

GREENHOUSE STUDY OF KIDNEY BEAN COMPETITION WITH BARNYARDGRASS AND HAIRY NIGHTSHADE IN THE PRESENCE OF VARIOUS LEVELS OF SOIL PHORPHORUS

Larry W. Mitich and Guy B. Kyser

Kidney beans (B), barnyardgrass (G), and hairy nightshade (N) were planted in six competitive arrangements (BBB, BBG, BBN, BGG, BNN, BGN) in six soil types [three levels of soil phosphorus (P) vs. lime (L) or no lime (U)]. Species interaction was evaluated under various levels of available P; addition of hydrated lime [Ca(OH)₂] increased soil pH, thereby decreasing availability of P.

The basic soil was a low P (8.8 ppm) loamy sand, pH 7.9, from Tulare County. P was added at 0, 50, or 100 ppm by weight in the form of 0-25-0 fertilizer mortared to pass through a size 50 screen; lime was added to half the soil at 0.3% by weight. Soil characteristics are summarized in Table 1.

Table 1. Summary of soil characters

	Added P (ppm)	pH	Available P (ppm)
Unlimed	0	7.9	8.8
	50	7.4	40.0
	100	7.0	71.0
Limed	0	9.6	10.1
	50	8.7	29.0
	100	8.3	64.0

The experiment was established in split blocks as follows:

- The six soil types were randomized within each of 4 replication blocks.
- Within each soil type, competitive arrangements were randomized.

Plants were seeded in 6-in. pots in a 'warm' greenhouse on the UC Davis campus on 6 July 1988. Before planting, pots were watered for 1 week to allow pH in limed soils to stabilize. Each pot was fertilized weekly with 120 ml of 10x normal strength Hoagland's solution without P. On 31 August all plants were cut at the soil level, dried, and later weighed. Dry plant weights were used for all analyses; average weight per pot was used for pots with more than one plant of a species.

In analysis it was found that bean plant weight increased greatly between 0 and 50 ppm added P; a slight but significant increase also appeared between 50 and 100 ppm added P. Bean plant weight also varied significantly with competitive arrangement: beans competed best against nightshade and worst against other beans. Added P and competitive arrangement interacted significantly as follows: a great increase in bean plant size owing to added P was found in pots where beans were not competing against other beans. In other words, P increased the interspecific competitive strength of bean plants. Neither barnyardgrass nor nightshade increased significantly in weight with added P, but both species showed the effects of competition. Barnyardgrass competed against itself just as well as it did against bean plants, and outcompeted nightshade. Nightshade obviously competed well only with other nightshade; it also showed significant variation between replication blocks.

Table 2. Factors significantly affecting growth of kidney beans, barnyardgrass, and nightshade in the greenhouse, UC Davis.

Plant	Factor	Unit	Average dry wt ¹ (grams)		LSD (5%)	
Kidney beans (B)	Phosphorus	0 ppm	6.8	C	2.85	
		50 ppm	19.0	B		
		100 ppm	21.9	A		
	Competition	BBB	10.5	E	2.79	
		BBG	12.6	DE		
		BBN	14.5	CD		
		BGG	15.5	C		
		BNN	23.4	A		
		BGN	19.1	B		
	P X competition	0 ppm	X BBB	5.0	H	4.83
			X BBG	5.1	H	
			X BBN	6.8	H	
			X BGG	7.6	GH	
			X BNN	9.7	FGH	
			X BGN	6.6	H	
		50 ppm	X BBB	12.1	EFG	
			X BBG	15.6	DE	
			X BBN	17.9	CD	
			X BGG	15.3	DE	
			X BNN	31.1	A	
X BGN			22.2	BC		
100 ppm		X BBB	14.4	DEF		
		X BBG	17.1	D		
		X BBN	18.8	BCD		
		X BGG	23.6	B		
		X BNN	29.4	A		
		X BGN	28.4	A		
Barnyardgrass	Competition	BBG	14.7	B	3.01	
		BGG	14.5	B		
		BGN	19.3	A		
Nightshade	Competition	BBN	1.48	AB	1.11	
		BNN	2.49	A		
		BGN	1.27	B		

¹Values followed by the same letter are not significantly different according to Duncan's Multiple Range Test. Average dry weight per pot.