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Differences in Seed Physical & Chemical Characteristics of Two Dry Bean Isolines.
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San Fernando, a black seeded cultivar, and it's white seeded mutant isoline NEP-2 have been compared for physico-chemical and anatomical traits (Agbo, Swanson, Hosfield). We measured two anatomical features which previously were qualitatively reported; leakage of seed contents during soaking; cooking times; and response to adverse storage and ageing. We used Sanilac for comparison to an industry standard navy bean.

Seed Anatomical Traits

Agbo, et al., reported the "bundle-like appearance of cells" on the adaxial surface of cotyledons for the three lines. Using scanning electron microscopy (SEM), we noted that the length (long axis) of "bundle" cells appears highly variable for any adaxial cotyledonary surface examined. However, average width of the cells indicates genotypic differences, with San Fernando (SF) having significantly wider bundle cells. Cotyledonary cell wall thickness (cross-section, by SEM) shows highly significant differences among the strains, with SF<N2<Sanilac.

Seed Leachate Conductivity

Current (microamperes) was measured for single seed soak cells with ca. 3.5ml distilled water/cell, using ASA model 610 analyzer (Agro Sciences, Inc., Lansing, MI). Soaking duration was 24 hours, as recommended. Water in randomly selected cells was analyzed for Potassium (K), Calcium (Ca) and Magnesium (Mg).

Seed Storage Treatments

1. Fresh: 1987 greenhouse grown, ca. 13% m.c., referred to as "1987."

2. Accelerated Ageing: 1986-87 greenhouse grown, ca 16% m.c., stored 4 months @ 24-25°C and 75% relative humidity. Referred to as "1986."

3. Naturally aged: 1985 field grown, ca. 13% m.c., stored under ambient conditions, refrigerated after 18 months. Referred to as "1985."

Sanilac scored consistently higher in average leachate conductivity per seed cell than NEP-2 and SF. SF scored lowest. Sanilac showed little response to ageing while SF and N2 conductivity increased with age and adverse storage. Total Ca, Mg and K content of soak water followed seed leachate conductivity (r=0.911) with K being the major component (r=0.918).

Cooking Treatment

Five hours @ 90.6°C±2°, 100ppm Ca^{++} added to distilled cook water. Beans were tested using the Washington State University modification (L.W. Hudson, personal communication, 1977) of the pin drop cooking apparatus developed by Mattson (1946) for studying the cooking rate of dry peas. Scarification accomplished by cutting 2-3mm x 4-5mm windows into seed coats and resting plunger pin on cotyledon tissue.

Cooking Times

Fresh San Fernando (1987) is the slowest cooking of the three genotypes whether soaked (24 hours) before cooking or not. NEP-2 appears to be equal to or faster than Sanilac. Scarification brought SF cooking times equal to that of white seeded lines, but only when seeds were soaked (24 hours) after scarification. Scarified unsoaked seeds of each line cooked dramatically faster than their whole seed coat counterparts. While accelerated ageing (1986) increased cooking times of all these lines, scarified SF seed showed cooking time distributions about equal to N2. Natural ageing (1985) produced a simular pattern: Increased cooking times for whole seed and scarified seed but with scarified SF approaching or equalling scarified white lines. The role of the seed coat is therefore clearly pivotal for cooking time and as a barrier to plunger penetration. When sufficient soaking and water entry is allowed, cotyledonary cell separation occurs as readily for SF as for N2. SF does not apparently respond differently than N2 to poor storage or natural ageing.

For SF and N2 pleiotropy is apparently involved in complex derived traits such as cooking time, as well as genetically more direct characteristics such as cell width, cell wall thickness, and cell membrane integrity (leachate measurements). Ageing differences measured here are apparently not affected by the seed color ground factor locus.

	BUNDLE CELL WIDTH, µm	CELL WALL THICKNESS, µm
SF	13.45*	1.66**
N2	12.83	2.01**
San	11.97	2.87**

Seed Leachate Conductivity (as mean cell current, µA)

	SF	N2	San
1987	47^{f}	58^{de}	82^{ab}
1986	52^{ef}	62^{de}	87^{a}
1985	64^{cd}	74^{bc}	82^{ab}

Whole (1987)

	No. Cooked/Uncooked	50% Cook, min
SF	5/28	----
N2	23/10	193
San	29/4	199

Window (1987)

	No. Cooked/Uncooked		50% Cook, min	
	Soak	No Soak	Soak	No Soak
SF	12/0	12/0	46	97
N2	12/0	12/0	46	50
San	12/0	12/0	57	47

References

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