

OBSERVATIONS ON THE POTATO DURING SEASONS

1928 - 29.

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## BOTANICAL OBSERVATIONS.

The basis of the writer's work is included in The Potato. In several directions further investigations have been made, those for 1927 being presented in the Supplement.

Newer work done during 1928<sup>9</sup> is reported briefly in the succeeding pages.

Previous observations, recorded in Chapters IV., VI., VII., and VIII. of The Potato, have been systematically checked for old varieties and extended to include the many new varieties which are coming on to the market. Several new characters which promised to be useful in the discrimination of varieties were subjected to a critical study in the field; and records were made of other characters which are significant, though, in some instances, less useful for field work.

The procedure adopted throughout 1928 was that outlined on pages 4, 5 and 6 of the Supplement, but in order to secure greater accuracy all observations were verified during the summer months by the writer and also independently by his assistant.

A detailed and comprehensive discussion of the observations made is considered unnecessary as the majority of them will most probably be published in due course by the Department of Agriculture for Scotland in Miscellaneous Publications, No.

3. Special attention will be directed, however, to such characters as have not yet been reported in published papers and books.

A. Length of Flower Pedicel.

Systematic measurements of the flower pedicel, from the absciss layer to the base of the receptacle, showed that it varied in length from 2 mm. to 9 mm. So far as the writer is aware, no <sup>systematic</sup> use has hitherto been made of this character and measurements were therefore made on a large number of varieties.

One variety - Blackheart - was found in which many flowers possess no pedicels, the absciss layer coinciding with the base of the receptacle. It was ascertained also that constancy of length existed only with mature flowers, i.e., when the stigmas were receptive and the anthers dehiscent: in immature flowers the pedicels had not yet reached their full stature. The following table gives the results of measurements which were made on not less than two hundred inflorescences of each common variety.

TABLE I. /

TABLE I.

Average Length of Flower Pedicel.

1.	2.	3.
Less than 5 mm.	5 mm. to 7 mm.	Over 7 mm.
Blackheart	: Abundance	: Arran Banner
Catriona	: Ally	: Bishop
Champion	: Arran Comrade	: Bobby Burns
Edzell Blue	: Arran Consul	: Cardinal
Electron	: Arran Victory	: Catriona Substitutes I.
Immune Ashleaf	: Ben Lomond	: Cumberland Ideal
Myatt's Ashleaf	: British Queen	: Farish's Pink Champion
Northern Star	: Crusader	: Herald
Orran Beauty	: Dunnottar Castle	: Holm Reds
Pathfinder	: Eclipse	: Keay's Champion
Raeburn's Gregor Cups	: Golden Wonder	: Keppleston Kidney
Royal Kidney	: Kerr's Pink	: Marconi
	: King Edward	: May Queen
	: King George	: Mr. Bresse Substitute
	: Majestic	: President
	: Reading Russet	: Ranfurly Red
	: Rhoderick Dhu	: Sunrise
	: Templar	: The Colourless Rogue
	: Tinwald Perfection:	
	: Up-to-date	
	: White City	
	: Yam	
	:	

The most striking feature which emerges from the above is that the length of the pedicel is approximately constant for each variety. Small variations admittedly occur, but notwithstanding these, columns 1 and 3 are strictly comparable. One of the most useful applications of this character is the differentiation of Catriona from Catriona Substitute I., two varieties /

varieties which strongly resemble one another in foliage and tuber but which differ markedly in length of pedicel.

#### B. Differences in the Leaflet Lobes.

It will be noted on page 69 of The Potato that the variety Up-to-Date may be distinguished from Tinwald Perfection by a difference in the leaflet lobes (cf. Figs. 8 and 9). This difference was first observed in 1927 and during 1928 the matter was further investigated. Table II. gives a classification of varieties for this character.

TABLE II.

Types of Leaflets.

Up-to-Date Type (Fig. 9)	:	Tinwald Perfection Type (Fig. 8.)
Beauty of Bute	:	Catriona
Ben Lomond	:	Golden Wonder
Bishop	:	Kerr's Pink
Doon Star	:	Langworthy
Edzell Blue	:	Orange-Anther Substitute
Herald	:	Rhoderick Dhu
Majestic	:	Rogue like Great Scot
Northern Star	:	Tinwald Perfection
Response	:	
Templar	:	
The Baron	:	
Up-to-Date	:	

Common varieties not mentioned above are inconstant and may have varying proportions of the two types on individual plants; nevertheless, for the varieties in the table the character is significant /

significant, a very large number of observations having failed to detect plants which do not have the majority of leaflets as described.

### C. Colour on the Leaf Midrib.

The colouring of the leaf midrib has already been dealt with on page 67 of The Potato. The pigment is restricted to the first sub-epidermal layer in the great majority of varieties, although occasionally it may be found to a depth of two or three cells. The following varieties, however, are outstanding in that pigment is found to a depth of at least ten cells, viz:-

Adirondack  
Edgecote Purple  
Dean (A. Dean)  
Keppleston Kidney  
Lord Tennyson  
Long Blue  
R. 192 x

In determining the above, all sections were made at a distance of about  $\frac{1}{4}$  inch from the base of the leaf midrib.

### D. Colour Associations.

Further observations were made during 1928 on the correlations mentioned on pages 16 and 17 of the Supplement.

In /

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x See "Key to Potato Trials and Collections", Board of Agriculture for Scotland, 1928.

In the first place, however, the location of the pigment in the tubers as described on page 92 of The Potato and pages 12 and 13 of the Supplement was again investigated, the work of last year being confirmed in every detail. The following characters are associated with coloured tuber-cork:-

(1) Coloured Flowers. Up to the present, 36 British, 4 French, 2 American, 1 Italian and 31 German varieties with coloured tuber-cork have been examined, the observations on the German varieties being made by Professor Dr. Klapp, Jena, and Regierungsrat Dr. K. Snell, Biologische Reichsanstalt, Berlin - Dahlem.

All these varieties have coloured flowers and it thus appears that a cork-coloured variety never possesses a white flower. Whenever a white flower is associated with a coloured tuber, the pigment in the latter is located entirely in the cortex. This was confirmed by the examination of 87 British and 34 German varieties with white flowers and coloured tubers.

(2) Highly coloured Pedicel Absciss Layer.

The absciss layers of a large number of varieties show faint colouring, but the following are outstanding in having this tissue very highly pigmented, viz:-

Adirondack /



Adirondack  
 Buchan Beauty  
 Beauty of Bute  
 Catriona Substitute I.  
 Centrifolia  
 Congo  
 Dean (A. Dean)  
 Italian Potato  
 Lord Tennyson  
 Markinch Seedling  
 No. 19  
 Pink Eye  
 Purple Eye  
 Rector  
 Red King Edward  
 R. 192  
 Sunrise  
 Unknown French Variety  
 Varadio.

All these are cork-coloured varieties. Professor Dr. Klapp reports, moreover, that of German varieties examined, 33 showed highly pigmented absciss layers and that an investigation of the tubers of these demonstrated that all had coloured cork.

(3) The Base of the Corolla.

The base of the corolla is generally light yellow, even in varieties which have coloured flowers. The following are the only British varieties in which purple has been found at the base of the corolla tube, viz:-

Adirondack  
 Catriona  
 Catriona Substitute I. (Faint)  
 (do.)  
 Dean (A. Dean)  
 Markinch Seedling  
 Lord Tennyson  
 Rector

All the above have colour on the tuber-cork. As with the previous character, additional evidence concerning this colour association has again been received from Professor Dr. Klapp, who found that, so far as could be determined in 1928, German varieties possessing coloured corolla bases also have coloured tuber-cork.

(4) Colour at the Points of Insertion of Peduncle Branches.

At the points of insertion of the peduncle branches there is normally no more colour than in the surrounding tissue. A number of varieties exist, however, which show intense colouring at this region. The area affected is small and may easily be overlooked, yet extensive observations show the character to be constant for the following varieties:-

Adirondack  
 Beauty of Bute  
 Buchan Beauty  
 Catriona  
 Catriona Substitute I.  
 Lord Tennyson  
 Pride of Bute  
 Rector.

Of the above, Pride of Bute is outstanding in that the pigment runs deeply into the tissue and is not limited to a few sub-epidermal layers. Again, with the exception of Pride of Bute, all these varieties have coloured tuber-cork.

(5) /

(5) Colour at Leaf Axil and Base of Petiole.

A large number of cork-coloured varieties often possess highly pigmented leaf axils and petiole bases. These varieties are shown in Table III.

TABLE III.

Varieties with Highly Coloured Leaf Axils.	:	Varieties with Highly Coloured Bases of Petioles.
Adirondack	:	Adirondack
Buchan Beauty	:	Dean (A. Dean)
Catriona	:	Echarpée
Catriona Substitute I.	:	Geante Blanche
Crimson Beauty	:	Lord Tennyson
Congo	:	Pink Eye
Dean (A. Dean)	:	R. 192
Echarpée	:	Rector
Geante Blanche	:	Red King Edward
Lord Tennyson	:	Varadio
R. 192	:	
Rector	:	
Red King Edward	:	
Varadio	:	

There are, however, a few varieties with unpigmented cork which show similar characters, e.g., Edzell Blue (base of petiole and leaf axil) and Old Long Blue (Leaf axil) so that an absolute correlation does not exist. Moreover, the colour at the leaf axil, and to a lesser extent at the base of the petiole, is frequently modified considerably by the environment in which the plant is grown; sunshine, dryness /

dryness and weak nourishment favour the development of pigment, while absence of sunshine, good nourishment and liberal applications of nitrogenous manures have the opposite effect. Injury to the stem generally intensifies colour in the tissues above the wound.

(6) Summary.

The following is a general statement of these colour associations so far as ascertained by the present observations:-

I. Varieties in which the tuber-cork is coloured invariably possess coloured flowers.

II. The tuber-cork is invariably coloured where the following characters appear:

(a) Highly pigmented pedicel absciss layer;

(b) Coloured corolla base;

and (c) Coloured base of berry.<sup>x</sup>

III. Frequently associated with coloured tuber-cork are:-

(a) Deep colouring at the points of insertion of the peduncle branches.

(b) Highly coloured leaf axil,

(c) Highly coloured base of petiole,

and /

<sup>x</sup>

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See The Potato p. 82. Only three such varieties have, however, been found.

and (d) Coloured rootlets of tuber sprout.<sup>x</sup>

In I. and II. above there seems to be evidence of definite genetic linkages.

#### E. Other Characters.

The following observations, though not directly applicable in field work, are nevertheless significant:-

1. The vascular tissue in the stems of R. 192 is purple.

In this respect the variety is unique; and

2. The variety Champion is outstanding in that it possesses flattened receptacle bases.

### INVESTIGATIONS ON INTERVARIETAL DIFFERENCES OF A CHEMICAL NATURE IN THE MATURE POTATO TUBER.

#### General.

The work carried out during season 1927-28, although preliminary in character, yielded positive results which clearly proved that scope existed for more extensive enquiry on similar lines. On the other hand, as this investigation will require considerable time and the special equipment of a laboratory, the writer approached the authorities of the Edinburgh and East of Scotland College of Agriculture, who have readily undertaken to /

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<sup>x</sup> See Table IV. of the Supplement.

to continue the work. A grant of £200 per annum (<sup>probably</sup> two years) for the furtherance of the investigations has been received from the Development Commission, and a research worker is already engaged on the subject, the general supervision being in the hands of the chemistry department of the College.

In these circumstances the writer has felt justified in limiting his enquiries to the confirmation of the work of last year and the investigation of the Nicotine Test which gave evidence in April, 1928, of providing a means of differentiating varieties.

#### A. Repetition of the Tests.

During winter 1928 the following varieties were subjected to the Alkali Test, the Oxidase Test and the Tyrosinase Test, (cf. Tables V. VII. and X.) viz:-

Abundance	Edinburgh Castle	Majestic
Ally	Edzell Blue	May Queen
Arran Chief	Golden Wonder	Ninetyfold
Arran Comrade	Great Scot	President
Arran Victory	Harbinger	Puritan
Bishop	Katie Glover	Tinwald Perfection
British Queen	King Edward	Up-to-Date
Champion	King George	Village Blacksmith
Crusader	Langworthy	
Dunottar Castle	Lochar	
Eclipse		

In the Blackening of Potato Tissue Test, only those varieties mentioned in columns 1 and 3 (Table IX.) were treated.

The tubers used were derived mainly from the East Craigs stocks /

stocks, although for some of the common varieties tubers were obtained from several sources.

The risk of experimental error has been anticipated by using at least 45 tubers of each variety. With the Blackening of Potato Tissue Test, however, fewer tubers were available. The tests were applied in the presence of I.M. Robertson, B.Sc., Research Student, Edinburgh and East of Scotland College of Agriculture, who confirmed the placing of the varieties in the various groups.

No substantial variations from the reactions obtained last year were found and thus additional confirmation is given to the four chemical tests detailed in the Supplement.

#### B. The Nicotine Test.

In this test advantage has been taken of the well-known destructive effects of alkaloids on vegetable tissue. When a solution of nicotine (40%) is painted on the cut surfaces of tubers the result is not always the same: in some varieties the cortex blackens in about one hour, while in others it is unaffected. Apparently what happens is that by destroying the tissue of the first series, the Nicotine liberates enzymes and the blackening is due in all probability to the action of these enzymes. The precise chemical process, however, is at present obscure and is <sup>to</sup> ~~now~~ being investigated at the Edinburgh and East of /

of Scotland College of Agriculture.

Owing to the high cost of the reagent and to the possibility of securing the same effect by the use of other alkaloids dissolved in suitable solvents, observations in this test have been restricted to a few varieties. In spring 1928, the following varieties were tested: Arran Comrade (100 tubers; 4 sources), Abundance (100 tubers; 4 sources), and Crusader (20 tubers; 2 sources). During the storage season, 1928-29, the following were tested:-

<u>Variety</u>	<u>Tubers</u>	<u>No. of Sources</u>
Abundance	90	4
Arran Comrade	130	9
Crusader	100	5
Dunottar Castle	100	4
Eclipse	138	8
King Edward	124	8
Majestic	86	5
Rhoderick Dhu	85	5

The results of these tests may be tabulated thus:-

1. 2. 3.

Cortex remaining white :	Inconstant :	Cortex Blackening
Dunottar Castle :	Abundance :	
Eclipse :	Crusader :	
King Edward :	King George :	Arran Comrade
	Majestic :	
	Rhoderick Dhu :	
	:	

The cortex was not <sup>always</sup> invariably entirely blackened in Arran

Comrade /



Comrade; about 4% of the tubers tested were only slightly affected. The absence of constant behaviour in Groups 2 and 3, requires further investigation: the technique may have been at fault. The possibilities of an alcoholic solution with its greater penetrating power are to be explored at the Edinburgh & East of Scotland College of Agriculture.

#### Application of the Test.

By means of this reaction stocks of varieties in Group 1 may be separated from those in Group 3. Moreover, blackened tubers in Group 1 varieties may be regarded as impurities.

#### VARIATIONS.

##### A. Bolters.

During season 1927 foliage grafts were made as described in Experiment 2 on page 55 of the Supplement. Three normal King Edward plants were used as stocks and the scions were derived from bolter plants of the same variety.

Two tubers from each grafted plant were planted in 1928 and grown adjacent to genuine King Edward bolters. The resultant plants were all normal, thus affording further evidence in favour of the conclusion arrived at on pages 56 and 57 of the Supplement.

B. /

B. Tuber Variation.

A variation of the King Edward variety has been found. The variation is indistinguishable from the normal type except in respect of the tubers which are whole-coloured and deep purple instead of parti-coloured and pink.