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# NODULATION PATTERN AND THEIR RELATIONSHIP WITH PLANT BIOMASS IN CERTAIN PULSES

S. ANTHONI RAJ *, V. UDAYASURIAN, * M. SAHUL HAMEED and S. R. SREERANGASAMY***

Nodule initiation was observed within 5 days after emergence in green gram, black gram, chickpea and pigeon pea. Detachable nodules formed 15 days after sowing in cowpea and chickpea, after 20 days in green gram and after 25 days in pigeonpea. Pigeonpea recorded the least number of nodules and nodule biomass among the legumes tested. A positive linear relationship between the age of plants and nodule number was observed in green gram, cowpea and pigeonpea and a negative relationship in cowpea. A positive correlation between nodule number and plant biomass was observed in cowpea and green gram and a negative correlation in chickpea and pigeonpea.

Pulses are grain legumes that have the unique faculty of fixing atmospheric nitrogen through nodules incited by the symbiotic *Rhizobium* bacterium. Althouth pulse crops are generally examined for nodulation at preflowering stage around 40 days in experimental trials (Anonymous, 1986), sampling and comparison of nodulation of crops of different stages pose a problem. It was reported that nodulation in greengram was the highest at preflowering stage i. e. 10 days before flowering stage (Shanmugam and Sree Rangasamy, 1981). However, Narayana and Gothwal (1954) reported that nodules close to the soil surface degenerated in 32 days in blackgram with an increase in their numbers in the secondary and tertiary roots. Most of these pulses are nodulated by the cowpea miscellany group *Rhizobium* spp, however, there exists a wide variation in the extent of nodulation in one and the same area. In order to assess the period of visible nodulation and their pattern, the peak nodulation stage and the extent of variation in nodule biomass among the commonly cultivated pulses in Tamil Nadu a field study was undertaken and the results are presented here.

## MATERIALS AND METHODS

Greengram [*Vigna radiata* (L.) Wilczek], blackgram [V. *mungo* (L.) Hepper , cowpea (*V. unguiculata* (L.) Walp], pigeonpea [*Cajanus cajan* (L.) Millsp] and chickpea (*Cicer arietinum* L.) were sown in replicated micro plots ($1m^2$) during rabi, 1985 in a field soil containing 1000 rhizobia of cowpea miscellany *Rhizobium* spp. per g of soil. At 5 days interval after sowing three plants in each of the three plots were removed by mean of a scoup/digging fork with least disturbance to the soil and the nodule

* Department of Agricultural Microbiology,

** School of Genetics, Tamil Nadu Agricultural University Coimbatore 641 003

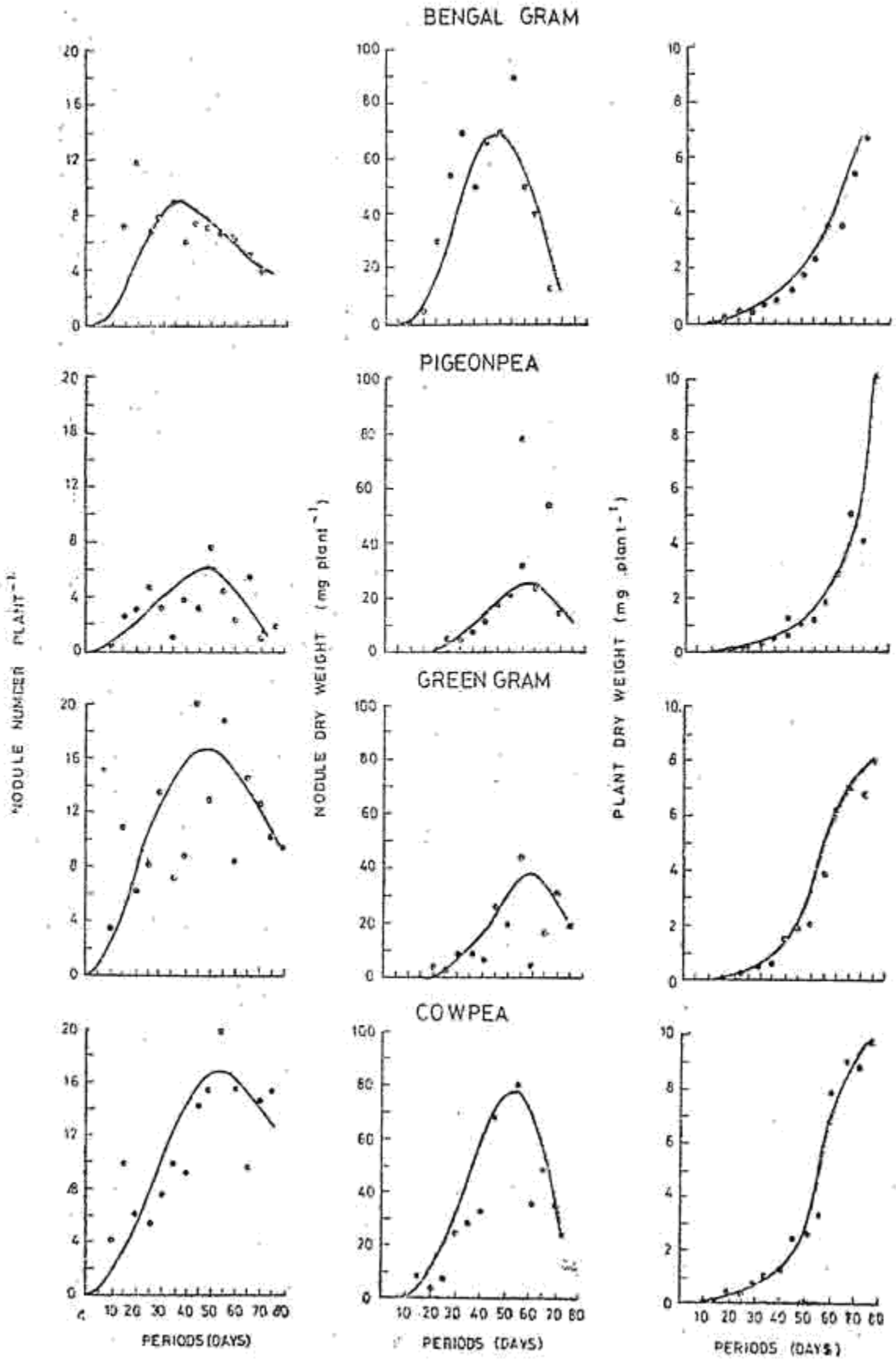
number was recorded. The nodules were separated from plants and both the nodules and plants were dried at 60°C for 3 days to determine the dry biomass. The nodule number, nodule dry weight (dry biomass) and the plant dry weights were plotted against the age of the plants. The data were analysed statistically and the correlations between age of plants, nodulation and biomass were determined.

## RESULTS AND DISCUSSION

Under field conditions nodule initiation was observed in all these pulses on 10th day after sowing i. e. within 5 days after emergence. However, detachable nodules (i. e.) sizeable nodules could be observed only after 15 days of sowing in cowpea and chickpea, after 20 days in green gram and after 25 days in pigeonpea. The succulence or tenderness of the cowpea and chickpea roots compared to the thin but hardy nature of pigeonpea might be the reason for earliness of nodulation in the former and a delay in the latter. In general, both the nodule number and dry weight, increased up to 45-55 days after which they declined (Fig. 1). Plant dry weight on the other hand increased very slowly in the initial stages and gained a momentum at peak nodulation stage suggesting the favourable effect due to nodulation. It is inferred that although these pulses are nodulated by cowpea miscellany group *Rhizobium* spp. the nodulation varied greatly among these legumes both in number and biomass suggesting that host response influences the extent of nodulation. There was relatively higher number of nodules in greengram and cowpee compared to chickpea and pigeonpea, the pigeonpea recording the least number of nodules and biomass.

It was reported that greengram showed better nodulation than other pulses (Anonymous, 1981). It is likely that due to the hardy nature of roots and longer duration pigeonpea harboured a lesser nodulation compared to the succulent roots of the shorter duration pulses tested. This was further confirmed by the fact that nodule number and biomass exhibited a steep rise with the age of the plants in all the other pulses tested than pigeonpea. The plant biomass increased till harvest in all these legumes, the sharp rise coinciding with the peak nodulation stage due to the flow of nitrogen from nodules to the plant. The nodule number and biomass decreased with the maturity of plants due to early senescence of the first formed nodules. Patil and Shinde (1980) reported that the decrease in nodule number was more pronounced towards maturity in all varieties of gram. Shanmugam and Sree Rangasamy (1981) also reported maximum number of nodules at pre-flowering stage followed by peak-flowering stage with a minimum in the ped initiation stage in greengram. It is interesting to observe a wide variation

CROP GROWTH AND NODULATION PATTERN IN CERTAIN PULSES



in nodulation of plants even among the genetically identical homogenous population of a pulse cultivar. This factor is the single largest factor causing concern in nodulation studies and Increasing the sample size has not ameleorated the situation The present studies indicated that the nodule number and biomass were higher around 45-50 days in cowpea, greengram and pigeonpea and 35-40 days in chickpea at the locati on studied. However, this may be subjected to variation due to environmental factors as these influence nodulation greatly.

There exists a positive linear relationship between the age of plants and nodule number in greengram, cowpea and pigeonpea which was significant only in cowpea (Table 1). A negative relationship between age and nodule number was observed in chickpea. There was a significant correlation between age of plants and nodule biomass in all pulses tested except chickpea. However, there was a significant correlation between age of the plant and plant dry biomass. A significant correlation between nodule number and nodule dry weight was observed only in green gram, cowpea and chickpea and not in pigeonpea. Although a positive correlation between nodule number and plant biomass in cowpea and green gram was observed it was significant only in cowpea. In chickpea and pigeonpea which are crops producing indeterminate type of nodules, a negative correlation between nodule number and plant dry biomass was observed which was significant in chickpea than in pigeonpea. There was not any significant correlation between nodule biomass and plant biomass in the latter two crops while there was a significant positive correlation between these two parameters in the former two crops.

Table 1. Correlation coefficients of nodulation parameters with the age and plant biomass

| Parameters | Green gram | Cowpea | Chickpea | Pigeonpea |
|---|---|---|---|---|
| Nodule number X Age | 0.36 | 0.70** | −0.26 | 0.07 |
| Nodule dry weight X Age | 0.62* | 0.66** | 0.16 | 0 55* |
| Plant dry weight X Age | 0.92** | 0.90** | 0.91** | 0.79** |
| Nodule number X Nodule dry weight | 0.71** | 0.77** | 0.38** | 0.28 |
| Nodule number X Plant dry weight | 0 13 | 0 30* | −0.36* | −0.10 |
| Nodule dry weight X Plant dry weight | 0.35* | 0.37* | 0.03 | 0.19 |

* Significant at 5% level

** Significant at 1% level

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