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EFFECT OF ADDING NITROGEN IN COMBINATION WITH MnO_2 ON THE GROWTH, YIELD AND COMPOSITION OF RICE

K. HARIKRISHNAN NAIR and M. M. KOSHY
Division of Soil Science & Agrl. Chemistry,
College of Agriculture, Vellayani

Various chemical and bio-chemical changes are taking place in submerged paddy soils. As a result of this many reduced substances are formed and some of them influence the development or activity of rice roots. Ponnamperuma *et al.* (1966) observed the beneficial effect of MnO_2 along with 0.4 per cent $CaCO_3$ in the growth and development of rice. The present investigation was undertaken with a view to evaluate the effect of nitrogen and MnO_2 on the growth, yield and chemical composition of rice.

Materials and Methods

A pot experiment was laid out in a $4^2 x 3$ randomized block design with four levels of nitrogen (30, 60, 90 and 120 kg N/ha in the form of ammonium sulphate) and four levels of MnO_2 (0, 20, 40 and 60 kg Mn/ha) in three replications. P_2O_5 and K_2O in the form of superphosphate and muriate of potash respectively to supply 60 kg/ha each and dolomite @ 1000 kg/ha were added. Vellayani sandy loam soil was used for the study. The rice variety used was Annapurna. Bio-metric measurements were periodically recorded. The grain and straw were analysed for N, P_2O_5, K_2O, CaO and MgO contents as per standard procedures.

Results and Discussion

The effect of nitrogen on height and tiller production was significant. Increase in height was noted due to MnO_2 application. The interaction between nitrogen and MnO_2 had no significant influence on these parameters (Table 1).

The increase in height may be due to the effect of Mn on the various enzyme systems involved in photosynthesis and in chlorophyll production as reported by Mallette *et al.* (1960). The effect of MnO_2 and the interaction between MnO_2 and N on tiller production were not significant. Similar results were reported by Oshima (1962) and Patnaik *et al.* (1966).

The data on grain yield (Table 2) show that N at 120 kg/ha and MnO_2 at 60 kg Mn/ha recorded maximum grain yield. The combined effect of N and MnO_2 was satistically insignificant. Generally, addition of N and Mn, increases grain yield of rice as N, the major nutrient and Mn, the micro-nutrient. Ponnamperuma *et al.* (1966) reported an increase in the yield of rice by the application of MnO_2. with regard to straw yield, the same trend was

Table 1
Growth characteristics of rice

Treatments		Height (cm)	Total No. of tillers per plant	No, of productive tillers per plant	% of productive tillers per plant
Mn (kg/ha)	N (kg/ha)				
0	30	55,0	8.33	6.33	76.00
	60	57.0	9.67	7.00	72.38
	90	59.0	11.00	8.00	72.72
	120	61.0	13.33	8.33	60.00
	Mean	58.0	10.58	7.42	70.28
20	30	56.0	8.00	6.33	79.2b
	60	58.0	9.33	7.33	77.78
	90	58.0	11.67	7.33	62.80
	120	66.0	11.00	8.33	75.72
	Mean	59.5	10.00	7.33	73.89
40	30	60.0	9.00	6,35	70.49
	60	59.0	10.00	7.31	73.10
	90	63.0	10.00	7.32	73.20
	120	63.0	11.67	9.00	77.12
	Mean	61.3	10.17	7.50	73.48
60	30	60.0	8.33	5.67	68.03
	60	61.0	9.00	6.65	73.82
	90	63.0	11.33	7.00	61.94
	120	66.0	11.33	9.00	79.65
	Mean	62.5	10.00	7.08	70.87
All levels	30	57.8	8.42	6.17	73.56
	60	58.8	9.50	7.07	74.27
	90	60.8	11.33	7.91	67.67
	120	64.0	12.83	8.67	73.12
	Mean	60.4	10.52	7.46	72.13
C. D. (0.05) for N or Mn.			1.646	0.743	0.790
C, D. (0,01)			2.217	1.001	1.064

observed for N, MnO_2 and the combination between them. Incremental doses of N and MnO_2 increased the growth of plant and in turn the straw **yield.** The grain-straw ratio and one thousand grain weight were not influenced by the treatments.

Table 2
Yield characteristics of rice

Treatment		Yield of grain/pot (g)	Yield of straw/pot (g)	Grain straw ratio	Thousand grain weight
Mn kg/ha.	N kg/ha.				
0	30	19.93	17.50	1.13	23.50
	60	23.61	23.17	1.02	23.47
	90	25.72	24,15	1.07	22.32
	120	27.90	25.47	1.09	22.66
	Mean	24.29	22.57	1.08	22.74
20	30	24.30	17.57	1.39	23.32
	60	23.44	19.95	1.16	23.71
	90	32.67	21.02	1.55	2248
	120	28.87	29.02	0.99	22.78
	Mean	27.32	21.84	1.27	23.07
40	30	19.57	18.97	1.03	22.72
	60	26.57	21.03	1.26	22.99
	90	34.55	20.05	1.72	23.03
	120	37.74	33.53	1.13	22.94
	Mean	29.61	23.40	1.29	22.92
60	30	28.67	20.70	1.39	23.01
	60	31.00	22.00	1.41	22.67
	90	38.30	22.15	1.73	22.84
	120	44.54	32.53	1.37	23.46
	Mean	35.63	24.35	1.48	23.46
All levels	30	25.38	18.69	1.33	23.21
	60	27.97	21 54	1.33	23.21
	90	35.27	21.84	1.64	22.67
	120	38.22	30.14	1.28	22 96
	Mean	31.71	22 99	1.40	23.00
C. D. (0.05) for N or Mn		1.276	3.482	—	—
C. D. (0.01) for N or Mn		1.719	4.689	—	—

The nitrogen content of grain (Table 3) was influenced significantly by increased doses of N, MnO_2 and their interaction. This observation is in partial agreement with the finding of Fujiwara (1959) who reported that Mn participates in N metabolism. The K_2O content of grain was unaffected by N unlike MnO_2 and N x MnO_2 treatments. The treatments had no effects on the K_2O content of grain. N and MnO_2 had significant effect on the CaO content, while nitrogen did not influence the MgO content in grain. However, significant results were

obtained for MnO_2 and the interaction between N and MnO_2. MgO content tended to decrease with increasee in the levels of MnO_2.

Table 3

Chemical composition of grain

Treatment		N	P_2O_5	K_2O	CaO	MgO
Mn kg/ha	N kg/ha	%	%	%	%	%
0	30	1.32	0.27	0.74	0.15	0.068
	60	1.43	0.26	0.76	0.16	0.082
	90	1.68	0.30	0.81	0.16	0.090
	120	1.74	0.31	0.81	0.14	0 099
	Mean	1.56	0.29	0.78	0.15	0.085
20	30	1.33	0.38	0.71	0.14	0,088
	60	1.58	0.41	0.70	0.15	0,069
	90	1.88	0.41	0.80	0.16	0.070
	120	1.93	0.42	0.77	0.14	0.065
	Mean	1.68	0.41	0.75	0.15	0.073
40	30	1.34	0.45	0.81	0.13	0.063
	60	1.58	0.44	0.75	0.08	0.061
	90	1.74	0.42	0.81	0.14	0.056
	120	1.90	0.57	0.80	0.14	0.050
	Mean	1.73	0.47	0.79	0.12	0.058
60	30	1.57	0.57	0.72	0.12	0.057
	60	1.65	0.55	0.74	0.12	0.051
	90	1.96	0.56	0.70	0.11	0.056
	120	2.07	0.56	0.76	0.11	0.051
	Mean	1.81	0.56	0.73	0.12	0.054
All levels	30	1.39	0.42	0.75	0.14	0.069
	60	1.57	0.42	0.74	0.13	0.006
	90	1.76	0.47	0.78	0.14	0.068
	123	1.91	0.47	0.79	0.13	0.066
	Mean	1.66	0.43	0.77	0.14	0067
C.D. (0.05) for N or Mn		0.061	0.020	—	0.003	0.0084
C.D. (0.01) for N or Mn		0.082	0.027	—	0.004	0.0041
C.D. (0.05) for N x Mn		0.016	0.074	—	0.007	0.0167
C.D. (0.01) for N x Mn		0.092	0.099	—	0.010	0.0223

The level of nitrogen in straw (Table 4) was influenced by N and MnO_2. The effect of MnO_2 on the P_2O_5 content of the straw was statistically significant but not for N and interaction between N and MnO_2. The K_2O content in straw was little influenced by the treatments. The MnO_2 had significant response on

Table 4
Chemical composition of straw

Treatment						
Mn kg/ha	N kg/ha	N %	P_2O_5 %	K_2O %	CaO %	MgO %
0	30	1,20	0.28	2.41	0.73	0.20
	60	1.20	0.28	2.27	0.83	0.21
	90	1.23	0.31	2.59	0.73	0.23
	120	1.29	0 30	1.72	0.73	0.20
	Mean	1.23	0.29	2,25	0.76	0.21
20	30	1 09	0 30	2.41	0.73	0.25
	60	1.18	0.31	2,32	0.73	0.19
	90	1.54	0.31	2.51	0.73	0.13
	120	1.62	0 32	2,27	0.63	0.17
	Mean	1.36	0.31	2.38	0.71	0.19
40	30	1.65	034	2.53	0.72	0.19
	60	1.71	0.31	2,47	0.67	0.16
	90	1.76	0.35	2.62	0.72	0.17
	120	1,85	0.40	2.50	0.62	0.15
	Mean	1.74	0,35	2,53	0.68	0.17
60	30	1.76	0.38	2.11	0.62	0.09
	60	1.85	0.38	2.23	0.62	0.12
	90	2.02	0.32	1,92	0.62	0.11
	120	2.30	0.39	2.60	0.62	0.14
	Mean	1.98	0.37	2.22	0.62	0.12
All levels	30	1.43	0.33	2.37	0.70	0.18
	60	1.49	0.32	2.32	0 71	0.17
	90	1.63	0.32	2.41	0,70	0.16
	120	1.77	0.35	2.27	0.65	0.17
	Mean	1.58	0,33	2.34	0.69	0.17
C. D. (0.05) for N x Mn		0135	—	—	—	0.102
C. D. (0.01) for N x Mn		0.183	—	—	—	—
C. D. (0.05) for N or Mn		0.068	0.032	—	0.025	0.016
C. D. (0.01) for N or Mn		0.091	0.043	—	00.33	0.021

സംഗ്രഹം

നെല്ലിന് നൈട്രജൻ, മാൻഗനീസ്ഡൈഓക്സൈഡ് ഇവ കൊടുത്തപ്പോൾ ചെടിയുടെ പൊക്കവും ധാന്യോൽപാദനവും വർദ്ധിച്ചതായും, നൈട്രജൻ മാത്രമായപ്പോൾ വൈക്കോലുൽപാദനം വർദ്ധിച്ചതായും കണ്ടു. മാൻഗനീസ്ഡൈഓക്സൈഡ് മാത്രവും അത് നൈട്രജനുമായി ചേർന്നപ്പോഴും വൈക്കോൽലുൽപാദനത്തിൽ ഒരു ഫലവും ഉണ്ടായില്ല. നെല്ല്, വൈക്കോൽ ഇവയുടെ അനുബന്ധത്തിനും വ്യത്യാസം സംഭവിച്ചില്ല. നൈട്രജനും മാൻഗനീസ്ഡൈഓക്സൈഡിനും നെൽമണിയിലേയും, വൈക്കോലിലേയും നൈട്രജന്റെ അംശത്തെ വർദ്ധിപ്പിക്കാൻ കഴിഞ്ഞപ്പോൾ ഫാസ്ഫറസിന്റെ അംശത്തെ മാൻഗനീസ്ഡൈഓക്സൈഡ് കൊണ്ടുമാത്രമേ വർദ്ധിപ്പിച്ചുള്ളൂ. മാൻഗനീസ്ഡൈഓക്സൈഡ് കൂട്ടി കൊടുത്തപ്പോൾ നെൽമണിയിലേയും വൈക്കോലിലേയും കാൽസ്യം ഓക്സൈഡിന്റെയും, മെഗ്നീഷ്യം ഓക്സൈഡിന്റെയും അംശം കുറഞ്ഞതായും കണ്ടു.

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