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Studies on the Effect of Manganese on the Nitrogen Fractions in Gingelly (*Sesamum indicum* L.)

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ABSTRACT

Biochemical changes due to Mn application were recorded at three stages of crop growth. Lower concentration of 2 ppm was more favourable for increasing the total nitrogen and protein contents. No relationship could be established between soluble nitrogen and Mn, but the non-protein nitrogen increased at 2 ppm and thereafter fluctuations were noted. The higher concentrations of Mn increased the ammoniacal and nitrate nitrogen.

INTRODUCTION

The nutrition of *Sesamum indicum* L. would appear to be complex as no definite manurial schedule for the cultivation of this crop based on its nutritional requirements has so far been formulated. Very little attention has been bestowed in the past to assess the requirements of micronutrients whose physiological and biochemical reactions on plants are numerous. It is needless to say that the micronutrient forms the prosthetic group of the enzyme system which controls the entire life cycle of the plant. The reaction of manganese on the biochemistry of *Sesamum* plant especially on the nitrogen fractions has been studied and the results are reported in this paper.

MATERIALS AND METHODS

An improved strain of gingelly (*Sesamum indicum* L.) TMV 3 was chosen and the experiment was conducted in a randomised block design in plastic buckets of 25 × 25 cm. containing 12 kg. of soil. The soil was incorporated before sowing with compost 12.5 tons/ha and ammonium sulphate 37.5, superphosphate 25.0 and muriate of potash 37.5 kg/ha and manganese as $MnSO_4$ at 0, 2, 4, 6 and 8 ppm. The effect of Mn on nitrogen fractions was studied at preflowering, mid-flowering and harvest stages which corresponded with 30, 60 and 90 days respectively after sowing. The nitrogen fractions were estimated using conventional methods and accepted procedure Humphries (1956).

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RESULTS AND DISCUSSION

The content of total nitrogen in the treated samples decreased progressively with stages. It was clear that the higher concentrations of Mn reduced the content of total nitrogen in the plant samples while the lowest concentrations did not alter the content to any resonable degree. At harvest stage, the highest concentration of 8 ppm reduced the content to 0.504 as against 1.232 per cent recorded in the control. The effect of Mn levels on the non-protein nitrogen showed different picture. At first and last stages all the concentrations of Mn reduced the level of non-protein nitrogen. But in the case of second sample, there was increase in values excepting 4 ppm Mn (Table 1).

TABLE 1. Effect of manganese on nitrogen fractions at pre-flowering (30) mid-flowering (60) and harvest stages(90 days) expressed in percentage

	Tt.	Age of plants (days)		
		30	60	90
Total nitrogen	T_0	2.912	2.296	1.232
	T_1	2.968	2.912	1.232
	T_2	2.884	2.352	1.344
	T_3	2.632	1.932	0.964
	T_4	2.660	1.792	0.504
Non-protein nitrogen	T_0	0.364	0.168	0.225
	T_1	0.308	0.196	0.112
	T_2	0.196	0.112	0.168
	T_3	0.112	0.168	0.168
	T_4	0.252	0.224	0.168

Table 1 [Continued]

Protein nitrogen		2.548	2.128	0.980
	T	2.660	2.716	1.120
	T	2.788	2.240	1.176
	T	2.520	1.764	0.976
	T	2.408	1.568	0.200
Ammoniacal nitrogen	T	0.392	0.336	0.616
	T	0.334	0.308	0.532
	T	0.336	0.308	0.532
	T	0.336	0.588	0.616
	T	0.336	0.588	0.616
Soluble Nitrogen	T_0	0.017	0.062	0.045
	T	0.028	0.075	0.045
	T	0.028	0.053	0.056
	T	0.011	0.062	0.062
	T	0.045	0.056	0.042
Nitrate Nitrogen	T	0.336	0.336	0.112
	T	0.252	0.664	0.112
	T_3	0.318	0.824	0.168
	T_4	0.784	1.036	0.208
	T_5	1.660	1.596	0.304

The trend of protein nitrogen was somewhat similar to the total nitrogen.

The effect on ammoniacal nitrogen was somewhat different. At first and final stages the trend of ammoniacal nitrogen ran parallel to each other. At the second stage the highest two concentrations brought a steep increase in the content to 75.0 per cent over control. Regarding soluble nitrogen the results were not consistent and definite relationship could be established from the data. Taking the stages into consideration, maximum values were obtained mostly at the preflowering stage.

The content of nitrate nitrogen showed a few interesting trends. At pre-flowering stage, all the concentrations except 8 ppm increased the nitrate nitrogen whereas similar but progressively increasing trend was noticed towards the maturity of the crop(Fig.1).

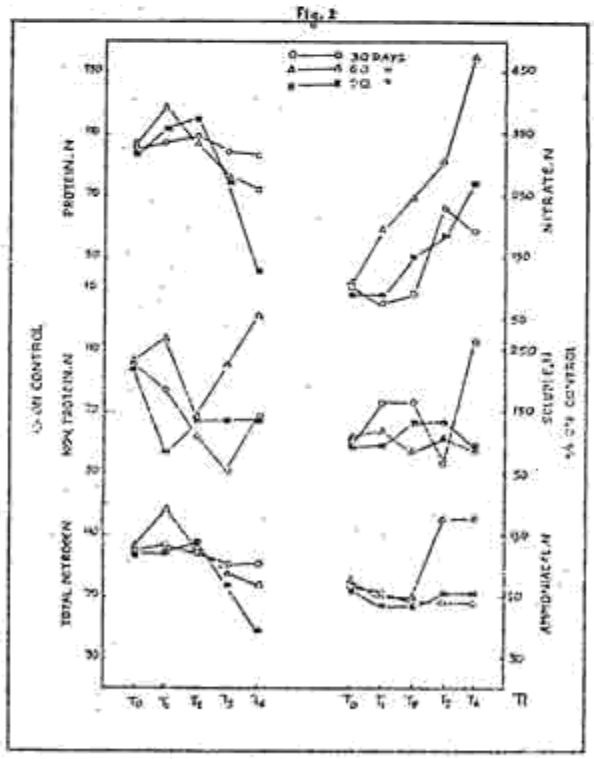

Fig. 1. Effect of manganes on nitrogen fractions.

It was clear from the data that low concentrations of Mn favoured the uptake of nitrogen while higher concentrations inhibited. No reasonable relationship could be established between Mn and soluble nitrogen on one hand and non-protein nitrogen and Mn on the other, except there was a slight increase at higher concentrations. The results may be interpreted in terms of protein synthesis and break down with impaired nitrogen metabolism, essentially by the failure of the mechanism of nitrate reduction. Similarly, Nance (1948) and Robertson (1951) failed to show the reduction of No_3 by Mn in wheat roots. This is in agreement with the present findings, but Burstrom (1950) contradicted this and concluded that Mn promoted catalysis and nitrate reduction in wheat roots. It would appear that there was more a failure of protein synthesis and it is protein break down only to a lesser extent. It was of interest that protein nitrogen ran parallel to total nitrogen with reference to increasing Mn levels. This is in agreement with the work of Erkama (1950) who showed negative association between protein content and Mn.

The constant level of soluble nitrogen would indicate that the protein synthesis and break down were going on in equal pace. This could be noted by the increased nitrate nitrogen and to some extent high ammoniacal

nitrogen at 6 and 8 ppm pointing out the failure of nitrate reduction mechanism which affected the protein synthesis and consequently the total nitrogen was reduced. Because of the reduction in protein synthesis, there was increase in non-protein nitrogen which assumed significance while the nitrogen metabolism was impaired under influence of high Mn concentration.

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