Short communication

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The stability of L1-mutant periclinal potato chimeras

H. W. HOWARD

Plant Breeding Institute Trumpington, Cambridge, England

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Summary

The varieties *Red Craigs Royal* and *Red King* are periclinal chimeras with the constitution, L1 uniform red – L2 white-splashed-pink – L3 white-splashed-pink. About 1 in a 100 plants has a tuber or part of a tuber showing reversion to L1 white-splashed-pink.

In both the United Kingdom and the United States of America there are important commercial varieties which arose as bud-sports and which are periclinal chimeras (Howard, 1970, Table 33). In these chimeras only layer L1 is mutant and layers L2 and L3 have still the unchanged composition of the parental variety. Such chimeras are usually recognised easily because, while the main part of the tuber periderm traces back to L1, small areas trace back to L2 (Fig. 1A). Estimates of natural mutation rates in potatoes have been made by Heiken (1958) and Howard (1959) but no data appear to have been published on the stability of chimeras in which L1 has a different constitution from L2 and L3.

At the Cambridge Plant Breeding Institute two varieties, *Red Craigs Royal* and *Red King*, have been used for several years as 'marker' plants because their tubers are easily recognisable. The two varieties arose respectively from *Craigs Royal* and *King Edward VII*, both of which have white-splashed-pink tubers, and they differ from the parental varieties in having almost uniform red tubers.

Reversion from almost uniform red to splashed-pink tubers is rare but it does occur. Normally there is not time when harvesting trials to record the frequency of

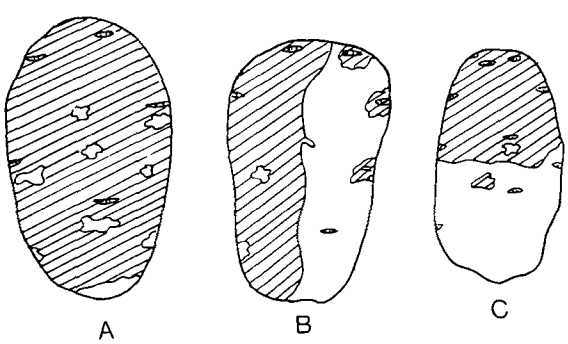

Fig. 1. (A) Tuber of *Red Craigs Royal*. Note small white patches of periderm often beneath eyes and also at stolon attachment end (B). Tuber half reverted to white-splashed pink (see also Fig. 2B). (C) Tuber with uniform red apical end and white-splashed-pink stolon attachment end. Pigmented areas of periderm hatched.

Table 1. Frequency of reversion from uniform red to white-splashed-pink tubers.

Variety	Sample	Number of plants	Total tubers	Number of tubers splashed pink[1]
Red Craigs Royal	A	50	534	0
	B	50	503	1
	C	50	456	$^1/_2$
	D	50	515	$^1/_6$
	E	50	525	0
	F	50	576	0
	G	50	522	$1^1/_3$
total		350	3631	3
Red King	A	200	3186	0
	B	385	7123[2]	$3^1/_2$[3]

[1] = Number of tubers splashed pink – for $^1/_2$, $^1/_6$ and $^1/_3$, see Figs. 1 B and 2.
[2] = Number of tubers not counted. *Red King* plants were infectors in a blight-resistance test (Langton, 1970). King Edward plants in this test averaged 18.5 tubers per plant.
[3] = One plant had a whole tuber white-splashed-pink and also another sectoral tuber, half red and half splashed-pink. Two other plants had single white-splashed-pink tubers each.

reverted tubers, particularly as the general impression is that reversions are infrequent. However, on three occasions time was found to dig plants carefully by hand and to record tuber numbers. The results are given in Table 1; plants were grown in the glasshouse in the following year to check that reversion had taken place and that the reverted tubers were not due to accidental mixing at digging. In a number of cases only part of a tuber had reverted (Figs. 1B and 2). This was not unexpected because it is known (Howard, 1961; Klopfer, 1965) that there are six initial cells for layer L1 which is the growing point layer to which most of the tuber periderm traces back. For *Red Craigs Royal* it would appear that about 1 plant in 70 can be expected to have one tuber or a sector of a tuber showing reversion from uniform red to splashed pink; this is equivalent to about 1 in a 1000 tubers. For *Red King* the data for frequency of reversion are not so satisfactory. In the first investigation no reverted tubers or tubers with reverted sectors were found. In the second investigation total number of tubers was not counted but has had to be estimated. About 1 in 120 plants had a whole tuber or part of a tuber showing reversion from uniform red to splashed pink; this is equivalent to about 1 in 2000 tubers. The frequency of reversion for *Red King* in this second investigation is therefore of the same order as that found for *Red Craigs Royal;* this frequency is higher than that expected from a general impression of digging *Red King* plants.

The change from splashed pink to almost uniform red is due to the loss of the dominant, pigment restricting gene, *M* (Howard, 1970). The change from uniform red to splashed pink could be due to a back-mutation but is much more likely to be

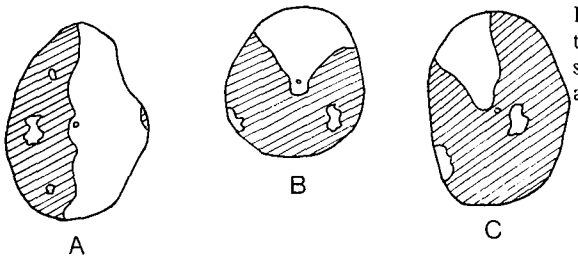

Fig. 2. Stolon-attachment end views of tubers with sectors reverted to white-splashed pink. See also Fig 1 B. Pigmented areas of periderm hatched.

due to the occasional replacement at the growing point of an L1 layer cell by a cell from L2 (this phenomenon is called 'perforation' by Bergann and Bergann, 1959).

In addition to the tubers with white-splashed pink sectors running from the apical end to the stolon-attachment end, there were also observed a few tubers in which the apical end was uniform red and the stolon-attachment end was white splashed pink (Fig. 1C). When such tubers were cut into uniform red and white-splashed-pink halves, it was found that both halves produced plants which had almost uniform red tubers. This can be accounted for – in the parti-coloured tubers, the red periderm at the apical end was formed from a cambium originating in the epidermis which traces back to L1 whereas the white-splashed-pink periderm at the stolon-attachment end was formed from a cambium formed in the hypodermis which traces back to L2. Similarly the small white patches of periderm in normal *Red Craigs Royal* and *Red King* are due to small areas of periderm tracing back to L2 (Asseyeva, 1931; Dorst, 1952; Howard, 1959 and 1970).

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