VARIATION IN OIL, NITROGEN AND METHIONINE LEVEL IN *LUPINUS MUTABILIS*

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ABSTRACT

Seed of 61 introduced genotypes of *Lupinus mutabilis* was screened for nitrogen, methionine and oil. There was marked variation among the characteristics in the genotypes screened. This suggestes the possibility of selecting for increased levels of all three factors. There was a significant positive ($P < 0.001$) relationship between seed nitrogen and methionine.

INTRODUCTION

The species *L.mutabilis* has the highest seed oil concentration of any cultivated lupin. Similarly, it has a high seed protein concentration[1]. It has been suggested that *L.mutabilis* has considerable potential in South America as a crop for the Andes region[2-4]. Experiments have already been conducted to evaluate its potential as a protein source in human diets[5-12].

In common with most legumes seed protein is low in methionine[1]. Savage *et al.*[13] showed that the nutritive value of cooked and leached *L.mutabilis* could be considerably improved by adding up to 0.5% DL-methionine. With the same samples of cooked and leached seed it was further shown that the maximum response to methionine was obtained with the addition of as little as 0.22%[14].

This suggests that selection of *L.mutabilis* with even marginally higher levels of methionine would have a considerable beneficial effect on the protein quality of cooked seed. In fact its biological value, at 84%, approaches that of unsupplemented, heat processed soya bean meal which is the major source of vegetable protein used in animal feeding.

Seed oil is important both for its energy value in food, and because its financial value can help cover the cost of alkaloid extraction.

To determine the variation in these major seed components, and their relationship with each other, the seed of 61 introduced genotypes of *L.mutabilis* were screened for their oil, nitrogen and methionine content.

MATERIALS AND METHODS

The 61 genotypes were obtained by plant introduction from a variety of sources. All genotypes were grown together at Lincoln College (a temperate environment) during the 1980-1 growing season, under conditions of moderate fertility in an 8 x 8 simple lattice design. After harvest at the end of the growing season, oil, nitrogen and methionine were measured on ground samples of whole seed.

Oil was determined on 1 g of ground sample by Soxhlet extraction in petroleum ether for 8 hours. Nitrogen was determined in triplicate by micro-Kjeldahl digestion with concentrated H_2SO_4 using $K_2SO_4/CuSO_4$ (19:1 w/w) catalyst. The ammonium sulphate formed was analysed by an automated procedure using a Technicon auto-analyser[15]. Methionine was measured using an automated method following pronase hydrolysis of ground seed[16].

RESULTS

Oil: The mean oil concentration among the 61 genotypes was 14.74%. Values ranged from 11.65% in line 4176a to 17.29% in HJ-1 an introduction from Peru. The majority of genotypes contained about 14.8% oil when grown in the Canterbury environment (FIG. 1).

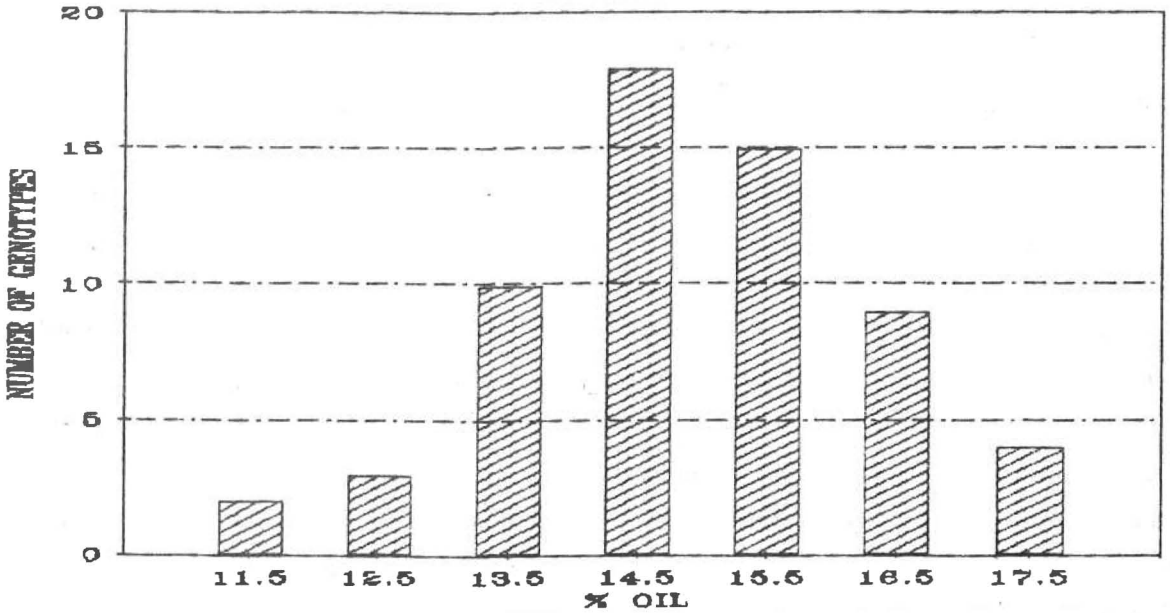

FIG. 1. The distribution of oil concentration among 61 genotypes of *L.mutabilis*.

Nitrogen: There was a similar wide range in nitrogen values among the 61 genotypes (Mean 7.44%: range 3.61-9.63%). The lowest value was in line 8076 and the highest in line 882 (FIG. 2). The median value was 7.69%.

Methionine: There was nearly a fourfold variation in methionine concentration in seed protein. Values ranged from 210 mg/16 g N (H6-77) to 1140 mg/16 g N (line 8376) with a median value of 470 mg/16 g N (FIG. 3).

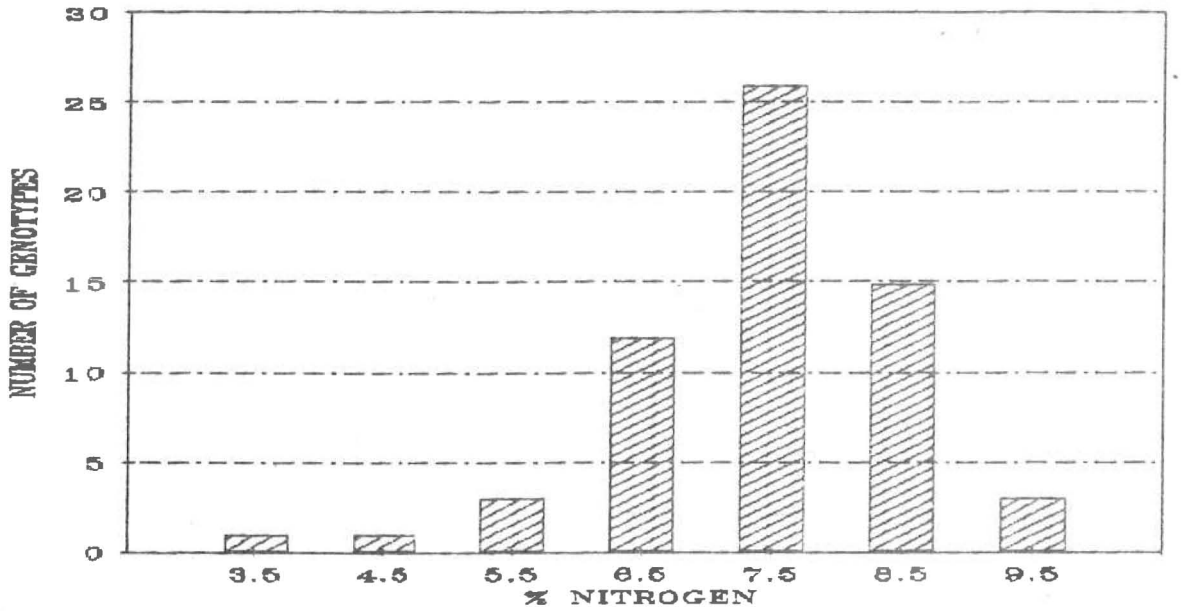

FIG 2. The distribution of nitrogen concentration among 61 genotypes of *L.mutabilis*.

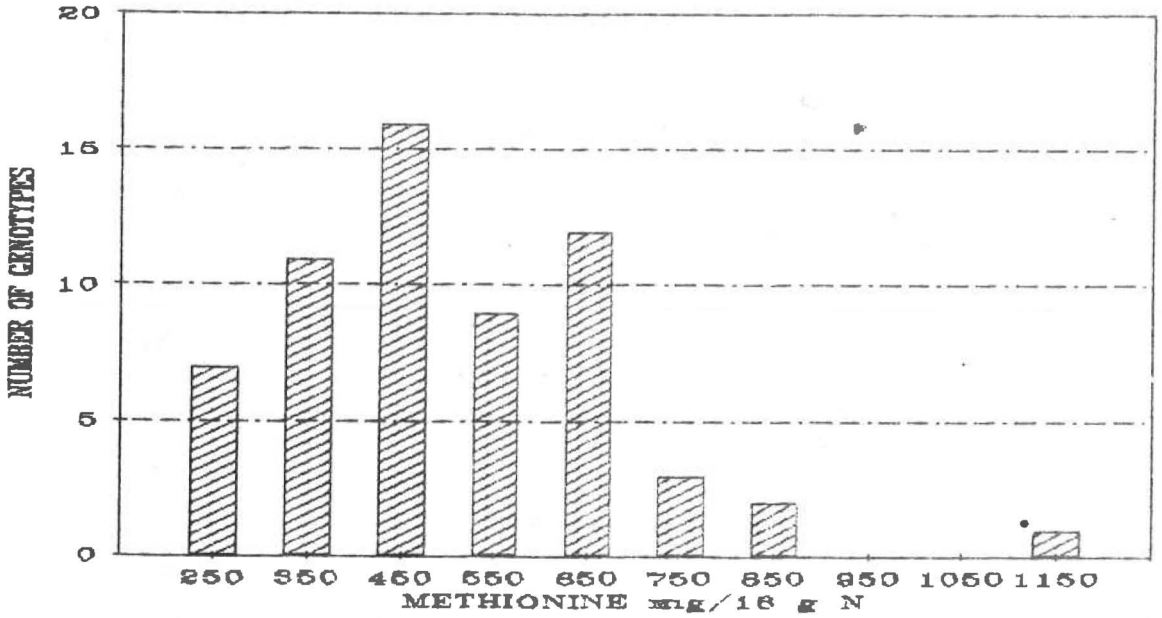

FIG. 3. The distribution of methionine concentration among 61 genotypes of *L.mutabilis*.

Relationship Between Oil and Seed Nitrogen: There was no relationship between the amount of oil and protein in the seed of the 61 genotypes of *L.mutabilis* tested (r = 0.238. N.S.). The regression accounted for only 5.75% of the total variance.

Relationship between Nitrogen and Methionine Concentration: The relationship between protein and methionine was significant ($P < 0.001$). The correlation coefficient (r) was 0.524 and the fitting of the regression accounted for 27.5% of the variance. The regression equation was:

$$Y = -156.2 + 88X^{***}$$

Where Y is methionine in mg/16 g N. and X is % nitrogen in seed (FIG. 4).

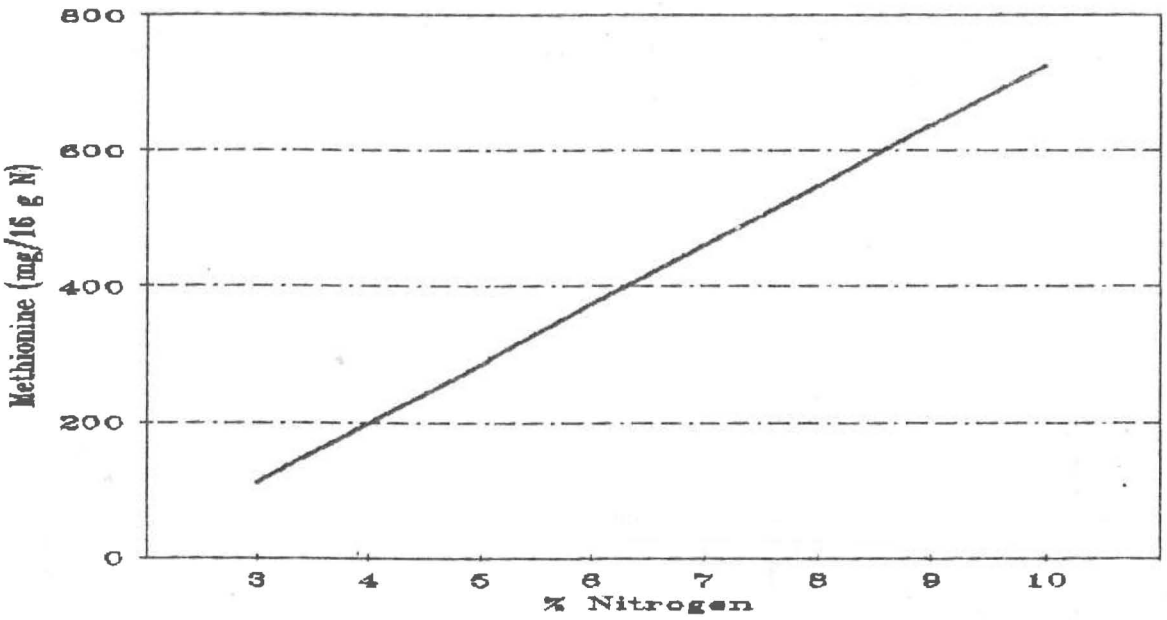

FIG. 4. The relationship between seed nitrogen concentration and methionine (mg/16 g N) in 61 *L.Mutabilis* genotypes.

DISCUSSION

The wide variation in oil, nitrogen and methionine concentration observed among these 61 genotypes of *L.mutabilis* suggests that it should be possible to select genotypes of this important South American lupin species for increased seed oil concentration, increased nitrogen content, and improved protein quality.

It is evident that the level of oil and nitrogen in *L.mutabilis* can be influenced by climate. When 17 of the genotypes grown here were grown in Canterbury in 1978, in a season that was considerably warmer than usual, the mean seed nitrogen concentration was 6.98% (range 6.41-7.54%). Oil values on the other hand were considerably higher (mean, 18.06%; range 15.75-22.03%)[17].

However, contary to the report of Horn *et al.*[17] seed oil, in *L.mutabilis* in this experiment, was not directly related to seed nitrogen concentration. Selection for one would therefore not necessarily produce a reduction in the concentration of the other.

The positive relationship between seed nitrogen concentration and methionine in this species (FIG. 4) suggests that selection of genotypes with a high seed nitrogen would also increase seed methionine level. It also suggests that the major storage proteins in *L.mutabilis* are high in methionine. Whether this is the case or not, will depend on further biochemical analysis of the seed globulins of *L.mutabilis*.

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