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1) Influence of genotype and growth stage on nitrogen fixation in soybeans.

One of the many characteristics that makes soybeans a desirable crop is their ability to fix nitrogen. In order to enhance this ability, it is necessary to look at the variation among various cultivars throughout their life cycle.

Genetic studies for Spanish clover (*Desmodium sandwicense* E. Mey) by Pinchbeck et al. (1980) showed a significant difference among genotypes in their ability to fix nitrogen. These differences suggest a genetic variation for nitrogen fixation in Spanish clover. Nitrogen fixation rates also vary with stages of the plant's growth. Hardy et al. (1968) reports that nitrogen fixation activity per plant in soybeans (*Glycine max* L. Merr.) is low prior to flowering, increases rapidly after flowering and decreases rapidly as the plant approaches the green bean stage.

Our objectives were to: 1) screen the 20 soybean varieties in Table 1 for nitrogen fixation potential, and 2) to determine the differences in nitrogen fixation among growth stages V4 (4 nodes on the main stem), R1 (at least 1 flower at each node), and R6 (pod containing full size green beans at one or more of the 4 uppermost nodes (Fehr et al., 1971).

Table 1. Maturity groupings of soybean cultivars tested for influence of genotype and growth stage on nitrogen fixation

Soybean cultivars				
MG IV	MG V	MG VI	MG VII	MG VIII
RA401	Bedford	Tracy	Braxton	Foster
RA480	Forrest	Davis	Hutton	Wright
Stevens	Wilstar 550	Centennial	Bragg	
	Essex	McNair 600		
	Bay	Greenseed 737		
		Lee		

Soybean cultivars were planted in sterile Dispo growth pouches and inoculated with USDA *Rhizobium japonicum* strains 3I1B 6 and 3I1B 122. Nutrients were supplied by Fahreaus nitrogen-free nutrients solution. The plants were

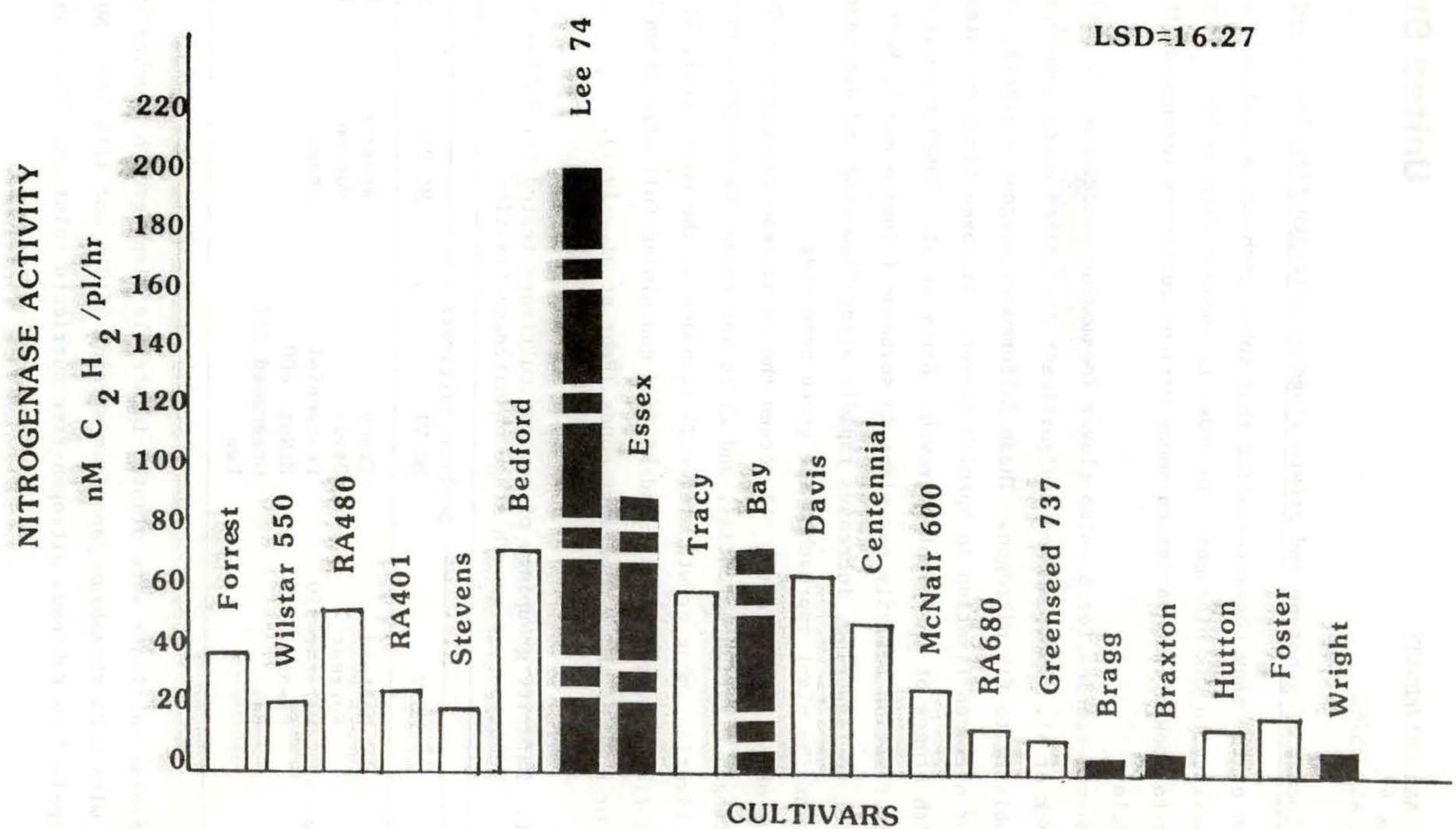

Fig. 1. Variation in nitrogenase activity among twenty commercial soybean cultivars.

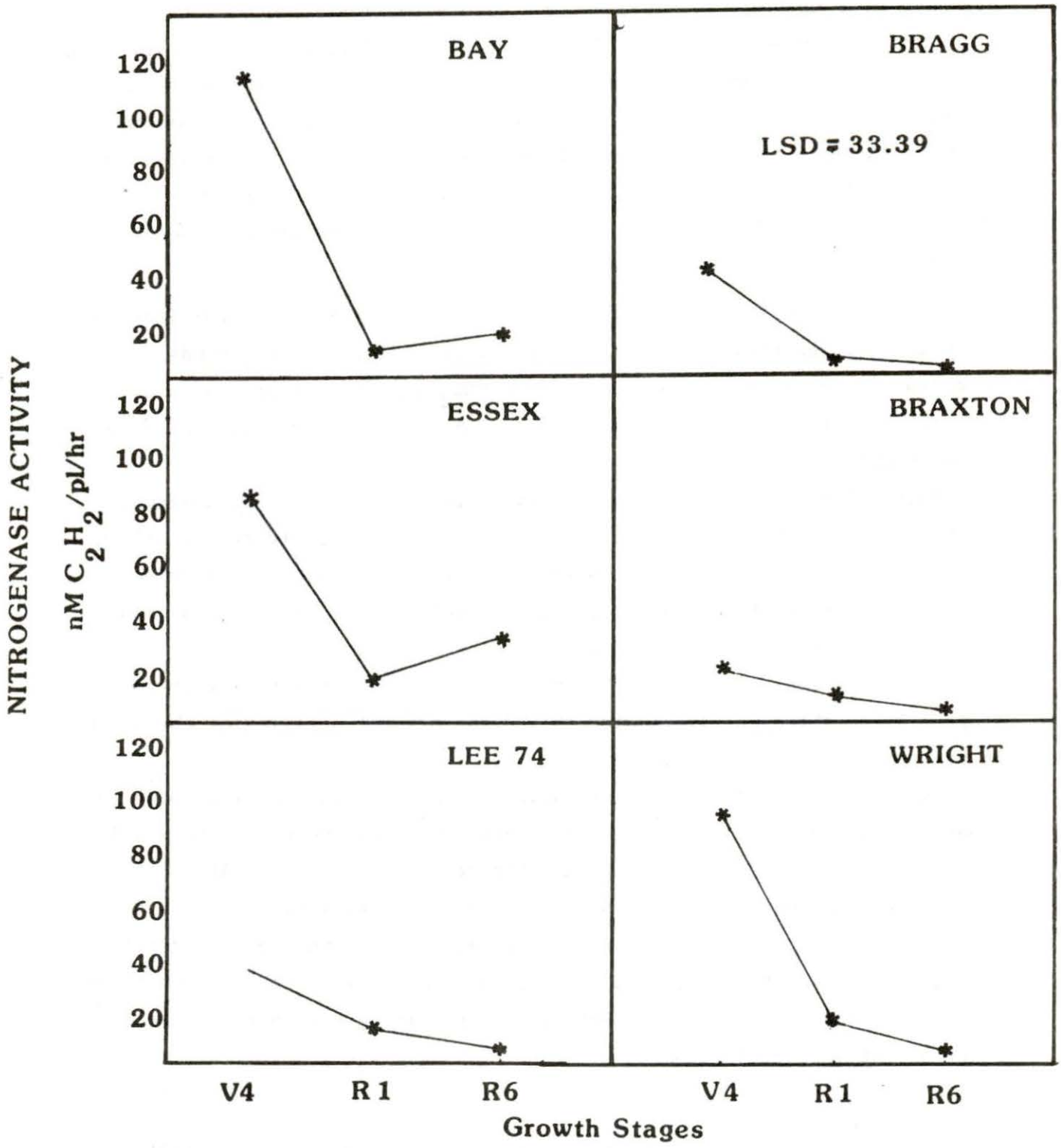

Fig. 2. Profiles of nitrogenase activity of six soybean cultivars.

grown in a growth chamber at 75 ± 5°F at 16 hr days for 35 days. They were arranged in a randomized complete block with 4 replications.

From the screening 'Bay', 'Essex', and 'Lee 74' were chosen as the highest nitrogen fixers and 'Braxton', 'Wright', and 'Bragg' were chosen as the lowest nitrogen fixers based on acetylene reduction. These cultivars were grown in the greenhouse in pro-mix A and inoculated with a commercial peat inoculant. Each cultivar was grown to the V4, R1, and R6 stage of growth. They were grown at 75 ± 5°F at a 16 hr light period. Arrangement was a split-plot design with four replications.

Results and discussion. Acetylene reduction revealed a significant variation in nitrogen fixation for the 20 cultivars (Fig. 1). There was a range in means per cultivar from 3.00 to 201.00 nMC_2H_2/pl/hr. There was a correlation among acetylene reduction and nodule number, nodule weight, and shoot fresh weight.

Seasonal variation among the cultivars Bay, Essex, Lee 74, Braxton, Wright, and Bragg was highly significant. The highest activity for all cultivars was at the V4 stage. As shown in Figure 2, nitrogenase activity decreased both at the R1 and R6 stages in all cultivars except Bay and Essex. Bay and Essex showed signs of recovery at the R6 stage.

Cultivars Bay, Wright, and Essex showed the highest activity at the V4 stage. These three cultivars also showed the highest activity at the R1 and R6 stages.

There seems to be significant variation in nitrogen fixation among cultivars. This variation continues throughout the life cycle, but the variation is most significant at the period before flowering (V4). After flowering, there is a continued decrease in nitrogenase activity.

Our ultimate goal in this area of research is to enhance nitrogen fixation in soybeans. Perhaps, through breeding, the decline in nitrogen fixation after flowering can be prevented, thus providing more nitrogen to the plant during seed production.

References

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