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Vertical distribution of DTPA- Manganese in Post-Harvest Soil of Wheat as Influenced by Crop Residue and Residual starter Zinc

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ABSTRACT

The present experiment is a part of a long-term experiment based on the effect of crop residue and residual starter zinc. This part of investigation "Vertical distribution of DTPA- Manganese in Post-Harvest Soil of Wheat as Influenced by Crop Residue and Residual starter Zinc". Distribution of available iron in different soil depths as influenced by the graded level of crop residues and residual starter zinc under rice-wheat cropping system in calcareous soil are presented. The data on depth wise distribution of available Mn as influenced by long term application of crop residue and residual starter Zn under rice-wheat cropping system are depicted in Table 1 and illustrated in Fig 2. The available Mn content in surface soil (0-15 cm) varied from 4.28 to 4.89 mg kg^{-1} while that in 15 - 30, 30 - 60 and 60 - 90 cm depths ranged from 4.32 to 4.96, 4.27 to 4.86 and 4.18 to 4.76 mg kg^{-1}, respectively. Increasing levels of crop residues significantly increased the DTPA-Mn content at all the depths viz. 0-15, 15-30, 30-60, 60-90 cm from 4.30 to 4.86,4.38 to 4.91, 4.28 to 4.82 and 4.19 to 4.73 mg kg^{-1} respectively. Residual Zn application significantly decreased the DTPA Mn content at 0.15, 15-30 and 30-60 cm depth from 4.58 to 4.55, 4.68 to 4.63 and 4.56 to 4.53 mg kg-1, respectively, however decrease was at par at 60-90 cm depth (4.46 to 4.44 mg kg^{-1}).

Key words: *Mn, Vertical distribution of DTPAMn, Crop residue, Rice-wheat, Cropping system*

Introduction

The wide scale adoption of this cropping system has increased the agricultural production but this intensive system over a period of time and nature of crop has set declining yield trend as well as deterioration in soil productivity even with optimum use of fertilizers. Hence, for restoration of soil fertility, there is an urgent need to look forward another option like, crop residue incorporation in soil for better production. India is likely to have a potential availability of 343 million ton. which is estimated to increase to the tune of 496 million ton till 2025 (Tandon, 1997). During last three decades, chemical fertilizers are playing a dominant role in rice based cropping systems. But the doses of fertilizers may be substituted by the incorporation of crop residues in soil. Incorporation of crop residue alters the soil environment and influences the microbial population in soil, which participates in nutrient transformation. So the present in-

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vestigation is based on depth wise distribution of manganese and iron in rice wheat cropping system as influenced by residual starter Zinc and crop residues.

As we know manganese is one of the essential nutrients for proper growth of the plants means process for growing a successful plant depends on this nutrient like, chloroplast formation photosynthesis of some enzymes and very important process is metabolism. The role of manganese is very crucial. Manganese is responsible for respiration, nitrogen assimilation and photosynthesis, manganese is also involved in pollen germination, pollen tube growth, root cell elongation and resistance to root pathogens without adequate dietary manganese may not process in our body and function properly. The minerals play a variety of role such as adding metabolism help in regulate blood sugar contributing to decreased inflammation. As manganese is a stress mineral it is vital for the human body but we need it in a small quantity Mn contributes to many body function including the metabolism of amino acids, cholesterol, carbohydrates and glucose it also plays important role in bone formation, blood clotting and reducing inflammation, if we are consuming too much manganese at supplements human can have side effects these can include loss of appetite reproductive issues slowed growth it may also cause anemia this is because manganese competes with iron for absorption without adequate dietary management in chemical process in our body may not function properly the mineral place a variety of role surcharge adding metabolism contributing to decrease inflammation reducing premenstrual cramps and more helping regulate blood sugar according to the Linear Spalling Institute the adequate daily intake for manganese is 2.3 milligrams per day in adult male and 1.8 milligrams per day in adult women. Nowadays several forms of manganese are found in supplement including Mnglucotain, manganese sulphate, magnet incorporate and amino acids relates of manganese. Manganese is available at stand-alone supplement or in combination products. Some foods are rich in magnesium like nuts such as almond and Pickens, beans and legumes such a Pinto beans autumn and branch serials whole wheat bread, brown rice, leafy green vegetables such as spinach, fruits such as pineapple and dark chocolate so we are seeing that wheat and rice are having quantity of manganeseas discussed earlier that manganese is an essential plant mineral nutrient playing a key role in several physiological process particularly photosynthesis manganese deficiency is widespread problem most often occurring in sandy soils, organic soiln and calcareous soil with pH above 6.0. We can say like other micronutrients we have discussed manganese requires only 10 PPM to 25 PPM in the soil but it packs a punch because manganese is not mobile inside plants we can find deficiency symptoms on the early growth since the nutrient effects chlorophyll production efficiency level themselves with unnatural leaf color younger leaves exhibit chlorosis so they will be kind of a light green instead of bright green in color theory says when we inspect closely we will discover chlorosis between the veins while the ways themselves remain a naturally dark magnesium (Kirmani, 2004) in the soil solution recharge plant roots by process called mass flow and diffusion in mass flow nutrients are carried in water as it moves from the soil through the plants and ultimately out of the leaves and into the atmosphere through the process called transpiration in diffusion nutrients move from an area to of higher concentration to one of lower concentration the pro availability of manganese (Fageria *et al*., 2003). In soil it is affected by soil pH and organic matter content the language level that is considered adequate at a pH reading of 6.2 in one soil will be considered efficient at water pH of 7.2 in another soil so test soil based on established manganese unavailable form to the available form is fine this provides a starting point by telling you whether the soil manganese level is high medium or low but because the amount of fixation where is based on soil texture and pH. While soil pH is too high or too low in marks while in Sandy leachable (Ho *et al*., 2019) and in any soil during a draught at a water pH rating above 6.5 Mn becomes tied up an available to plants you may encounter toxicity problems in sandy soil with poor water holding capacity manganese list away but lack of moisture can cause problem (Kumar *et al.*, 2017). in any soil old with soil conditions can also exert a double whammy on manganese regardless of soil texture in those conditions microbial activity slows down so less Mn is mineralized form from the soil because plant growth also slows down, up deficiency will occur regardless of how much magnesium is in the soil. Also look for magnesium toxicity in waterlogged conditions manganese oxide which is unavailable to plant undergoes a chemical reduction and enters the soil solution target area for manganese deficiency is high (Kulhánek *et al.,* 2016). So the present investigation is based on “depth wise distribution of manganese in rice wheat cropping system as influenced by residual starter Zinc and crop residues.”

Materials and Methods

A brief description of the materials and methods used in the present investigation entitled “Vertical distribution of DTPA- Manganese in Post-Harvest Soil of Wheat as Influenced by Crop Residue and Residual starter Zinc” is outlined as follows.

Materials

Chemical

All Chemicals used in the present investigation were of analytical grade

Glass Ware and Plastic Ware

All the glassware and plasticware used in the present investigations were of good quality, properly washed in acidified detergent solution followed by tap water, and finally rinsed thrice with distilled water

Water

Deionized and double glass distilled water free from dissolved gaseous impurities were used in the laboratory analysis.

Collection of Samples for Laboratory Works

Soil Samples

Soil samples from each of the 48 plots after the harvest of the 36th crop were collected from different depths (0-15, 15-30, 30-60, 60-90, and cm) with the help of post hole anger. These samples were air-dried and processed to pass through 70 mesh sieve and stored in polyethylene bags for analysis.

Methods for Field Experiment

A field experiment was started in *Rabi,* 1993-94 in light-textured highly calcareous soil deficient in available Zn at Dr. Rajendra prasad central agricultural university Research farm, Pusa and the current investigation period is 2011-12. as per the details given below. Wheat cv. HP 1102 was grown as a general crop applying recommended dose of N, P_2O_5, and K_2O before the start of the experiment. After harvest, the straw was weighed and treated as crop residue for the first crop during *Kharif*, 1994.

Treatments

Details of Field Experiment

A long-term field experiment is being conducted since 1994 at RAU, Pusa Farm with the following details, where observations weretaken.

Treatment	:	16 (4 main treatment and 4 subtreatment)
Replication	:	3
Design	:	Split Plot
PlotSize	:	5 x 2m
Croprotation	:	Rice (cv. Rajshree), Wheat (cv. HD2824)

A detailed layout plan of the experiment is given in Fig.1.

N

R_1		R_2		R_3	
$CR_1 Zn_1$	IRRIGATION CHANNEL	$CR_3 Zn_4$	PATH	$CR_2 Zn_1$	IRRIGATION CHANNEL
$CR_1 Zn_2$		$CR_3 Zn_3$		$CR_2 Zn_4$	
$CR_1 Zn_3$		$CR_3 Zn_2$		$CR_2 Zn_3$	
$CR_1 Zn_4$		$CR_3 Zn_1$		$CR_2 Zn_2$	
$CR_2 Zn_1$		$CR_4 Zn_4$		$CR_1 Zn_2$	
$CR_2 Zn_2$		$CR_4 Zn_3$		$CR_1 Zn_1$	
$CR_2 Zn_3$		$CR_4 Zn_2$		$CR_1 Zn_3$	
$CR_2 Zn_4$		$CR_4 Zn_1$		$CR_1 Zn_4$	
$CR_3 Zn_1$		$CR_2 Zn_4$		$CR_4 Zn_3$	
$CR_3 Zn_2$		$CR_2 Zn_3$		$CR_4 Zn_1$	
$CR_3 Zn_3$		$CR_2 Zn_2$		$CR_4 Zn_4$	
$CR_3 Zn_4$		$CR_2 Zn_1$		$CR_4 Zn_2$	
$CR_4 Zn_1$		$CR_1 Zn_4$		$CR_3 Zn_2$	
$CR_4 Zn_2$		$CR_1 Zn_3$		$CR_3 Zn_4$	
$CR_4 Zn_3$		$CR_1 Zn_2$		$CR_3 Zn_1$	
$CR_4 Zn_4$		$CR_1 Zn_1$		$CR_3 Zn_3$	

Fig. 1. Layout Plan

Main Plot	*Sub Plots*
Crop residue levels - 4 (Applied toeachcrop)	Zn - levels – 4 (Applied only to the first crop

CR_1 and No crop residue (CR_0)
CR_2 and 25% of straw produced(CR_{25})
CR_3 and 50% of straw produced(CR_{50})
CR_4 and 100% of straw produced (CR_{100})
Zn_1 and no Zn (Zn_0)
Zn_2 and 2.5 kg Zn ha^{-1} ($Zn_{2.5}$) Zn_3 & 5. Kg Zn ha^{-1} ($Zn_{5.0}$)
Zn_4 and 10 kg Zn ha^{-1} ($Zn_{10.0}$) Recommended dose of fertilizers (NP K) for both crop are 120: 60: 40 Kg ha^{-1}. Rice and wheat crops are being grown continu-

ously under the rice-wheat system during *Kharif* and *Rabi* seasons. The chopped straw of the previous crop treated as crop residues were incorporated as per treatment.

Details of treatment combinations, therefore, were as follow:

1. CR_1ZN_1	5.	CR_2ZN_1	9.	CR_3ZN_1	13.	CR_4ZN_1
2. CR_1ZN_2	6.	CR_2ZN_2	10.	CR_3ZN_2	14.	CR_4ZN_2
3. CR_1ZN_3	7.	CR_2ZN_3	11.	CR_3ZN_3	15.	CR_4ZN_3
4. CR_1ZN_4	8.	CR_2ZN_4	12.	CR_3ZN_4	16.	CR_4ZN_4

DTPA Analysis of soil by the method Lindsay, W.L. and Norvell, W.A. 1978

Statistical Analysis and Presentation of Data

Wherever possible the experimental data were subjected to analysis of variance as per the procedure of Panse and Sukhatme (1967). The critical difference (CD) at a 5 percent level of probability was worked out for comparing the significant treatment effects.

Results

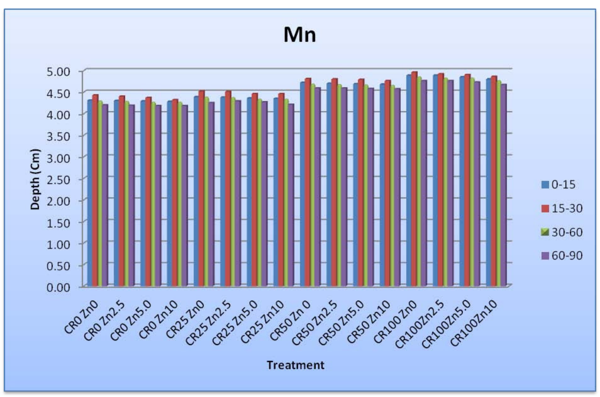

Fig. 1. Vertical distribution of Manganese (mg Kg^{-1}) content of PHS of wheat (18thCycl

Discussion and Conclusion

DTPA-Mn

The data on depth wise distribution of available Mn as influenced by long term application of crop residue and residual starter Zn under rice-wheat cropping system are depicted in Table 1 and illustrated in Fig. 2. The available Mn content in surface soil (0-15 cm) varied from 4.28 to 4.89 mg kg^{-1} while that in 15 - 30, 30 - 60 and 60 - 90 cm depths ranged from 4.32 to 4.96, 4.27 to 4.86 and 4.18 to 4.76 mg kg^{-1}, respectively. A critical examination of the data revealed that available Mn content was higher in 15-30 cm of depth (Bhat, 2010) and after that it progressively decreased downward up to 90 cm (Batagund). Higher value of available Mn in the depth (15-30 cm) may be due to higher organic matter content which retain available Mn. Low amount of Mn found in all depth of soil under study in comparison to 15-30 cm of soil (Chesnin, *et al.*, 1950) might be due to low mobility of Mn down the profile. The results are in accordance with Khanday *et al.,* (2017). This may due to complexation with organic matter and clay, which restrict their movement in lower depth. At all the depths, higher amount of available Mn was found in the plot receiving 100% of crop residue and no residual starter Zn. The data were found statistically significant in depths (0-15, 15-30 and 30-60 cm) with regards to levels of crop residues, residual Zn levels and their

Table 2. Vertical distribution of DTPA- Mn (mg kg^{-1}) in Post-Harvest Soil of Wheat (36th crop) as Influenced by Crop Residue and Residual starter Zinc.

Treatment	Depth (Cm) 0-15	15-30	30-60	60-90	Mean
CR_0 Zn_0	4.31	4.43	4.30	4.20	4.31
CR_0 $Zn_{2.5}$	4.30	4.40	4.29	4.19	4.30
CR_0 $Zn_{5.0}$	4.29	4.37	4.27	4.18	4.28
CR_0 Zn_{10}	4.28	4.32	4.27	4.18	4.26
Mean	4.30	4.38	4.28	4.19	4.29
CR_{25} Zn_0	4.39	4.52	4.39	4.25	4.39
CR25 Zn2.5	4.38	4.51	4.38	4.29	4.39
CR25 Zn5.0	4.36	4.46	4.34	4.27	4.36
CR_{25} Zn_{10}	4.35	4.46	4.34	4.21	4.34
Mean	4.37	4.49	4.36	4.26	4.37
CR_{50} Zn_0	4.72	4.81	4.69	4.59	4.70
CR50 Zn2.5	4.70	4.80	4.68	4.59	4.69
CR50 Zn5.0	4.69	4.79	4.67	4.58	4.68
CR_{50} Zn_{10}	4.68	4.76	4.66	4.57	4.67
Mean	4.70	4.79	4.68	4.58	4.69
CR_{100} Zn_0	4.89	4.96	4.86	4.76	4.87
CR100Zn2.5	4.89	4.92	4.83	4.76	4.85
CR100Zn5.0	4.85	4.90	4.83	4.73	4.83
CR100Zn10	4.80	4.86	4.77	4.67	4.78
Mean	4.86	4.91	4.82	4.73	4.83
Zn_0	4.58	4.68	4.56	4.45	4.57
Zn2.5	4.57	4.66	4.55	4.46	4.56
Zn5.0	4.55	4.63	4.53	4.44	4.54
Zn_{10}	4.55	4.63	4.53	4.44	4.54
Mean	4.56	4.65	4.54	4.45	4.55
CD (0.05%) CR	0.04	0.03	0.04	NS	
Zn	0.02	0.02	0.02	0.12	
CR x Zn	0.08	0.06	0.08	NS	
CV (%)	1.27	1.23	1.39	4.25	

interaction however at 60-90 cm depth only crop residues were found significant. Increasing levels of crop residues significantly increased the DTPA-Mn content at all the depths viz. 0-15, 15-30, 30-60, 60-90 cm from 4.30 to 4.86, 4.38 to 4.91, 4.28 to 4.82 and 4.19 to 4.73 mg kg^{-1} respectively. Residual Zn application significantly decreased the DTPA Mn content at 0.15, 15-30 and 30-60 cm depth from 4.58 to 4.55, 4.68 to 4.63 and 4.56 to 4.53 mg kg^{-1}, respectively, however decrease was at par at 60-90 cm depth (4.46 to 4.44 mg kg^{-1}). Decrease in Mn content due to residual Zn application might be due to antagonistic relationship between Zn and Mn in soil.

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