VIOLET SEED COLOUR IN *ALBUS* LUPINS

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ABSTRACT

Crosses were made between white-seeded Ethiopian and Mediterranean landrace accessions of *albus* lupins (*Lupinus albus* L.). The aim of the crosses was as a first step to pyramid genetic resistance to pleiochaeta root rot (*Pleiochaeta setosa*) with resistance to Anthracnose (*Colletotrichum lupini*). The F_1 was crossed to white-seeded susceptible breeding lines with complementary genetics (*pauper* low-alkaloid, *brevis* early flowering, disease susceptible). In the subsequent F_2 unexpected brown seeds of the *graecus* type were seen. In the F_3 some material segregated for a violet seed colour not previously reported. The intensity and distribution of colour was variable. The violet seed colour is inherited but the mechanism of control is complicated and has not been fully determined.

KEYWORDS

Lupinus albus, white lupins, broad-leaf lupins, genetics, seed coat colour

INTRODUCTION

Commercial varieties and landraces of *Lupinus albus* L. (white or broad-leaf lupins) are usually a pure-white seed colour. This is part of their attractiveness as a human snack food. In the Mediterranean region (Greece, Balkans, southern Italy) there exist *graecus* types (Buirchell and Cowling, 1998) which have a marbled brown seed colour. The *graecus* brown colour of the testa is dominant over white (Gladstones, 1970; Gladstones, 1998) and brown × white crosses segregate for a single gene. The seed coat is maternal tissue and so visualisation of segregation is delayed by one generation.

MATERIALS AND METHODS

P25758 (= P_1) is an *albus* lupin landrace resistant to the pathogenic fungus *Pleiochaeta setosa*, the causal agent of pleiochaeta root rot, and originates from the island of Crete in the eastern Mediterranean (Sweetingham and Yang, 1998; Wunderlich *et al.* 2008). P27174 (= P_2) is an Ethiopian landrace that is resistant to *Colletotrichum lupini* (the pathogen responsible for Anthracnose) (Phan *et al.* 2007). Both of these landraces have pure-white seed-coat colour, which has been stably-inherited in our hands over many generations. These landraces were crossed to produce F_{1A} seeds. The F_{1A} (P_1/P_2) was, in turn, used as a male in a cross with various breeding lines (= P_3) which had good local adaptation, high yield, *pauper* low alkaloid, and white seeds but which were disease susceptible. The breeding genotypes were numbered lines (WK208, WK209, WK210, WK211, WK213, WK214, WK222, WK223, WK225, WK226, WK227, WK229). Bulk breeding populations generated unexpected non-white seed colours, so this was investigated further using seed retained from the earlier generations.

The F_{1B}s ($P_3//P_1/P_2$) were selfed to produce bulk F_2s and bulk F_3s. Single F_3 seeds were further grown to produce F_4 families. The two landraces (P27174 and P25758) were also crossed directly with breeding lines (P_1/P_3 and P_2/P_3), selfed to F_2, scored for seed colour, and single plants selfed to F_3.

RESULTS AND DISCUSSION

The F_{1A} and F_{1B} seeds produced were all white seed colour. In the simple landrace × breeding line crosses (i.e. P_1/P_3 and P_2/P_3), all F_2 and F_3 progeny were also 100% white, indicating that no genes for seed colour were segregating. This reflects our normal experience with breeding populations. However, the seeds of the F_2 from the $P_3//P_1/P_2$ crosses were either white or all brown. The intensity of the brown colouration varied from very dark to pale within one family, with the distribution of the brown colour also varying from mild to intense (Kazimierski, 1960). The most extreme brown seeds were a very dark colour with the whole seed coat covered.

F_3-derived F_4 families from $P_3//P_1/P_2$ were produced from crosses involving three of the breeding lines (WK208, WK210 and WK214). White single seeds gave 100% pure white progeny ($n = 71$), whereas brown seeds segregated to give brown families ($n = 50$), white families ($n = 15$) or violet families ($n = 7$). It appears that the violet seed colour can be fixed in a homozygous genotype, since some violet breeding lines from the bulk populations produced 100% violet seed.

The violet colour had not been seen before and, as far as the authors are aware, has not been reported elsewhere. The violet colouration varied in intensity and distribution in a similar way to the brown colour. The distribution of colour (intensity and degree of spread over the seed surface) may have separate genetic

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control. The violet colour is in the ‘Violet Group’ and is close to colours 86C and 83D in standard horticultural colour charts (RHS, 1995). The violet colour has no commercial value and must be removed from breeding populations.

We postulate that the Ethiopian and Mediterranean landraces are harbouring additional recessive genes for seed colour which, when combined, give brown and violet. Several mechanisms of inheritance can be postulated (for example multi-genic, multi-allelic, gene dosage) but none seems to adequately explain the observations. Further work is required.

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