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EFFECT OF SIMAZINE AND ATRAZINE ON THE MINERALIZATION OF FERTILIZER AND MANURE NITROGEN

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SUMMARY

Laboratory experiments were carried out with alluvial sandy loam soil to study the effect of simazine and atrazine herbicides at four levels (0.5, 1.0, 1.5 and 2.0 kg/ha) on the mineralization of nitrogen (ammoniacal and nitrate production) from fertilizer urea and sludge sources. The herbicides stimulated nitrate production. No specific trend in total mineralized nitrogen, ammoniacal and nitrate nitrogen was observed by varying the levels of herbicides. Mineralization of total nitrogen (ammoniacal and nitrate nitrogen) in presence of simazine and atrazine from the different sources in the descending order was:

Urea > Sludge + Urea > Sludge > No Nitrogen.

INTRODUCTION

A large number of herbicides are directly or indirectly added to soil to control weeds. Besides achieving the main objective of destroying a particular weed, these often have side effects on sensitive soil microorganisms like nitrifiers by reducing their activity. Recently Prasad *et al.*[4] have reviewed the effect of agricultural chemicals on nitrification. In the present study simazine and atrazine have been tested for their effects on mineralization of urea and sludge manure nitrogen in laboratory experiments.

MATERIALS AND METHODS

Sandy loam soil from the Indian Agricultural Research Institute farm with pH: 7.9; electrical conductivity: 0.40 mmho/cm; cation exchange capacity:

9.6 me/100 g; organic carbon: 0.23 per cent; ammoniacal nitrogen: 2 mg/kg; nitrate nitrogen: 3 mg/kg; available P: 36 kg/ha; available K: 319 kg/ha was used for incubation studies.

Simazine and atrazine were applied at four levels *viz* 0.5, 1.0, 1.5, and 2.0 kg active ingredient/ha and nitrogen at the rate of 200 ppm (440 kg N/ha soil) through sludge, sludge + urea and urea. Control treatments were kept for nitrogen in addition to the control for herbicides. Herbicides were applied in the form of water suspension from the 50 per cent wettable powder formulations. The sludge used contained 1.0 per cent nitrogen.

Soils in lots of 250 g each was throughly mixed with the calculated amounts of the herbicides and the nitrogen source (urea was applied in water solution) as per the treatments and incubated for 90 days in wide mouth bottles at 25 ± 2°C at field capacity moisture level.

Representative 25-g soil samples from each treatment were drawn at 15, 30, 45, 60, 75, and 90 days and analysed for ammoniacal and nitrate nitrogen following distillation method (Jackson[2]). The magnesium oxide and Devarda's alloy were used to distill ammoniacal and nitrate nitrogen respectively from the same sample. All the samples were analysed in duplicate and the results reported are the average of these and expressed as mg of ammoniacal and nitrate nitrogen per kg of the soil.

RESULTS AND DISCUSSION

A. Effect of herbicides on production of ammoniacal and nitrate nitrogen

The results presented in Fig. 1–6 show that in general, application of simazine as well as atrazine increased the total amount of ammoniacal + nitrate nitrogen produced as compared to the untreated soils. The increase was about two times in 15 days. The treated soil remained a better source of total nitrogen mineralized throughout the period of the study. The increase in the dose of the herbicides did not show any specific trend in the mineralization of nitrogen and these chemicals even at 2.0 kg/ha level did not affect adversely the total mineralization of nitrogen and nitrate production over control at all the stages. The ammonium content was found to be lower by

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Figs. 1–6. Effect of simazine and atrazine on ammonium and nitrate nitrogen production.

Key: o – – – o Control
△ – – – △ 0.5 kg/ha
□ – – – □ 1.0 kg/ha
○ – – – ○ 1.5 kg/ha
× – – – × 2.0 kg/ha

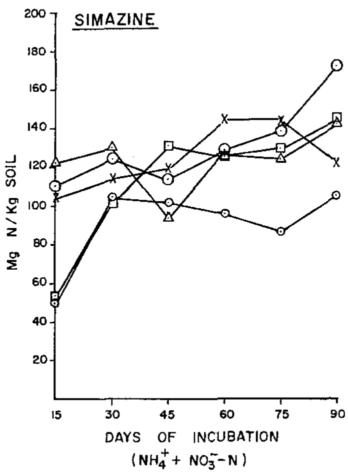


Fig. 1

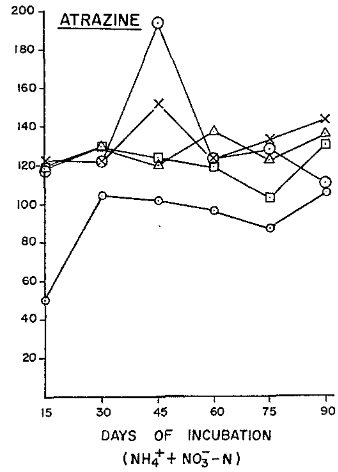
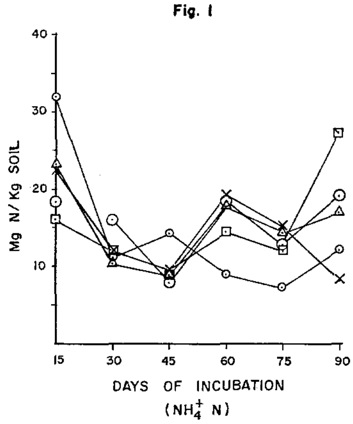


Fig. 2



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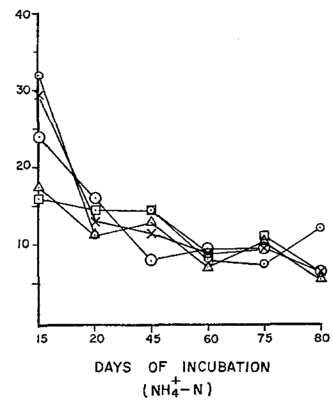

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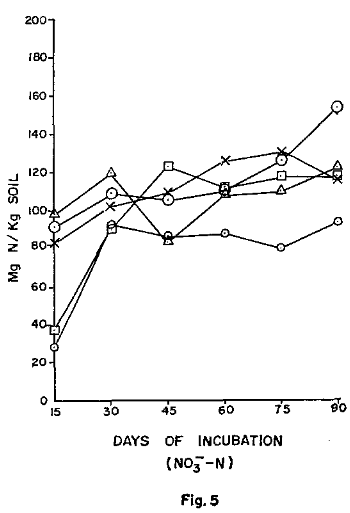

Fig. 5

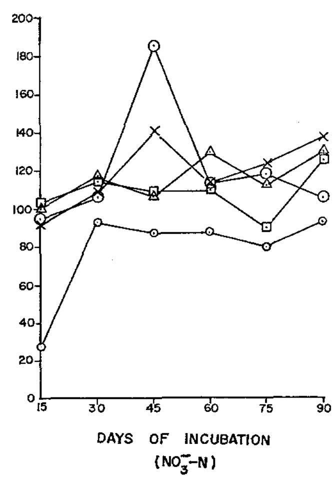

Fig. 6

the application of herbicides in the various stages, probably because of faster conversion of ammonium to nitrate.

Production of nitrate too was stimulated by various dosages of herbicides over control. The effect was more prominent during the early days of incubation and the amount of nitrate nitrogen was approximately three times more in case of soils treated with herbicides than the soils receiving no herbicides at 15 days analysis. Furthermore even at 90 days the herbicide treated soils were better source of nitrate than the control. No specific trend was noted in nitrate production by increasing the levels of the herbicides. The effect, however, remained unchanged irrespective of the herbicide. The differences for nitrate content due to different levels of the herbicides at different stages of incubation were found to be statistically significant.

B. Effect of the sources of nitrogen on production of ammoniacal and nitrate nitrogen

Urea nitrogen mineralized faster than the sludge nitrogen or its combination with urea. The results in the descending order with respect to the total amount of ammoniacal + nitrate nitrogen produced were:

Urea > Sludge + Urea > Sludge > No Nitrogen.

The production of ammoniacal nitrogen did not show any definate trend with the change in the nitrogen source from sludge to urea or their combination but as such the soil receiving urea nitrogen produced more cationic nitrogen over control and other sources of nitrogen (Fig. 7–12). A similar order was noticed on comparison of ammoniacal + nitrate nitrogen produced in presence of herbicides in treated and untreated manured soil. The differences were statistically significant.

Figs. 7–12. Mineralization of fertilizer and manure nitrogen in presence of simazine and atrazine

Index: ○– – –○ No nitrogen
△– – –△ Sludge-N
□– – –□ Sludge + urea-N
●– – –● Urea-N

SIMAZINE

ATRAZINE

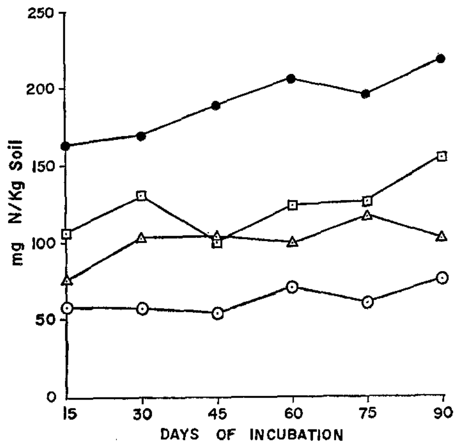

Fig. 7 $(NH_4^+ + NO_3^-)$-N

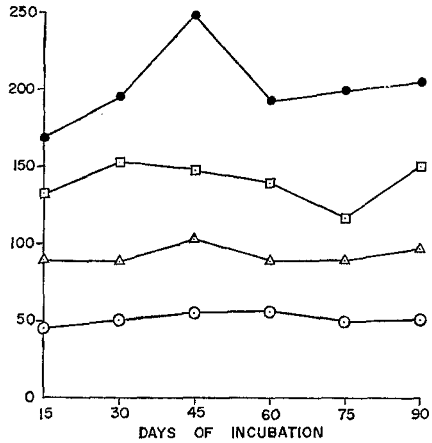

Fig. 8 $(NH_4^+ + NO_3^-)$-N

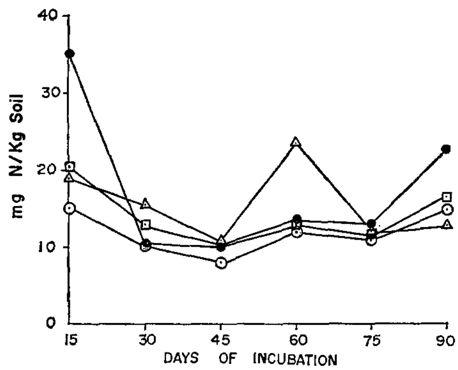

Fig. 9 $(NH_4^+$-N)

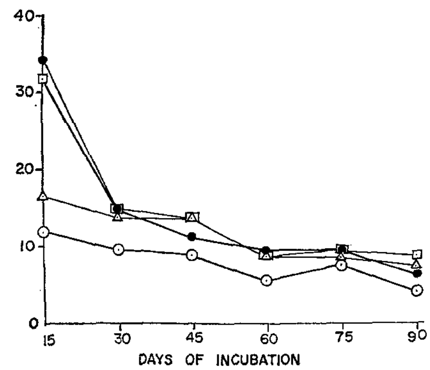

Fig. 10 $(NH_4^+$-N)

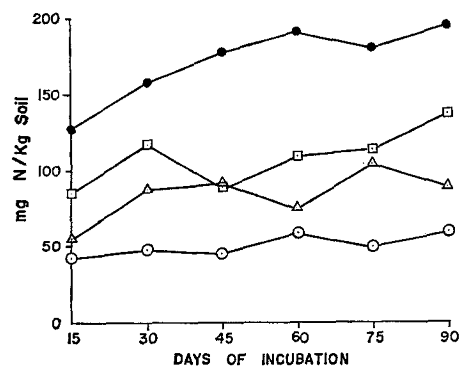

Fig. 11 $(NO_3^-$-N)

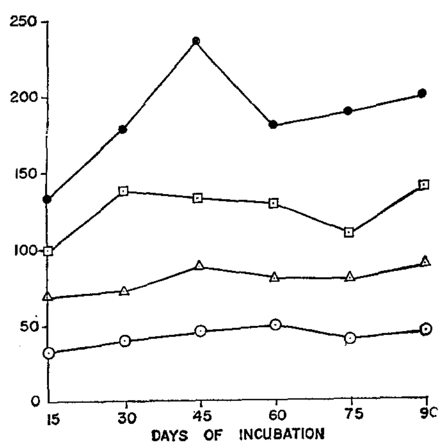

Fig. 12 $(NO_3^-$-N)

TABLE 1(a)

Effect of varying levels of herbicides on mineralization of nitrogen in sludge, urea and their combination

Herbicide level (kg/ha)	No nitrogen						Sludge nitrogen					
	Days of incubation											
	15	30	45	60	75	90	15	30	45	60	75	90
Simazine												
0.5 Ammoniacal	22.4	6.4	9.6	19.2	12.6	12.8	21.1	12.8	9.6	22.4	16.0	12.8
Nitrate	41.6	51.2	44.8	41.6	38.4	51.2	70.4	112.0	60.8	67.2	79.9	78.4
Total	64.0	57.6	54.4	60.8	51.2	64.0	91.5	124.8	70.4	89.6	95.9	83.2
1.0 Ammoniacal	12.8	19.2	12.8	12.8	16.0	12.8	16.0	9.6	6.4	22.4	9.6	12.8
Nitrate	76.8	80.0	64.0	137.6	99.2	86.4	96.0	137.6	182.4	65.4	140.8	134.4
Total	89.6	99.2	76.8	150.4	115.2	99.2	112.0	147.2	188.8	87.8	150.4	147.2
1.5 Ammoniacal	6.4	9.6	3.2	19.2	12.8	38.4	16.0	22.4	9.6	22.4	12.8	12.8
Nitrate	41.6	45.8	51.2	54.4	54.4	64.0	67.2	60.8	64.0	83.2	102.4	96.0
Total	48.0	55.4	54.4	73.6	67.2	102.4	83.2	83.2	73.6	105.6	115.2	108.8
2.0 Ammoniacal	12.8	9.6	9.6	9.6	16.0	6.4	22.4	16.0	9.6	38.4	16.0	9.6
Nitrate	38.4	44.8	41.6	57.6	48.0	64.0	32.0	73.6	86.4	89.6	134.4	76.8
Total	51.2	54.4	51.2	67.2	64.0	70.4	54.4	89.6	96.0	128.0	150.4	96.4
Atrazine												
0.5 Ammoniacal	traces	6.4	12.8	6.4	9.6	3.2	16.0	9.6	9.6	9.6	9.6	6.4
Nitrate	22.4	41.6	38.4	83.2	48.0	44.8	96.0	102.4	76.8	108.8	73.6	76.8
Total	22.4	48.0	51.2	89.6	57.6	48.0	112.0	112.0	86.4	118.4	83.2	83.2
1.0 Ammoniacal	16.0	9.6	12.8	3.2	9.6	6.4	19.6	12.8	16.0	9.6	9.6	6.4
Nitrate	38.4	51.2	51.2	48.0	35.2	44.8	67.2	83.2	83.2	60.8	105.6	83.2
Total	54.4	60.8	64.0	51.2	44.8	51.2	86.8	96.0	99.2	74.0	115.2	89.6
1.5 Ammoniacal	9.6	12.6	3.2	9.6	6.4	6.4	19.2	16.0	12.8	6.4	12.8	6.4
Nitrate	44.8	48.0	48.0	60.8	51.2	54.4	96.0	54.4	134.4	86.4	83.2	80.0
Total	54.4	60.8	51.2	70.4	57.6	60.8	115.2	70.4	147.2	92.8	96.0	86.4
2.0 Ammoniacal	12.8	12.8	9.6	9.6	9.6	3.2	9.6	16.0	12.8	6.4	6.4	6.4
Nitrate	44.8	48.0	64.0	60.8	54.4	51.2	73.5	70.4	83.2	80.0	76.8	134.4
Total	57.6	60.8	73.6	70.4	64.0	54.4	83.2	86.4	96.0	86.4	83.2	140.8
Control Ammoniacal	22.4	6.4	6.4	traces	6.4	3.2	19.2	16.0	19.2	12.8	6.4	16.0
Nitrate	16.0	16.0	28.0	3.2	12.8	29.8	19.2	57.6	67.2	73.6	67.2	73.6
Total	38.4	22.4	35.2	3.2	19.2	33.0	38.4	73.6	86.4	86.4	73.6	89.6

Table 1(a) (*continued*)

Herbicide level (kg/ha)	Sludge + urea nitrogen						Urea nitrogen					
	Days of incubation											
	15	30	45	60	75	90	15	30	45	60	75	90
Simazine												
0.5 Ammoniacal	25.6	12.8	9.6	16.0	16.0	25.6	25.6	9.6	6.4	12.8	12.8	16.0
Nitrate	137.6	121.6	64.0	131.2	137.6	142.2	147.2	195.2	166.4	198.4	185.6	230.4
Total	163.2	134.4	73.6	147.2	153.6	167.8	172.8	204.8	172.8	211.2	198.4	246.4
1.0 Ammoniacal	6.4	6.4	9.6	6.4	9.6	16.0	28.8	12.8	9.6	16.0	12.8	67.2
Nitrate	41.6	44.8	44.8	54.4	44.8	44.8	150.4	98.4	195.2	192.0	188.8	204.8
Total	48.0	51.2	54.4	60.8	54.4	60.8	179.2	111.2	204.8	208.0	201.6	272.0
1.5 Ammoniacal	16.0	19.2	9.6	19.2	12.8	16.0	35.2	12.8	9.6	12.8	12.8	9.6
Nitrate	108.8	134.4	112.0	118.4	153.6	230.4	150.4	195.2	192.0	185.6	195.2	227.2
Total	124.6	153.6	121.6	137.6	166.4	226.4	185.6	208.0	201.6	198.4	208.0	236.8
2.0 Ammoniacal	16.0	12.8	9.6	12.8	12.8	6.4	38.4	9.6	9.6	16.0	16.0	9.6
Nitrate	108.8	121.6	118.4	144.0	147.2	150.4	153.6	172.8	192.0	211.2	188.8	169.6
Total	124.8	134.4	128.0	156.8	160.0	156.8	192.0	182.4	201.6	227.2	204.8	179.2
Atrazine												
0.5 Ammoniacal	35.2	12.8	12.8	6.4	9.6	6.4	19.2	16.0	16.0	9.6	12.6	6.4
Nitrate	124.8	126.6	137.6	131.2	144.0	153.6	160.0	198.4	176.0	198.0	185.6	130.4
Total	160.0	139.4	150.4	137.6	153.6	160.0	179.2	214.4	192.0	207.5	198.4	136.8
1.0 Ammoniacal	12.8	19.4	16.0	9.6	12.8	6.4	16.0	16.0	12.8	6.4	12.8	6.4
Nitrate	131.2	118.4	128.0	140.4	16.0	121.6	179.2	208.4	176.0	192.0	208.0	125.0
Total	144.0	137.6	144.0	150.4	28.8	128.0	195.2	224.4	188.8	198.4	220.8	131.4
1.5 Ammoniacal	32.0	16.0	12.8	9.6	9.6	6.4	35.2	19.2	3.2	12.8	9.6	6.4
Nitrate	102.4	140.8	147.2	134.4	144.0	147.2	137.6	182.4	416.0	169.6	195.2	104.8
Total	134.4	156.8	160.0	144.0	153.6	153.6	172.8	201.6	419.2	182.4	204.8	111.2
2.0 Ammoniacal	41.6	12.8	12.8	9.6	12.8	9.6	54.4	12.8	9.6	12.8	6.4	6.4
Nitrate	105.6	137.6	147.2	137.6	153.6	156.8	147.2	172.8	268.8	179.2	212.2	137.6
Total	147.2	150.4	160.0	147.2	166.4	166.4	201.6	185.6	278.4	192.0	218.5	144.0
Control Ammoniacal	38.4	12.8	16.0	9.6	6.4	19.2	48.0	9.6	16.0	9.6	9.6	9.6
Nitrate	35.2	166.4	108.8	105.6	89.6	121.6	41.6	134.4	144.0	169.6	150.4	147.2
Total	73.6	179.2	124.8	115.2	96.0	140.8	89.6	144.0	160.0	179.2	160.0	156.8

TABLE 1(b)

C.D. values at 5%

Treatments	Ammonium + nitrate						Ammonium						Nitrate					
	15	30	45	60	75	90	15	30	45	60	75	90	15	30	45	60	75	90
Chemical	3.4	3.1	3.0	3.9	3.7	4.5	1.6	0.8	1.2	1.1	1.4	1.3	3.0	4.4	2.7	N.S.	3.1	3.9
Level	N.S.	4.4	4.2	5.5	5.2	6.3	2.2	1.2	1.7	1.5	N.S.	1.8	4.2	6.2	3.8	4.9	4.4	5.5
Nitrogen source	4.9	4.4	4.2	5.5	5.2	6.3	2.2	1.2	1.7	1.5	N.S.	1.8	4.2	6.2	3.8	4.9	4.4	5.5
Chemical × level	6.9	6.2	6.0	7.8	7.3	9.0	3.1	1.6	2.3	N.S.	2.7	2.6	6.0	8.7	5.4	6.9	6.2	7.7
Chemical × source	6.9	6.2	6.0	7.8	7.3	9.0	3.1	1.6	N.S.	2.1	2.7	2.6	6.0	8.7	5.4	6.9	6.2	7.7
	9.7	8.8	8.4	11.0	10.4	12.7	4.4	2.3	3.3	3.0	N.S.	3.7	8.4	12.3	7.6	9.8	8.7	10.9
Chemical × level × source	13.8	12.4	11.9	15.5	14.7	17.9	6.2	3.3	4.7	4.2	N.S.	5.2	11.9	17.4	10.7	13.8	12.3	15.4
Control *vs* Treated	13.8	12.4	11.9	15.5	14.7	17.9	6.2	3.3	4.7	4.2	5.39	N.S.	11.9	17.4	10.7	13.8	12.3	15.4
Between control	13.8	12.4	11.9	15.5	14.7	17.9	6.2	3.3	4.7	4.2	N.S.	5.2	11.9	17.4	10.7	13.8	12.3	15.4

C. The combined effect of various levels of herbicides and manures on production of ammoniacal and nitrate nitrogen

The perusal of results given in Table 1 shows that the application of both the herbicides resulted in approximately equal or increased production of ammonical + nitrate nitrogen in case of all the manures except at 30 days in sludge + urea combination. However, no specific trend was noted in case of ammoniacal nitrogen production with increasing levels of herbicides. The production of nitrate nitrogen was markedly enhanced by herbicide application over control. The maximum (ammonium + nitrate) nitrogen production was observed at 1.0 kg/ha level of simazine in all the nitrogen treatments except in the case of sludge plus urea treatment.

The stimulation of nitrate production as observed in the present investigation with the application of simazine and atrazine corroborate the findings[5 6] in which an increase in the rate of nitrification with simazine and atrazine treatments in the initial stages of incubation studies was recorded. There have been numerous reports[1 3] which tend to show that the triazines at normal rates of application do not affect nitrification adversely. The present study too tends to indicate that simazine and atrazine application either do not affect or stimulate nitrate production.

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