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EFFECT OF INTEGRATED APPLICATION OF INORGANIC AND ORGANIC SOURCES ON YIELD AND MICRONUTRIENT UPTAKE BY PEARL-MILLET

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Abstract: *An experiment to find out the relative performance of two sources of organic and NPK is in progress in alluvial soils (Inceptisol) of College of Agriculture Gwalior, with nine treatments & 3 replications is in progress since 2004 in randomized block design. Data presented has been obtained from the crop grown during Kharif 2014-15.*

The results indicate that integrated use of 50% of optimum NPK + 50% vermicompost produced significantly higher grain yield over remaining treatments except optimum NPK. Two sources of organics resulted in lower yield, however maximum total uptake of Cu, Fe, Zn, Mn was recorded in 100% NPK. Maximum net profit and B:C ratio were recorded by the use of optimum NPK (Rs.31918/- and 2.44) respectively.

Keywords: *Cu, Fe, Zn, Mn, FYM, Pearl-millet, nutrient uptake, yield.*

Introduction: Pearlmillet is a common crop grown in *Kharif by* marginal and small farmers in alluvial soil region of northern Madhya Pradesh under Pearl millet – mustard and Pearl millet-wheat cropping systems. Under intensive cultivation, there are reports of reduction in yield even due to constant use of NPK fertilizers. The reduction in the yield is generally traced due to deficiency of secondary and micronutrients. Soil research results of the last decade show that at the present time, among micronutrients, Zn deficiency is the most detrimental to effective crop yield. Other important micronutrients that increase crop yield (most to least effect) are Fe, B, Mn, Cu, and Mo. In the case of calcareous soils, the conventional notion that micronutrients increase crop yield by 15%-30% is an underestimated range. Enhanced removal of micronutrients as a consequence of adoption of high yielding varieties and intensive cropping together with the use of high analysis NPK fertilizers coupled with limited/no use of organic manures and less recycling of crop residues are important factors contributing to the accelerated depletion of micronutrients from the soils has resulted in the depletion of micronutrient Cations from the soil reserves. Integrated nutrient management (INM) is a concept, which aims at the maintenance of soil fertility and plant nutrient supply in an optimum amount for sustaining soil health and crop productivity through optimization of the benefits from all possible sources of plant nutrient in an integral manner.

Materials and Methods

Field study was conducted at the Crop Research Farm of Rajmata Vijayaraje Scindia Agriculture University, Gwalior (M.P.) in Kharif season 2014-15 with Pearmillet as a test crop. The 100% NPK recommended dose of fertilizer for Pearlmillet was 80 kg N, 40 kg P_2O_5 and 20 kg K_2O ha^{-1} respectively. The experiment consisted of nine treatments replicated three times in a randomized block design viz., FYM @ 160 q ha^{-1} (T_1), N_{40} P_{20} K_{10} + FYM @ 80 q ha^{-1}: T_2, N_{20} P_{10} K_5 + FYM@120q ha^{-1}: T_3, N_{60} $P_{30}K_{15}$ + FYM@ 40 q ha^{-1}: T_4, Vermicompost 5334 kg ha^{-1}: T_5, $N_{40}P_{20}K_{10}$ +Vermocompost @ 2667 kg ha^{-1}: T_6, $N_{20}P_{10}K_5$ + Vermicompost @ 4000 kg ha^{-1}: T_7, $N_{60}P_{30}K_{15}$ + Vermicompost @ 1334 kg ha^{-1}: T_8, $N_{80}P_{40}K_{20}$: T_9. The farmyard manure (FYM) was obtained from small dairy holders.

The FYM @ 160 q ha^{-1} was incorporated one month before sowing as per treatments. Total N, P, and K contents of the FYM were 0.50, 0.25 and 0.50 % respectively. Half of the N and entire dose of P, K were applied at the basal dose and remaining quantity of N was top dressed after 35 days, in the form of urea, di-ammonium phosphate, murate of potash. Grain and straw yields were recorded after harvest of crop. The grain and straw samples were digested in di-acid mixture of HNO_3 and $HClO_4$ (2:5) for micronutrients estimation. Plant uptake of Cu, Fe, Zn and Mn were computed by multiplying the yield with the respective nutrient content. After harvest of the crop, the composite surface (0-15 cm) soil samples from each plot of the experimental field were analyzed for p H, EC, OC, by following standard procedures.

Results and Discussion

Soil Properties: A perusal of data in table 1 showed that continuous use of chemical fertilizers and their combination with organics resulted in no changes in p H and EC of the soil.

Organic Carbon: The organic carbon of soil increased significantly with the application of FYM and vermicompost along with graded dose of fertilizers (table 1). The highest buil-up of OC in the soil was recorded in 100% NPK, which was at par with 25% vermicompost + 75% NPK and 75% vermicompost + 25% NPK. Thus, integrated application of organics with chemical fertilizers (vermicompost + NPK) resulted in significantly higher organic carbon content in soil. The increase in OC content in the manorial treatment combinations is attributed to direct addition of organic manure in the soil which stimulated the growth and activity of microorganisms and also due to better root growth, resulting in the higher production of biomass, crop stubbles and residues [1]. The subsequent decomposition of these materials might have resulted in the enhanced carbon content of soil. These results are in agreement with the findings [2].

Table-1 Influence of integrated application of inorganic and organic sources on soil chemical properties of post-harvest soil and yield.

Treatments	pH(1:2)	EC (dSm^{-1})	OC (gkg^{-1})	Grain Yield ($kgha^{-1}$)	straw Yield ($kgha^{-1}$)
100% FYM	7.4	0.42	4.24	3170.66	9723
50% FYM + 50% NPK	7.7	0.42	4.36	3549.3	12038
75% FYM +25% NPK	7.7	0.43	4.49	3468.23	12038
25% FYM + 75% NPK	7.5	0.44	4.46	3693.43	12346
100% Vermicompost	7.7	0.42	4.34	3044.73	11575
50% Vermi +50% NPK	7.6	0.45	4.5	4192.46	11266
75% Vermi + 25% NPK	7.5	0.45	4.5	3450.16	10957
25% Vermi + 75% NPK	7.6	0.46	4.59	3774.46	12964
100% NPK	7.4	0.46	4.61	3891.6	14507
Sem(±)	0.11	0.005	0.05	215.55	605.15
CD (0.05%)	NS	0.016	0.17	646.271	1814.04

Grain and Straw Yields: Higher yield in comparison to 100% FYM and 100% vermicompost were recorded with 50% vermicompost + 50% NPK (table 1). There was a significant response of different treatments as compared to organic sources. Grain yield varied from 3044.73 to 4192.46 kg ha^{-1} under different treatments which were in T_5 (100% vermicompost) and T_6 (50%vermicompost+50%NPK) respectively. Application of P along with N considerably increased yield of pearlmillet compared to the application of FYM alone. A better supply of phosphorus has been associated with prolific root growth resulting in enhanced water and nutrient absorption. The application of K along with NP significantly increased the grain and straw yield of pearlmillet over FYM and vermicompost alone, emphasizing on the essentiality of balanced fertilization to obtain higher pearlmillet productivity. As K play a number of indispensable roles in a wide range of function. Increasing fertility levels increased the yield of pearlmillet in different combination of NPK + vermicompost. The results obtained in present study are in conformity [3-4].

Micronutrient Uptake: Application of balanced fertilization of N, P and K led to significantly higher NPK uptake in comparison to FYM and vermicompost alone (table 2). Nutrient uptake was influenced significantly by the application of chemical fertilizers alone or in combination with FYM and vermicompost. The highest total uptake (grain + straw) of Cu, Fe, Zn, Mn (154.557, 633.67, 362.740 and 313.187 g ha^{-1} respectively) was recorded with the incorporation of 100% NPK and lowest 65.87, 420.05, 203.407 and 195.177 gha^{-1} in T1 respectively.However

the performance of different treatments was observed in following descending order T9 > T8 > T7 > T6 > T4 >T3 > T2 > T5 and T1. It is obvious as uptake is a function of nutrient content and yield was higher NPK treated plots in comparison to FYM, vermicompost and their combinations.

Table-2: Influence of integrated application of inorganic and organic sources on micronutrient uptake

Treatments	Total nutrient uptake (g ha^{-1})			
	Cu	Fe	Zn	Mn
100% FYM	65.87	420.05	203.407	195.177
50% FYM +50% NPK	85.723	501.3	256.47	234.19
75% FYM + 25% NPK	89.287	503.81	255.083	235.68
25%FYM + 75% NPK	102.993	531.66	276.413	250.48
100% Vermicompost	79.513	385.11	241.843	222.26
% 50Vermicompost + 50% NPK	112.15	550.98	291.747	261.35
% Vermicompost 75+ 25% NPK	108.067	502.56	267.97	241.193
25% Vermicompost + 75% NPK	133.05	582.54	319.873	282.247
100% NPK	154.557	633.67	362.74	313.187
CD (P=0.05)	14.45	97.16	38.19	31.75

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