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(Received : April 1998 ; Revised : September 2000)

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Madras Agric. J.. 87(1-3): 108 - 113 January - March 2000
https://doi.org/10.29321/MAJ.10.A00432

# Effects of organic amendments and zinc on the yield content and uptake of zinc by wheat and maize grown in succession

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**Abstract :** A green house experiment was conducted on a Zn deficient sandy soil, to study the effect of FYM (10 and 20 t/ha), wheat straw 5 and 10 t/ha and Zn levels (0, 12.5, 25.0 and 50.0 kg. Zinc sulphate / ha) on the yield, content and uptake of Zn by wheat (HDM-1553) and hybrid maize (ganga-5) grown in succession. Application of FYM and wheat straw increased the yields of both wheat and maize crops. The magnitude of increase in yield of wheat crop was more with FYM than with wheat straw. Higher level of wheat straw showed more increase in second crop of maize and indicated a residual effect. In absence of organic amendments, application of Zn increased the yield of both the crops. Application of organic amendments increased the content and uptake of Zn in wheat and maize crops. Application of FYM showed higher values of content and uptake of Zn in wheat and maize crops. Application of FYM showed higher values of content and uptake than wheat straw. Increased application in levels of Zn increased the content and uptake of Zn in both the crops. *(Key Words : Organic amendments, Zinc, Yield, Content, Uptake)*

Intensive agriculture, no doubt, has increased the production, but it has also given problems of exhaustion of soil fertility. Wide spread deficiency of Zn and response of crop to its application have been reported by several workers. There are problems of disposal of agricultural residues such as straw of wheat and paddy and stalks of bajra, jowar and maize. Reports on the effect of addition of organic matter on the availability of Zn are of variable nature. The availability of Zn has been found to decrease or increase depending on the type of organic material added to the soil (Duraiswamy et al., 1988). The availability of Zn, due to addition of organic matter was also affected by the type of soil (Shukla, 1971), kind and the quantity of organic matter added to the soil. Keeping these facts in

view, an experiment was conducted to study the effect of different levels of organic amendments and Zn on the yield, content and uptake of Zn by wheat and hybrid maize grown in succession.

## Materials and Methods

Bulk soil samples from a depth of 18 cm were collected from a field situated in the village Oran, Sabarkantha district of Gujarat. Pot culture experiment was carried out during the year 1992 in the glass house of Department of Soil Science, Anand. Three kg of Zn deficient sandy soil (Typic Torripsamment) was filled in each pot. The soil has pH 8.4. EC 0.25 $dSm^{-1}$. CEC 7.8 meq/100 g and Organic carbon 0.28 per cent. The sand, silt and clay contents were 89.7, 6.9 and 2.3 per cent respectively. The dithizone-ammonium acetate extractable Zn (0.29 ppm) was determined according to the procedure of shaw and Dean (1952). The soil was low in available nitrogen, potassium and medium in available phosphorus. All the soil properties were estimated by following the standard procedures. Two successive crops of wheat (variety HDM-1553) and maize (variety Ganga-5) were grown. The treatments included organic amendments viz., control, FYM @ 10 and 20 t/ha, wheat straw @ 5 and 10 t/ha and four levels of Zn (0, 12.5, 25.0, 50.0 kg $ZnSO_4$ per hectare) as $ZnSO_4$ 7H20. There were totally twenty treatment combinations replicated twice. Organic amendments were incorporated in the soil one month before sowing. The pots were maintained at field capacity throughout this period by regular addition of double distilled water. After one month the soil in the pots was air dried and sieved through plastic sieve and the required amount of nutrients were added. Nitrogen $P_2O_5$ and $K_2O$ were applied @ 120, 60 and 60 ppm through $(NH_4)SO_4$, $KH_2PO_4$ and $K_2SO_4$. Nitrogen was given in 3 splits. First 20 ppm was given at the time of incorporating organic amendments, second split of 40 ppm N was applied as basal does along with entire quantities of $P_2O_5$, $K_2O$ and Zn at the time of sowing. The remaining 60 ppm N was applied after 30 days from the date of sowing of wheat crop. Plants were harvested after complete maturity. Since soil was deficient in other nutrient elements, Cu and Mn were added @5 ppm whereas Mo was applied @ 0.5 ppm at the time of sowing. The pots were irrigated with distilled water as and when required. The second crop of maize was grown in the same soil after the harvest of wheat crop. The soil was treated with N, $P_2O_5$ and $K_2O$ @ 120, 60 and 60 ppm respectively. Entire quantities of $P_2O_5$ and $K_2O$ and half of N were given at the time of sowing. Remaining half quantity of N was given after 25 days from the date of sowing of Maize crop. The plants were harvested after 45 days from the date of sowing, oven dried at 70°C and the dry matter yields were recorded. The maize, wheat grain and straw samples were analysed for total Zn and uptake were calculated. The organic amendments used were analysed for the Zn content (FYM = 63.4 ppm, wheat straw = 13.9 ppm)

## Results and Discussion

*Wheat grain + straw yield*

The effect of various organic amendments were significantly superior to control in increasing the yields. The addition of organic amendments increased the wheat straw yield and grain + straw yield significantly over control (Table 1). The increase might be due to favourable effect of organic amendments on microbial activity and root proliferation in soil which helped in solublizing the native and applied Zn. The results were in accordance with the results of Duraisamy et al., (1988). Application of wheat straw @ 5.0 t/ha did not differ significantly over control while rest of the levels of organic amendments were significant in increasing the grain + straw yield over control. Farm yard manure application significantly increasing the grain + straw yield over control. Farm yard manure application significantly increased the grain + straw yield over wheat straw. This might be due to differences in the availability of Zn due to initial Zn content of the material. Farm yard manure and wheat straw contained 63.4 and 13.9 ppm Zn respectively. Besides this factor, low availability of Zn under wheat straw might be due to complexing of Zn in microbial tissue due to its low rate of decomposition.

*Maize dry matter yield*

The addition of organic amendments was found to increase the maize dry matter yield and total (wheat + maize) dry matter yield significantly over control (Table 2). All the levels of organic amendments increased the yield significantly over control. Application of wheat straw at 10 t/ha was found to be significant over application of wheat straw at 5 t/ha. The interaction effects were non-significant.

Application of FYM and wheat straw increased the yields of both the crops. The per cent increase over control were 12.9, 18.1, 6.1 and 11.3 by FYM at 10.0 t/ha, FYM at 20.0 t/ha, wheat straw at 5.0 t/ha and wheat straw at 10.0 t/ha respectively in case of wheat (grain + straw). In the second crop of maize, the values of per cent increase over

control were 10.4, 9.7, 7.1 and 15.6 by FYM @ 10.0 t/ha, FYM at 20.0 t/ha, wheat straw at 5.0 t/ ha and wheat straw at 20.0 t/ha respectively. Thus higher level of wheat straw showed more increase in second crop and indicated a residual effect. In general, the magnitude of increase was more with FYM than with wheat straw. In an incubation study, FYM and wheat straw applications were not found to affect the Zn availability adversely (Anonymous, 1972). The pot experiment also showed similar trend with respect to yield.

The overall response of Zn was not observed due to addition of organic amendments. However, the effect of Zn application was observed in treatment where only Zn and no organic amendments were added. The per cent increase in the yields by 50 kg zinc sulphate / ha over no Zinc were 22.8, 6.48, 17.82 and 14.16 in case of wheat grain, wheat grain + straw, maize and total (wheat + maize) dry matter respectively. Increase in yield due to application of Zn may be attributed to the fact that the initial Zn (0.29 ppm) in the experimental soil was below the critical limit of 0.5 ppm.

*Zn content in wheat*

The effect of organic amendments on the content of Zn was significant in case of wheat straw (Table 3). Application of FYM and wheat straw at 10 t/ha increased the Zn content significantly over FYM and wheat straw applied at 20 and 5 t/ha respectively. The higher level of FYM decreased the Zn content significantly to its lower level. The decrease could partly be attributed to more dry matter production under this treatment. The effect of Zn levels on Zn content of grain and straw was significant. The content of Zn increased from 0.09 ppm at zero level to 0.14, 0.18 and 0.21 ppm in grain and 0.14, 0.22 and 0.26 ppm in straw at 12.5, 25 and 50 kg Zn SO4/ha, respectively, Duraiswamy et al (1988) reported the same trend of results.

The interaction effects of organic amendments x Zn were significant in case of straw. The FYM x Zn interaction revealed a significant decrease in Zn content by FYM @ 20 t/ha over FYM 10 t/ha at ZnO and 12.5 kg Zn $SO_4$/ ha.

*Zn uptake by wheat*

The effect or organic amendments on the uptake of Zn by wheat grain and straw was significant over control (Table 4). Applicaiton of FYM at 10 t/ha increased the total Zn uptake by wheat significantly over FYM and wheat straw applied at 20 and 5 t/ha respectively. Between the two sources of organic amendments, the FYM was found to be significantly superior over wheat straw in increasing the total uptake. Total Zn uptake by wheat crop showed a progressive increase with increasing levels of Zn.

*Zn content in maize*

Farm yard manure application was found to be significantly superior over wheat straw in increasing the Zn content of maize (Table 5). Application of Zn significantly increased the Zn content. the interaction effects were found to be non-significant.

*Zn uptake by maize*

The uptake of Zn (table 5) was significantly increased by addition of organic amendments. Application of FYM at 10 t/ha increased the Zn uptake significantly over all the levels of organic amendments except FYM applied at 20 t/ha. Between the two sources, FYM application increased the Zn uptake significantly over wheat straw. Zn uptake was found to increase significantly with addition of Zn.

In the present study, the content and uptake of Zn by both the crops were higher in the organic amendment treatment than control (Tables 3, 4 and 5) confirming to the findings of Golakiya and patel (1991). This might be due to increased availability of native and applied Zn due to addition of FYM and wheat straw. The content and uptake of Zn were in higher amount under FYM than wheat straw in both the crops. This might be due to more addition of Zn through FYM. The levels of organic amendments also affected content and uptake. The content and uptake of Zn were higher under lower level (10 t/ha) of FYM and higher level (10 t/ha) of wheat straw in both the crops. This might be due to higher availability of Zn under these treatments. The reduction in content and uptake by addition of FYM at 20 t/ha might be due to chelation of Zn with highly decomposed organic molecules. In case of lower level of wheat straw, reduction might be due to production of organic acids in lesser amount. This might have dissolved smaller amount of native Zn in the medium. Shukla (1971) observed an increase in Zn availability in lighter texture soils due to addition of sucrose. As suggested by him, the increase was due to production of organic acids as a result of decomposition and also due to low buffering capacity of the soil. In this experiment, the soil under study is sandy in nature. The Zn content and uptake in both the crops were found to increase due to Zn application. Similar results were obtained by Kuldeep Singh (1988).

**Table 1.** Effect of organic amendments and Zn on the grain straw yield (g/pot) of wheat

| Organic amendments | Zn levels (kg $SO_4$/ha) | | | | | Zn levels (kg $SO_4$/ha) | | | | | Zn levels (kg $SO_4$/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 12.5 | 25.0 | 50.0 | Mean | 0 | 12.5 | 25.0 | 50.0 | Mean | 0 | 12.5 | 25.0 | 50.0 | Mean |
| | Grain yield | | | | | Straw yield | | | | | Grain + Straw yield | | | | |
| Control | 3.20 | 3.64 | 3.13 | 3.93 | 3.48 | 6.67 | 6.22 | 6.56 | 6.58 | 6.51 | 9.87 | 9.86 | 9.69 | 10.51 | 9.98 |
| FYM @ 10.0 t/ha | 4.08 | 4.00 | 3.56 | 3.60 | 3.81 | 7.18 | 6.94 | 7.79 | 7.95 | 7.47 | 11.26 | 10.94 | 11.35 | 11.55 | 11.28 |
| FYM @ 20.0 t/ha | 4.22 | 3.90 | 3.77 | 4.02 | 3.98 | 7.97 | 7.89 | 7.44 | 7.98 | 7.82 | 12.19 | 11.79 | 11.21 | 12.00 | 11.80 |
| Wheat straw @ 5.0 t/ha | 3.88 | 3.28 | 3.32 | 4.14 | 3.66 | 6.50 | 6.75 | 7.88 | 6.93 | 7.02 | 10.38 | 10.03 | 11.20 | 11.07 | 10.68 |
| Wheat straw @ 10.0 t/ha | 3.41 | 4.15 | 4.39 | 4.21 | 4.04 | 7.91 | 5.91 | 6.76 | 7.73 | 7.08 | 11.32 | 10.06 | 11.15 | 11.94 | 11.12 |
| Mean | 3.76 | 3.80 | 3.64 | 3.98 | - - | 7.25 | 6.74 | 7.29 | 7.44 | - - | 11.00 | 10.54 | 10.93 | 11.42 | - - |
| CD (P=0.05) Organic Amendments | | | | NS | | | | | 0.85 | | | | | 0.80 | |
| Zn Levels | | | | NS | | | | | NS | | | | | NS | |
| Interaction | | | | NS | | | | | NS | | | | | NS | |

**Table 2.** Effect of organic amendments and Zn on the dry matter yield (g/pot) of maize and total (Wheat + Maize) dry matter yield.

| Organic amendments | Zn levels (kg Zn $SO_4$/ha) | | | | | Zn levels (kg Zn $SO_4$/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 12.5 | 25.0 | 50.0 | Mean | 0 | 12.5 | 25.0 | 50.0 | Mean |
| | Maize dry matter yield | | | | | Total (Wheat maize) dry matter yield | | | | |
| Control | 20.14 | 21.28 | 21.90 | 23.75 | 21.77 | 33.01 | 31.14 | 31.59 | 34.26 | 31.75 |
| FYM @ 10.0 t/ha | 24.81 | 23.81 | 23.63 | 23.90 | 24.04 | 36.07 | 34.75 | 34.98 | 35.45 | 35.32 |
| FYM @ 20.0 t/ha | 25.23 | 23.32 | 23.23 | 23.80 | 23.90 | 37.42 | 35.11 | 34.44 | 35.80 | 35.70 |
| Wheat straw @ 5.0 t/ha | 22.53 | 22.66 | 24.15 | 23.98 | 23.33 | 32.91 | 32.69 | 35.35 | 35.05 | 34.01 |
| Wheat straw @ 10.0 t/ha | 26.16 | 25.20 | 23.88 | 24.45 | 25.17 | 37.48 | 35.26 | 35.03 | 37.39 | 36.29 |
| Mean | 23.77 | 23.25 | 23.36 | 24.18 | - | 34.78 | 33.77 | 34.28 | 35.59 | - |
| CD (P=0.05) Organic Amendments | | | | | | | | | | |
| Zn Levels | | | | | | 1.46 | | | | 1.66 |
| Interaction | | | | | | NS | | | | NS |
| | | | | | | NS | | | | NS |

**Table 3.** Effect of organic amendments and Zn application on the Zn content (ppm) in Wheat grain and straw

| Organic amendments | Zn levels (kg Zn $SO_4$/ha) | | | | | Zn levels (kg Zn $SO_4$/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 12.5 | 25.0 | 50.0 | Mean | 0 | 12.5 | 25.0 | 50.0 | Mean |
| | Grain | | | | | Straw | | | | |
| Control | 20.0 | 33.2 | 47.2 | 51.0 | 37.9 | 10.7 | 15.6 | 21.2 | 26.9 | 18.6 |
| FYM @ 10.0 t/ha | 25.1 | 38.4 | 55.9 | 57.1 | 44.1 | 18.7 | 26.2 | 35.1 | 35.6 | 28.9 |
| FYM @ 20.0 t/ha | 22.9 | 36.7 | 52.2 | 51.0 | 40.7 | 10.4 | 13.9 | 30.7 | 38.8 | 23.4 |
| Wheat straw @ 5.0 t/ha | 25.1 | 34.5 | 49.7 | 50.9 | 40.1 | 10.8 | 23.7 | 28.7 | 38.7 | 23.5 |
| Wheat straw @ 10.0 t/ha | 23.7 | 38.4 | 49.0 | 54.7 | 41.5 | 10.1 | 26.9 | 33.1 | 38.7 | 27.2 |
| Mean | 23.4 | 36.2 | 50.8 | 52.9 | - | 12.1 | 21.3 | 29.8 | 34.1 | - |
| CD (P=0.05) Organic Amendments | | | | NS | | | | | 3.30 | |
| Zn Levels | | | | 5.81 | | | | | 2.96 | |
| Interaction | | | | NS | | | | | 6.63 | |

**Table 4.** Effect of organic amendments and Zn application on the Zn uptake (mg /pot) by wheat grain and straw

| Organic amendments | Zn levels (kg Zn $SO_4$/ha) | | | | | Zn levels (kg Zn $SO_4$/ha) | | | | | Zn levels (kg Zn $SO_4$/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 12.5 | 25.0 | 50.0 | Mean | 0 | 12.5 | 25.0 | 50.0 | Mean | 0 | 12.5 | 25.0 | 50.0 | Mean |
| | Grain | | | | | Straw | | | | | Grain + Straw | | | | |
| Control | 0.06 | 0.12 | 0.15 | 0.20 | 0.13 | 0.07 | 0.10 | 0.14 | 0.18 | 0.12 | 0.13 | 0.22 | 0.29 | 0.38 | 0.25 |
| FYM @ 10.0 t/ha | 0.10 | 0.15 | 0.20 | 0.21 | 0.17 | 0.13 | 0.18 | 0.27 | 0.28 | 0.22 | 0.24 | 0.34 | 0.47 | 0.49 | 0.38 |
| FYM @ 20.0 t/ha | 0.10 | 0.14 | 0.20 | 0.20 | 0.16 | 0.08 | 0.11 | 0.21 | 0.31 | 0.18 | 0.18 | 0.25 | 0.42 | 0.51 | 0.34 |
| Wheat straw @ 5.0 t/ha | 0.10 | 0.11 | 0.16 | 0.21 | 0.15 | 0.07 | 0.16 | 0.23 | 0.21 | 0.17 | 0.17 | 0.27 | 0.39 | 0.42 | 0.31 |
| Wheat straw @ 10.0 t/ha | 0.08 | 0.16 | 0.21 | 0.23 | 0.17 | 0.08 | 0.16 | 0.22 | 0.30 | 0.19 | 0.16 | 0.32 | 0.44 | 0.53 | 0.36 |
| Mean | 0.09 | 0.14 | 0.18 | 0.21 | - | 0.09 | 0.14 | 0.22 | 0.26 | - | 0.18 | 0.28 | 0.40 | 0.47 | 0.36 |
| CD (P=0.05) Organic Amendments | | | | NS | | | | | 0.030 | | | | | 0.035 | |
| Zn Levels | | | | 0.26 | | | | | 0.029 | | | | | 0.031 | |
| Interaction | | | | NS | | | | | NS | | | | | NS | |

**Table 5.** Effect of organic amendments and Zn application on the Zn content and uptake by maize

| Organic amendments | Zn levels (kg $SO_4$/ha) | | | | | Zn levels (kg $SO_4$/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 12.5 | 25.0 | 50.0 | Mean | 0 | 12.5 | 25.0 | 50.0 | Mean |
| Control | 25.6 | 31.2 | 35.6 | 39.4 | 33.0 | 0.52 | 0.66 | 0.78 | 0.93 | 0.72 |
| FYM @ 10.0 t/ha | 26.1 | 34.8 | 39.1 | 50.7 | 37.7 | 0.65 | 0.83 | 0.92 | 1.21 | 0.90 |
| FYM @ 20.0 t/ha | 26.2 | 31.4 | 33.9 | 49.0 | 35.1 | 0.66 | 0.73 | 0.78 | 1.17 | 0.83 |
| Wheat straw @ 5.0 t/ha | 28.1 | 32.5 | 34.4 | 36.2 | 32.8 | 0.63 | 0.74 | 0.83 | 0.87 | 0.77 |
| Wheat straw @ 10.0 t/ha | 25.0 | 31.9 | 31.2 | 39.4 | 31.9 | 0.65 | 0.80 | 0.75 | 1.00 | 0.80 |
| Mean | 26.2 | 32.4 | 34.8 | 42.9 | - | 0.62 | 0.75 | 0.81 | 1.04 | - |
| CD (P=0.05) Organic Amendments | | | | 5.27 | | | | | 0.103 | |
| Zn Levels | | | | 4.93 | | | | | 0.091 | |
| Interaction | | | | NS | | | | | NS | |

Application of FYM at 10 and 20 t/ha and wheat straw @ 5 and 10 t/ha were found beneficial in this Zn deficient sandy soil.

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(Received : October 1997 ; Revised : July 2000)

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Madras Agric. J., 87(1-3): 113 - 116 January - March 2000

# Effective short term storage technique for mango seed

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**Abstract :** Propagation of mango is mainly through grafts. The recalcitrant nature of the seed interferes with the production of quality root stalk. Studies with different storage techniques in two different cultivars of mango viz. Neelum and Goa revealed that stones stored in ash and wet gunny bags retained viability for a maximum period of ten weeks. Stones sown immediately after removing the pulp had the maximum germination of 73 per cent. Storing the seeds in mud pots, saw dust and under shade was least effective. *(Key Words : Recalcitrant seed, Mango, Storage, Ash, Wet gunny, Mud pot, Saw dust, Shade)*

The demand for quality of mango fruits is steadily increasing both in the domestic market and in international trade. Hence, requirement for quality seedlings is also on the rise. To produce quality seedlings production of good quality root stalk is a pre-requisite, which in turn dependents on the viability of the seed. The mango seed due to its recalcitrant nature loses viability within five to eight days of de-pulping. Stones are usually collected from local people in an unscientific manner. A simple and practical technology to enhance the viability of the nuts available locally will be useful for people engaged in seedling production. In this context, a study was undertaken at Tamil Nadu Agricultural University to evaluate the use of locally available techniques for improving the viability of mango seeds.

## Materials and Methods

Two popular mango cultivars of Tamil Nadu and Kerala viz., Neelum and Goa were chosen for the study. Cultivar Neelum is available from mid-season till the end of the season (June to August). Seeds are mostly monoembryonic . Goa, a popular variety of Kerala, arrives early (end of April) to the market. The seeds are polyembryonic and mainly used as root stalk. The treatments adopted for the storage of mango seeds were:

T1 - Storage in ash

T2 - Storage in mud pot

T3 - Storage in sawdust

T4 - Storage in shade

T5 - Storage in wet gunny.

The seeds treated with ash and saw dust @ 1 kg of seed in 5 kg of ash and 3 kg of saw dust respectively was kept in an open bucket in a room. The gunny bag was wetted periodically to maintain the moisture. Nearly 175 seeds were stored under each treatment. Ten seeds each in three replications were sown at fortnightly intervals in seed beds and the following observations were taken :