

## OUTCROSSING RATES WITHIN AND BETWEEN GENE POOLS IN COMMON BEAN

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Estimates of outcrossing rate of six cultivars of common bean (*Phaseolus vulgaris* L.) at the South Coast Research and Extension Center, Irvine, CA, were determined in 1989 and 1991 with a mean of 4.3% and a range over the two years from 2.9 to 6.4% (Ibarra-Perez, Ehdaie and Waines, 1997). A significantly higher mean level of outcrossing (8.8%) was obtained at the University of California Agricultural Experiment Station, Riverside, CA, in the same years. In 1994, estimates of outcrossing among four cream bayo-seeded bean cultivars on the INIFAP Research Station (Campo Experimental Valle del Guadiana), Durango, Mexico, had a mean of 4.2% (Ibarra, Waines and Castillo, 1996). Bean cultivars used in those studies belonged to the same gene pool; however, Ibarra-Perez, Ellstrand and Waines (1996) suggested that bean cultivars from different gene pools crossbreed but at a lower rate. Therefore, a further study was undertaken to assess the extent of outcrossing within and between gene pools in common bean.

In summer 1996, two field experiments were conducted on the INIFAP Research Station at Durango and the University of California Research and Extension Center at Irvine, CA. Durango is located at high elevation (1800 m) in the central plateau of Mexico, whereas Irvine is at low elevation (15 m) near the coast of Southern California. In both locations, the same experiment was conducted at approximately the same time of the year, with planting in July and harvest in November. Two cultivars, "Pinto Nacional-1" (green hypocotyl and white flower color) and "Durango-222" (purple hypocotyl and purple flower color) represented the Mesoamerican (Durango race) gene pool, and "Redcloud" (green hypocotyl and white flower color) and "Black Valentine" (purple hypocotyl and purple flower color) represented the south American (Andean) gene pool. Four outcrossing blocks were planted using this germplasm. Each block was separated by 40 m (Irvine) or bordered by a field of corn (Durango) and consisted of fifteen 21-m-long rows. Seeds from the corresponding purple-hypocotyl male parents were machine planted at a seed density of 10 seeds/m. The green-hypocotyl female parents were assigned to 18 five-row plots, 3-m long with rows 0.76 m apart. The center row of each plot was hand planted with a sample of 10 seeds of the corresponding female parents, and later thinned to five plants interspersed every 0.50 m among the male plants.

Preliminary results on observed outcrossing rate are listed in Table 1. The data indicate that average outcrossing at Irvine, the low elevation site, was almost four times that at Durango. This presumably has to do with native bee or other insect populations, which may be less at Durango because of higher elevation and cooler temperatures than at Irvine. Alternatively, it may have to do with different amounts of pesticides used in agriculture in Durango and Irvine, which may have a detrimental effect on insect populations and hence on outcrossing rate.

On average, the rate of outcrossing was higher for the two Mesoamerican cultivars than for the two Andean cultivars at both locations. However, the Andean female parent Redcloud was

poorly adapted and produced a low number of pods, especially at Durango. The rate of outcrossing for the Andean female with the Mesoamerican male was the same as the Andean female with the Andean male at both locations. The rate of outcrossing for the Mesoamerican female with Andean male showed highly significant interactions with locations; it had the lowest outcrossing rate at Durango and the highest rate at Irvine. Hence, our original hypothesis was not correct. Perhaps the pollinators had less preference for purple flowers at Irvine, and visited both purple and white colored flowers, than at Durango. Among these four cultivars, individual cultivar characteristics and location had greater effects on outcrossing percentage than gene pool relationships.

**Table 1.** Number of pods and selfed and hybrid seedlings scored and mean observed outcrossing rate (%) of common bean cultivars from different gene pools determined at two locations

Location	Durango, DG., Mexico				Total	Irvine, CA, USA				Total
	Outcrossing blocks					Outcrossing blocks				
Variable	PN × DG	PN × BV	RK × DG	RK × BV		PN × DG	PN × BV	RK × DG	RK × BV	
# Pods	2,091	2,692	267	1,054	6,104	1,270	3,636	888	1,465	7259
# Seedlings	7,096	10,503	527	2,901	21,027	3,978	13,116	2,505	4,857	2,4456
# Selfs	7,057	10,472	525	2,890	20,944	3,923	12,835	2,488	4,819	2,4065
# Hybrids	39	31	2	11	83	55	281	17	38	391
Outcrossing rate (%)	0.55a*	0.30c	0.38b	0.38b	0.40	1.38b	2.14a	0.68c	0.78c	1.60

PN = Pinto Nacional 1, DG = Durango 222, MesoAmerican gene pool; RK = Redkloud, BV = Black Valentine, Andean gene pool.

\* Means within each location followed by a different letter are significant at  $P \leq 0.05$  according to LSD test.

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## References

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