

## FATE OF BIURET IN TEA SOILS<sup>o</sup>

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This paper reports laboratory incubation studies on biuret decomposition in tea soils. The effect of chemical and thermal sterilization, soil organic matter, temperature and moisture on the degree of biuret degradation was investigated. It was found that biuret undergoes complete degradation in tea soils within ten weeks. Chemical and thermal sterilization of the soil retarded biuret decomposition while the presence of organic matter accelerated the process. At 40°C the process of biuret decomposition was appreciably lower than at 30°C. Minimum decomposition was observed at 10°C. Moisture at 30 per cent (Field capacity) accelerated the decomposition of biuret more than at 10 per cent. The results of the above investigations indicate that the trace amounts of biuret present in urea based fertilizer mixtures undergoes ready decomposition in tea soils and the probability of biuret accumulation is very unlikely.

### INTRODUCTION

Tea (*Camellia sinensis*) is a vegetative crop where the young shoots (two leaves and the bud) are harvested regularly and processed to produce the black tea of commerce. Tea responds to high levels of fertilizer nitrogen (240-360 kg N/ha/year).

In the past ammonium sulphate has been used as the main source of nitrogenous fertilizer for the tea plantations. With the availability of urea as an alternate source of nitrogen, the Institute carried out a large number of field experiments to ascertain the feasibility of substituting urea for ammonium sulphate. In these experiments, at the end of two cycles, both urea and sulphate of ammonia gave similar yields (Tillekeratne, L.M. de W. 1970; Sandanam *et al.*, 1980). Further investigation using <sup>15</sup>N-labelled fertilizers showed that both sources of nitrogen behaved very similarly in relation to plant uptake as well as immobilization and mineralization in the soil (Wickremasinghe *et al.*, 1984; 1985).

Urea is now being used as an alternate source of nitrogen because it is cheaper per unit of N and acidifies the soil to a lesser extent than ammonium sulphate.

Biuret found as an impurity in commercial grade urea was found to be high in the crystalline form. The high biuret content in earlier crystalline urea preparations was reported to cause considerable damage to tung trees and orange trees (Impey and Jones, 1960). In Greenhouse experiments, Stratoska and Clarke (1950) observed that biuret reduced the dry weight of perennial rye grass. Webster *et al.* (1957)

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found that biuret affected protein synthesis in *Xanthium pennsylvanicum* plants. The lower limit for biuret toxicity in potato, wheat and maize were in the region of 3-4 kg/ha for potato, 6 kg for wheat and 12 kg for maize (Gadet et al., 1959).

However, with the advent of prilled urea this has been overcome to a great extent and today most commercial grade prilled urea contains less than 0.5% biuret.

Despite the fact that only trace amounts of biuret is present in the urea, it is necessary to ascertain whether the use of urea based fertilizer mixtures could lead to the accumulation and build up of biuret in tea soils.

This paper reports the results of some laboratory experiments carried out to study the decomposition of biuret in tea soils.

## MATERIALS AND METHODS

Field moist soil from St Coombs Estate was sieved through a 10 mm sieve and used for the above study.

Field moist soil treated with biuret (10.0 mg Biuret/10.0 g soil) was incubated aerobically at 22° C up to 12 weeks. The incubated samples were withdrawn in triplicate after 0 hours and at weekly intervals thereafter and the biuret extracted with repeatedly with water. The soil extracts were pooled and concentrated at 50°C under reduced pressure using a Buchi Roto Vapor. A soil blank was also included along with the control. Biuret was determined by the A.O.A.C. method (1960). Recovery tests showed that 90% of the added biuret can be accounted for by this.

## RESULTS

Under laboratory conditions, at field moisture level, after two weeks only 30% of the added biuret is decomposed (Fig. 1). However, after ten weeks the decomposition is almost complete.

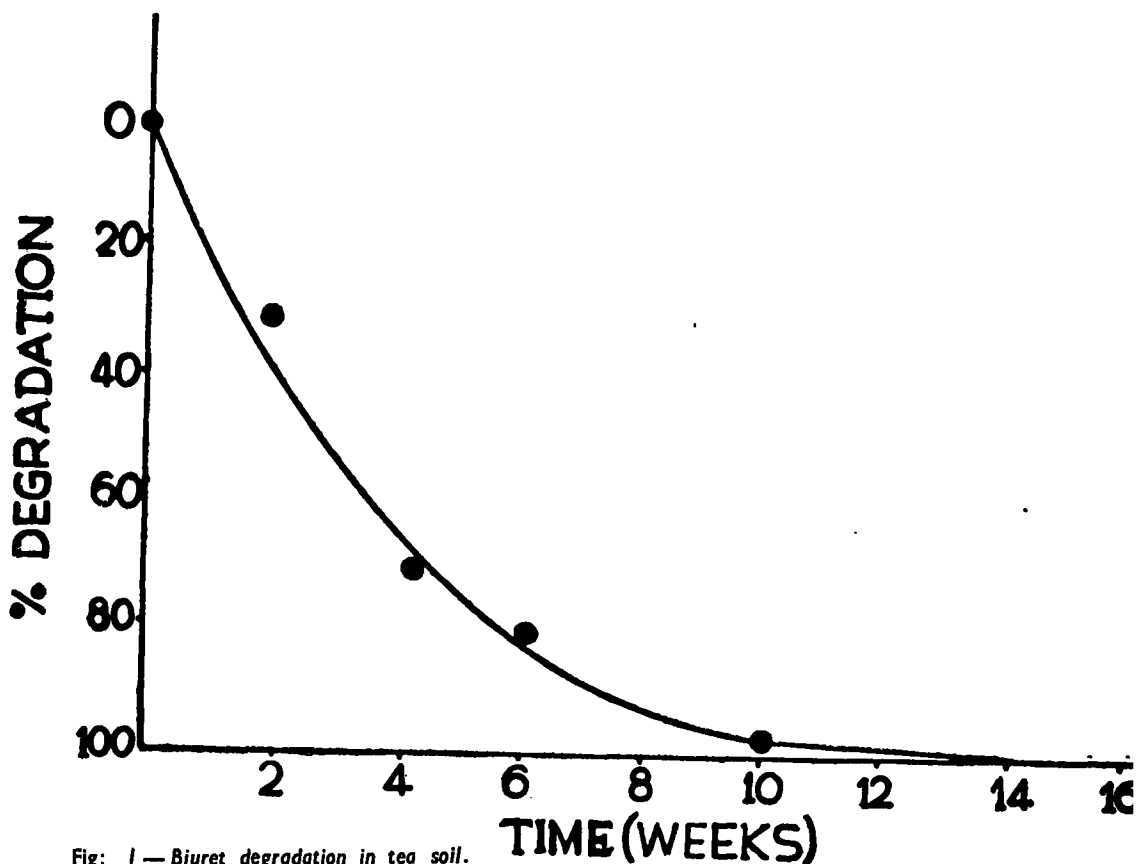


Fig: 1 — Biuret degradation in tea soil.

The results of heat and toluene treatment on biuret degradation in tea soils are presented in Table I.

TABLE I — The effect of heat and toluene on biuret decomposition <sup>o</sup>

Treatment	Biuret added (mg)	Biuret recovered (mg)	% Degradation
Control	10.0	2.5	75.0
Heat	10.0	8.0	20.0
Toluene	10.0	8.0	20.0

<sup>o</sup>Average of 3 replications

LSD for treatment means at 0.001 per cent level=9.024

It is evident from the above table that heat sterilization and chemical treatment with toluene retarded the biuret degradation by as much as 55 per cent.

Table 2 shows the influence of mulch on the rate of decomposition of biuret in tea soil.

TABLE 2—The effect of mulch on biuret decomposition in soil <sup>o</sup>

Treatment	Biuret added to soil (mg)	Biuret recovered after 4 weeks (mg)	% Degradation
Soil with mulch	10.0	2.4	76.0
Soil without mulch	10.0	6.6	34.0

<sup>o</sup>Average of 3 replications

LSD for treatment means at 0.001 per cent level = 18.6

The effect of organic matter on biuret degradation showed that the breakdown is 42% more in soils with mulch.

Influence of temperature on the decomposition of biuret in tea soil is presented in Table 3.

TABLE 3—Influence of temperature on biuret degradation <sup>\*</sup>

Treatment (°C)	Biuret added to soil (mg)	Biuret recovered after 4 weeks (mg)	% Degradation
22 (Room Temp)	10	3.3	67.0
10	10	8.3	17.0
30	10	2.1	79.0
40	10	5.1	49.0

<sup>\*</sup>Average of 3 replications

LSD for treatment means at 0.001 per cent level = 10.1

The breakdown of biuret is significantly reduced at 10°C while the highest degradation was recorded at 30°C. At room temperature (22°C) the decomposition is about 50% more than that at 10°C, but 12% less than at 30°C. At 40°C, however, the decomposition was reduced and only 49% of the biuret was decomposed within an incubation period of 4 weeks.

The influence of soil moisture on the decomposition rate of biuret in tea soil is tabulated in Table 4.

TABLE 4—Effect of moisture levels on biuret degradation in soil <sup>\*</sup>

Moisture (%)	Biuret added (mg)	Biuret recovered after 4 weeks (mg)	% Degradation
20	10	4.56	54.4
25	10	4.36	54.4
30	10	3.92	60.8

<sup>\*</sup>Average of 3 replications

LSD for treatment means at 0.01 per cent level = 8.6

Soil moisture had the least impact on biuret degradation at the three moisture levels tested. Rate of decomposition was highest at 30% moisture which also happens to be the field capacity of this soil.

## DISCUSSION

A knowledge of the influence of soil factors such as soil temperature, soil moisture and soil organic matter on the rate of decomposition of biuret becomes a matter of importance when urea containing detectable quantities of biuret is used as a sole source of nitrogen for mature tea in Sri Lanka. A thorough understanding of the behaviour of this phytotoxic compound is necessary if urea were to be used as the exclusive source of nitrogen for mature tea.

This study has shown that the degradation of biuret is influenced by factors such as temperature, moisture and organic matter status of the soil.

The degradation of biuret was found to be a biological process and hence all factors that favour a build up of microbes in the soil have also increased the rate of degradation of biuret. Thus, the soil organic matter, through its influence on microbial population has increased the rate of degradation of biuret to a marked extent. Additional information on the microbial nature of this process is evident from the treatments where the soils were sterilized either thermally or chemically. Both thermal and chemical treatments of the soils could have had a detrimental effect on the microbes thereby causing a reduced degradation in those two treatments.

Temperature had a profound effect on the breakdown of biuret. The fact that the rate of decomposition was higher at 30°C and lowest at 10°C emphasizes that this process is microbial in nature, as the activity of the microbes generally increased with increase in temperature to an optimum temperature beyond which it starts declining again due to thermal damage inflicted on the microbes in the soil. The rate of decomposition reported here agrees well with the temperatures tested in this study. Similar effects on microbial process such as nitrification in soil have been reported by others (Parker and Larson, 1962).

Soil moisture also showed some effect on the decomposition of biuret. Fertilizers are generally applied to the tea fields when the soil is wet and therefore increased degradation of biuret could be expected during such times.

Of the factors tested in this study, temperature and soil organic matter were found to have profound effect on the degradation of biuret in soil. At 30°C and with adequate quantities of mulch in the soil more than 75% of the added biuret was decomposed within 3-4 weeks of application. With high soil temperatures (25-35°C) and available mulch encountered in most tea areas the chances of biuret accumulating in the soil to phytotoxic levels would be minimal. Further, the trace amount of biuret present in prilled urea and the leaching of biuret in urea based fertilizers away from the root zone also minimizes the chances of biuret accumulation in the soil as well as its build up to phytotoxic levels in the plant.

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