CHEMICAL DEFENSES OF LOTUS CORNICULATUS

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My research examined several factors associated with chemical defenses in Lotus corniculatus. The cost of producing condensed tannins and cyanogenic glycosides was measured by correlating plant size and reproductive output with chemical concentrations. I found that cyanide concentration was not related to plant size, but that condensed tannin concentrations were positively correlated with plant size; larger plants had higher tannin concentrations. Both tannin and cyanide concentrations were depressed when plants produced fruits. Defense costs change as plants mature and begin to reproduce. Cost of defense chemical production cannot be predicted merely on the basis of chemical size, composition or concentration.

Nitrogen fixation can influence the ratio of carbon to nitrogen in legumes by providing nitrogen in nutrient-poor habitats, and by reducing carbon to support symbiotic nitrogen fixation. Lotus corniculatus clones were grown under three nitrogen availabilities, including a treatment which relied solely on symbiotic nitrogen fixation. Plants which supported symbionts had lower biomass and lower tannin concentrations which appears to be a result of the large carbon demand of nitrogen fixation. Plants supporting symbionts often had relatively low protein concentrations. Plants growing under low nutrient conditions tended to have relatively low cyanide concentrations. Although symbiotic nitrogen-fixing plants were smaller, they had three times the reproductive output of plants in either of the fertilized treatments. This pattern does not fit the carbon availability theory, but suggests that fixing plants may contain higher concentrations of nitrogenous compounds (amides) which are differentially allocated to reproduction.

Plant secondary compounds such as tannins may influence herbivore choice. To determine how herbivory was influenced by chemical defenses, Spodoptera eridania larvae were given a choice of plants whose chemical profiles were altered by fertilization. Herbivores chose plants which had been grown with symbiotic nitrogen fixation as their only nitrogen source more often than fertilized plants. Choice was based on protein concentration, not tannin concentration.

Plant secondary compounds may be influenced by herbivory. Plant clones were grown under three nitrogen availabilities, including a treatment which relied solely on symbiotic nitrogen fixation. Plants were then damaged by S. eridania larvae. All damaged plants, regardless of fertilization regime, were smaller, had lower reproductive outputs, higher protein concentrations and higher tannin concentrations than non-damaged plants. Cyanide concentration was not influenced by herbivory.

Both genetic and environmental sources of variation were examined for shoot biomass, reproductive output, cyanide, condensed tannin and protein concentrations in clones growing under three nutrient availabilities. While cyanide was typically affected only by genetic factors, and protein was greatly influenced by environmental factors, all other plant measures had strong genetic and environmental control. Another source of variability in allocation patterns was related to the size/age of the parent plant. Replicates from older/larger plants had greater reproductive outputs, larger shoot biomass, lower root biomass and lower protein concentrations. Replicates from older/larger parents were also more astringent, although cyanide concentration was not different.