EFFECT OF SEED TREATMENT AND HARVEST DATE ON THE YIELD AND QUALITY OF WARE POTATOES

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Teagasc acknowledges with gratitude the support of the European Union Structural Funds (EAGGF) in the financing of this research project

ISBN 1 901138 71 2

September 1998

Teagasc
The Science of Farming and Food

EUROPEAN UNION
European Agricultural Guidance and Guarantee Fund

Teagasc, 19 Sandymount Avenue, Dublin 4

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SUMMARY

The objective of this project was to investigate the effects of pre-planting seed handling procedures on the growth, yield and quality of the new Oak Park-bred potato variety Rooster. Statutory regulations and increased sophistication in packaging and presentation by retail outlets require that ware potatoes comply with narrower tuber size specifications. Appropriate pre-planting seed handling procedures provides the grower with an opportunity to influence emergence, crop establishment, yield at early harvest, tuber size distribution and quality.

Compared with cold-stored seed tubers, physiologically aged seed tubers of the variety Rooster emerged faster, achieved similar levels of crop establishment, provided 22% higher yield in the grade 45-65 mm, 25% higher in the grade 45-80 mm, 59% higher in the grade 60-80 mm, 10% higher total yield and higher dry-matter content at the first desiccation date. Yield differential diminished with delay in desiccation date until at the final desiccation date yield in the grade 45-65 mm was 9% higher, yield in the grade 45-85 mm was similar, yield in the grade 60-80 mm was 25% greater and total yield was also similar.

Cold stored seed tubers emerged at a similar rate to that of seed desprouted prior to planting, achieved 96% crop establishment and produced yield in the grades 45-65, 45-80, 60-80 mm and total yield and dry-matter content similar to those from seed desprouted prior to planting.

Seed tubers stored at ambient conditions and planted with a semi-automatic planter, emerged faster than seed stored at ambient conditions and desprouted prior to planting, achieved similar levels of crop establishment to physiologically aged seed, produced similar yield in the grades 45-65, 45-80, 60-80 mm and total yield and dry-matter content as those from seed desprouted prior to planting and produced a 33% increase in yield of tubers 60-80 mm at the first desiccation date but similar yield at final desiccation date as seed desprouted prior to planting.

Seed tubers stored at ambient conditions, desprouted prior to planting and planted with an automatic planter general emerged slower than seed from cold store or non-desprouted seed from ambient store, achieved only a 90% level of crop establishment in one year from four but produced similar ware yields, total

yields and dry-matter content as seed from cold store or non-desprouted seed from ambient store.

INTRODUCTION

Potato seed tubers are generally marketed on one tonne pallets with the tubers packed in 50 kg jute sacks. When stored under ambient conditions the tubers break dormancy and produce considerable sprout growth if planting is delayed. Of the 1451 commercial potato growers in Ireland less than 300 have access to refrigerated storage where seed tubers could be held under controlled conditions prior to planting and thus prevent excessive sprout growth. Uncontrolled sprout growth prior to planting depletes substrate reserves. Additionally, long sprouts foul the cup mechanisms on automatic planters, resulting in missing plants or variation in interplant distance. Subsequently this affects the tuber size distribution (Munzert, 1983) and consequently the commercial value of the resultant ware crop. During 1994 to 1997 a study was conducted, where the effect of pre-planting seed handling procedures on crop establishment and ware yield of the variety Rooster at three desiccation dates was investigated with a view to optimising procedures at farm level.

METHODS

Seed handling

Seed tubers of the variety Rooster (Elite or Super Elite Certification) 35 - 55 mm were purchased each year. On receipt, the tubers were allocated to four groups. Two groups were kept in the original jute sacks on pallets in an ambient potato store while the remaining two groups were placed in sprouting trays in a commercial potato cold store (4^0c). One of these groups was stored throughout in the cold store until planting whereas the other group was removed from the cold store and exposed to physiological ageing under fluorescent lights for 200 day-degrees >4^0c then returned to the cold store to await planting.

Crop establishment

Standard husbandry practices were applied during the growing season. The trial was planted each year according to the following schedule:

Treatment 1: Seed tubers stored throughout in a cold store and planted using a semi-automatic planter.

Treatment 2: Seed tubers stored in a cold store, but exposed to physiological ageing as described and planted using a semi-automatic planter.

Treatment 3: Seed tubers stored in an ambient store and planted without deliberate sprout removal using a semi-automatic planter.

Treatment 4: Seed tubers stored in an ambient store, desprouted immediately prior to planting then planted using an automatic planter.

The planting and desiccation dates are presented in Table 1.

Observations

Rate of emergence: The number of emerged plants were counted at 2 -3 day intervals and counting continued until values stabilised.

Tuber yield: Plots were harvested approximately three weeks after the final desiccation date. The produce of each plot was graded over square mesh riddles into 9 size fractions: <35, 35-40, 40-45, 45-50, 50-55, 55-60, 60-65, 65-80, >80 mm. and the weight in each fraction recorded. Yield in composite fractions was obtained by combining the values for the appropriate discrete fractions.

Dry matter content: Percentage dry matter was determined after tubers were washed, chipped and oven dried at 100^0C for 48 hrs.

Table 1: Panting and desiccation dates 1994 - 1997

Year	Planting date	Desiccation dates		
		1	**2**	**3**
1994	May 8	August 24	September 6	September 22
1995	April 21	September 6	September 19	October 5
1996	May 10	August 27	September 6	September 18
1997	April 9	August 25	September 4	September 17

RESULTS AND DISCUSSION

Rate of emergence

The rate of emergence, expressed as days after planting to 50% emergence (DAP_{50}), was faster for physiologically aged seed tubers than tubers from the three remaining treatments (Table 2) (O'Brien and Allen, 1984). The DAP_{50} values for physiologically aged seed were quite consistent over four years. The rate of emergence for seed stored at ambient temperature and planted using a semi-automatic planter without deliberate desprouting was similar to that of seed planted directly from the cold store. The slowest rate of emergence was achieved by seed desprouted prior to planting (Marinus, 1992) and planted using an automatic planter. Sprout length on cold stored seed typically ranged 4 - 6 mm. at planting while sprouts on seed stored at ambient temperature generally ranged 30 - 50 mm. Even when the seed was not deliberately desprouted, many of these long sprouts were removed during transfer from the sacks to the seed trays or during the hopper filling operation.

Table 2: Effect of pre-planting seed handling treatments on number of days after planting to 50% emergence; cv. Rooster; 1994 - 1997

Treatment	1994	1995	1996	1997
Seed - Cold stored until planting	38.5	33.8	32.5	40.3
Seed - Physiologically aged 200 dd >4 ^{0}C	24.7	28.2	25.8	26.0
Seed - Ambient store ; semi automatic planter	33.2	34.7	31.0	39.2
Seed - Ambient store ; automatic planter	37.5	40.7	34.5	42.0

Crop establishment

During four seasons, the highest level of crop establishment was achieved by planting physiologically aged seed tubers (Table 3) (O'Brien *et al.*, 1983). Satisfactory establishment was also achieved by planting cold stored seed and seed from ambient storage using a semi- automatic planter. In 1994 and 1995 the number of plants established from seed desprouted prior to planting was significantly lower than from the remaining treatments while in 1996 and 1997 there was no significant difference in crop establishment due to pre-planting seed handling. The level of crop establishment for ambient stored, desprouted seed in 1994 would be expected to result in reduced tuber yield, whereas in 1995, the establishment value approached 95% therefore despite a statistically significant reduction it is unlikely that yield would be effected.

Table 3: Effect of pre-planting seed handling treatments on % crop establishment; cv. Rooster; 1994 - 1997

Treatment	1994	1995	1996	1997
Seed - Cold stored until planting	96.0	100	99.3	98.4
Seed - Physiologically aged 200 dd >4 ^{0}C	97.9	100	99.6	99.1
Seed - Ambient store ; semi automatic planter	96.9	99.7	98.4	98.9
Seed - Ambient store ; automatic planter	90.0	94.7	98.6	97.5

Tuber yield

Tuber size in potatoes marketed as ware is controlled by Statutory Regulation. Currently the size limit for tubers in this grade is set at 45 - 80 mm. In addition however there are niche markets for a range of other tuber sizes. The most important of these are 'premium pre-packs' and 'spillers'/'bakers' where tuber sizes of 45 - 65 mm and 60 - 80 mm respectively are specified

Tuber yield 45 - 80 mm

The effect of pre-planting seed handling treatments and desiccation date on yield of tubers 45 - 80 mm of cv. Rooster for 1994, 1996 and 1997 is shown in Table 4. No data is available for graded yield in 1995. The main effects of seed treatment and desiccation date were each highly significant.

However there was a significant interaction between seed treatment and desiccation date since the rate of tuber bulking between desiccation dates depended upon the seed handling treatment. In general, bulking rates were greater between the first and second desiccation dates than between the second and third. (Cormac *et al*., 1992). There is a consistent pattern to the effects of treatment on yield at the first desiccation date. The highest yield of tubers 45 - 80 mm was consistently provided by physiologically aged seed (Burke, 1997), with the next highest yields from seed stored at ambient temperatures and planted without deliberate desprouting. The lowest yields in this grade were provided either by seed planted from cold store or by seed desprouted prior to planting (McGee *et al*., 1984).

Table 4: Effect of pre-planting seed handling treatments and desiccation date on yield of tubers 45 - 80 mm ($t.ha^{-1}$); cv. Rooster. (Mean 1994, 1996 and 1997)

Treatment	Desiccation date		
	1	2	3
Seed - Cold stored until planting	38.8	45.8	50.5
Seed - Physiologically aged 200 dd >4 ^{0}C	48.6	51.1	54.9
Seed - Ambient store ; semi automatic planter	42.6	47.0	49.0
Seed - Ambient store ; automatic planter	40.5	44.4	51.5

Tuber yield 45 - 65 mm

Data on yield in this fraction is only available for the years 1994 and 1996 (Table 5). Again the main effects of desiccation date and seed treatment were highly significant during both seasons and there was a significant interaction in 1994. The basis for the interaction is similar to that discussed above. A minimal increase in yield of tubers 45 - 65 mm occurred between the first and third desiccation dates for plants from physiologically aged seed whereas substantial increases were recorded for the remaining treatments and especially the cold stored treatment (Table 5).

In 1996, seed treatment significantly affected yield at each desiccation date and while statistically significant increases in yield were observed between desiccation dates these were largely provided by two treatments - cold stored seed and seed desprouted prior to planting. No increases were recorded for plants from physiologically aged seed or from seed planted without desprouting. This lack of increase in yield in the grade 45 - 65 mm despite a delay in desiccation date occurs because while average tuber size increases during the interval, no new tubers are formed and since some of the existing tubers out grow the upper size limit, yield in the grade remains stable.

Table 5: Effect of pre-planting seed handling treatments and desiccation date on yield of tubers 45 - 65 mm ($t.ha^{-1}$); cv. Rooster. (Mean 1994 and 1996)

Treatment	Desiccation date		
	1	2	3
Seed - Cold stored until planting	26.4	33.8	34.4
Seed - Physiologically aged 200 dd >4 ^{0}C	32.2	33.2	33.5
Seed - Ambient store ; semi automatic planter	27.4	31.1	31.1
Seed - Ambient store ; automatic planter	28.9	30.8	34.4

Tuber yield 60 - 80

The effect of pre-planting seed handling treatments and desiccation date on yield of tubers in the grade 60 - 80 mm during 1994, 1996 and 1997 is presented in Table 6. Yield in this grade was extremely low at the first desiccation dates in 1994 and 1996 especially on plants from cold stored seed or where seed was desprouted prior to planting. There were significant differences between seed treatments at each desiccation date and yields increased significantly with delay in desiccation date. In 1994 and 1996 - the years having restricted growing seasons (Table 1) - physiological ageing significantly increased yield at each desiccation date

Table 6: Effect of pre-planting seed handling treatments and desiccation date on yield of tubers 60 - 80 mm (t.ha^{-1}); cv. Rooster. (Mean 1994, 1996 and 1997)

Treatment	Desiccation date		
	1	2	3
Seed - Cold stored until planting	14.1	20.5	23.6
Seed - Physiologically aged 200 dd >4 ^{0}C	22.4	26.5	29.6
Seed - Ambient store ; semi automatic planter	18.5	23.1	24.8
Seed - Ambient store ; automatic planter	13.9	20.7	24.4

Total yield

The effect of pre-planting seed handling treatments and desiccation date on total tuber yield of Rooster during 1994 - 1997 is shown in Table 7. There was considerable variation in total yield between seasons, with the lowest average yields in 1994 and 1996 due to late planting (Table 1) and consequently reduced growing season. Highest average yields were recorded in 1995 and 1997, two years typified by long growing seasons (Table 1). But whereas periods of soil moisture stress, alleviated by irrigation, were encountered in 1995, growth continued uninterrupted in 1997. In 1994, 1996 and 1997 there were significant interactions between seed handling treatments and desiccation date, when the rate of increase in tuber yield between desiccation dates depended upon the seed handling treatment. In 1995 total yield was not affected by seed handling treatment, but there were significant increases with delay in desiccation date

Table 7: Effect of pre-planting seed handling treatments and desiccation date on total tuber yield (t.ha^{-1}); cv. Rooster. (Mean 1994 - 1997)

Treatment	Desiccation date		
	1	2	3
Seed - Cold stored until planting	50.7	58.4	62.1
Seed - Physiologically aged 200 dd >4 ^{0}C	55.4	59.6	64.2
Seed - Ambient store ; semi automatic planter	51.0	55.8	61.7
Seed - Ambient store ; automatic planter	50.5	55.5	62.0

Dry matter content

The effect of pre-planting seed handling treatments and desiccation date on tuber dry matter content in 1994 1996 and 1997 is shown in Table 8. In 1994, the dry matter content of tubers grown from physiologically aged seed was significantly higher at each desiccation date than tubers from the remaining pre-planting treatments. In 1996, at the first desiccation date tubers from both the cold stored and physiologically aged seed had significantly higher dry matter content than tubers from seed held at ambient temperature. However, by the final desiccation date tubers from the cold stored seed, physiologically aged seed and from seed held in ambient store not desprouted prior to planting all had similar dry matter content and only tubers from ambient seed desprouted prior to planting had significantly lower dry matter content. There was no effect of pre planting seed handling treatment on tuber dry matter content in 1997. There were significant increases in dry matter content with successive delays in desiccation date during each of the three years (Rex, 1991).

Table 8: Effect of pre-planting seed handling treatments and desiccation date on % dry matter; cv. Rooster. (Mean 1994, 1996 and 1997)

	Desiccation date		
Treatment	1	2	3
Seed - Cold stored until planting	19.6	19.8	21.1
Seed - Physiologically aged 200 dd >4 ^{0}C	20.3	21.1	21.8
Seed - Ambient store ; semi automatic planter	19.5	20.2	21.2
Seed - Ambient store ; automatic planter	19.2	20.5	20.9

CONCLUSIONS

- Compared with cold-stored seed tubers physiologically aged seed tubers of the variety Rooster
  - emerged faster
  - achieved similar levels of crop establishment
  - provided 22% higher yield in the grade 45 - 65 mm
  - 25% higher in the grade 45 - 85 mm
  - 59% higher in the grade 60 - 80 mm
  - 10% higher total yield
  - higher dry matter content at the first desiccation date

- The yield differential diminished with delay in desiccation date until at the final desiccation date
  - yield in the grade 45-65 mm was 9% greater
  - yield in the grade 45 - 85 mm, was similar
  - yield in the grade 60 - 80 mm was 25% greater
  - total yield was also similar

- Cold stored seed tubers
  - emerged at a similar rate to that of seed desprouted prior to planting
  - achieved 96% crop establishment
  - produced yield in the grades 45 - 65, 45 - 80, 60 - 80 mm, total yield and dry matter content similar to those from seed desprouted prior to planting

- Seed tubers stored at ambient conditions and planted with a semi-automatic planter
  - emerged faster than seed stored at ambient conditions and desprouted prior to planting
  - achieved similar levels of crop establishment to physiologically aged seed
  - produced similar yield in the grades 45 - 65, 45 - 80, 60 - 80 mm, total yield and dry matter content as those from seed desprouted prior to planting
  - produced a 33% increase in yield of tubers 60 - 80 mm at the first desiccation date but similar yield at final desiccation date as seed desprouted prior to planting

- Seed tubers stored at ambient conditions desprouted prior to planting and planted with an automatic planter
  - generally emerged slower than seed from cold store or non-desprouted seed from ambient store, achieved only a 90% level of crop establishment in one year from four
  - produced similar ware grade yields, total yield and dry matter content as seed from cold store or non-desprouted seed from ambient store

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