Comparison of agronomic performance of white and black seeded near-isogenic lines of common beans

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Introduction

Market classes of dry edible beans are often based on seed coat colour and size of beans. Generally black beans are known to be more susceptible to white mould (*Sclerotinium sclerotinia*) than navy beans. White and black seed coat is controlled by the "P" gene with the dominant allelic, conditioning black seed coat. The whiteness of the navy bean is due to lack of pigmentation, determined by the "p" or ground factor gene. The basic gene "P" and two other groups of colour genes and modifier genes produce various seed coat colours (Prakken, 1971). White seed coat colour also has modifiers and with a recessive "p" and these (i.e. "gri") produce various shades of navy bean colour (Izquierdo et al. 1981). There is a possibility of association with economically significant agronomic traits as visually detectable seed colour is controlled by various genes scattered on the bean genome. Seedling vigour, plant growth, seed yield and reaction to diseases (i.e. root rot, white mould) are reported to be different between the two seed types (Dickson and Boettger, 1976; Dickson and Petzoldt 1988). This study was initiated to test agronomic performance of white and black seeded near-isogenic lines.

Materials and Method

Two crosses: A white (navy) bean cv "Avanti" and line HR40 were crossed with a black bean cv "Midnight". Cross 1 (Avanti / Midnight) and Cross 2 (HR40 / Midnight) were advanced by single seed descent to F_5. Then, plant rows were advanced to derive near-isogenic lines to $F_{6,8}$ by selecting equal number of white and black seeded lines within family. **Field trials:** Four performance trials with 6 families containing 4 white and 4 black lines were conducted at 2 sites in two years. In a split-split plot layout with 3 replications, two crosses were arranged as main plots that contain 6 families as sub-plots, and 4 white and 4 black seeded lines within each family as sub-sub-plot. Maturity, plant height and seed yield were recorded, and desirability of plant types were visually scored as 1 (unacceptable) to 5 (most desirable erect type).

Results and Discussion

Maturity: Both crosses had among-family differences in maturity. Also lines within family were significant (Table 1). Black seeded lines were slightly earlier than white lines in maturity (Table 2) although black cv Midnight matures later than white seeded parent. **Seed yield:** Both crosses 1 and 2 showed significant differences among families for seed yield but only cross 2 had differences among-lines within family (Table 1). This led differences between white and black seeded lines of cross 2. White seeded lines had higher seed yield than black seeded lines (Table 2). **Desirability of plant type**: Visual scores of plant types were different among families in cross 1 and among lines within family in cross 2 (Table 1). This led to differences between seed colour, showing that white seeded lines had more desirable erect plant type than black seeded lines in cross 2 though cv Midnight had more upright plant type (Table 2). **Plant height**: Plant height was recorded only in 1999 and only cross 2 showed differences among lines within family and this led to show differences between white and black seeded lines. White seeded lines were slightly taller than black seeded lines (data not presented).

It was interesting to detect that most differences of the agronomic performances between two seed colour groups were in cross 2. These may have resulted from wider parental differences in yield potential and maturity of the two parental lines in cross 2. The results did not support fully the association of seed colour and agronomic performance of dry beans but selection of lines for both seed types should be feasible in white and black seeded crosses. Further testing is planned to investigate these lines for seedling vigour under adverse conditions (i.e temperature, soil compaction and heavy soils) and reactions to diseases (i.e. white mould and root rot).

References:

Dickson, M.H. and M.A. Boettger. 1976. Bean Improv. Coop. 19:24-25.
Dickson, M.H. and R. Petzoldt. 1988. JASHS 113:111-114.
Izquierdo, J.A., J.D. Kelly, G.L. Hosfield and M.A. Uebersax. 1981. Bean Improv. Coop. 36:44-45.
Prakken, R. 1971. Bean Improv. Coop. 14: 49-52.

Table 1. Combined ANOVA of Crosses 1 and 2 for Maturity, Visual scores Seed Yield at Harrow and St. Thomas, ON in 1998 and 1999

Source of variation	d.f	Maturity		Visual score		Seed yield	
		C1	C2	C1	C2	C1	C2
Year	1			**			*
Location	1			**	**		
E(a)	6						
Family	5	*	**	**	**	**	
Lc X F	5			**	**		
Y x F	5						
E(b)	20						
Line/F	7		**	**	**		**
Ln x F	35				**	*	
Lc x Ln	7				**	**	
Y x Ln	7					**	
Lx x F x L	35						
Y x F x L	35						
E(c)	396						
CV (%)		16.9	12.8	2.4	2.4	15.3	12.9
Mean		2408	2509	83.1	82.0	3.2	3.5

Table 2. Means of white and black seeded lines within family significant in contrast tests for maturity, visual score and seed yield of two crosses at Harrow and St. Thomas, ON in 1998 and 1999.

Family	Maturity (day)				Visual S (1-5) @		Yield (kg/ha) @	
	Cross 1		Cross 2		Cross 2		Cross 2	
	White	Black	White	Black	White	Black	White	Black
1	82.1	82.0	82.8	80.8**	3.6	3.3**	2530	2357**
2	82.0	80.2**	83.1	81.7**	3.5	3.6	2674	2528**
3	83.6	82.4**	83.8	82.4**	3.7	3.4**	2796	2520**
4	84.7	82.1**	84.8	80.8**	3.6	3.4*	2706	2555*
5	85.1	84.7	84.1	81.1**	3.6	3.6	2596	2664
6	85.7	82.5**	81.3	79.3**	3.5	3.4	2068	2112
Mean	83.9	82.3*	83.0	81.0**	3.6	3.5*	2562	2456**

@ Visual scores in cross 1 and yield in cross 1 were not significant and not presented.
* and ** indicate significant difference between white and black seeded lines within family and overall mean.