The Genetic Identity of a Patented Yellow Bean

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SUMMARY

Since a 1980 Supreme Court decision, it is possible in the United States to obtain a utility patent for crop cultivars and other life forms. These cultivars have to be novel, non-obvious, and useful. One of the controversial awards of the United States Patent and Trademark Office is a utility patent for the yellow-seeded bean cultivar 'Enola'. Using DNA fingerprinting based on 133 amplified fragment length polymorphisms (AFLP), we investigated the relationships between Enola and a representative sample of 56 domesticated common bean accessions, including a subsample of 24 cultivars with yellow seeds similar to those of Enola. A first experiment showed that most yellow-seeded beans, including Enola, belong to a tightly knit subgroup of the Andean gene pool. Enola was most closely related to the pre-existing Mexican cultivar Azufrado Peruano 87. A second experiment showed that a sample of 16 individuals of Enola displayed a single 133-AFLP-fragment combination, which was also observed among a third of the individuals of Azufrado Peruano 87. We conclude that Enola is neither a novel nor non-obvious derivative from a Mexican yellow bean cultivar, probably 'Azufrado Peruano 87.'

RESULTS

Experiment 1 (Figs. 1 & 2)

• AFLP analysis (133 markers from 6 primer combinations) in a sample of 56 lines, including 24 yellow-seeded cultivars (Fig. 1).

• Principal coordinate analysis shows that the Peruano-type yellow beans form a tightly knit group within the Andean gene pool (Fig. 2)

•Within the Peruano group, Enola is most similar to the Mexican cultivar Azufrado Peruano 87 (AP87).

Experiment 2 (Fig. 3)

• AFLP analysis (133 markers from 6 primer combinations) in a sample of 16 individuals each of Enola, AP 87, and Mayocoba (a U.S. cultivar).

• Enola is monomorphic for the 133 markers. Its haplotype is also found in AP 87 and Mayocoba, although the latter show additional haplotypes.
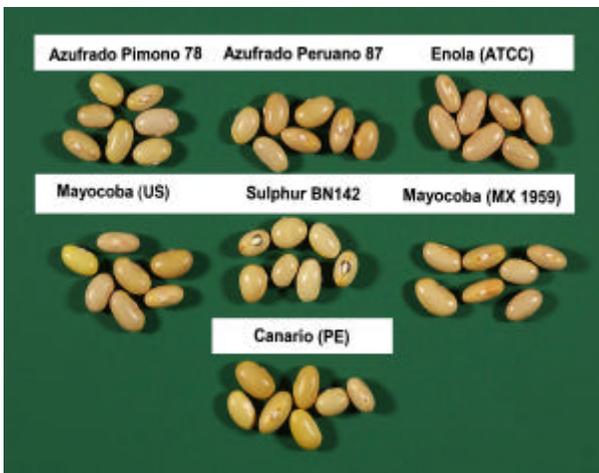

Fig. 2. Principal coordinate analysis of AFLP diversity in a sample of 56 common bean cultivars. Square symbols: Middle American gene pool; circles: Andean gene pool. Boxed entries and filled symbols: yellow seed coat entries. AP78: Azufrado Peruano 78; AP87: Azufrado Peruano87; AR87: Azufrado Regional 87. The eigenvalues of the three axes are 58%, 7%, and 5%. For further explanations about the identity of the different groups, see text.

DISCUSSION

• The most likely origin of Enola is from an improved cultivar in Mexico, likely AP 87, based on probability calculations resulting from the data presented here (Table 1).
• Enola does not satisfy the novelty and non-obviousness statutory requirements of the patent legislation. It does not satisfy the distinctness and non-essential derivation requirements of the PVP legislation.
•See also data of Bassett et al. (2002) showing that the yellow seed color genotype pre-existed in the obsolete Dutch cultivar 'Wagenaar.'

Fig. 3. UPGMA dendrogram showing the relationships among combinations of AFLP fragments found in three Peruano-type bean cultivars: Enola ATCC (red color), Azufrado Peruano 87 (AP87) (green), and Mayocoba 1998 PRO (blue). Each branch represents a different combination. Individuals to the right of vertical bars have identical combinations. The numbers within the tree are bootstrap values.

Fig. 1. Yellow-seed cultivars analyzed in this study. Mayocoba (MX 1959) and Canario (PE) are representative of the parents that gave rise to the Peruano type cultivar class. Examples of this class are the Mexican cultivars Azufrado Pimono 78 (the original Peruano-type cultivar released in 1978) and Azufrado Peruano 87 (released in 1987) (Voysest V, 2000). Enola is a patented and PVP certified yellow-seeded cultivar (Proctor, 1999; U.S. Department of Agriculture, National Genetic Resources Program, 2003). Sulphur BN142 is an ancient U.S. cultivar described as early as 1931 (Hedrick 1931).
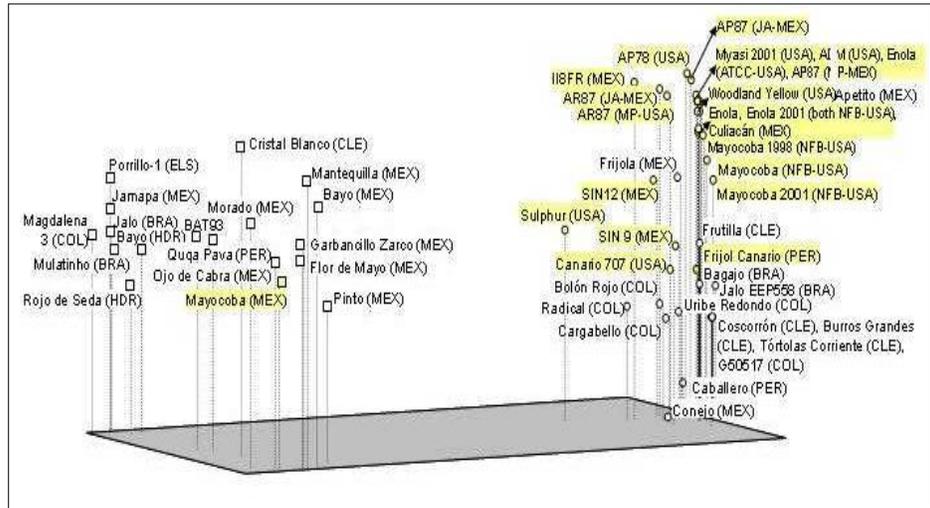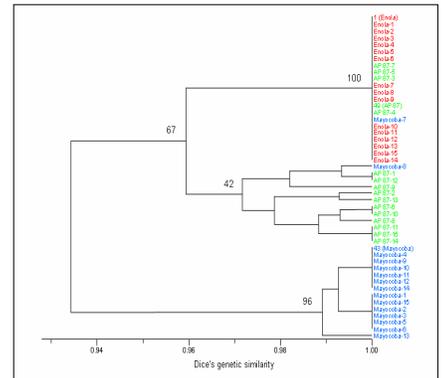
Table 1. Probability of a match to the AFLP marker profile shown by cultivar Enola assuming various hypothetical breeding scenarios.

Breeding scenario	Number of independent markers	Probability	Variance
Cross between any Andean and Mesoamerican cultivar analyzed in this study	31	1×10^{-18}	2×10^{-18}
Cross between original yellow-seeded Middle American (Mayocoba, G13094) and Andean (Frijol Canario) cultivars	31	3×10^{-14}	5×10^{-12}
Cross between any pair of yellow-seeded cultivars	24	3×10^{-5}	2×10^{-4}
Selection without crossing from:			
Mayocoba	-	6×10^{-2}	4×10^{-3}
Azufrado Peruano 87	-	3×10^{-1}	1×10^{-3}