

REPORT

Potato variety dormancy ranking trial 2020-21

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1. Summary

The loss of CIPC for the control of sprouting during storage has placed greater emphasis on the other tools available to store managers that include alternative sprout suppressants, variety choice and store management practices.

Long, or longer dormant, varieties can reduce the reliance on sprout suppressants. Dormancy of potato varieties varies widely and is governed by genetic factors, timing of tuber initiation and by multiple other physiological and environmental factors during crop growth and storage. Unfortunately, the availability of independent data on dormancy scores for commonly grown varieties is both sparse and conflicting.

The objective of this project is to provide relative dormancy data for varieties to guide storage decisions and potential timings for sprout control. In this third year of the project, a collective total of thirty-five varieties used for fresh, chip or crisp markets were planted at the trial site, Mark Means, JS Means Ltd, Terrington St. Clement, Norfolk. Following harvest, tubers were stored under common conditions at Sutton Bridge CSR with sprouting assessed on a weekly basis.

Dormancy was ranked relatively in order of date from approximate tuber initiation, or from harvest, to 50% sprouting (>3mm).

2. Experimental section

2.1 Introduction

There are numerous varieties that could be used for the different potato markets. However choice must take into account customer preference, potential yield, ease of agronomy, disease resistance, storage etc. The markets most affected by the loss of CIPC are those of chip and crisp processing.

Knowledge of the expected or typical dormancy duration of a variety provides a guide to how long the tubers can be stored before sprout development is initiated. This informs choice of variety for different durations of storage, planning for sprout control interventions and for sale of the crop. Longer dormant varieties offer the potential of higher tuber quality over long-term storage and with reduced need for sprout control.

Tubers, or more strictly the buds, may pass through three phases of dormancy:

- *Endodormancy* is a period of deep dormancy in which sprouting does not occur even under favourable conditions due to internal physiological factors.
- *Ecodormancy* in which sprouting could occur under favourable conditions but is inhibited by unfavourable external factors for example low temperature.
- *Paradormancy* is the physiological control of lateral buds by the apical bud - apical dominance.

This project is largely concerned with endodormancy. Dormancy break occurs before sprout development. There is no simple method for determining actual dormancy break so, for this project, visible sprouting is used as a proxy for dormancy break and is of itself an important quality parameter requiring management.

Numerous factors affect the duration of dormancy including the genetic background, conditions during tuber growth and storage conditions. The dormancy of varieties can be ranked if identical conditions of field and store are maintained.

2.2 Material and methods

The varieties used in the trial are listed in Table 1.

Tuber seed was planted on the trial field site, courtesy of Mark Means, JS Means Ltd, Tilney All Saints, Norfolk on 23rd April 2020. The field was monitored on the weekly basis. Tuber initiation (TI) was estimated based on 50% field emergence, listed in Appendix Table 4.2. Harvest took place on 7th September 2020.

The trial site received the same crop inputs and protection as the surrounding field crop. Tubers, between 45-65 mm, were taken from each variety, placed into 15°C and 95% RH within a controlled environment room for the duration of storage.

The sprouting of fifty tubers of each variety was assessed weekly and judged to have occurred when a sprout reached 3mm in length. The number of days to 50% sprouting was taken from the line of best fit (by eye) for each varieties sprouting curve. Dormancy was recorded as days from estimated TI to 50% sprouting. The detailed dormancy protocol is described in Appendix 4.1.

Table 1. Varieties, by typical market, used in dormancy trials 2020-21.

Market		
French Fry (Chip)	Crisp	Fresh pack
Agria	Arsenal	Alison
Alverstone Russet	Heraclea	Asterix
Arsenal	Lady Claire	Desiree
Asterix	Lady Rosetta	Estima
Challenger	Markies	Jazzy
Desiree	Taurus	King Edward
Estima	Triple 7	Maris Peer
Fontane	VR808	Maris Piper
Innovator		Melody
Ivory Russet		Mozart
Lady Amarilla		Nectar
Lady Anna		Orchestra
Lady Claire		Sunita
Lady Rosetta		
Maris Piper		
Markies		
Performer		
Rooster		
Royal		
Russet Burbank		
Sagitta		

2.3 Results

Dates for measured 50% TI ranged over approximately 2 weeks from 18th to 30th June 2020. Details are shown in appendix Table 4.1

The average time to 50% sprouting from the date of TI is shown in Table 2. This data has been ranked in order of increasing dormancy and is presented as a histogram (Appendix Figure 4.2). It is evident from this figure that no straightforward division into specific dormancy groupings can be made. A relative ranking of each variety and possible market is shown in Table 3.

Table 2. Dormancy of varieties from date of TI.

Variety	Dormancy from tuber initiation (days)
Agria	183
Alison	153
Alverstone Russet	183
Arsenal	163
Asterix	137
Challenger	167
Desiree	237
Estima	177
Fontane	164
Heraclea	152
HZA 1496	151
Innovator	175
Ivory Russet	210
Jazzy	126
King Edward	109
Lady Amarilla	139
Lady Anna	160
Lady Claire	165
Lady Rosetta	138
Maris Peer	156
Maris Piper	169
Markies	218
Melody	190
Mozart	171
Nectar	181
Orchestra	136
Performer	203
Rooster	158
Royal	184
Russet Burbank	191
Sagitta	166
Sunita	181
Taurus	217
Triple 7	136
VR808	161

Table 3. Relative ranking of dormancy for varieties in different markets.

From top to bottom of the table dormancies range from 109 - 237 days from TI to 50% sprouting.

Fresh Pack	Chip	Crisp
King Edward Jazzy Orchestra Asterix Alison Maris Peer Maris Piper Mozart Estima Nectar Sunita Melody Desiree	Asterix Lady Rosetta Lady Amarilla Rooster Lady Anna Arsenal Fontane Lady Claire Sagitta Challenger Maris Piper Innovator Estima Agria Alverstone Russet Royal Russet Burbank Performer Ivory Russet Markies Desiree	Triple 7 Lady Rosetta Heraclea VR808 Arsenal Lady Claire Taurus Markies

2.4 Discussion

Numerous different methodologies have been, and are, used by different organisations and companies to provide data on the dormancy of varieties. Unfortunately, in many cases the methodology or description of dormancy rating is somewhat or entirely unclear. For example, the European Cultivated Potato Database (<https://www.europotato.org>) records the dormancy of some varieties on a 1 - 9 dormancy scale but, unfortunately, the methodologies used by the various contributors are not described within the database.

Relatively few varieties were assessed during the first year of the trial (2018-19) and it was possible to allocate them into approximate short/medium and long dormancy

categories. The dormancy of the varieties in this year's trial (2020-2021), when plotted, is very evidently a continuum with no obvious division into dormancy categories (Appendix Figure 4.2). We have used 50 % sprouting as a visual estimate for the duration of dormancy. The use of an estimate of the spread of the data e.g. 20-80 % sprouting would probably reinforce the continuous nature of the varietal dormancy data. In this report we have provided data to provide a guide to the relative ranking of dormancy of different varieties without division into specific dormancy groupings (Table 4). Surprisingly, and for a second consecutive year, Desiree was very long dormant. The reason for this result is not apparent. The seed and growing plants were not subject to any different treatments to the other varieties in each year's trial.

Dormancy is considered to be initiated at the time of TI (Burton 1989). However, for most reports for which methodologies are available, dormancy has been measured from the date of harvest. This year's trial dormancy data was calculated from measured TI.

Tuber initiation

TI occurs around 20 to 30 days, or more, following plant emergence and lasts for a period of approximately 10 to 14 days <http://cipotato.org/wp-content/uploads/2014/07/006162-2.pdf>. Given the very wide range of genotypes used in current agriculture and the relatively limited number of genotypes used in scientific research it may be that there is larger variance within these timings.

Various factors influence TI and its duration, discussed by O'Brien *et al.* (1998). The relative contribution of any of the factors is not fixed. For example, physiological ageing of seed tubers has a determinant influence on tuber initiation (Struik and Wiersema, 1999) but other studies have indicated that this is not necessarily the case under standard agricultural practices (O'Brien *et al.*, 1998). van Ittersum and Scholte (1992) found tubers grown under different temperature regimes could age differently but dormancy was negligibly affected. van Ittersum (1992) further demonstrated that the duration of dormancy of tubers from a single plant varied greatly with tuber weight (for some cultivars), the date of tuber initiation and the position of the tuber on the plant during tuber growth all having an effect. We have no information on the tuber root position but tuber sizes selected at harvest were usually greater than 45mm. It is known that immature tubers have a longer dormancy period compared to tubers harvested at

maturity Delaplace (2008). In these trials some varieties would have been harvested before or after a commercial harvest would have taken place and so there would be some differences in maturity between varieties and between seasons.

Year to year variation in dormancy

Seasonal differences in dormancy duration were observed over the three years of the trial. Generally longer durations were found during trial year 2 (2019-20, Appendix Table 4.3). Approximately 40% of varieties were within a 10% difference of dormancy duration between trial years 1 and 2, 25% between years 2 and 3, and 67% between years 1 and 3. Despite this variation relative dormancy was approximately maintained throughout the trial years to date (Appendix Table 4.4). However, some varieties, including Arsenal, Melody and Royal, had very different dormancy durations between years of the trials and substantially changed relative position in different years of the trial.

Burton (1989) noted that unusually cold or hot weather during tuber development in the field often resulted in long or short dormancy respectively. Wang *et al.* (2016) presented data on year-to-year variations in dormancy although there were also differences in planting date, and therefore of TI, and of harvest dates. The authors attributed the variation to different environmental conditions during the growing season and also seasonality. van Ittersum (1992) reviewed the then available literature and concluded that only a few cases were known where the interaction between cultivar and year, season or site of production was absent.

The variation found in these trials to date did not generally affect the relative dormancy rankings although may confound direct comparison of variety dormancy ratings available elsewhere.

Overall these results provide growers with robust information on dormancy for varietal choice.

2.5 References

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4. Appendices

Appendix Table 4.1. Tuber initiation dates, used in dormancy trial 2020-21.

Variety	Tuber Initiation date
Agria	25/05/2020
Alison	24/05/2020
Alverstone Russet	24/05/2020
Arsenal	30/05/2020
Asterix	24/05/2020
Challenger	24/05/2020
Desiree	26/05/2020
Estima	28/05/2020
King Edward	18/05/2020
Fontane	26/05/2020
Heraclea	25/05/2020
HZA 1496	25/05/2020
Innovator	23/05/2020
Ivory Russet	24/05/2020
Jazzy	24/05/2020
Lady Amarilla	26/05/2020
Lady Anna	26/05/2020
Lady Claire	30/05/2020
Lady Rosetta	23/05/2020
Maris Peer	20/05/2020
Maris Piper	23/05/2020
Markies	25/05/2020
Melody	25/05/2020
Mozart	27/05/2020
Nectar	24/05/2020
Orchestra	26/05/2020
Performer	25/05/2020
Rooster	26/05/2020
Royal	20/05/2020
Russet Burbank	24/05/2020
Sagitta	26/05/2020
Sunita	25/05/2020
Taurus	25/05/2020
Triple 7	23/05/2020
VR808	23/05/2020

Appendix 4.1. SBCSR dormancy assessment protocol

Place sampled tubers in a labelled paper sack and place in the nominated store at 15C (± 0.5 C) and 95% relative humidity.

Assess individual tubers as soon as possible and thereafter at approximately 1 week intervals (or at intervals specified in the study plan). Storage should take place with samples held in paper sacks.

On each assessment occasion record the date, and the number of tubers with sprout(s) greater than or equal to ($\geq$) 3mm. Sprouted tubers should then be discarded.

Continue assessment until all tubers have sprouted.

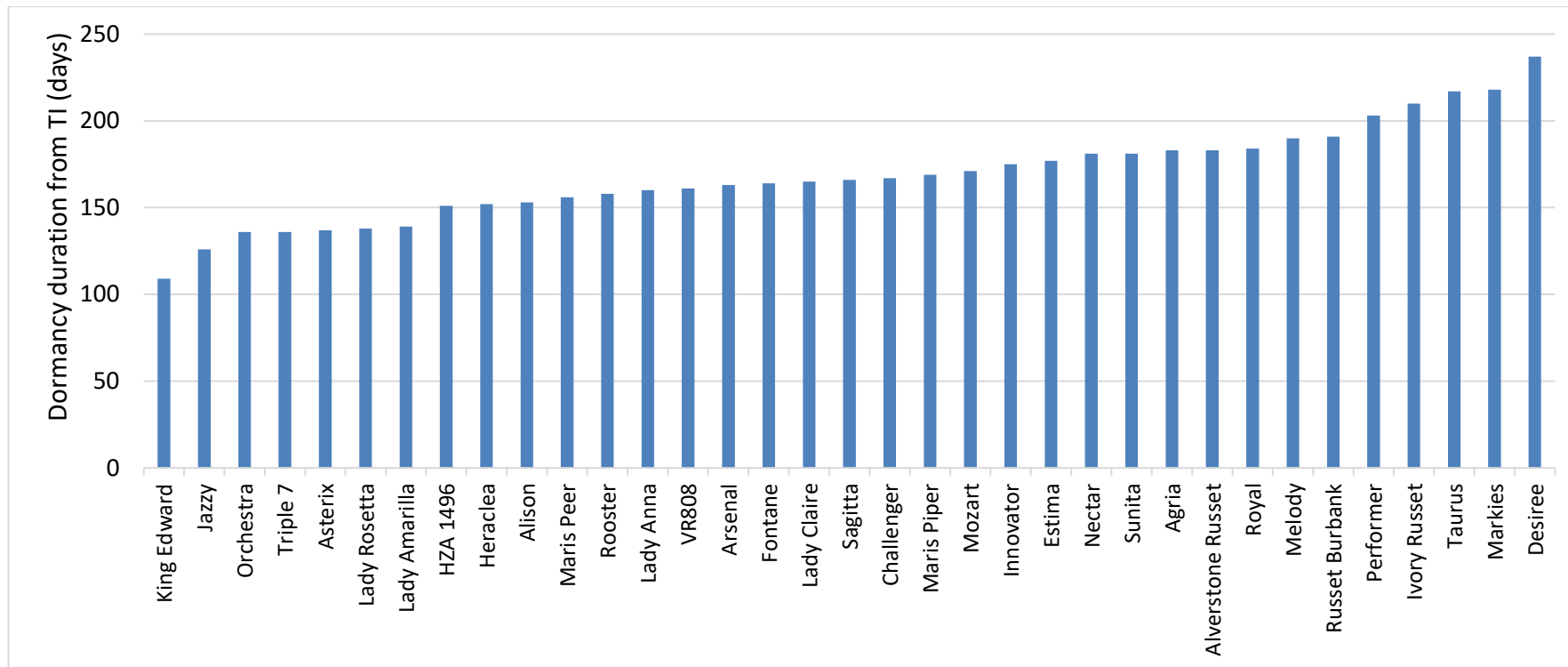
Some potato diseases (e.g. soft-rotting) may influence sprout growth. Tubers developing rot in store should be discarded and the reason recorded. Some tubers may not sprout even after an extended period and can be discarded as instructed by the study director.

Discarded tubers should be excluded from the data used to estimate dormancy.

The dormant period (50% intercept), measured in days, is estimated after plotting the cumulative proportion of tubers with sprouts ≥ 3 mm against days in store or harvest date

Appendix 4.2.

Figure 4.2. Dormancy ranking of all varieties



Appendix 4.3

Table 4.3. Comparison of dormancy duration between years of this trial

The average dormancy duration in days from TI, for varieties grown at least in two years of the trial (2018-2019 and 2019-2020 and 2020-2021).

Variety	Duration of dormancy (days from TI)			Difference in dormancy (days) between trial years		
	2018-19	2019-20	2020-21			
	trial year 1	trial year 2	trial year 3	1 and 2	1 and 3	2 and 3
King Edward		155	109			46
Asterix		169	137			32
Heraclea		180	152			28
Laura	173	180		-7		
Maris Peer	163	185	156	-22	7	29
Triple7	160	185	136	-25	24	49
Melody	163	189	190	-26	-27	-1
Maris Piper	170	191	169	-21	1	22
VR808	177	192	161	-15	16	31
Challenger	174	194	167	-20	7	27
Sagitta	173	195	166	-22	7	29
Brooke	202	196		6		
Rooster		196	158			38
Nectar	170	197	181	-27	-11	16
Sunita	183	200	181	-17	2	19
Arsenal		200	163			37
Lady Claire		202	165			37
Agria		202	183			19
Innovator	181	203	175	-22	6	28
Lady Anna		205	160			45
Estima	178	206	177	-28	1	29
Russet Burbank	218	207	191	11	27	16
Alcander	179	207		-28		
Alverstone		207	183			24
Georgina	167	208		-41		
Panther	179	209		-30		
Royal	165	212	184	-47	-19	28
Mozart	217	213	171	4	46	42
Taurus	231	222	217	9	14	5
Markies	233	223	218	10	15	5
Lanorma	217	224		-7		
Performer	209	226	203	-17	6	23
Ivory Russet		233	210			23
Desiree		264	237			27

Table 4.4. Relative dormancy ranking of varieties between years of the trials

	Trial year		
	1	2	3
	2018-19	2019-20	2020-21
Triple7		King Edward Asterix Heraclea Laura	King Edward Triple7 Asterix Heraclea
Maris Peer		Maris Peer Triple7	Maris Peer Rooster
Melody		Melody	Lady Anna VR808 Arsenal Lady Claire Sagitta Challenger
Royal			Maris Piper Mozart Innovator Estima
Georgina			Nectar Sunita Agria Alverstone Royal Melody
Maris Piper		Maris Piper	
Nectar		VR808	
Laura		Challenger	
Sagitta		Sagitta	
Challenger		Brooke	
VR808		Rooster	
Estima		Nectar	
Alcander		Sunita	
Panther		Arsenal	
Innovator		Lady Claire	
Sunita		Agria	
Brooke		Innovator	
Performer		Lady Anna	
Mozart		Estima	
Lanorma			
Russet		Russet	
Burbank		Burbank	Russet Burbank
		Alcander	
		Alverstone	
		Georgina	
		Panther	
		Royal	
		Mozart	
Taurus		Taurus	Performer Ivory Russet
Markies		Markies	Taurus Markies
		Lanorma	
		Performer	
		Ivory Russet	
		Desiree	Desiree