increase in productivity through integration of cropping with poultry + fish + mushroom, pigeon + fish + mushroom and fish + mushroom was respectively, 168, 188 and 129 per cent higher than cropping alone. The mean over two years also brought out similar trend of productivity response in each farming system.

Integration of poultry and pigeon required very little of water and total water requirement in integration of improved cropping with fish + mushroom + poultry/pigeon, was lesser than the water requirement of cropping alone in one hectare land area. Integrating efficient allied components with cropping results in effective water budgeting with better economic returns in lowland farming.

References

Noble, R.P. and Rashidi, B. (1990). Aquaculture Technology transfer to small holder farmers in Malawi, Southern Africa - NAGA, *The ICLARM Quartly.* **16**: 14-16.

Rangaswamy, A. and Jayanthi, C. (1994). Recycling of organic wastes in integrated farming systems. p.114-118. In. Proc. Natl. Training on organic farming, GOI & Tamil Nadu Agric. Univ. Coimbatore 1-8, Sep., 1994.

Shanmugasundaram, V.S. and Balusamy, M. (1993). Rice-Fish-Azolla. An integrated Farming system in lowlying wetlands. *Farming systems.* **9**: 105-107.

Shanmugasundaram, V.S. and Ravi, K. (1992). Rice + fish + azolla in integration. *NAGA, The ICLARM Quarterly.* **15** (2) : 2-29.

Thanh Hung, LE. (1992). Integration of crustacean aqaculture with coastal rice farming in vietnam-NAGA. *The ICLARM Quartly.* **15**(2): 2-29.

Tiwari, P.N.(1993). Integrated Farming Research for sustaining food production *J. Nuclear Agric, Biol.* **20**: 1-13.

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Effect of different organic manures, tillage methods and crop residue management on the availability of micronutrients

K. APPAVU, S. POONGOTHAI AND P. SAVITHRI

Department of Soil Science and Agricultural Chemistry, TNAU, Coimbatore - 641 003, Tamil Nadu

Abstract : Field experiments were conducted with sorghum (Co.26) - soybean (Co.1) cropping sequence in Typic Ustropept soil with different tillage operations and manure treatments. The post harvest soil samples of soybean were analysed for DTPA-Zn, Cu, Fe and Mn content. The results showed that incorporation of organic manures (coirpith, poultry manure, goat manure and FYM) increased the available Zn and Fe content, while the availability of Cu was not influenced by the incorporation of organic manures. Ploughing with country plough and burning the stubbles *in situ* significantly increased the Zn content, while for Fe it was C_2 (country ploughing and composting the stubbles in situ) and for Mn, C_1 and C_2 recorded the highest value. As regards DTPA-Cu, disc ploughing under dry condition recorded the highest value. All the four micronutrient cations were higher in the surface soil than in sub-soil. *(Key words : Sorghum, Soybean, Tillage, Organic manures, Micronutrients.)*

Tillage mixes and incorporates organic debris into the soil. Organic C has been associated with improvements in many soil physical and biological properties including bulk density, aggregation and mineralization of plant nutrients (Bruce *et al.*, 1990). Enhanced respiration and microbial biomass turn over are often observed soon after tillage (Reicosky and Lindstrom, 1993). Dick (1983) observed that mechanical incorporation of fertilizer within the root zone is not possible with no tillage and the nutrient taken up by plant roots from the sub-soil are recycled to the top layer through plant residue mulch. Hence, the present investigation was taken up to assess the effect of different organic manures, tillage methods and crop residue management practices in sorghum-soybean cropping system.

Materials and Methods

Field experiments were laid out in Typic Ustropept soil with sorghum (Co.26) - soybean (Co.1) cropping system with a pH of 8 and E.C. of 0.5 dSm^{-1}. There were 24 treatment combinations replicated three times in split-plot design.

Main plot treatments : Tillage and crop residues management

C_1 - Ploughing with country plough, collection and burning of stubbles in situ

C_2 - Ploughing with country plough, collection of stubbles and composting in situ with Pleurotus.

C_3 - Irrigating the field - disc ploughing and incorporating the stubbles.

C_4 - Disc ploughing without irrigation.

Sub-plot treatments

T_1 - NPK + Composted coirpith @ 12.5 t ha^{-1}

T_2 - NPK + Raw coirpith @ 12.5 t ha^{-1}

T_3 - NPK + Poultry manure @ 5 t ha^{-1}

T_4 - NPK + Goat manure @ 5 t ha^{-1}

T_5 - NPK + FYM @ 12.5 t ha^{-1}

T_6 - NPK alone

The above tillage treatments were imposed after the harvest of sorghum crop while the manure treatments were imposed before sowing the main crop of sorghum. Recommended dose of N, P_2O_5 and K_2O were applied to both the crops as urea, single super phosphate and muriate of potash respectively. The soil samples from 0-15 (D_1) and 15-30 cm (D_2) depths were collected after the harvest of soybean crop and analysed for DTPA-Zn, Cu, Fe and Mn content using Atomic Absorption Spectrophotometer (Lindsay and Norvel, 1978).

Results and Discussion

Iron (Table 1)

The DTPA-Fe content differed significantly for the tillage treatments, manure application and depth. The DTPA-Fe content was significantly higher for the incorporation of poultry manure, composted coirpith and raw coirpith, while FYM and goat manure application recorded on par with NPK control. However, the values were in the deficiency level only. Acidic nature of coirpith might have led to bringout a marginal increase in the availability of iron. As regards the different tillage operations, the highest value was associated with C_2 (1.65 mg kg^{-1}) and it recorded significantly higher value than the rest (C_1, C_2 and C_4) which were on par among themselves. The surface soil (0-15 cm) was found to have significantly higher DTPA-Fe content (1.60 mg kg^{-1}) than sub-surface soil (1.54 mg kg^{-1}). This was in accordance with the findings of Franzluebbers and Hons (1996). Among the different two way interaction C x T alone was significant. At C_2 and C_3 all the manure treatments were on par while at C_4, T_1, T_2 and T_3 were on par and recorded significantly higher value than NPK control.

Zinc (Table 2)

The DTPA-Zn content was significantly increased from 0.87 mg kg^{-1} (NPK alone) to 1.18 mg kg^{-1} (NPK + composted coirpith @ 12.5 t ha^{-1}). In general, application of different organic manures (coirpith, poultry manure, goat manure and FYM) significantly increased the Zn availability and the ranking was composted coirpith > poultry manure > raw coirpith > FYM > goat manure > NPK control. Marginal level of sufficiency in the DTPA-Zn content could be achieved by the incorporation of organic manure.

Among the different tillage operations, C_1 (ploughing with country plough and burning the stubbles in situ) recorded significantly higher DTPA-Zn content (1.09 mg kg^{-1}) than C_2 and C_3 which were on par. Biederbeck *et al.* (1980) also reported that burning of residues enhanced the release of plant nutrients. Here too, the surface soil contained more value (1.12 mg kg^{-1}) than sub-surface soil (1.00 mg kg^{-1}). As regards the interaction effect, in C x D interaction, at all cultural treatments except C_3, the sub-surface soil recorded significantly lower value than surface soil while at C_3 (Disc ploughing after irrigation and incorporation of stubbles) the values recorded for surface and sub-surface soil were on par. Interestingly in the T x C interaction, it was seen that Zn availability was found to be influenced by country ploughing and composting the stubbles and disc ploughing after irrigation.

Manganese (Table 3)

The DTPA-Mn content varied from 10.8 to 12.2 mg kg^{-1} for the manure treatments. The lowest value of 10.8 was associated with T_2, T_3 and T_5

Table 1. Effect of crop residues and tillage management on the availability of DTPA-Fe (mg kg^{-1})

	Treatments	C_1		C_2		C_3		C_4	
		D_1	D_2	D_1	D_2	D_1	D_2	D_1	D_2
1	NPK + Composted coirpith @ 12.5 t ha^{-1}	1.59	1.59	1.61	1.53	1.68	1.47	1.76	1.88
2	NPK + Raw coirpith @ 12.5 t ha^{-1}	1.60	1.43	1.81	1.73	1.61	1.68	1.71	1.59
3	NPK + Poultry manure @ 5 t ha^{-1}	1.69	1.48	1.58	1.64	1.56	1.43	1.71	1.66
4	NPK + Goat manure @ 5 t ha^{-1}	1.60	1.51	1.57	1.63	1.68	1.43	1.71	1.66
5	NPK + FYM @ 12.5 t ha^{-1}	1.57	1.41	1.70	1.72	1.47	1.42	1.29	1.51
6	NPK alone (control)	1.48	1.22	1.65	1.58	1.54	1.55	1.45	1.43
CD		T:0.09	C:0.08		C x D	:NS		T x C	:0.18

Table 2. Effect of crop residues and tillage management on the availability of DTPA-Zn (mg kg^{-1})

	Treatments	C_1		C_2		C_3		C_4	
		D_1	D_2	D_1	D_2	D_1	D_2	D_1	D_2
1	NPK + Composted coirpith @ 12.5 t ha^{-1}	1.28	1.12	1.12	1.01	1.30	1.23	1.25	1.09
2	NPK + Raw coirpith @ 12.5 t ha^{-1}	1.35	1.06	1.15	0.96	1.07	1.11	1.05	0.91
3	NPK + Poultry manure @ 5 t ha^{-1}	1.44	1.13	1.11	0.91	1.14	1.10	1.17	1.02
4	NPK + Goat manure @ 5 t ha^{-1}	0.99	0.99	1.16	1.03	1.11	1.03	1.11	0.97
5	NPK + FYM @ 12.5 t ha^{-1}	1.06	0.97	1.23	1.00	0.99	1.07	1.09	1.13
6	NPK alone (control)	0.95	0.94	0.92	0.81	0.89	0.78	0.95	0.95
CD		T:0.06	C:0.05		C x D	0.07		T x C	:0.13

Table 3. Effect of crop residues and tillage management on the availability of DTPA-Mn (mg kg^{-1})

	Treatments	C_1		C_2		C_3		C_4	
		D_1	D_2	D_1	D_2	D_1	D_2	D_1	D_2
1	NPK + Composted coirpith @ 12.5 t ha^{-1}	15.2	10.7	13.8	9.30	15.3	8.20	11.2	8.6
2	NPK + Raw coirpith @ 12.5 t ha^{-1}	12.4	9.20	13.0	8.60	15.5	8.50	10.8	8.2
3	NPK + Poultry manure @ 5 t ha^{-1}	14.1	8.90	11..3	9.00	12.2	8.80	13.3	9.1
4	NPK + Goat manure @ 5 t ha^{-1}	14.0	9.30	14.0	9.90	14.4	9.60	13.4	10.6
5	NPK + FYM @ 12.5 t ha^{-1}	15.2	8.20	14.3	10.7	9.20	7.80	12.6	8.30
6	NPK alone (control)	15.6	9.10	14.5	13.9	8.40	7.50	10.1	8.00
CD		T:0.72	C:0.09		C x D	0.83		T x C	:1.01

Table 4. Effect of crop residues and tillage management on the availability of DTPA-Cu (mg kg^{-1})

	Treatments	C_1		C_2		C_3		C_4	
		D_1	D_2	D_1	D_2	D_1	D_2	D_1	D_2
1	NPK + Composted coirpith @ 12.5 t ha^{-1}	3.03	2.58	3.15	2.65	2.67	3.02	3.28	3.22
2	NPK + Raw coirpith @ 12.5 t ha^{-1}	2.82	2.49	3.02	2.74	3.17	3.00	3.23	2.96
3	NPK + Poultry manure @ 5 t ha^{-1}	2.70	2.55	3.15	2.76	3.11	3.24	3.55	3.39
4	NPK + Goat manure @ 5 t ha^{-1}	2.81	2.41	3.09	2.90	3.27	3.23	2.65	3.01
5	NPK + FYM @ 12.5 t ha^{-1}	3.14	2.13	3.09	3.09	2.99	2.88	3.23	3.06
6	NPK alone (control)	3.05	2.47	2.79	2.86	2.97	3.05	3.49	3.60
CD		T:NS	C:0.11		C x D	:0.15		T x C	:0.26

treatments, while the highest one was recorded in T_4 treatment which was also on par with T_1 and both remained significantly superior over T_2, T_3, T_5 and T_6. Ploughing with country plough and either burning the stubbles in situ or composting with *Pleurotus* and urea helped to increase the content of DTPA-Mn significantly while C_3 and C_4 recorded lower values. Disc ploughing in dry condition as well as after irrigation did not have impact on the availability of Mn. Here too, the surface soil contained more DTPA-Mn than sub-surface soil. The T x D interaction reflected the non influential nature of manure incorporation on Mn content of sub-surface soil. In the C x T interaction, it was seen that unlike the main effect at T_2 the highest value was associated with C_2 and at T_4 it was on par with C_4. Lal *et al.*, (1994) also observed that, mould board system had lower values of exchangeable cations as a result of the mould board plough mixing top soil, residue and nutrients into the zone below the 15 cm sampling depth.

Copper (Table 4)

The DTPA-Cu varied from 2.92 to 3.06 mg kg^{-1}. The difference among treatments did not attain the level of statistical significance. As regards tillage operations, differences among them are significant. The values varied from 2.68 to 3.22 mg kg^{-1} which were associated with C_4 (Incorporation of stubbles by disc ploughing under dry condition) and C_1 (Country ploughing and burning the stubbles in situ) respectively. The ranking was C_4 C_3 C_2 C_1. The trend indicated that burning the stubbles as well as composting the stubbles in situ causes a marked reduction in the availability of copper. The DTPA-Cu content was significantly higher in the surface soil than lower layer (15-30 cm).

The C x D interaction reflected the on par performance of C_3 treatment (Disc ploughing after irrigation) for the DTPA-Cu content at both depth unlike the remaining tillage treatments. The T x C interaction showed that at C_2 and C_4 highest value was seen for T_5 and T_6 treatments respectively.

Conclusions

To conclude, the availability of Zn and Fe was increased by the incorporation of organic manures with no effect on the availability of Mn and Cu. As regards the ploughing treatments, ploughing and burning the stubbles and composting stubbles increased the availability of Zn, Fe and Mn. All the four micronutrient cations were higher in the surface than in sub-surface soil.

References

Biederbeck, V.O., Chambell, C.A., Bowren, K.EW., Schnitzer, M. and Mclver, R.N. (1980). Effect of burning cereal straw on soil properties and grain yield in Saskatchewan. *Soil Sci. Soc. Am. J.* **44**: 103-111.

Bruce, R.R., Langdale, G.W. and Dillard, A.L. (1990). Tillage and crop rotation effect on characteristics of a sandy surface soil. *Soil Sci. Soc. Am. J.* **54**: 1744-1747.

Dick, W.A. (1983). Organic carbon, nitrogen and phosphorus concentrations and pH in soil profiles as affected by tillage intensity. *Soil Sci. Soc. Am. J.* **47**: 102-107.

Franzluebbers, A.J. and Hons, F.M. (1996). Soil profile distribution of primary and secondary plant available nutrients under conventional and no tillage. *Soil and Tillage Research.* **39**: 229-239.

Lal, R., Mahboubi, A.A. and Fausey, N.R. (1994). Long term tillage and rotation effects on properties of a Central Ohio soil. *Soil Sci. Soc. Am. J.* **58**: 517-522.

Lindsay, W.L. and Norvell, W.A. (1978). Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.* **42**: 421-428.

Reicosky, D.C. and Lindstrom, M.J. (1993). Fall tillage method : Effect on short term carbondioxide flux from soil *Agron. J.* **85**: 1237-1243.

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