variability, heritability and genetic advance are comparatively high for primary branches, test weight and pods cluster. This suggests that these traits may be improved through selection.

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Effect of 2, 4-D on Mineralization of Nitrogen in Black Soils

In general, the herbicides applied at normal rates do not affect the mineralization of nitrogen in the soils. But under certain conditions, the herbicides could be detrimental to the ammonification or nitrification processes in soils. Fleig (1952) reported that the application of 2, 4-D had no effect on nitrification. But Treater *et al.* (1958) found that application of 2, 4-D at higher rates inhibited nitrification. According to Dakhanian and Kolosova (1962) 2, 4-D at 4 kg/ha increased nitrogen content of soil twice or thrice than the normal content. Castro (1964) observed that at normal rates of application, 2, 4-D did not reduce the nitrogen content of the soil. Bubey (1969) studied the effect of certain herbicides on nitrification in some tropical soils and reported that maximum inhibition of nitrification by the herbicides occurred in a soil of low nitrifying capacity while soils of normal field values had no effect. An incubation study was conducted to find out the effect of the herbicides 2, 4-D on the mineralisation of nitrogen in black soils, and the results are presented below.

The herbicide 2, 4-D was dissolved in sufficient water to bring the soil to approximately 60 per cent of the maximum water holding capacity. These solutions were added to the beakers containing the soils in such a manner as to moisten uniformly 250 g samples of air dry soils. Samples were replicated twice and incubated at room temperature.

At fortnightly intervals, representative samples were drawn and are shaken with distilled water for 30 minutes (1:20 soil water ratio adopted). The extracts were filtered. Ammoniacal nitrogen was determined by the method described by Shrikande (1941). Nitrate nitrogen was determined by disulphonic acid method described by Harpen (1924). Samples are analysed upto 90th day and the results are discussed.

In the untreated control soils, NO_3 was produced at a constant rate with an initial increase upto 45th day (Table 1). In the 2, 4-D treated soils, the increase in nitrate production was at a lesser rate upto 45th day. Thereafter, NO_3 production reduced considerably below the untreated soils, but as the rate of application of 2, 4-D increased, the effect on NO_3 production was not adverse.

TABLE 1. Nitrate nitrogen production with passage of time (ppm)

	Number of days after incubation						Mean
	15	30	45	60	75	90	
2, 4-D at 2 kg. in 450 lb water/ac.	0.80	3.20	10.00	1.60	2.10	2.10	3.30
do 4 kg. do	1.30	2.30	2.50	2.10	3.20	3.40	2.50
do 6 kg. do	1.60	1.60	4.20	3.40	4.90	5.40	2.50
2, 4-D at 2 kg + urea at 75 kg / N / ac.	2.10	6.00	20.00	8.90	4.90	5.10	7.80
do + $(NH_4)_2 SO_4$ do	6.30	5.10	16.20	8.90	4.20	3.80	7.62
do + $NaNO_3$ do	4.70	4.20	10.00	20.00	17.70	20.00	12.77
Urea at 75 kg N/ac.	5.60	8.20	13.50	10.00	10.00	10.00	9.60
Ammonium sulphate at 75 kg N/ac	6.20	5.00	16.20	16.70	16.20	15.00	12.62
Sod. Nitrate at 75 N/ac	4.20	9.50	16.20	30.00	30.00	30.00	19.98
Control	1.70	5.50	8.70	8.90	8.90	10.00	7.29

In general, the depression in nitrate production due to different doses of 2, 4-D was only temporary and is not statistically significant. Nitrate production in these soils was on par with the untreated soil.

In general, application of nitrogenous fertilizers increased nitrate production and the increase was more than that in unfertilised soil. Among the fertilized soils, soil which received sodium nitrate registered significantly higher nitrate content than soils fertilized with ammonium sulphate and urea.

When 2, 4-D was applied to the soils fertilized with any of the nitrogen

TABLE 2. Per cent nitrification

	No. of days after incubation											
	15		30		45		60		75		90	
	I	II	I	II	I	II	I	II	I	II	I	II
2, 4-D at 2 kg in 450 lb. water per/ac.	—0.90	—	—2.30	—	+1.10	+1.32	—7.30	—	—0.80	—	—7.90	—
do 4 do	—0.40	—	—2.20	—	—6.40	—	—6.80	—	—6.70	—	—6.60	—
do 6 do	—0.10	—	—3.90	—	—4.70	—	—5.50	—	—4.00	—	—4.60	—
2, 4-D at 2 kg+ Urea at 75 kg N/ac.	+0.40	+0.48	+0.30	+0.50	+11.10	+13.30	0.00	—	—4.00	—	—4.90	—
do + $(NH_4)_2 SO_4$ do	+4.60	+5.52	—0.40	—	+ 7.30	+ 8.76	0.00	—	—4.70	—	—6.20	—
do + $NaNO_3$ do	+3.00	+3.60	—0.30	—	+ 1.10	+ 1.32	—11.10	+13.30	+8.80	10.56	+10.00	12.00

I: Increase due to treatment

II: Per cent nitrogen nitrified

TABLE 2. Per cent nitrification

	No. of days after incubation											
	15		30		45		60		75		90	
	I	II	I	II	I	II	I	II	I	II	I	II
2, 4-D at 2 kg in 450 lb. water per/ac.	—0.90	—	—2.30	—	+1.10	+1.32	—7.30	—	—0.80	—	—7.90	—
do 4 do	—0.40	—	—2.20	—	—6.40	—	—6.80	—	—6.70	—	—6.60	—
do 6 do	—0.10	—	—3.90	—	—4.70	—	—5.50	—	—4.00	—	—4.60	—
2, 4-D at 2 kg+ Urea at 75 kg N/ac.	+0.40	+0.48	+0.30	+0.50	+11.10	+13.30	0.00	—	—4.00	—	—4.90	—
do + $(NH_4)_2 SO_4$ do	+4.60	+5.52	—0.40	—	+ 7.30	+ 8.76	0.00	—	—4.70	—	—6.20	—
do + $NaNO_3$ do	+3.00	+3.60	—0.30	—	+ 1.10	+ 1.32	—11.10	+13.30	+8.80	10.56	+10.00	12.00

I: Increase due to treatment

II: Per cent nitrogen nitrified

sources, production of nitrate improved and were more than from the soils which received only 2, 4-D. Ammonium sulphate was the best followed by sodium nitrate in the initial stages, but after thirty days urea was the best among the three. This type of delayed activity of urea may probably be due to the fact that urea requires a few more days for conversion of the amide form of nitrogen to the available nitrate form. After forty fifth day, both urea and ammonium sulphate registered a drop in nitrate production, though the production was better than in the soils with the herbicide alone. The process of nitrification was steadily increasing in the soils which received nitrogen in the form of sodium nitrate along with the herbicide. After 45th day the rate of nitrification increased by twelve per cent over the untreated soils (Table 2). When 2, 4-D was mixed along with either urea or ammonium sulphate, a decrease in nitrate production was recorded. When the herbicide was mixed with sodium nitrate and applied to the soil, there was a decrease in nitrate production.

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