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EFFECT OF HERBICIDES ON UREA HYDROLYSIS IN TEA SOILS

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Effect of Diuron (Karmex), Paraquat (Gramoxone) and Glyphosate (Roundup) on urea hydrolysis in tea soils from different tea growing districts (St. Coombs, Passara and Hantane) with normally recommended and a ten-fold increase in concentration of the herbicide was studied under simulated field conditions. None of the herbicides had any inhibitory effect on urea hydrolysis in tea soils at both concentrations of the herbicides tested.

INTRODUCTION

Continuous use of high levels of ammonium sulphate fertilizers (200 - 300 kg N ha^{-1} $year^{-1}$) in tea plantations of Sri Lanka over the past 20 to 30 years have led to an increase in the acidity of the tea soils. Currently urea is being increasingly used as an alternative source of nitrogen because urea acidifies the soils less than ammonium sulphate and releases less potassium (K), calcium (Ca) and magnesium (Mg) into the soil solution from cation exchange sites (Wickremasinghe, Nalliah and Wijedasa, 1985a) and is also cheaper per unit of nitrogen. Wickremasinghe, Nalliah and Paramasivam (1984) using ^{15}N labelled fertilizers reported that urea and ammonium sulphate were equally efficient sources of nitrogen for mature tea and were immobolized and mineralized to very similar extents under Sri Lankan acid tea soil conditions (Wickremasinghe, Rodgers and Jenkinson, 1985 b).

Since tea in Sri Lanka is grown in undulating mountain slopes (500 - 2000 m amsl) receiving a high rainfall (150 - 350 mm) loss of soil due to erosion is a major problem. This is further aggravated by manual weed control measures adopted in these tea lands. The physical removal of the weeds either by using scrapers (sorandi), mammoties and/or by hand pulling results in the loss of valuable top soil by disturbance with each operation leading to soil erosion and making the soils progressively less fertile. Under these conditions the plant fails to respond to applied fertilizers because of the very poor nutrient and moisture retention capacity of the soil.

It is in this context that the use of chemical weed control measures assumes importance in minimising soil erosion on tea lands. However, since urea is being increasingly used it is also important to know the effect of these herbicides on the rate of hydrolysis of urea to ammonium ions. Cervelli *et al.* (1976) observed that certain substituted urea herbicides (Fenuron, Monuron, Diuron, Linuron and Neburon) were found to inhibit urea hydrolysis from 10 - 30 per cent in some Italian soils.

Since urea is a neutral molecule it cannot be held by the cation exchange sites of the soil unlike ammonium sulphate until it is hydrolysed in the soil to ammonium ions by the enzyme urease. Wickremasinghe, Sivasubramaniam and Nalliah (1981) reported that the ambient levels of urease present in tea soils from different tea growing districts of Sri Lanka are adequate to hydrolyse the applied urea fertilizers and that it takes less than four days to completely hydrolyse the equivalent of 100 kg urea N applied ha^{-1} per application.

In the present study we report the effect of Diuron (Karmex) (3(3, 4 dichloro phenyl) -1, 1 dimethyl urea), Paraquat (Gramoxone) (11′ dimethyl 44′ bipyridylium dichloride) and Glyphosate (Roundup) (N-phosphono methyl Glycine) on urea hydrolysis in tea soils.

MATERIALS AND METHODS

In this experiment, air dried surface soil (0-15 cm) sampled from different tea growing districts was used. Each sample was mixed thoroughly and screened through a 2 mm sieve. The physico-chemical properties of these soils are given in Table 1.

TABLE 1 — *Characteristics of the tea soil from different locations*

Sampling depth and location	*Soil texture**			*Total N%*	*Total C%*	*pH in 2N KCl*
	Clay	*Silt*	*Sand*			
(0—15 cm) St. Coombs (1500 m amsl) ..	39·6	23·2	37·2	0·18	2·64	4·1
(0—15 cm) Passara (800 m amsl) ..	26·8	14·2	59·0	0·17	2·30	4·0
(0—15 cm) Hantane (1000 m amsl) ..	37·6	10·6	51·8	0·12	1·42	4·1

* Per cent of oven dry soil (105° C)

Air dried soil equivalent to ten g of oven dried soils were taken in 125 ml wide mouthed bottles and treated with 1 ml of urea solution containing 1,000 μg urea N and the soils were adjusted to 50% water holding capacity. The recommended concentration and a ten-fold increased concentration of the solution of each herbicide i.e. Diuron, Paraquat and Glyphosate were added to the soil, 24 h before the urea addition to allow the herbicide to reach an adsorption equilibrium.

All incubations were carried out in duplicate under aerobic conditions at room temperature for five days and the extent of urea hydrolysis determined by analysing the soil for unhydrolysed urea at 24 h intervals (Douglas and Bremner, 1970).

RESULTS AND DISCUSSION

The effect of herbicides on urea hydrolysis in St Coombs, Passara and Hantane soils is shown in Figs 1, 2 and 3 respectively with (a) no herbicides, (b) Diuron, (c) Paraquat and (d) Glyphosate at recommended concentration and ten-fold increased concentration. Despite the herbicide addition, more than 90% of the added urea N was hydrolysed to ammonium ions within 72 hours in all soils confirming that none of the added herbicides significantly affected the soil urease in these soils. This may be due to the ambient levels of urease present in the tea soils being adequate to hydrolyse the applied urea fertilizers (Wickremasinghe *et al.* 1981). It is evident from these observations that the above herbicides used in chemical weed control of tea have no significant inhibitory effect on urea hydrolysis in Sri Lankan tea soils despite a 10-30% inhibitory effect reported in some Italian soils (Cervele *et al.*, 1976).

It will thus be obvious that chemical weed control using Diuron, Paraquat and Glyphosate has no inhibitory effect on urea hydrolysis in Sri Lanka tea soils and that immediately after the spraying of herbicides, ground application of urea based fertilizer mixtures could be followed up, without any adverse effects on the efficiency of hydrolysis of urea fertilizers.

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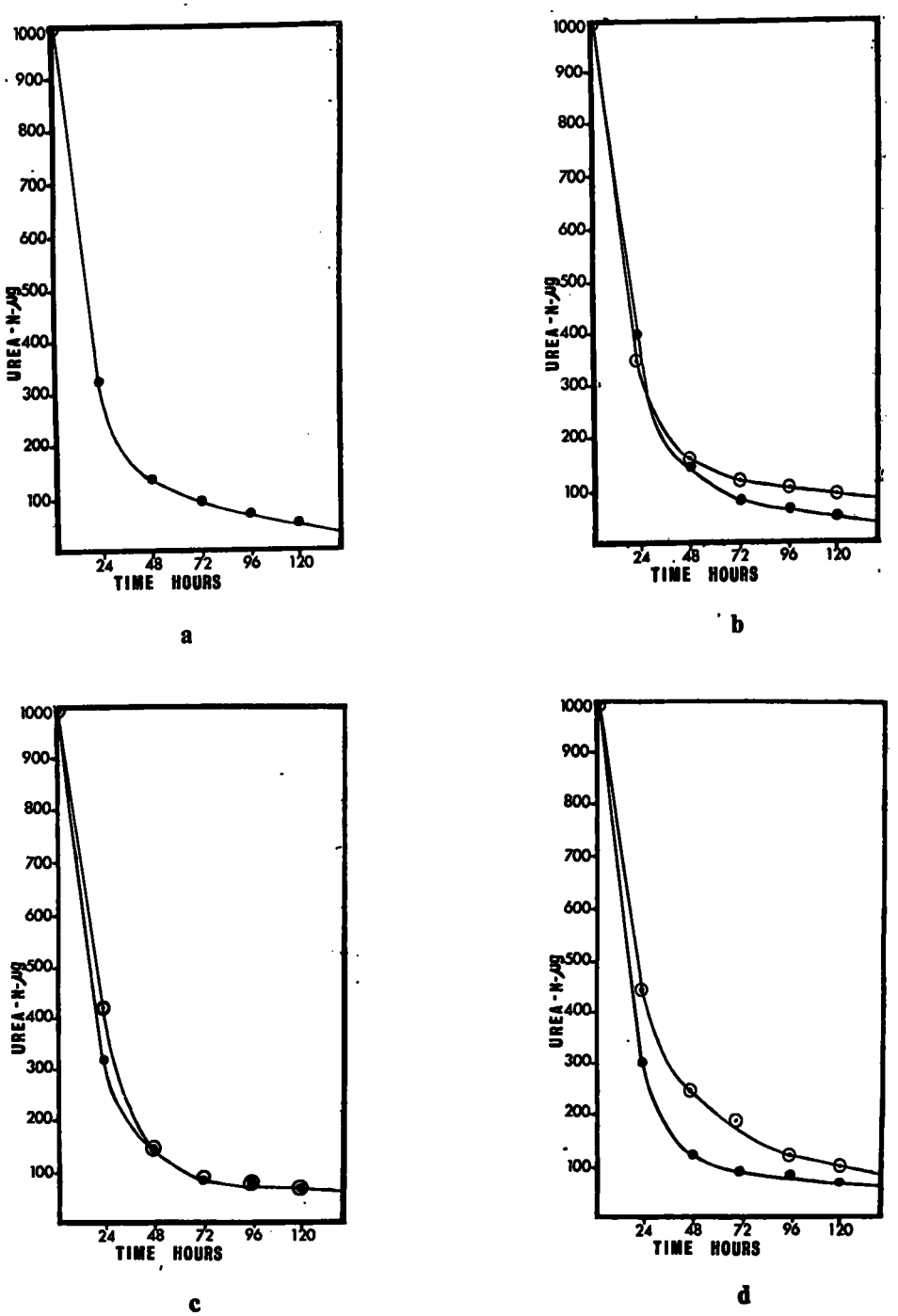

Fig. 1—Urea hydrolysis in St. Coombs soil with a (No herbicides,) b (Diuron), c (Paraquat) and d (Glyphosate) at recommended concentration (● - ●) and ten-fold increased concentration (○ - ○).

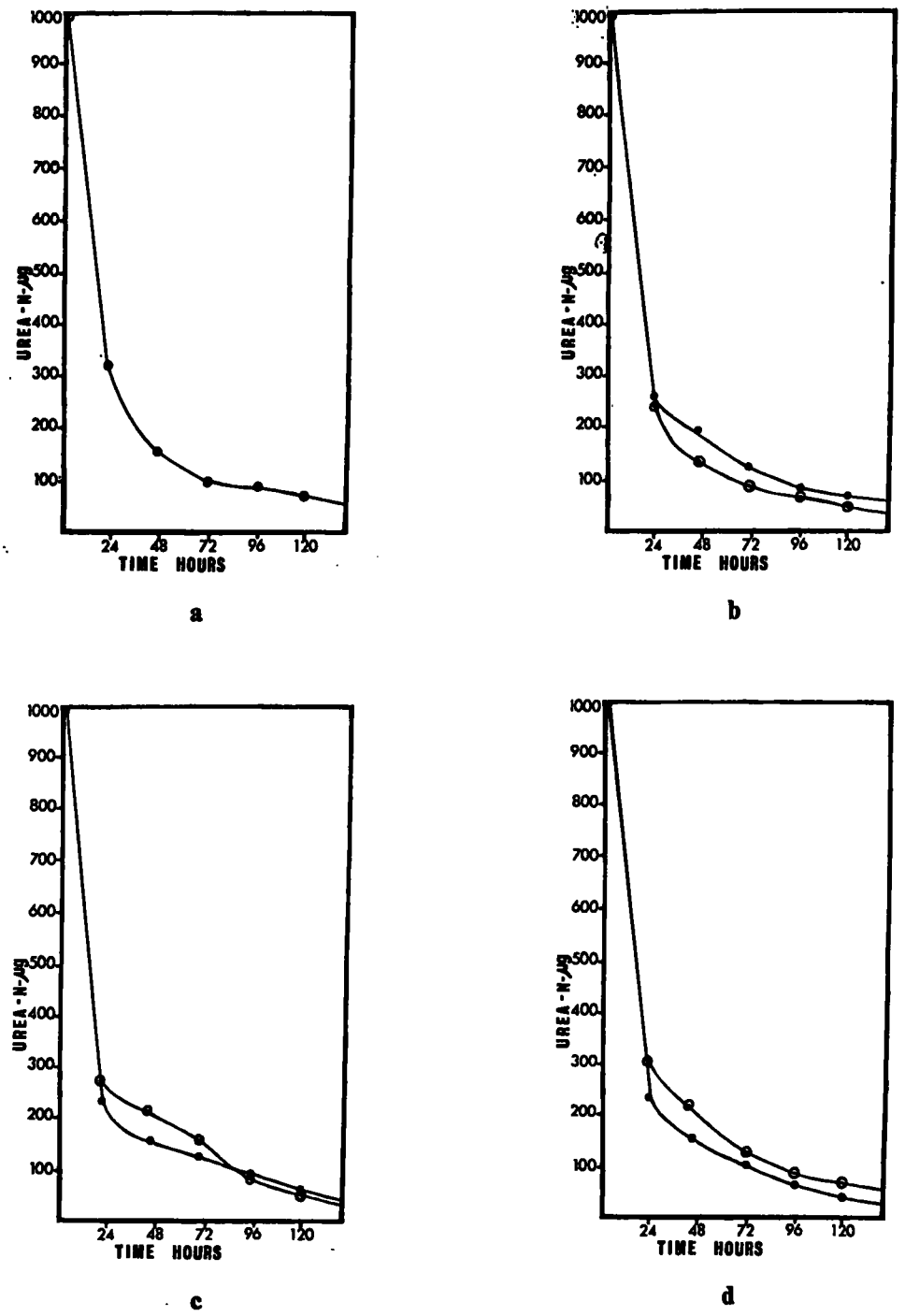

Fig. 2—Urea hydrolysis in Passara soil with a (No herbicides), b (Diuron), c (Paraquat) and d (Glyphosate) at recommended concentration (● - ●) and ten-fold increased concentration (○ - ○).

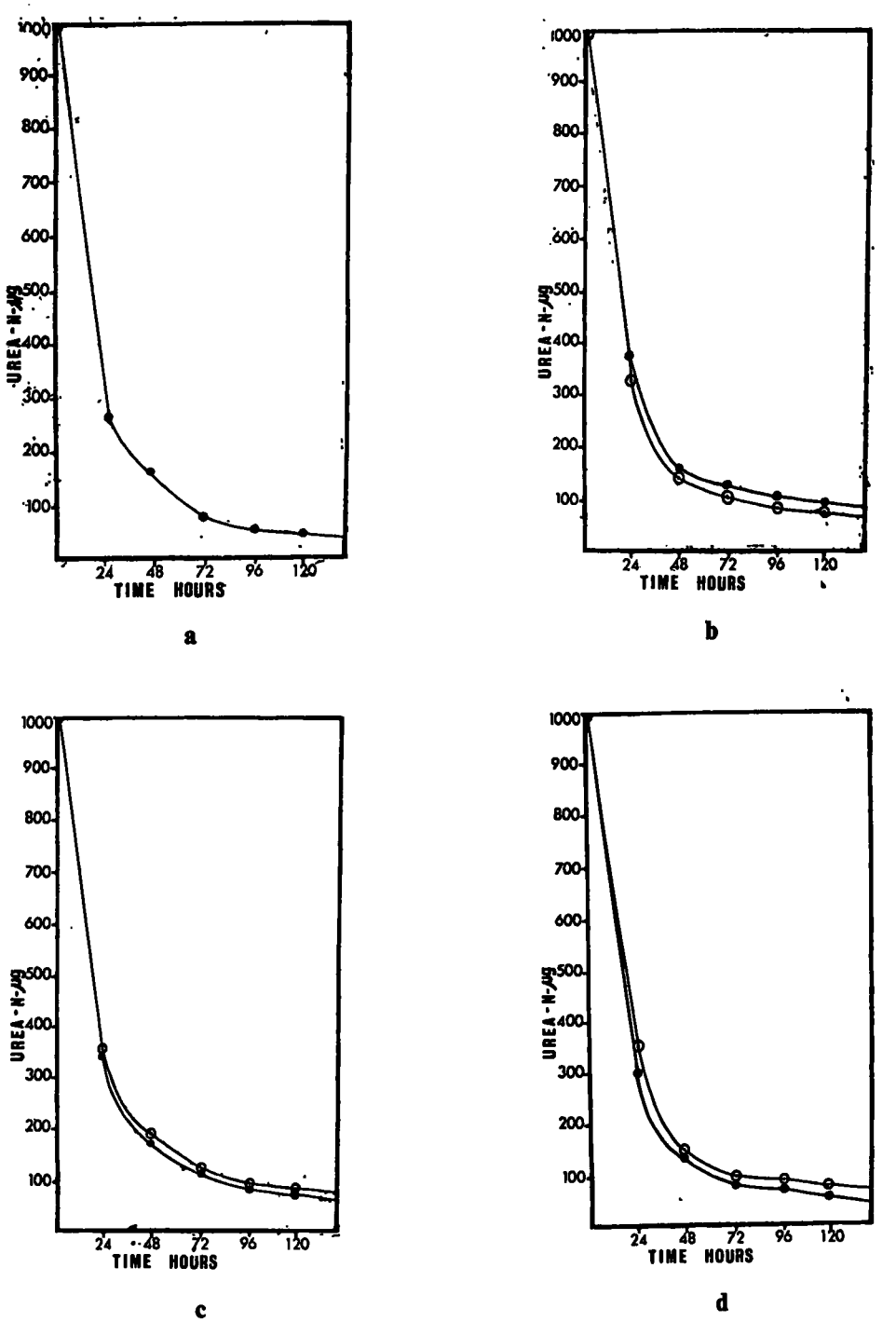

Fig. 3—Urea hydrolysis in Hantane soil with a (No herbicides), b (Diuron), c (Paraquat) and d (Glyphosate) at recommended concentration (● – ●) and ten-fold increased concentration (○ – ○).