NITROGEN NUTRITION OF GINGER (ZINGIBER OFFICINALE)

EFFECTS OF SOURCES, RATES, AND TIMES OF NITROGEN APPLICATION

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SUMMARY

Two fertilizer experiments were conducted in the field at Beerwah, South-East Queensland. In the first experiment leaf nitrogen concentrations, and the yield of ginger shoots and rhizomes at early and late harvests increased both with the total amount of nitrogen applied up to the highest level studied (336 kg N/ha as ammonium nitrate) and with the number of applications making up the total. At all levels of nitrogen application the apparent recovery of fertilizer nitrogen increased in the order 1 application < 2 applications < 4 applications. At 33.6 kg N/ha there appeared to be no advantage in dividing the total N applied into more than 4 applications but the data suggested higher recoveries of nitrogen with 8 applications at 112 kg N/ha and 336 kg N/ha. In the second experiment, ammonium nitrate, urea, and ammonium sulphate were found to be equally effective as nitrogen fertilizers for ginger when applied at equal rates of nitrogen per hectare. However, in terms of cost effectiveness they rated in the order urea > ammonium nitrate > ammonium sulphate.

All three nitrogen sources acidified the soil, the decrease in soil pH during the growing season increasing with increasing rate of application. In Experiment 1 split applications, which increased the recovery of applied nitrogen in the crop, also increased the extent of acidification. In Experiment 2 ammonium sulphate tended to be more strongly acidifying than the other fertilizers but the difference was statistically significant only at the highest rate of nitrogen application. Because of the strong effects of nitrogen supply on both yield and soil pH, the highest yields were associated with end-of-season pH values below 5.0.

INTRODUCTION

In Australia, ginger is an intensively managed crop and high yields are obtained. Thus in the 1976–77 growing season the national average yield was 33.4 t/ha. Substantial amounts of nitrogen fertilizer are used to obtain these high yields (up
to 830 kg/ha) but little information is available concerning optimum rates and times of application or the most suitable forms of nitrogen fertilizer for ginger production. Wiley\textsuperscript{12} noted that substantial leaching losses of nitrogen were likely because growers applied 50\% of their total nitrogen at planting and a further 25\% in the first 16 weeks, a period during which only about 11\% of the total growth of the crop occurs. Lee et al.\textsuperscript{5} obtained high yields with relatively low rates of nitrogen (\leq 300 kg/ha) in an experiment in which the total fertilizer nitrogen was divided into 10 applications the size and timing of which was varied according to the anticipated seasonal demand for the element. However the study did not include a direct comparison with other methods of nitrogen application. In addition, Lee et al.\textsuperscript{5} used ammonium nitrate as their nitrogen source whereas at the time, ammonium sulphate was the main nitrogen fertilizer used in the Australian ginger industry, apart from organic nitrogen sources such as poultry manure, mull mud* and blood and bone\textsuperscript{1}. Hence once again direct comparisons could not be made.

The present paper describes two field experiments undertaken to test the effects of varying rates and times of nitrogen application on ginger yields, and to compare three different nitrogen sources.

**METHODS**

Both experiments were carried out on a freely-draining grey sandy loam soil on a commercial ginger farm at Beerwah in South-Eastern Queensland. Chemical characteristics of the soil, methods of preparation of ginger seed pieces, and planting procedures were as described previously\textsuperscript{5}. Both experiments were located within a block of commercial ginger, and apart from the fertilizer treatments, were managed by the cooperating farmer as a part of his crop. Both experiments were planted on the same day (September 11). Rainfall for the growing season (September to May) was 1993 mm, being distributed as follows (mm): Sept. 45, Oct. 45, Nov. 190, Dec. 215, Jan. 214, Feb. 680, Mar. 165, Apr. 210, and May, 219. Basal nutrients were applied at the same rates and in the same manner as in a previous experiment at the same site\textsuperscript{5}. Since results the previous season had indicated that maximum yields could be obtained with rates of nitrogen application of 200 to 300 kg/ha\textsuperscript{5}, it was decided to restrict the range of nitrogen applications studied to 0 to 336 kg/ha in the present experiments. Sprinkler irrigation (5 to 10 mm) was used to water in sidedressings of basal nutrients and of nitrogen on each occasion.

**Experiment 1 – Rates and times of nitrogen application**

Ammonium nitrate was applied at 33.6, 112 or 336 kg N/ha either as a single dressing at planting or split into two equal dressings (September 11 and March 1), four equal dressings (September 11, January 26, March 1 and March 29) or eight equal dressings (September 11, December 22, January 26, February 16, March 1, March 15, March 29, and April 12). An absolute control receiving no nitrogen was also included. A split plot design was used with the nitrogen treatments as main plots, and two

* By-product of the local sugar industry.