Development of an ideotype for weathering resistance in mungbean

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Cultivars of green gram radiata) mungbean (Vigna are generally susceptible to weather damage following rainfall at maturity. The black gram mungbean (V. mungo), cv. Regur, is relatively resistant to weather damage (Williams et al., these Proceedings) and differs from cultivars of green gram in many pod and seed traits. The contribution of these traits to weathering resistance is unknown. The aims of this study were to identify traits associated with differences in weathering among lines, describe an ideotype for weathering resistance, and thereby improve the breeding process for mungbean.

Methods

A screening procedure was developed which enabled 302 lines of green gram and black gram to be evaluated for resistance to weathering under controlled conditions (Williams et al., these Proceedings). The degree of weather damage was measured using germination tests and expressed as an index of seed death (SDI). These data were combined with those describing variability among lines for 26 pod and seed traits potentially involved in weathering. Models for weathering resistance were developed using regression analyses.

Results and discussion

Simple phenotypic correlations confirmed that no single trait reliably predicted or explained the weathering responses of the 302 lines. However, the stepwise addition of traits to a multivariate regression (signif. $P<0.01$) described a weathering resistant ideotype for mungbean as possessing the combination of a large pod wall weight to surface area ratio (PW/SA), high levels of persistent hardseededness, late maturity, and large seeds (Table 1). The mechanism/s whereby these traits directly or indirectly contribute to weathering resistance remains to be clarified. Nevertheless, selection for the traits described in the ideotype may enable undesirable lines to be discarded earlier in the breeding process. The relatively modest success of the model in accounting for variation in the weathering responses (R^2 = 17%, 301df) suggests that, additional research is needed to identify sources of unexplained variation, and if possible, other factors involved in resistance to weathering. In the short term, this approach has confirmed earlier studies that showed that hardseededness, in particular, may improve the weathering resistance of mungbean. Breeding toward this aim has commenced (1).

Table 1. The combination of pod and seed traits ($P<0.01$) resulting from multiple stepwise regression for weathering resistance as measured by an index of seed death following exposure of 302 lines to controlled weathering.*

Trait	Partial regression coefficients (and SEs)		R^2	Total* R^2
	Standardized	Actual		
Pod weight/surface area	- 0.26 (0.07)	- 0.19 (0.05)		
Pod length (mm)	- 0.17 (0.07)	- 0.21 (0.09)		
Hardseededness	- 0.19 (0.06)	- 0.18 (0.06)		
Days to flower	- 0.19 (0.06)	- 0.39 (0.13)		
Seed size (g/1000)	- 0.16 (0.07)	- 0.22 (0.11)	16.7	21.3

* R^2 for a multiple regression involving all 26 traits.

1. Williams, R.W., Imrie, B.C., Lawn, R.J., and Byth, D.E. 1988. Proc. Aust. Plant Breeding Conf., Wagga Wagga, 1988. pp. 89-90.