Treatment	Iron uptake			Manganese uptake			Zinc uptake			copper uptake		
	40 DAS	70DAS	HS	40 DAS	70DAS	HS	40 DAS	70DAS	HS	40 DAS	70DAS	HS
T_1	635.2	985.5	3672.5	140.5	203.5	384.2	35.10	46.82	102.31	36.58	36.56	101.35
T_2	818.5	1132.6	4087.3	183.2	260.4	428.5	52.40	72.36	153.48	52.85	73.45	150.52
T_3	845.0	1225.3	4279.5	188.6	284.2	473.1	60.15	92.45	157.50	57.72	91.50	194.65
T_4	1070.5	1725.3	4410.6	330.2	440.4	708.9	82.70	141.78	294.73	81.48	141.50	292.54
T_5	1052.4	1670.2	4314.8	306.5	404.1	657.4	79.80	139.20	288.50	78.42	138.45	288.10
T_6	1060.8	1690.5	4360.5	318.3	421.2	683.4	80.48	140.69	291.25	80.62	139.52	290.25
T_7	1015.5	1589.7	4463.5	285.4	385.5	631.2	76.18	133.25	266.43	74.70	136.74	275.50
T_8	975.5	1510.8	4425.7	260.3	367.2	605.8	72.50	127.35	270.18	71.56	134.71	264.35
T_9	1125.4	1850.4	4642.4	365.7	505.8	763.2	87.02	148.25	308.45	86.12	148.30	310.52
T_{10}	1185.6	1975.6	4865.2	380.5	530.2	792.3	90.65	155.72	325.60	90.62	155.70	325.80
T_{11}	925.3	1380.1	4358.1	216.5	312.1	525.4	66.12	120.70	248.18	78.45	130.40	247.45
T_{12}	930.1	1408.4	4387.2	225.4	330.4	552.5	67.64	121.26	252.40	64.64	131.62	250.75
T_{13}	938.6	1430.2	4409.3	240.3	348.4	578.1	69.00	121.45	255.20	66.35	133.30	252.40
T_{14}	1085.1	1752.6	4442.3	345.2	460.2	734.8	83.40	142.25	297.12	67.25	143.25	299.30
T_{15}	888.4	1300.4	4312.6	203.5	303.5	502.8	63.51	115.36	238.70	60.25	127.35	236.25
SEd±	**17.40**	**38.65**	**95.80**	**4.45**	**8.30**	**12.10**	**1.75**	**2.82**	**4.84**	**1.83**	**2.41**	**5.41**
CD(P=0.05)	**35.60**	**79.30**	**198.42**	**9.17**	**17.20**	**25.40**	**3.60**	**5.82**	**9.98**	**3.78**	**4.97**	**11.14**

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