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INTRODUCTION: Snap beans were primarily developed in Europe after the Columbian Exchange through selection for low fiber pods, thicker pod walls, and pod stringlessness (Myers & Baggett, 1999). Abundant evidence supports separate domestications of dry beans in the Andean and Mesoamerican centers, and the best available evidence suggests that snap beans were derived from dry bean from both centers, although the majority descend from the Andean gene pool (Gepts, 1998). While most snap beans were developed in Europe, they are not exclusively found there. Snap beans may have also been developed in China, and there is evidence that at least one bean with low fiber pod traits may have been developed by Native Americans, viz. 'Trail of Tears.' Three unique bean populations from China, Spain, and North America have the potential to shed light on the broader development of snap beans and their dissemination pathways out of the Americas using modern molecular tools. The first of these populations is an uncatalogued collection of Chinese snap beans assembled from a trip in 1991 by Michael Dickson (Cornell Univ.) consisting of 58 genotypes. The second consists of a selection of 11 Spanish genotypes from the Misión Biológica de Galicia – CSIC (Pontevedra, Spain) collection. These are a subset of lines selected from this collection that possess edible pod traits (de Ron, personal communication). The last population, the BeanCAP diversity panels, consists 149 snap beans mostly from commercial bean lines in North America and Europe.

MATERIAL AND METHODS: Genomic DNA was extracted from young trifoliate leaves using a CTAB method and genotyped by the Soybean Genomics and Improvement Laboratory (Beltsville, MD) using the Illumina Infinium Genechip BARCBEAN6K_3 platform. The 'adegenet' R package was used to perform principal coordinate analysis, visualize the analysis, and then perform a discriminate principal component analysis with two clusters.

RESULTS AND DISCUSSION: Three axis of the principal coordinates analysis accounted for 50% of the variation with the first axis consisting of the Mesoamerican by Andean split. The Mesoamerican grouping consists mainly of heirloom pole bean accessions (Table 1). Notable Mesoamerican lines within the BeanCAP were 'Trail of Tears' and several Pole Blue Lake lines. Two old American heirloom snap beans were also of Mesoamerican origin, namely 'Aunt Hattie' and 'Grandma Nellie's Yellow Podded Mushroom Pole Bean.' Eighty-six percent of the Chinese genotypes were Mesoamerican whereas only 8% of the snap bean BeanCAP were Mesoamerican in origin (Table 1).

The plot showed Andean groupings for European Extra Fine with Bush Blue Lake snap beans on the second axis distinct from Romanos and phaseolin type 'C' snap beans. Both European Extra Fine and Bush Blue Lake types represent substantial mixing between centers of domestication. Intermediate to these two extremes were the majority of commercial bush snap bean cultivars. Very few of Spanish accessions were of Mesoamerican origin (Table 1), with the majority of these grouping with Romano types. Refugee types formed a distinct group within the Andean center, but may have had some introgression from Mesoamerican germplasm distinct from what occurred with Bush Blue Lake snap beans.

Considering that the BeanCAP is representative of North American and European commercial lines and commercial breeding materials, the high number of Mesoamerican lines within the Chinese population could be a source of new germplasm and new traits for breeders and geneticists.

Table 1. Categorization of genotypes by center of origin based on a discriminate analysis of principle components with 2 clusters. An Andean origin is indicated by a "1" and a Mesoamerican origin is indicated by a "2".

Accession	Origin	Accession	Origin	Accesson	Origin	Accession	Origin	Accession	Origin	Accession	Origin
Chinese genotypes		91-3008	2	Benton	1	Gallatin_50	1	Paloma	1	Tapia	1
91-1009	2	91-3013	2	Black_Valentine	1	Galveston	1	Panama	1	Tendercrop	1
91-1028	2	91-3110	1	Blue_Peter_Pole	2	Gina	1	Paulista	1	Tendergreen	1
91-1033	2	91-3225	2	Bogota	1	Gold_mine	1	Pix	1	Teseo	1
91-1073	2	91-3255	2	Booster	1	Goldrush	1	Polder	1	Thoroughbred	1
91-1096	2	91-3346	2	Brio	1	Green_Arrow	1	Pole_Blue_Lake	2	Titan	1
91-1098	2	91-3389	2	Brittle_Wax	1	Grenoble	1	Pole_Blue_Lake_S7	2	Top_Crop	1
91-1104	2	91-3405	2	Bronco	1	Hayden	1	Pretoria	1	Trail_of_Tears	2
91-1145	2	91-3436	2	Cadillac	1	Hercules	1	Profit	1	True_Blue	1
91-1215	1	91-3588	1	Calgreen	1	Hialeah	1	Prosperity	1	Ulysses	1
91-1285	2	91-3594	2	Carlo	1	Hystyle	1	Provider	1	Unidor	1
91-1309	1	91-3709	2	Carson	1	Idaho_Refugee	1	Redon	1	US_5_Refugee	1
91-1443	1	91-3736	2	Castano	1	Igloo	1	Renegade	1	Valentino	1
91-1542	2	91-3857	2	Catania	1	Impact	1	Rocdor	1	Venture	1
91-1555	2	91-3915	2	Celtic	1	Jade	1	Rockport	1	Warrior	1
91-1574	1	91-3918	2	Charon	1	Kentucky_Wonder	2	Roller	1	Widusa	2
91-1613	2	91-3921	2	Cherokee	1	Koala	1	Roma_II	1	Zeus	1
91-1643	2	91-3982	2	Coloma	1	Kylian	1	Romano_118	1	Zodiac	1
91-1664	2			Contender	1	Labrador	1	Romano_Gold	1		
91-1672	2	**Spanish genotypes**		Corbette_Refugee	1	Landmark	1	Royal_Burgundy	1	**BeanCAP dry beans**	
91-1728	2	PHA0008	1	Cyclone	1	Landreths_Stringless	1	Saporro	1	Montcalm	1
91-1738	1	PHA0112	1	Dandy	1	Magnum	1	Scorpio	1	Olathe	2
91-1748	2	PHA0192	1	Derby	1	Masai	1	Seabiscuit	1	Seafarer	2
91-1750	2	PHA0224	2	Doral	1	Matador	1	Secretariat	1	Gloria	2
91-1755	2	PHA0272	1	Dusky	1	McCaslan_42	2	Selecta	1		
91-1759	2	PHA0315	2	Dutch_Double_White	2	Medinah	1	Serengeti	1	**Heirloom genotypes**	
91-1768	2	PHA0319	1	Eagle	1	Mercury	1	Serin	1	Aunt_Ada	1
91-1772	2	PHA0385	1	Ebro	1	Minuette	1	Seville	1	Aunt_Hattie	2
91-1892	2	PHA0401	1	Embassy	1	Navarro	1	Shade	1	Cosse_Violette	2
91-1940	2	PHA0402	1	Envy	1	Nicelo	1	Sirio	1	Grandma_Nellies	2
91-1976	2	PHA0453	1	Espada	1	Nomad	1	Slenderella	1	Guatemalan_hierloom	2
91-1989	2			Esquire	1	Normandie	1	Slenderpack	1	Hidatsa_Shield_Figure	1
91-2093	2	**BeanCAP snap beans**		EZ_Pick	2	NY6020_5	1	Sonesta	1	New_Mexico_Cave	2
91-2094	2	Acclaim	1	Ferrari	1	Opus	1	Spartacus	1	Swiss_Landfrauen	1
91-2095	2	Angers	1	Festina	1	Oregon_1604M	1	Speedy	1		
91-2096	2	Astun	1	Flavio	1	Oregon_2065	2	Stallion	1	**Other genotypes**	
91-2097	2	Balsas	1	Flavor_Sweet	1	Oregon_5402	1	Stayton	1	FM1_Pole_Blue_Lake	2
91-2099	2	Banga	1	Flo	1	Oregon_5630	1	Storm	1		
91-2100	2	BBL156	1	Fortex	2	Oregon_91G	1	Strike	1		
91-2101	2	BBL274	1	FR_266	1	Oregon_Giant_Pole	2	Stringless_French	1		
91-2102	1	Benchmark	1	Fury	1	Palati	1	Summit	1		

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