Potato Res. 15 (1972): 220–235

Carry-over effects of sprouting and haulm destruction in the potato seed crop[1]

J. C. HOLMES and D. GRAY[2]

Edinburgh School of Agriculture, Edinburgh, Scotland

Accepted for publication: 14 January 1972

Zusammenfassung, Résumé p. 233

Summary

Seed of differing maturity dates of cv. *Arran Pilot* and *Majestic* were produced by planting sprouted and unsprouted mother tubers and by either destroying the foliage 2–3 weeks before senescence or allowing natural maturity to take place. Seed from crops of earlier natural maturity sprouted earlier and in *Arran Pilot* grew faster if sprouting was encouraged soon after harvest. Other small differences in sprout growth were recorded, but none of the treatments applied to the first generation crop affected the time of emergence, stem number, growth of foliage or tubers in the second generation crop.

Introduction

The number and rate of growth of meristems on the seed tuber after harvest is largely controlled by the conditions of storage prior to planting (Toosey, 1963; Goodwin, 1963). However it has been shown in Japan (Kawakami, 1936, 1953, 1962) that the effects of source of seed and plant maturity can modify the effect of storage environment with subsequent effects on tuber yields and their components. In Britain differences in yield response in crops grown from seed of different origin have been explored for the early ware crop (Goodwin et al., 1969) and differences in response shown to be due to differences in tuber meristem activity.

Sadler (1961) has shown that the apical sprout is the first to start growing after harvest and in conditions favourable for growth (above 5 °C) the growth of the laterals is suppressed and the tuber becomes apically dominant. Where the growth of the apical bud is suppressed as in cool storage (below 5 °C) there is a progressive decline in apical dominance with increasing length of the period of cool storage.

It would be expected that early maturing seed crops would show an earlier loss of apical dominance than tubers maturing later but sprouted at the same time. Madec and Perennec (1955) have noted that tubers obtained from late plantings in the previous season showed a greater degree of apical dominance than tubers obtained from early plantings when set up to sprout at the same time. In the experiments re-

[1] Edinburgh School of Agriculture Miscellaneous Publication No. 501.
[2] Present address: National Vegetable Research Station, Wellesbourne, England.

ported here differences in maturity were produced by growing a mother seed crop from tubers which were sprouted and had well developed sprouts at planting time or were cool stored and unsprouted at planting. In one year the effects of burning off the mother seed crop were examined. The main interest was whether such possible effects on apical dominance would affect tuber number in the subsequent seed crop.

Materials and methods

Two experiments, each spanning two years (1963–5 and 1964–6), and each involving the two varieties *Arran Pilot* and *Majestic*, were made on the Edinburgh School of Agriculture farms. During the first season, seed lots of differing maturities were produced and in the winter months between seasons, additional sprouting treatments were applied factorially. In the second season, the effects of the combinations and interactions of the previous treatments were tested. Treatment combinations are given in Table 1. Throughout the sprouting periods, illumination by fluorescent tube lighting was provided for 8 hours per day, and trays were moved weekly to equalise incident light.

Details of the differences in date of maturity produced at the end of the first season and dates of burning off are given in Table 2. In the second season of each experiment, all plots were allowed to mature naturally.

Field layout, first season

For the first season in each experiment, treated tubers were planted in a randomised block design, but yields were not measured. After harvest the tubers were stored in the dark at 3–5 °C until November when tubers from each sprouting treatment were sorted to give samples of equal mean tuber weight in two size classes. For *Arran Pilot* in both experiments and *Majestic* in Exp. I, these mean size classes were 98 and 49 g, and for *Majestic* in Exp. II 107 and 64 g. These seed lots were then divided to receive the 3 sprouting treatments prior to the second season.

Sprouts measurements

Five marked tubers from each of the 12 (Exp. I) or 18 (Exp. II) treatment combinations for both varieties were examined periodically during the sprouting and storage period prior to the second season and sprout measurements made.

Field layout, second season

A split plot design was used in both experiments. In Exp. I (2 replicates), variety and seed size were on main plots and the 12 treatment combinations on sub plots. In Exp. II (3 replicates) seed size was confounded with replicates, varieties were on main plots, treatments N^2, M^2, O^2 on sub-plots and treatment combinations N^1, M^1, $O^1 \times$ BD, MAT on sub-sub-plots.

Each plot provided 5 sample lifts of 3 guarded plants, and a final harvest of 27 guarded plants. At each sample harvest, records were made of stem numbers, foliage

Table 1. Experimental treatments

Experiment[1] I			
Winter[2] '63/64	Summer[3] '64	Winter '64/65	Summer '65
Uniform seed of *Majestic* and *Arran Pilot* allocated to 4 sprouting treatments[4] N^1, Nc^1, M^1, O^1	Seed produced from N^1, Nc^1, M^1, O^1 under same conditions; allowed to mature naturally[5]	Seed from N^1, Nc^1 M^1, O^1 split for 3 sprouting treatments[6] N^2, M^2, O^2	Effect of 12 treatment combinations on 2 varieties measured. Planted 25 April[7]
Experiment II			
Winter '64/65 Uniform seed of *Arran Pilot* and *Majestic* allocated to 3 sprouting treatments[8] N^1, M^1, O^1	Summer '65 Seed produced from N^1, M^1, O^1 under same conditions, half of each burned down early (BD) and half allowed to mature naturally (MAT)[9]	Winter '65/66 Seed from N^1, M^1, O^1 × BD, MAT split factorially for 3 sprouting treatments[10] N^2, M^2, O^2.	Summer '66 Effect of 18 treatment combinations on 2 varieties measured. Planted 27 April[11]

Details of treatments[12]
N sprouted in November (December in Exp. II) at 8–10 °C till sprouts 1 cm long then kept at 2–6 °C.[13]
Nc sprouted at 5–8 °C from November till planting time.[14]
M sprouted in March at 8–10 °C till sprouts 1 cm long then at 2–6 °C.[15]
O unsprouted; stored in the dark at 2–6 °C.[16]
The suffixes 1 and 2, e.g. N^1 and N^2, indicate in which generation the treatments were applied.[17]
BD foliage burned down by Reglone spray 2–3 weeks before natural maturity.[18]
MAT foliage allowed to senesce naturally.[19]

[1] *Versuch – Essai;* [2] *Winter – Hiver;* [3] *Sommer – Eté*
[4] *Einheitliches Pflanzgut von* Majestic *und* Arran Pilot, *verteilt auf 4 Vorkeimverfahren – Plant de calibre uniforme de* Majestic *et* Arran Pilot *soumis à 4 modalités de prégermination*
[5] *Pflanzgut erzeugt aus N^1, Nc^1, M^1, O^1 unter gleichen Bedingungen; natürliche Reife – Plants issus de N^1, Nc^1, M^1, O^1, produits dans les mêmes conditions; maturité naturelle*
[6] *Pflanzgut aus N^1, Nc^1, M^1, O^1 aufgeteilt auf 3 vorkeimverfahren – Plants issus de N^1, Nc^1, M^1, O^1, répartis en 3 traitements de prégermination*
[7] *Einfluss von 12 Verfahrenskombinationen auf zwei Sorten. Gepflanzt am 25. April – Effet des 12 combinaisons de traitements sur 2 variétés. Plantation le 25 avril.*
[8] *Einheitliches Pflanzgut von* Arran Pilot *und* Majestic, *verteilt auf 3 Vorkeimverfahren – Plant de calibre uniforme de* Arran Pilot *et* Majestic *soumis à 3 modalités de prégermination*
[9] *Pflanzgut erzeugt aus N^1, M^1, O^1 unter gleichen Bedingungen zur Hälfte früh abgebrannt (BD), die andere Hälfte natürliche Reife (MAT) – Plants issus de N^1, M^1, O^1 produits dans les mêmes conditions une moitié de chaque culture défanée précocement (BD), l'autre moitié à maturité (MAT)*
[10] *Pflanzgut aus N^1, M^1, O^1 × BD, MAT aufgeteilt faktoriell auf 3 Keimverfahren N2, M2, O2 – Plants issus de N^1, M^1, O^1 × BD, MAT répartis en 3 traitements de prégermination N2, M2, O2.*
[11] *Einfluss von 18 Verfahrenskombinationen auf zwei Sorten. Gepflanzt am 27. April – Effet de 18 combinaisons de traitements sur 2 variétés. Plantation le 27 avril.*
[12] *Einzelheiten der Verfahren – Détails des traitements*

[13] *N vorgekeimt im November (Dez. in Versuch II) bei 8–10°C, bis die Keime 1 cm lang waren, dann bei 2–6°C gehalten – Prégermés en novembre (décembre dans l'essai II) à 8–10°C jusqu'à une longueur des germes de 1 cm, conservés ensuite à 2–6°C.*

[14] *Nc vorgekeimt bei 5–8°C von November bis zur Pflanzzeit – Nc prégermés à 5–8°C de novembre jusqu'au moment de la plantation*

[15] *M vorgekeimt im März bei 8–10°C, bis die Keime 1 cm lang waren, dann bei 2–6°C gehalten – M prégermés en mars à 8–10°C jusqu'à une longeur des germes de 1 cm, placés alors à 2–6°C.*

[16] *O nicht vorgekeimt; dunkel gelagert bei 2–6°C – O non prégermés, conservés à l'obscurité à 2–6°C*

[17] *Die Bezeichnungen 1 und 2, z.B. N^1 und N^2, geben an, in welcher Generation die Verfahren angewendet wurden – Les exposants 1 et 2, par ex. N^1 et N^2, indiquent la génération à laquelle le traitement a été appliqué*

[18] *BD Kraut mittels Reglone 2–3 Wochen vor der natürlichen Reife abgebrannt – BD feuillage détruit par pulvérisation de Réglone 2–3 semaines avant la maturité naturelle*

[19] *MAT natürlich gealtertes Kraut – MAT feuillage qui a atteint la maturité naturelle*

Tabelle 1. Versuchsverfahren.
Tableau 1. Traitements expérimentaux.

Table 2. Dates of maturity and of burning off.

Experiment[1]	Treatments (see Table 1)[2]	Date of natural maturity[3]		Date of burning down[4]	
		Arran Pilot	*Majestic*	*Arran Pilot*	*Majestic*
I	N^1	7 Sept.	7 Oct.		
	Nc^1	3 sept	7 Oct.		
	M^1	9 Sept.	7 Oct.		
	O^1	18 Sept.	15 Oct.		
II	N^1	20 Aug.	20 Aug.	30 July	7 Aug.
	M^1	20 Aug.	30 Aug.	30 July	7 Aug.
	O^1	25 Aug.	11 Sept.	13 Aug.	20 Aug.

[1] *Versuch – Essai*
[2] *Behandlung (siehe Tabelle 1) – Traitement (voir le tableau 1)*
[3] *Datum der natürlichen Reife – Date de la maturité naturelle*
[4] *Abgebrannt – Défanagé*

Tabelle 2. Daten der natürlichen Reife und der Abbrennung.
Tableau 2. Dates de la maturité naturelle et du flambage.

and tuber weights. Dry weights were obtained in the early part of the season by ovendrying the entire samples, but later by drying sub-samples, at 100°C for 24 hours.

Agronomic practice

Fertilizer at the rate of 125 kg N and P_2O_5 and 150 kg of K_2O per hectare was broadcast and worked into the soil before opening the drills 71 cm apart. In the first season of Exp. II seed was planted at 25 cm spacing; on the other 3 occasions, planting was at 46 cm spacing. After the tubers were covered, weeds were controlled by a pre-

emergence spray of Linuron or a Linuron-paraquat mixture at recommended rates. Anti-blight protective sprays were given regularly after the susceptible stage of growth.

Results

The effects of the seed storage treatments applied prior to the second generation (N^2, M^2, O^2) will be described elsewhere along with the results of similar treatments made in other experiments. These treatments will be discussed here only where they influenced the effects of the treatments applied to the first generation crop.

Differences between the seed lots after the first season's treatments were detected in the date of maturity, and in Exp. II in the dry matter content of tubers. Sprouting advanced the date of maturity compared with unsprouted seed by 5–15 days in *Arran Pilot* and 8 to 22 days in *Majestic* (sec Materials and methods). In Exp. II, burning down the foliage 2–3 weeks before natural maturity gave tubers of between 2 and 3 percentage units less dry matter than at natural maturity in both varieties (Table 3).

Effect of sprouting and foliage destruction in the first generation on the development of sprouts and stems in the next generation

In Exp. I, when at the end of the first season, seed was allowed to sprout in November

Table 3. Effect of treatments to the mother-seed crop in Exp. II on the tuber dry matter content at harvest.

Treatment of first generation seed crop[1]		% DM content of daughter tubers from the first generation crop[2]			
		Arran Pilot		*Majestic*	
N^1	MAT	16.8	15.4	18.1	16.9
	BD	13.8		15.7	
M^1	MAT	17.2	15.4	19.1	17.3
	BD	13.7		15.6	
O^1	MAT	17.0	16.0	20.3	19.3
	BD	15.1		18.4	
	S.E.	±0.28		±0.25	
Mean burnt down[4]		14.2		16.6	
Mean mature[5]		17.0		19.1	

[1] *Behandlung der ersten Generation Pflanzkartoffeln (Mutterknollen) – Traitement de la 1e génération de culture de plants*

[2] *% TS-Gehalt der Tochterknollen aus dem Bestand der ersten Generation – % de teneur en matière sèche de tubercules-fils issus de la 1e génération des cultures de plants*

[3] *Mittel – Moyenne*

[4] *Abgebrannt – Défanagé*

[5] *Gereift – Maturité*

Tabelle 3. Einfluss der Behandlungen des Mutterpflanzgutes in Versuch II auf den Trockensubstanzgehalt der Knollen bei der Ernte.

Tableau 3. Effets de traitements appliqués à une culture de plants dans l'essai II sur la teneur en matière sèche du tubercule à la rècolte.

Table 4. Dates on which sprout growth commenced in daughter tubers in relation to treatments of the mother-seed tubers.

Treatment of first generation seed crop[2]		Date of first sprout growth on second generation tubers[4]			
		Arran Pilot		*Majestic*	
		set up to sprout in[3] November N^2 (Dec. Exp. II)	set up to sprout in[3] March M^2	set up to sprout in[3] November N^2 (Dec. Exp. II)	set up to sprout in[3] March M^2
Experiment[4] I	N^1	26 Nov.	7 Feb.	14 Dec.	9 Mar.
	Nc^1	25 Nov.	7 Feb.	15 Dec.	9 Mar.
	M	27 Nov.	7 Feb.	20 Dec.	9 Mar.
	O^1	2 Dec.	7 Feb.	25 Dec.	9 Mar.
Experiment[4] II all treatment combinations[5] (N^1, M^1, O^1 × BD, MAT)		14 Dec.	11 Feb.	3 Jan.	14 Mar.

[1] *Datum des ersten Keimwachstums bei der zweiten Knollengeneration – Date de la première croissance des germes sur la seconde génération de tubercules*
[2] *Behandlung der Mutterpflanzknollen – Traitement de la première génération de culture de plants*
[3] *Zum Vorkeimen angesetzt im – Mis à germer en*
[4] *Versuch – Essai*
[5] *Alle Kombinationsverfahren – Tous les traitements combinés*

Tabelle 4. Daten des Beginns des Keimwachstums in den Tochterknollen je nach Behandlung der Mutterpflanzknollen.
Tableau 4. Dates auxquelles a commencé la croissance des germes dans les tubercules-fils en fonction des traitements des plants-mères.

(N^2), the 3 lots from the earlier maturing sprouted crops (N, Nc^1, M^1) produced visible sprouts 5–11 days earlier than the seed from the unsprouted crop (Table 4). This difference was not seen in Exp. II (when the first sprouting was not till December), nor in either experiment on tubers prevented from sprouting until March (M^2). There was no effect of burning down the foliage on the time when sprouts started to grow.

The effect of the first season's treatments on the number and length of sprouts and the degree of lateral branching at planting time of the second season are given in Tables 5 and 6; the effect on the number of stems developed after planting is shown in Table 7. There were few significant effects attributable to the treatments given to the seed of the previous generation. In Exp. II, tubers from mature seed crops of *Majestic* were more apically dominant when sprouted in December than burned down crops (Fig. 1), but subsequently stem numbers were similar. There were no consistent effects of burning down *Arran Pilot* on sprout number, but seed from the matured crop produced slightly more main stems. The N^1 N^2 treatment combination in *Arran Pilot* gave a greater degree of branch development on the sprouts than the M^1 N^2 or O^1 N^2

Table 5. Effect of sprouting treatments and foliage destruction in the first generation seed crop on the number and length of sprouts per tuber on the daughter seed at planting time.

Treatment of the first generation seed crop[2]	Second generation seed tubers[1]											
	Arran Pilot						*Majestic*					
	Number of sprouts[3]		number of sprouts[3] > 8 mm		sprout length[4] (mm)		number of sprouts[3]		number of sprouts[3] > 8 mm		sprout length[4] (mm)	
	N^2	M^2	N^2	M^2	N^2	M^2	N^2	M^2	N^2	M^2	N^2	M^2
Experiment[5] I												
N^1	4.6	6.3	2.0	3.3	86.2	64.3	4.8	5.1	1.2	1.8	29.5	30.9
Nc^1	4.1	6.3	2.0	3.5	83.0	61.0	3.2	4.9	1.2	1.5	27.0	28.7
M^1	4.3	6.5	2.3	2.4	74.9	56.2	4.0	5.1	1.4	1.9	32.5	29.2
O^1	4.3	5.3	2.9	2.9	81.5	54.5	3.6	4.8	1.6	1.8	31.8	31.3
S.E.	±0.47		±0.20		±4.66		±0.47		±0.20		±4.66	
Experiment[5] II												
N^1	6.6	10.2	2.9	3.2	82.1	62.3	9.1	12.4	2.2	4.1	50.7	64.3
M^1	6.6	10.6	2.8	3.1	76.2	62.1	9.2	12.7	2.0	3.6	43.0	57.5
O^1	7.1	9.9	2.4	3.4	61.3	63.7	8.6	12.2	1.8	3.5	36.4	58.8
S.E.	±0.47		±0.25		±6.31		±0.47		±0.25		±6.31	
BD	7.1	10.4	2.6	3.2	66.0	61.5	9.5	13.4	2.0	3.6	45.2	62.5
MAT	6.4	10.1	2.9	3.3	80.4	63.9	8.4	11.4	2.0	3.8	41.5	57.9
S.E.	±0.38		±0.20		±5.13		±0.38		±0.20		±5.13	

[1] *Zweite Generation Pflanzknollen (Tochterknollen) – Seconde génération de plants*
[2] *Behandlung der ersten Generation Pflanzgut (Mutterpflanzknollen) – Traitements de la première génération de culture de plants*
[3] *Anzahl Keime – Nombre de germes*
[4] *Keimlänge – Longueur des germes*
[5] *Versuch – Essai*

Tabelle 5. Einfluss der Keimbehandlungen und der Krautvernichtung bei den Mutter-Pflanzknollen auf die Anzahl und Länge der Keime pro Knolle beim Tochterpflanzgut zur Pflanzzeit.
Tableau 5. Effets des traitements de germination et de la destruction du feuillage appliqués à la première génération de culture de plants sur le nombre et la longueur des germes par tubercule des plants-fils au moment de la plantation.

combinations. There was a tendency for poorer lateral branch development of sprouts on the tubers from the burnt-down treatments.

Sprout length

In Exp. I there were no significant effects of the first generation seed-treatments on total sprout length during storage or at planting (Fig. 2, Table 5). However, in Exp. II, first generation seed-treatments which gave earlier crop maturity (N^1 and M^1) subsequently increased the rate of sprout growth in both varieties during the first 6 weeks

Table 6. Effect of sprouting treatments and foliage destruction in the first generation seed crop on the number of lateral branches developed on sprouts of second generation seed tubers at planting time.

Treatment of the first generation seed crop[2]	Second generation seed tubers; number of lateral branches developed on sprouts (per tuber)[2]			
	Arran Pilot		*Majestic*	
	N[2]	M[2]	N[2]	M[2]
Experiment[4] I				
N[1]	5.2	4.8	0	0
Nc[1]	4.9	4.0	0	0
M[1]	4.8	3.6	0	0
O[1]	4.4	4.0	0	0
S.E.	±0.41			
Experiment II				
N[1]	10.7	5.3	3.7	0.4
M[1]	9.2	4.4	3.4	0.5
O[1]	7.4	5.9	3.3	0.4
S.E.	±0.38		±0.38	
BD	8.3	4.8	3.4	0.4
MAT	9.8	5.6	3.5	0.6
S.E.	±0.31		±0.31	

[1] *Behandlung der Mutterpflanzknollen (erste Generation) – Traitement appliqué à la première génération de culture de plants*

[2] *Knollen des Nachbaus; Anzahl Seitentriebe an den Keimen (pro Knolle) – Seconde génération de plants; nombre de ramifications latérales des germes (par tubercule)*

[3] *Versuch – Essai*

Tabelle 6. Einfluss der Keimbehandlungen und der Krautvernichtung bei den Mutterpflanzknollen auf die Anzahl und Länge der Keime pro Knolle beim Tochterpflanzgut zur Pflanzzeit.

Tableau 6. Effets des traitements de germination et de défanage appliqués à la première génération de culture de plants sur le nombre de ramifications latérales des germes de la seconde génération de plants au moment de la plantation.

of growth when tubers were sprouted in December (Fig. 3). The initial differences established were maintained until planting time in both varieties though these were only significant in *Arran Pilot* (Table 5). Burning down the first generation seed crop in *Arran Pilot* resulted, when the tubers were subsequently sprouted in December, in a shorter sprout length per tuber than when the same crop was allowed to mature naturally (Table 5). There was no effect of the mother-crop seed-treatments on sprout length when the tubers were sprouted in March.

These differences in sprout length due to treatment of the first generation seed crop made no difference in the time of emergence after planting.

Effect of sprouting and foliage destruction in the first generation on the field growth and tuber yield of the next generation

There were no interactions between the first generation seed-treatments and the stor-

Table 7. Effect of sprouting treatments and foliage destruction in the first generation seed crop on the number of mainstems and the total number of stems at ground level per hill in the second generation (mean of 15 plants).

Treatment of first generation seed crop[2]	Second generation seed tubers[1]							
	Arran Pilot				*Majestic*			
	number of mainstems per hill[3]		total number of stems per hill[4]		number of mainstems per hill[3]		total number of stems per hill[4]	
	N^2	M^2	N^2	M^2	N^2	M^2	N^2	M^2
Experiment[5] I								
N^1	2.0	3.2	7.7	11.4	1.5	2.2	5.7	5.8
Nc^1	2.1	2.9	7.7	10.3	1.5	2.0	5.3	5.9
M^1	2.1	2.9	8.2	10.7	1.7	2.3	5.4	5.7
O^1	1.9	2.6	8.2	8.9	1.7	2.0	4.9	5.8
S.E.	±0.24		±0.38		±0.24		±0.38	
Experiment[5] II								
N^1	2.3	2.8	8.5	7.2	2.0	3.2	4.9	5.1
M^1	2.5	2.5	7.6	6.6	1.9	3.1	4.6	5.4
O^1	2.2	2.8	8.0	8.1	1.6	2.9	5.2	5.3
S.E.	±0.10		±0.21		±0.10		±0.21	
BD	2.4	2.3	7.5	7.2	1.8	3.1	4.9	5.2
MAT	2.7	2.6	8.6	7.4	1.8	3.0	4.8	5.4
S.E.	±0.10		±0.17		±0.10		±0.17	

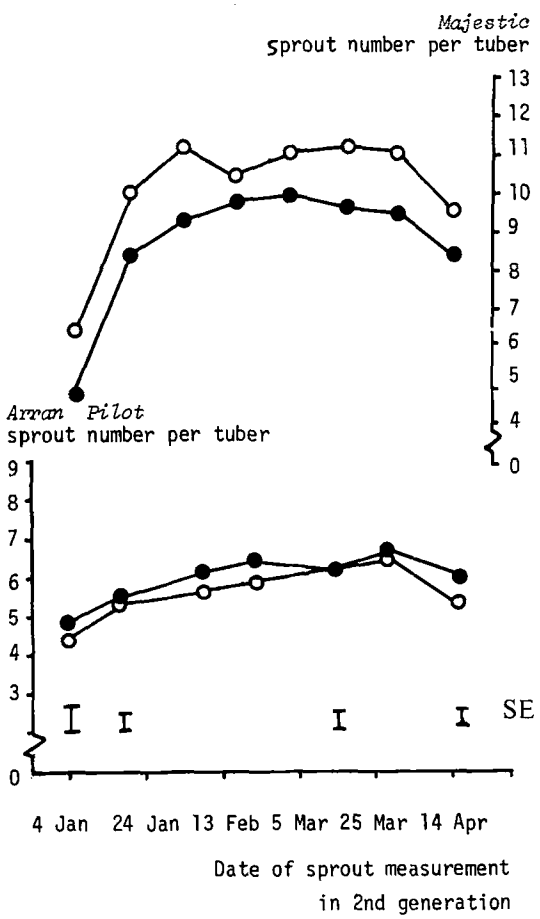
[1] *Knollen der zweiten Generation (Nachbau) – Seconde génération de plants*
[2] *Behandlung der Mutterpflanzknollen (1. Generation) – Traitement de la première génération de culture de plants*
[3] *Anzahl Haupttriebe pro Pflanze – Nombre de tiges principales/touffe*
[4] *Gesamtzahl de Triebe pro Pflanze – Nombre total de tiges/touffe*

Tabelle 7. Einfluss der Keimverfahren und der Krautvernichtung bei den Mutterpflanzknollen auf die Anzahl der Haupttriebe und die Gesamtzahl der Triebe und der Bodenoberfläche pro Pflanze in der zweiten Generation (Mittel von 15 Pflanzen).
Tableau 7. Effets des traitements de germination et de défanage appliqués à la première génération de culture des plants sur le nombre de tiges principales et le nombre total de tiges par touffe au niveau du sol dans la seconde génération (moyenne de 15 plantes).

age treatments imposed on the daughter seed tubers. The results are presented as means over seed size and second generation storage treatments (N^2, M^2, O^2).

The five sample lifts made during the growth of the second generation crops revealed no differences in foliage or tuber growth due to treatment of the first generation seed crop (Gray, 1969). Table 8 gives the yield of tubers, and the 'ware and 'seed' fractions and total tuber number. For none of these values was there any significant effect of treatments given to the first generation seed crop. The yield and tuber results given in

Fig. 1. Effect of early foliage destruction in the first generation seed crop on the change in sprout number on second generation tubers when set up to sprout in December. Experiment II.



○ First generation seed crop burned down – *Erste Generation Saatgut (Mutterpflanzknollen) abgebrannt – Première génération de culture de plants incinérée*

● First generation seed crop allowed to mature naturally – *Erste Generation Saatgut (Mutterpflanzknollen) natürlich ausgereift – Première génération de culture de plants maturée naturellement*

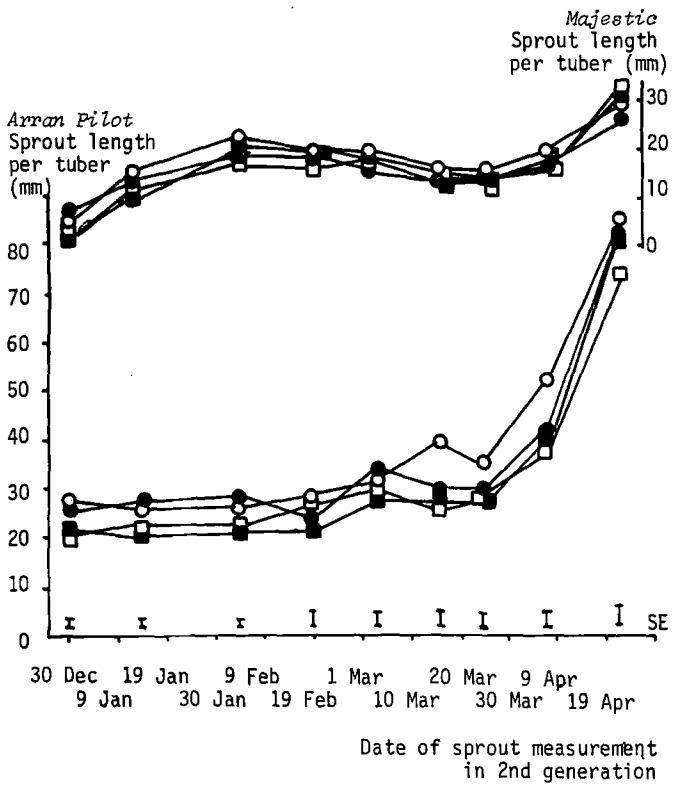
Sprout number per tuber – *Anzahl Keime pro Knolle – Nombre de germes par tubercule*

Date of sprout measuremen t in 2nd generation – *Datum der Keimmessung bei der zweiten Generation – Dates de mensuration des germes en seconde génération*

Abb. 1. Einfluss früher Krautvernichtung bei den Mutterpflanzknollen auf die Aenderung in der Keimzahl der Knollen der zweiten Generation bei Beginn des Vorkeimens im Dezember. Versuch II.

Fig. 1. Effet du défanage prématuré en première génération de culture de plants sur le nombre de germes en seconde génération de tubercules lorsque ceux-ci sont mis à germer en décembre. Essai II.

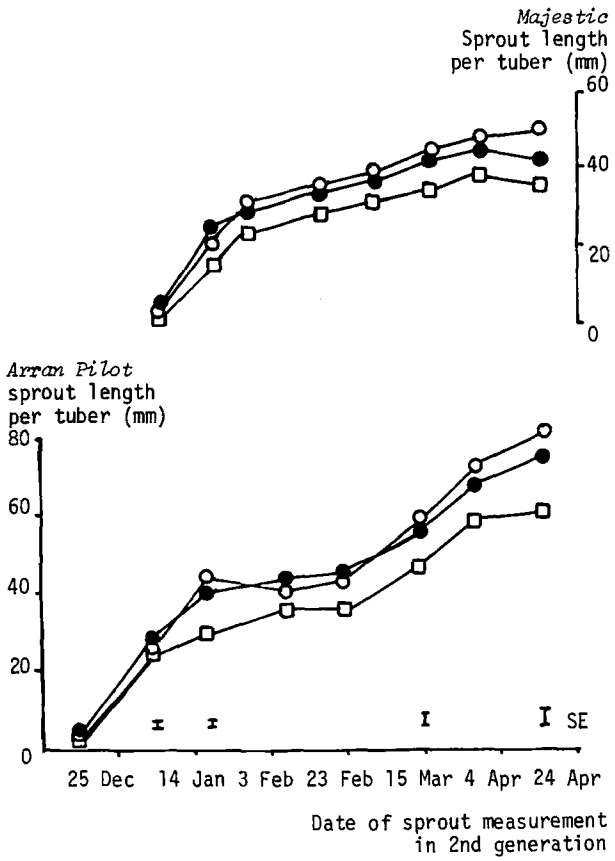
Fig. 2. Effect of sprouting treatments applied to the first generation seed crop on the change in sprout length of second generation tubers when set up to sprout in November. Experiment I.



First generation seed treatments – *Erste Generation Saatgut – Première génération de culture de plants*:
○ Sprouted Nov. at 8–10°C and then to 2–6°C – *Gekeimt im November bei 8–10°C und dann bei 2–6°C aufbewahrt – Germination en novembre à 8–10°C et ensuite à 2–6°C*
● Sprouted Nov. at 5–8°C – *Gekeimt Nov. bei 5–8°C – Germination en novembre à 5–8°C*
□ Sprouted Mar. at 8–10°C and then to 2–6°C – *Gekeimt März bei 8–10°C und dann zu 2–6°C – Germination en mars à 8–10°C et ensuite à 2–6°C*
■ Unsprouted – *Nicht vorgekeimt – Aucune germination*
Sprout length per tuber (mm) – *Keimlänge pro Knolle (mm) – Longueur des germes par tubercule (mm)*
Date of sprout measurement in 2nd generation – *Datum der Keimmessung bei der zweiten Generation – Dates de mensuration des germes en seconde génération*

Abb. 2. Einfluss der Keimbehandlungen der Mutterpflanzknollen auf den Wechsel in der Keimlänge der Knollen der zweiten Generation bei Beginn des Vorkeimens im November. Versuch I
Fig. 2. Effets de traitements de germination appliqués à la première génération de culture de plants sur la longueur des germes de la seconde génération, mise en germination en novembre. Essai I

Fig. 3. Effect of sprouting treatments applied to the first generation seed crop on the change in sprout length of second generation tubers when set up to sprout in December. Experiment II.



First generation seed treatments – *Erste Generation Saatgut – Première génération de culture de plants:*
Sprouted in Dec. at 7–10°C and then kept at 2–6°C – *Gekeimt im Dez. bei 8–10°C und dann bei 2–6°C aufbewahrt – Germinée en décembre à 8–10°C et ensuite conservation à 2–6°C*
● Sprouted in Mar. at 8–10°C and then kept at 2–6°C – *Gekeimt im März bei 8–10°C und dann bei 2–6°C aufbewahrt – Germination en mars à 8–10°C et ensuite à 2–6°C*
□ Unsprouted – *Nicht gekeimt – Plants non germés*

Sprout length per tuber – *Keimlänge pro Knolle – Longueur des germes par tubercule*
Date of sprout measurement in second generation – *Datum der Keimmessung bei der zweiten Generation – Dates de mensuration des germes en seconde génération*
Abb. 3. Einfluss der Keimbehandlungen der Mutterpflanzknollen auf den Wechsel in der Keimlänge der Knollen der zweiten Generation bei Beginn des Vorkeimens im Dezember. Versuch II.
Fig. 3. Effets de traitements de germination appliqués à la première génération de culture de plants sur la longueur des germes de la seconde génération, la mise en germination ayant lieu en décembre. Essai II.

Table 8. Effects of sprouting treatments and foliage destruction in the first generation on tuber yields in the second generation (mean over seed size and N^2 M^2 O^2).

Treatment of first generation seed crop[1]		Second generation seed tubers[2]			
		total tuber yield[3]	'seed' yield[4] 32–57 mm (1000 kg/ha)	'ware' yield[5] >57 mm	Total tuber number[6] (1000/ha)
Experiment II					
Arran Pilot	N^1	31.5	21.2	9.7	380
	Nc^1	32.3	22.2	9.4	366
	M^1	33.0	22.0	10.3	380
	O^1	30.8	21.7	8.5	372
Majestic	N^1	39.5	22.5	16.5	373
	Nc^1	37.2	20.1	16.6	351
	M^1	37.2	19.6	17.2	348
	O^1	37.1	19.8	17.0	350
	S.E.	±0.87	±0.74	±0.72	±13.2

Experiment II		Total tuber number/3 hills[7]	Total tuber yield (kg/3 hills)[8]
Arran Pilot	N^1	43.4	2.44
	M^1	45.1	2.71
	O^1	44.5	2.76
	S.E.	±2.75	±0.20
	BD	43.2	2.47
	MAT	45.5	2.80
	S.E.	±2.24	±0.17
Majestic	N^1	57.2	3.82
	M^1	52.2	3.44
	O^1	51.8	3.67
	S.E.	±2.75	±0.20
	BD	55.4	3.63
	MAT	52.1	3.66
	S.E.	±2.24	±0.17

[1] *Zweite Generation Saatknollen (Nachbau) – Seconde génération de plants*
[2] *Behandlung der Mutterpflanzknollen (1. Generation) – Traitement de la première génération de culture de plants*
[3] *Gesamtknollenertrag – Production totale de tubercules*
[4] *Ertrag in Saatgutgrösse – Production de plants*
[5] *Ertrag in Speisegrösse – Production de tubercules 'commerciaux'*
[6] *Gesamtknollenzahl – Nombre total de tubercules*
[7] *Gesamtknollenzahl/3 Pflanzen – Nombre total de tubercules/3 touffes*
[8] *Gesamtknollenertrag kg/3 Pflanzen – Production totale de tubercules en kg/3 touffes*

Tabelle 8. Einfluss der Keimbehandlungen und der Krautvernichtung bei den Mutterpflanzknollen auf den Knollenertrag in der zweiten Generation (Mittel über Saatgutgrösse und N^2 M^2 O^2).
Tableau 8. Effets de traitements de germination et de défanage en première génération sur la production de tubercules dans la seconde génération (Moyennes basées sur les calibrages des plants et les modalités N^2 M^2 O^2).

Table 8 for Exp. II are from the final sample lift, because flooding prevented the lifting of the special harvest area.

Discussion

Treatments which can bring forward the harvest date and affect the maturity date of the seed potato crop in the United Kingdom are in practice pre-sprouting and early foliar destruction, the former being undertaken to obtain a greater yield and/or earlier harvest, and the latter to prevent blight (*Phytopthera infestans*) spread or to limit the size of the tubers. Most seed producers attempt to plant near to the optimal date of mid-April although some variation in maturity date of the crop will result from differences in planting date. The results of the experiments described here (in agreement with Krijthe, 1962) show that both pre-sprouting and early foliar destruction applied to the first generation seed crop have discernable effects on the growth of sprouts on the daughter tubers if these are allowed to grow soon after harvest. It is also clear that these effects are too small to have any discernable influence on the succeeding crop. In regard to foliar destruction, this is also in agreement with the results of Koltermann (1927), Rosa (1928), Wright and Peacock (1934) and Emilsson (1949). When sprouting and planting follow soon after harvest as described by Kawakami (1936, 1953, 1962), treatment of the mother-seed crop to bring about earlier maturity can be important. In north-west Europe where the interval between harvest of the mother crop and planting of the next is about 7 months, manipulation of the mother seed crop by sprouting or burning down is unlikely to have any measurable effect on a following seed or maincrop ware crop. Goodwin et al. (1969) showed that even for the early ware crop, variation in the maturity of the seed crop caused by different dates of harvesting had little effect on the subsequent crop, when the different seed lots were well sprouted under the same conditions before planting. Their results also support the findings here, that the kind of sprouting treatments applied to the seed prior to planting is of greater importance in determining the performance of the crop than any manipulation of the seed crop in the previous generation.

Acknowledgement

We thank the Potato Marketing Board for the Research Grant made in support of this work.

Zusammenfassung

Ueber Nachwirkungen des Vorkeimens und der Krautvernichtung im Pflanzkartoffelbau

An der Edinburgh School of Agriculture Farms wurden zwei Versuche während je zwei Jahren (1963–65 und 1964–66) durchgeführt, um die Einflüsse des Vorkeimens und der Krautvernichtung bei der 1. Generation Pflanzgut (Mutterknollen) auf das Keimwachstum, Pflanzen-

wachstum und den Ertrag im Nachbau (2. Pflanzgutgeneration) zu untersuchen. Beide Versuche umfassten die Sorten *Arran Pilot* und *Majestic*. Einzelheiten der Verfahren sind in Tabelle 1 angegeben. Durch das Vorkeimen des für die Pflanzguterzeugung benützten Saatgutes (1. Pflanzgutgeneration) wurde das Reifedatum im Vergleich zu dem nicht vorgekeimten Saatgut bei *Arran Pilot* um 5–16 Tage, bei *Majestic* um 10–20 Tage vorverlegt (Abschnitt Material und Methoden). In Versuch II (Abbrennen des Krautes 2–3 Wochen vor der natürlichen Reife) wies das geerntete Pflanzgut beider Sorten einen um 2–3% niedrigeren Trockensubstanzgehalt auf als bei natürlicher Reife (Tabelle 3).

Pflanzgut, erzeugt von vorgekeimten (N^1, Nc^1 und M^1) Mutterknollen (sog. 1. Pflanzgutgeneration) zeigte in Versuch I, nicht aber in Versuch II, ein früheres Auskeimen (Tabelle 4) als Pflanzgut von nicht vorgekeimten (O^1) Mutterknollen. Die Einflüsse der Vorkeim-Behandlungen auf die Keimzahl, Keimlänge und die Entwicklung waren unterschiedlich, aber in Versuch II bildeten Saatknollen von *Arran Pilot* der früh vorgekeimten (N^1) Mutterknollen längere Keime als jene von spät vorgekeimten (M^1) oder nicht vorgekeimten (O^1) Beständen (Tabelle 5). Saatgut von abgebrannten Beständen (B.D.) von *Arran Pilot*, nicht jedoch von *Majestic*, brachte kürzere Keime als Saatgut von natürlich ausgereiften Beständen (MAT). Es zeigte sich kein Einfluss irgendeiner bei den Mutterknollen angewendeten Vorkeim- oder Krautvernichtungsbehandlungen auf die Anzahl der Stengel (Tabelle 7), das Pflanzenwachstum oder auf die Erträge (Tabelle 8) des Nachbaues (2. Pflanzgutgeneration). Es kann daraus geschlossen werden, dass in Nordwest-Europa die Unterschiede in den Reifezeiten, die durch das Vorkeimen der Mutterknollen oder durch das frühe Abbrennen des Krautes hervorgerufen werden, ohne bedeutenden Einfluss auf die Leistungen des erzeugten Nachbaues bei der Pflanz- oder Speisekartoffelerzeugung bleiben.

Résumé

Transmission des effects de la prégermination et de la destruction des tiges sur la récolte de plants de pommes de terre

Deux expériences, s'étendant chacune sur deux années (1963–65 et 1964–66) et portant chacune sur les variétés *Arran Pilot* et *Majestic*, ont été réalisées à la ferme de l'Ecole d'Agriculture d'Edimbourg pour déterminer les effets de la prégermination et de la destruction du feuillage effectuées sur une première génération d'une culture de plants, sur le développement des germes, le développement de la culture et la production de la seconde génération. On trouvera les traitements détaillés dans le tableau 1. La prégermination de la première génération avance la date de maturité, de 5–16 jours chez *Arran Pilot* et de 10–20 jours chez *Majestic*, par rapport aux plants non germés (Matérials et méthodes). Dans l'expérience II, la destruction complète du feuillage 2–3 semaines avant la maturité naturelle diminue la teneur en matière sèche des plants de 2–3% par rapport à la maturité naturelle, et cela chez les deux variétés (tableau 3).

Dans l'expérience I mais non dans l'expérience II, les plants issus de la récolte d'une première génération prégermée (N, Nc^1 et M^1) germent plus tôt (tableau 4) que les plants récoltés non prégermés (O^1). Les effets des traitements de prégermination sur le nombre, la longueur des germes et sur le développement sont variables mais dans l'expérience II les plants d'*Arran Pilot* issus de la première génération germée précocement (N^1) produisent des germes plus longs que ceux issus de cultures germées tardivement (M^1) ou non prégermées (O^1) (tableau 5). Chez *Arran Pilot* mais non chez *Majestic*, les plants issus de cultures défanées (B.D.) donnent des germes plus courts que les plants provenant de cultures qui ont pu atteindre leur maturité naturelle (MAT). Il n'apparaît aucun effet, ni de la prégermination, ni de la destruction du feuillage appliqué à la première génération de production de plants, sur le nombre de tiges (tableau 7), le développement de la culture ou la production (tableau 8) en seconde génération. Il est conclu que, dans le Nord-Ouest de l'Europe, la variation des dates de maturité causée par la prégermination du plant-mère ou la destruction prématurée des fanes n'a guère d'influence sur les productions de plants ou de pommes de terre de consommation dans la génération suivante.

References

Emilsson, B., 1949. Studies on the rest and dormant periods in the Potato tuber. *Acta. Agric. Svec.* 3: 189–284.

Goodwin, P. B., 1963. Mechanism and significance of apical dominance in the potato tuber. *Proc. 10th Easter School agric. Sci. Univ. Nott. 63–71.*

Goodwin, P. B., Brown, A., Lennard, J. H. & Milthorpe, F. L., 1969. Effect of centre of production, maturity and storage treatment of seed tubers on the growth of early potatoes. I. Sprout development in storage. *J. agric. Sci., Camb.* 73: 161–166.

Goodwin, P. B., Brown, A., Lennard, J. H. & Milthorpe, F. L., 1969. Effect of centre of production, maturity and storage treatment of seed tubers on the growth of early potatoes. II. Field growth. *J. agric Sci., Camb.* 73: 167–176.

Gray, D., 1969. A study of some factors affecting tuber number in *Solanum tuberosum* L. Ph. D. thesis, University of Edinburgh.

Kawakami, K., 1936. Improving potato seed tubers for spring crops. (Japanese) *Nogyo-Keizai* 3: 399–405.

Kawakami, K., 1953. Physiological aspects of potato seed tubers. *Mem. Hyogo Univ. Agric.* 2: 1–114.

Kawakami, K., 1962. The physiological degeneration of potato seed tubers and its control. *Eur. Potato J.* 5: 40–49.

Koltermann, A., 1927. Die Keimung der Kartoffelknolle und ihre Beeinflussung durch Krankheiten. *Angew. Bot.* 9: 289–339.

Krijthe, N., 1962. Observations on the sprouting of seed potatoes. *Eur. Potato J.* 5: 316–333.

Madec, P. & Perennec, P., 1955. The possibilities of sprouting potatoes and their consequences. (French). *Annls Amél. Pl.* 5: 555–574.

Rosa, J. T., 1928. Relation of tuber maturity and of storage factors to potato dormancy. *Hilgardia* 3: 99.

Sadler, E., 1961. Factors influencing the development of sprouts of the potato. Ph. D. thesis, University of Nottingham.

Toosey, R. D., 1963. The influence of sprout development at planting on subsequent growth and yield. *Proc. 10th Easter School agric. Sci. Univ. Nott.* 79–95.

Wright, R. C., & Peacock, W. M., 1934. Influence of storage temperatures on the rest period and dormancy of potatoes. *Tech. Bull. Dept. Agric. U.S.A.* 424; pp. 22.