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MICROBIAL PROPERTIES AND SOIL ENZYMATIC ACTIVITIES AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT AND SUPPLY IN FINGER MILLET–MAIZE CROPPING SEQUENCE OF EASTERN DRY ZONE OF KARNATAKA

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ABSTRACT
Field experiments conducted at the Zonal Agricultural Research Station, Gandhi Krishi Vigyan Kendra, University of Agricultural Sciences, Bangalore involving growing of finger millet during Kharif and maize in Rabi during the *seasons* of 1999 -2000 and 2000 – 2001 indicated the positive influence of intensive manuring programme on microbial activities in soil after the harvest of finger millet and maize. Microbial biomass C content in soil was found to be relatively higher in the plots amended with both FYM and lime. Urease activity was comparable among the several treatments. Furthermore, the liming of soils resulted in increased pH and improved biological activity thus contributing to higher urease activity. Significantly higher dehydrogenase activity was recorded in soil with plots amended with FYM, lime and both FYM and lime. It was also observed that the activity of phosphatase enzyme in the soil was decreased with the application of NPK fertilizers at increased levels.

KEY WORDS: Intensive manuring, Microbial C content, Urease, Phosphatase, Dehydrogenase, Crop sequence.

INTRODUCTION

Intensive use of fertilizers, nutrients, manures and other soil amendments like used to maximise production may thus affect soil properties. Crop sequences represent a system approach in crop production research enabling the available natural resources to be preserved and more efficiently utilized. Finger millet is usually grown during kharif in most part of Karnataka and maize with high production potential is being cultivated in rabi season, thus representing better sequence. Microbial biomass is a labile fraction of soil organic matter and is an index of soil microbial activity. The activities of micro organisms play a major role in nutrient recycling organic matter decomposition and turnover. Very little information is available with regard to soil microbial activities due to effect of fertilizers and manures. Therefore, an attempt was made to investigate the soil microbial characteristics along with enzyme activities in Finger millet – maize crop sequence.

MATERIALS & METHODS

Field experiments were conducted at the Zonal Agricultural Research Station, Gandhi Krishi Vigyan Kendra, University of Agricultural Sciences, Bangalore during *kharif* (finger millet) and *Rabi* seasons of 1999 - 2000 and 2000 – 2001. The experiment consisted of eleven treatments involving organics, inorganic and amendments and it was laid out in Randomized Complete Block design with four replications. The gross plot size was 16 mt X 9 mt and finger millet was sown during kharif followed by Maize during rabi in cropping sequence. Recommended cultural operations implemented for both crops. Recommended fertilizer dose adopted for fingermillet was 100:50:50kg NPK /ha and for maize 150:75:40kg NPK /ha. Urea was used as a source of nitrogenous fertilizer, Single Super Phosphate (except T9) and DAP (only T9) as a source of P fertilizer and muriate of potash as potassium source. For treatments that included FYM it was supplied to respective plots at 10 tons /ha to first crop (fingermillet) in fingermillet – maize crop sequence. The same thing holds good in case of treatments which included lime and lime was incorporated much before application of FYM and it was applied based on lime requirement. The necessary growths as well as yield observations were collected at different growth stages and harvest. For estimation of Urease activity method adopted was that of Watts and Crisp (1954) and for Phosphatase was that of Tabataboi and Bremner (1969) and for dehydrogenase procedure outlined by Casido *et al*. (1964) was adopted.

The data was analyzed for individual years as well as pooled analysis for both the years and results are discussed based on the pooled data only. Fischer's method of analysis of variance was applied for the analysis and interpretation of the data as given by Panse and Sukhatme (1967).

RESULTS & DISCUSSION

Microbial biomass Carbon content (µ / g soil)

In the present investigation, microbial biomass C content in soil (Table -1) was found to be relatively higher in the plots amended with both FYM and lime (T10), FYM (T8) and lime (T5) as compared to the plots treated with only chemical fertilizers after finger millet and maize harvests.

The reasons for increased microbial biomass C due to liming could be attributed to the increased soil pH and favourable atmosphere created in the soil for the activity of all groups of micro-organisms. Farm Yard Manure besides being a good source of carbon and nutrients is also responsible for increasing the organic matter status of the soil. This could be one of the important reasons for relatively higher microbial biomass C content observed in FYM amended plots. These results are in conformity with the reports of Kamalesh *et al.* (1991) and Collins *et al.* (1992).

TABLE 1: Microbial biomass Carbon content (µ / g soil) as influenced by integrated nutrient supply and management in finger millet – maize crop sequence

Treatments	Microbial biomass Carbon content (g) (After finger millet)			Microbial biomass Carbon content (g) (After Maize)		
	1999 -2000	2000 -2001	Pooled	1999-2000	2000-2001	Pooled
T1: 50% Recommended NPK	186.50	187.50	187.25	175.50	175.75	175.62
T2: 100% Recommended NPK	196.50	200.00	198.50	190.50	192.50	191.50
T3: 150% Recommended NPK	226.50	227.75	227.25	207.50	209.00	208.75
T4:Recommended NPK+ Hand weeding	199.50	200.25	200.00	194.00	194.50	194.25
T5: 100% NPK + Lime	290.75	291.75	291.25	279.50	281.75	281.00
T6: 100% NP	184.50	186.75	182.25	175.50	176.50	176.00
T7: 100% N	187.50	181.00	184.25	183.00	182.50	182.75
T8: 100% NPK + FYM	291.00	293.50	292.25	290.50	291.00	291.25
T9: 100% NPK (S free)	201.75	204.50	203.25	180.75	182.25	181.50
T10: 100% NPK + FYM + Lime	294.25	297.50	296.00	303.00	304.50	303.75
T11: Control	170.50	172.50	171.75	158.25	160.50	159.50
S. Em+	0.661	0.674	0.773	0.709	0.645	0.584
CD @5%	1.923	1.946	2.260	2.049	1.862	1.686

Urease activity (µ urea hydrolyzed / g / hour)

It was revealed from the data that Urease activity (Table -2) was comparable among the several treatments after finger millet and maize harvests except in control and N alone plots (4.51). Higher Urease activity was correlated with higher microbial population in plots of T5, T8, T10 and T3 treatments. Furthermore, the liming of T5 soils resulted in increased pH and improved biological activity thus contributing to higher Urease activity. The results are in conformity with the findings of Kiss *et al*. (1975) and Balasubramanian *et al*. (1975).

TABLE 2: Urease activity (µ urea hydrolyzed / g / hour) as influenced by integrated nutrient supply and management in finger millet – maize crop sequence

Treatments	Urease activity (µ urea hydrolyzed / g / hour) (After finger millet)			Urease activity (µ urea hydrolyzed / g / hour) (After Maize)		
	1999 -2000	2000 -2001	Pooled	1999-2000	2000-2001	Pooled
T1: 50% Recommended NPK	147.85	148.60	148.23	149.75	150.61	150.18
T2: 100% Recommended NPK	150.61	151.25	151.05	152.77	153.67	153.22
T3: 150% Recommended NPK	158.01	158.37	158.19	159.42	160.36	159.89
T4:Recommended NPK+ Hand weeding	130.76	131.07	130.67	132.08	133.11	132.60
T5: 100% NPK + Lime	160.65	161.38	161.02	162.20	163.31	162.76
T6: 100% NP	151.19	152.16	151.68	152.12	152.89	152.50
T7: 100% N	64.40	65.40	64.90	66.33	66.36	66.35
T8: 100% NPK + FYM	157.94	157.68	157.83	158.72	159.67	159.20
T9: 100% NPK (S free)	150.91	151.45	151.06	152.39	153.46	153.14
T10: 100% NPK + FYM + Lime	161.18	162.22	161.70	163.20	164.11	163.65
T11: Control	51.11	52.60	51.86	53.08	54.46	53.77
S.Em+	0.171	0.277	0.240	0.415	0.280	0.312
CD @5%	0.499	0.810	0.701	1.214	0.820	0.913

Dehydrogenase activity (µ TPF / g soil)

Significantly higher Dehydrogenase activity (table -3) was recorded in soil with plots amended with FYM (T8), lime (T5) and both FYM and lime (T10), while the lowest activity was measured in control and N alone plots after finger millet and maize experiments. The corresponding values of total microbial bio mass for limed plots, N alone and control plots after both finger millet and maize experiments appeared to be correlated well with the Dehydrogenase activities and this is in agreement with McLaren and Peterson (1967) who noticed correlation between Dehydrogenase activity and the microbial activity in the soil. The higher Dehydrogenase activity with T8, T5 and T10 could be related to the increased soil pH and consequent congenial atmosphere created there upon for the micro – organisms to become very active.

TABLE 3: Dehydrogenase activity (µ TPF / g soil) as influenced by integrated nutrient supply and management in finger millet – maize crop sequence

Treatments	Dehydrogenase activity (µ TPF / g soil) (After finger millet)			Dehydrogenase activity (µ TPF / g soil) (After Maize)		
	1999 -2000	2000 -2001	Pooled	1999-2000	2000-2001	Pooled
T1: 50% Recommended NPK	66.54	65.57	66.18	60.31	61.08	60.70
T2: 100% Recommended NPK	68.99	69.26	69.13	63.79	65.25	64.52
T3: 150% Recommended NPK	70.93	70.77	70.85	66.02	67.46	66.74
T4:Recommended NPK+ Hand weeding	63.74	64.51	64.13	62.08	63.07	62.58
T5: 100% NPK + Lime	72.59	73.03	72.82	77.49	78.54	78.02
T6: 100% NP	58.19	58.80	58.50	56.92	57.16	57.04
T7: 100% N	55.77	55.45	55.61	51.77	52.61	52.19
T8: 100% NPK + FYM	72.73	73.22	72.98	69.09	70.97	70.03
T9: 100% NPK (S free)	61.58	61.84	61.81	58.10	59.05	58.58
T10: 100% NPK + FYM + Lime	80.25	80.62	80.42	81.44	82.50	81.97
T11: Control	52.03	51.96	51.99	50.45	51.22	50.84
S.Em+	0.591	0.587	0.534	0.462	0.482	0.298
CD @5%	1.807	1.696	1.544	1.336	1.392	0.861

Phosphatase activity (µ PNP/ g soil)

In the present investigation, acid Phosphatase activity in the soil (table - 4) was found to be maximum with FYM applied (T8 and T10) and lime amended plots (T5) after finger millet and maize experiments (4.50). It was also observed that the activity of Phosphatase enzyme in the soil was decreased with the application of NPK fertilizers at increased levels (T3). It is reported by many workers that readily available forms of phosphorus in the soil hindered the activity of micro-organisms responsible for the Phosphatase activity by catabolic repression.

TABLE 4: Phosphatase activity (µ PNP/ g soil) as influenced by integrated nutrient supply and management in finger millet – maize crop sequence

Treatments	Phosphatase activity (µ PNP/ g soil) (After finger millet)			Phosphatase activity (µ PNP/ g soil) (After Maize)		
	1999 -2000	2000 -2001	Pooled	1999-2000	2000-2001	Pooled
T1: 50% Recommended NPK	179.47	181.86	180.60	180.44	181.70	181.32
T2: 100% Recommended NPK	175.20	175.46	175.21	177.80	179.35	178.58
T3: 150% Recommended NPK	176.36	176.73	176.53	177.12	177.89	177.51
T4:Recommended NPK+ Hand weeding	179.30	180.41	179.85	180.24	181.19	180.71
T5: 100% NPK + Lime	197.10	196.57	196.83	186.07	188.72	187.39
T6: 100% NP	171.58	171.45	171.51	170.04	170.27	170.16
T7: 100% N	158.84	161.15	159.99	156.89	160.42	158.66
T8: 100% NPK + FYM	197.31	198.81	198.06	194.39	195.01	194.70
T9: 100% NPK (S free)	173.06	175.21	174.14	164.05	164.18	164.12
T10: 100% NPK + FYM + Lime	226.13	229.84	227.99	206.77	209.03	208.05
T11: Control	153.84	156.30	155.08	156.14	156.68	156.41
S.Em+	0.604	0.767	0.454	0.726	0.654	0.520
CD @5%	1.745	2.240	1.325	2.097	1.890	1.520

CONCLUSION

Thus, it is quite natural that the activities of enzymes would increase with the creation of favorable atmosphere in the soil for the growth and multiplication of micro-organisms involved. Application of lime as well as FYM has been reported to bring an ideal condition in soil for the growth and multiplication of various kinds of micro-organisms.

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