NITRATE REDUCTASE IN RELATION TO NODULATION IN COWPEAS AND MUNG BEANS

GRAIN legumes including chick peas (*Cicer arietinum*), red gram (*Cajanus cajan*), cowpeas (*Vigna sinensis*), mung beans (*Phaseolus radiatus*) and others largely depend upon their own nitrogen fixation ability to meet their nitrogen requirements[1]. There is usually a lag of 15 to 30 days between germination and the establishment of nitrogen fixation system in most grain legumes. The growth rates during this period are slow and possibly the plant must depend on the soil nitrogen during this period. This would necessitate the functioning of nitrate reductase in these plants. How nitrate reductase activity functions in relation to nodulation is not known. We here report the nitrate reductase activity during growth and development of cowpeas and mung beans in relation to nodulation.

Cowpeas c v C 152 and mung beans c v Hybrid 45 were grown under field conditions from July to early October, 1973. Leaf samples for nitrate reductase assay from the topmost fully expanded leaves were taken at weekly intervals from the time of germination to fruit development. Nitrate reductase was assayed by the *in vivo* method of Klepper *et al.*[2]. Weekly samples of 15 plants in three groups of each were uprooted carefully to determine nodule number and weight.

Both in mung beans and cowpeas, very high nitrate reductase activity was observed in cotyledonary leaves (Fig. 1). The enzyme activity came down to the lowest level by 3rd week but started rising again and reached another peak in the fifth week. There was a rhythmic behaviour in nitrate reductase in both cowpea and mung beans.

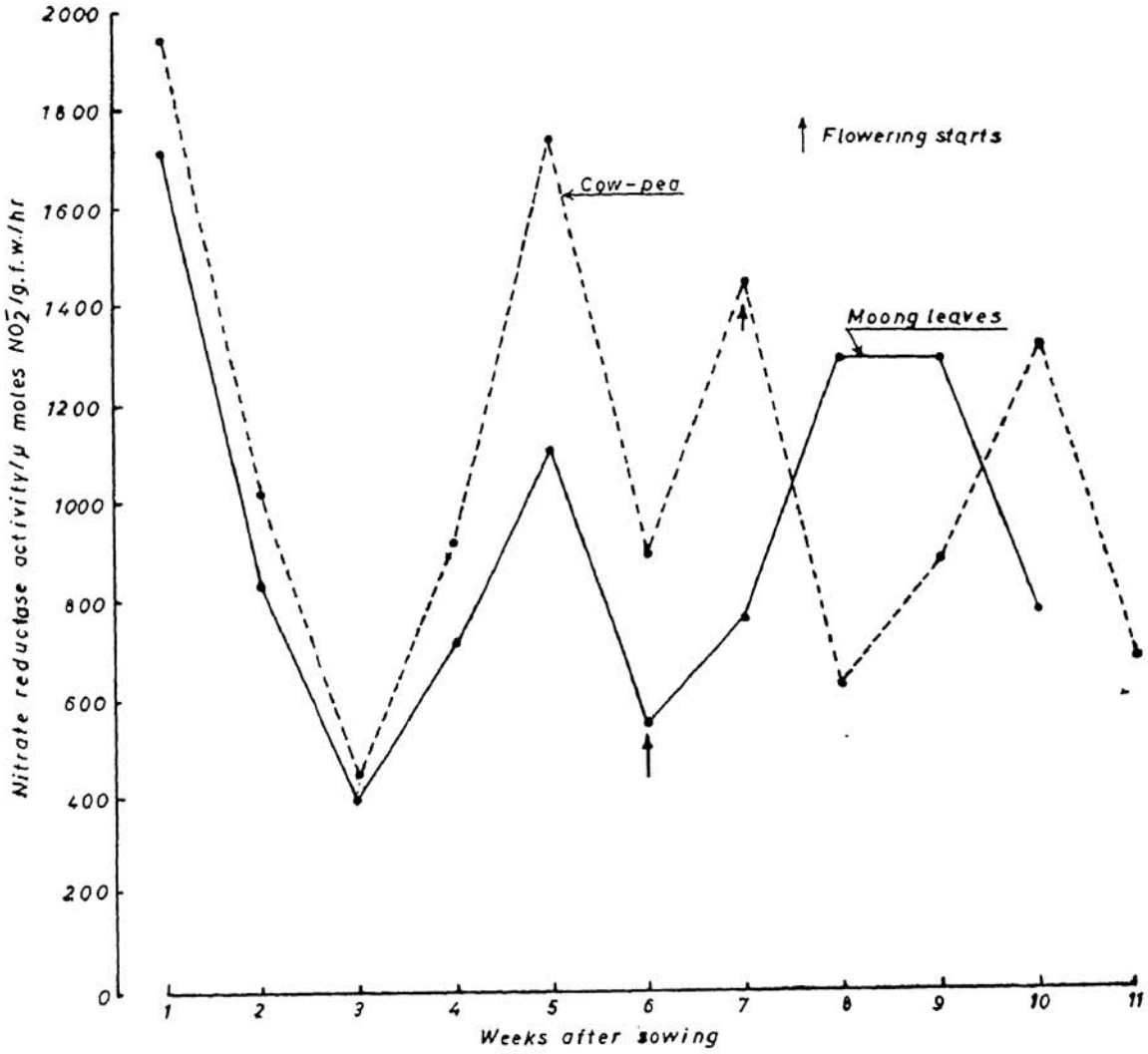

FIG. 1. Nitrate reductase activity during growth of cowpea and mung leaves.

Root nodules appeared in both cowpeas and mung beans by 2nd week after sowing and their number reached the peak in 4th and 5th week respectively (Fig. 2). In cowpeas, the nodule dry weight peak was recorded in 6 weeks while in mung beans the nodule dry weight was maximum in 5 weeks. Thus, it appears that in cowpeas there is a lag between the increase in number and the growth of nodules. However, in mung beans the two processes is probably simultaneous.

It is important to note that both in cowpeas and mung beans by the time flowering started the number and weight of nodules already started declining. In fact, when the flowering was profuse by 8th and 9th week, there were very few nodules left on the plants. It was at this time when the third and fourth peaks of nitrate reductase activity in mung beans and cowpeas appeared.

Nitrate reductase is substrate inducible and is considered an important enzyme in relation to protein and grain yield in cereals[3]. High nitrate reductase activity prior to the termination of nodulation possibly indicates the source of nitrogen as nitrates from the soil. Is the existence of rhythm in nitrate reductase activity a characteristic of these plants or associated with the formation and decay of nodules? In the latter event the senescent nodules rich in nitrogen may disintegrate to produce nitrate. Therefore, the entire nitrogen fixed by nodules in reduced form may not be used as such but converted to nitrate form before utilization by the plant. This would necessitate re-evaluation of energy requirement of the plant in terms of free nitrogen fixation and utilization as worked out by Bergerson[4]. Furthermore, we will need an evalua-

tion of nitrate reductase activity in leguminous crops besides their nodulation and nitrogen fixation ability.

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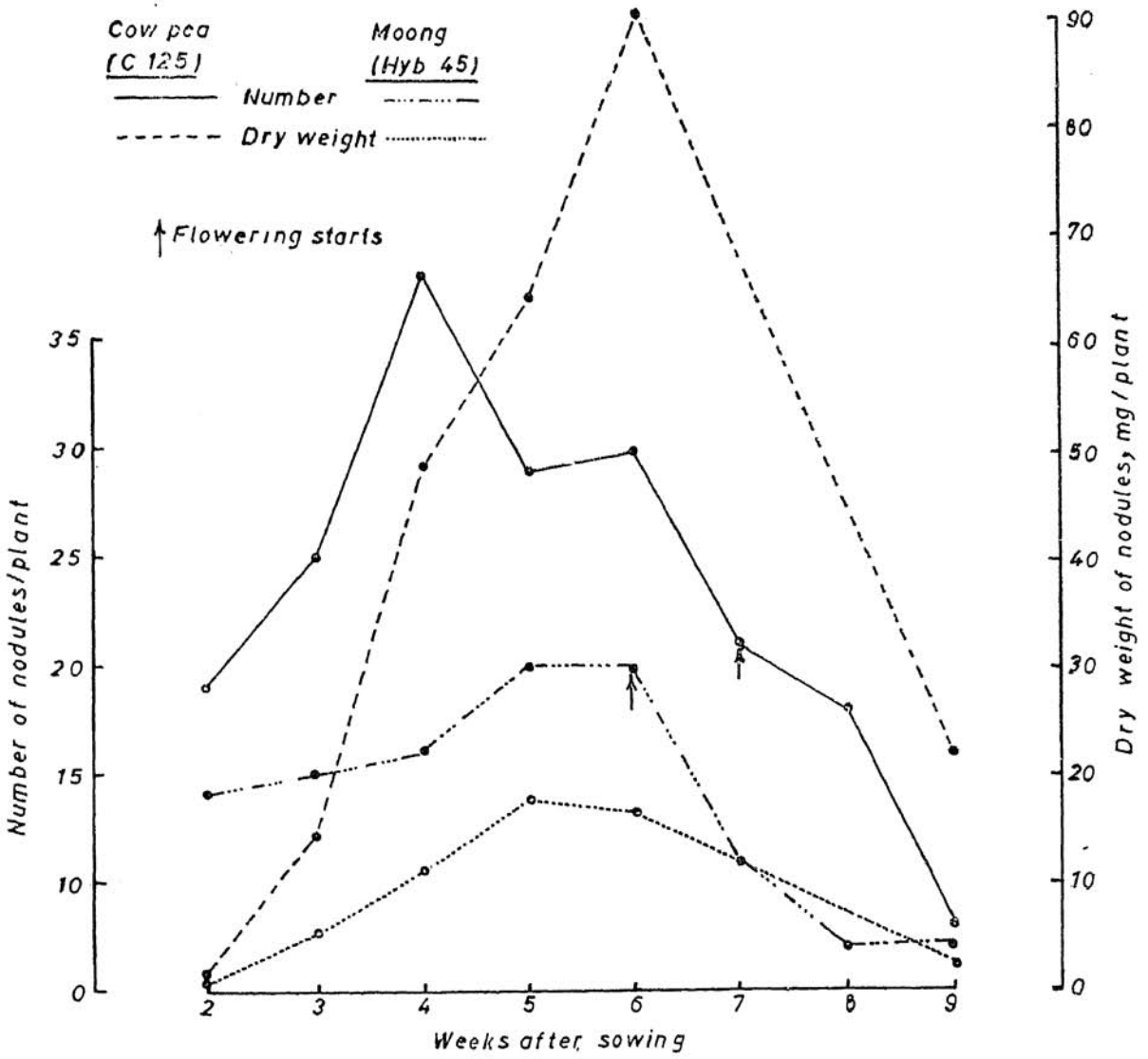

FIG. 2. Nodule number and weight during growth in cowpea and mung.

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