Nitrate reduction and dinitrogen fixation in chickpea

J. Evans

Agricultural Research Institute, Wagga Wagga, N.S.W.

In legumes nodulated by *Rhizobium,* mineral N and N2 may contribute to N nutrition. Nitrate (NO_3) is known both to inhibit and stimulate N2 fixation and to affect the total period of N assimilation. The relative use of N2 and NO_3 can affect costs of production, soil fertility and management of N for optimum yield. The potential for assimilation and interaction of NO3 and N2 is being investigated in chickpea *(Cicer arietinum)* a grain legume of potential value in continuous cropping systems in southern Australia. Initial studies are reported here and describe the seasonal profiles of N2 fixation and NO_3 reduction in plants exposed simultaneously to both N sources.

Methods

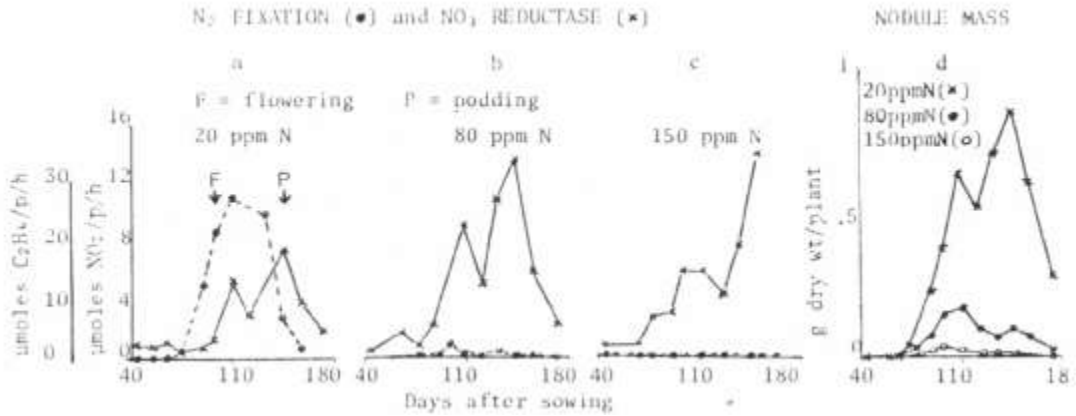
Chickpea, inoculated with *Rhizobium,* was grown in sandy soil in pots which were saturated frequently (2-3 times/week) with solutions of KNO_3 containing 20, 80, 150 ppm N. Assays for nitrogenase (N_2 fixation) and NO_3 reductase activities, and measurement of plant growth, were conducted throughout the sea- son. Potential N2 fixation was monitored by C_2H_2 reduction using a procedure similar to Hardy et *al (1),* capacity for NO_3 reduction monitored by *in vivo,* foliar NO_3 reductase activity (NRA) according to the method of Jaworski (2).

Results and Discussion

Results are shown in Fig. 1. The period of acquisition of N by N2 fixation was shorter than for acquisition by NO_3 reduction (Fig. la). Capacity for NO3 reduction occurred in seedlings before establishment of a symbiotic pro- cess and during seed formation after symbiotic activity had ceased. In- creasing assimilatory activities 80 days after sowing shows that, at lower levels of NO_3 (Fig. la),both N sources contribute to the demand for N resulting from the potential for plant growth during spring. By contrast, activities decreased markedly during fruiting (Fig. la,b,c) and, because this is usually a period of high N demand in legumes, current assimilation of N may be inadequate for the requirement of high protein seeds. High NO_3 level in- creased potential NRA but reduced N2 as a source N (Fig. la,b,c) by reducing nodule mass (Fig. Id) and nodule efficiency (not shown).

These data will he used to assist in developing a strategy for optimising the benefits of N2 fixation (as a conservative N source) and NO_3 (as a supplementary source to foster early growth and extend the period of acquisition

Fig. 1. Interaction of nitrate reduction with N2 fixation in chickpea.



1. Hardy, R.W.F., Burns, R.C., Herbert, R.R., Holsten, R.D. and Johnston, E.K. 1971. Plant and Soil. Special Volume : 561-590.

2. Jaworski, E.G. 1971. Biochemical and Biophysical Research Communications. 43 : 1274-1279.