# NOTE ON THE INHERITANCE OF THE KING EDWARD TYPE OF COLOUR IN POTATOES

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## Introduction

Two types of pigmentation are found in potato tubers: in the first type the periderm is coloured and the underlying parenchyma is colourless, and in the second the periderm is colourless and the pigment is found in the outermost layer of the cortex. Moreover, Lunden (1937) has shown that the two tuber colour types are determined by different genes. It is, therefore, somewhat surprising to find that Black (1933), in discussing the cross King Edward (colour in the periderm) × Flourball (colour in the outer layer of the cortex), does not distinguish between the two different types of pigmentation in the progeny. As a matter of fact, as is shown in this paper, it is possible to score the progeny of this cross for the four types of tuber—King Edward, Flourball, King Edward superimposed on Flourball, and white.

## The cross King Edward × Flourball

King Edward rarely flowers, but flowering can be induced by grafting on to a tomato stock. It was from such a tomato graft that we were able to make the cross with Flourball as pollen parent. The cross was made in 1942 and the seedlings raised in an insect-proof glasshouse in 1943. Tubers from each seedling were planted out in the field in 1944 and scored for tuber colour.

In scoring for tuber colour no difficulty was found in determining the location of the pigment as the periderm can easily be stripped off with the thumb nail. All tubers with colour in the periderm also had the localization of the pink colour to areas surrounding the eyes as is found in King Edward, while all the tubers with pigment in the outer cortex had a uniform distribution of the pink pigment as found in Flourball. The seedlings were classified into four types and the results are shown in Tables 1 and 2.

A simple factorial explanation of these results is possible (but not so simple as the 12 : 4 for red : white suggested by Black (1933) for this cross). First, King Edward is simplex for a dominant gene, K, which determines localized production of pink pigment in the periderm, while Flourball is nulliplex for this gene (it is now generally accepted that the potato is an autotetraploid, e.g. Cadman (1942, 1943)). Secondly, Flourball is simplex for a dominant gene, R, which determines uniform production of pink pigment in the outer layer of the cortex, while King Edward is nulliplex for this gene. Thus we should expect two approximately 1 : 1 ratios, the first for Edward type : non-Edward (actually found 10 : 15) and the second for Flourball type : non-Flourball (actually found 10 : 15). Table 2 shows the results analysed into the two 1 : 1 ratios.

Confirmation for this factorial explanation of the results can be found in Collins (1924)

and Black (1933). Thus, in the cross King Edward × Majestic (white). Collins obtained a ratio of 46 Edward type : 46 white; this clearly confirms the suggestion that King Edward is simplex for the gene K. Evidence for Flourball being simplex for the gene R can be found in Black's work, e.g. Up-to-date (white) × Flourball (pale red) gave 19 red + 9 flush : 29 white. It also appears, however, that there are genes modifying the action of R.

These King Edward seedlings were also interesting in that many of them resembled King Edward very closely in their haulm. King Edward has very characteristic tops, and it might be suggested that this was due to the paracrinkle virus which is found in every King Edward plant. None of the seedlings, however, contained paracrinkle (Carson, Howard, Markham & Smith, 1944). This striking resemblance of King Edward seedlings to King Edward itself was also noticed by Collins (1924).

Table 1

| | | No. of seedlings with tubers of types | | | |
|---|---|---|---|---|---|
| Family | Cross | King Edward | King Edward superimposed on Flourball | Flourball | White |
| 48/43 | King Edward × Flourball | 6 | 4 | 6 | 9 |
| 49/43 | Gladstone × Flourball | 15 | 11 | 15 | 20 |
| 50/43 | Gladstone bolter × Flourball | 11 | 2 | 3 | 10 |

Table 2. *Analysis of results given in Table* 1

| | | No. of seedlings | |
|---|---|---|---|
| Family | Cross | Edward : non-Edward | Flourball : non-Flourball |
| 48/43 | King Edward × Flourball | 10 : 15 | 10 : 15 |
| 49/43 | Gladstone × Flourball | 26 : 35 | 26 : 35 |
| 50/43 | Gladstone bolter × Flourball | 13 : 13 | 5 : 21 |

The crosses Gladstone × Flourball and Gladstone bolter × Flourball

The variety Gladstone has tubers which resemble those of King Edward in having pink areas about the eyes, the pink pigment being located also in the periderm. Also, as can be seen from Tables 1 and 2, Gladstone behaves genetically in a similar manner to King Edward when crossed with Flourball. Gladstone bolter, which has similar tubers to those of normal Gladstone, appears at first sight, however, to behave in a different way. As can be seen in Tables 1 and 2, while the segregation in family 50/43 for Edward : non-Edward is similar to that found in the other two families, there is a large deficiency of Flourball types (both Flourball and King Edward on top of Flourball). This is, however, almost certainly due to the fact that the plants were harvested before they were mature. The development of pink pigment in the outer layer of the cortex is often very small in immature tubers, e.g. in the variety Kerr's Pink. The seedlings from Gladstone bolter would also be expected to be later than those from Gladstone itself in the same way as they have been found to be wilder than seedlings from Gladstone itself (Carson & Howard, 1944). The deficiency of plants of the Flourball types is therefore probably due to misclassification of immature Flourball type plants as whites and immature Edward on top of Flourball type plants as Edward type plants.

SUMMARY

1. The potato varieties King Edward and Gladstone are simplex for the gene **K** which produces areas of pink pigment in the periderm of the tubers, and nulliplex for the gene **R**.

2. The variety Flourball is nulliplex for K, and simplex for the gene **R** which produces pink colour in the outer layer of the cortex of potato tubers.

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