

Effects of drying potatoes (*Solanum tuberosum* L.) after harvest on the incidence of disease after storage

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Summary

Drying potatoes for 2 weeks after harvest decreased the severity of skin spot, silver scurf, black dot and black scurf after 20–26 weeks' storage at 5 °C. Diseases were decreased more after early than late harvest.

Introduction

Experiments in 1980–84 with potato tubers (*Solanum tuberosum* L.) inoculated or naturally infected with *Polyscytalum pustulans* (Owen & Wakef.) Ellis showed that holding tubers for up to 3 weeks in dry conditions after harvest greatly decreased the severity of skin spot in store (Hide & Cayley, 1987). Further experiments were made in 1986–88 with naturally infected tubers on the effects of pre-storage drying on four blemishing diseases.

Materials and methods

1986. After harvest in early October, six replicate 50-tuber samples of cv. Désirée were held either in sealed plastic bags (damp) or on trays (dry) at 10 or 15 °C. After 2 weeks, tubers that had been dried were placed in plastic bags and sealed and all samples were stored at 5 °C for 20 weeks.

1987. Tubers of cvs Estima and Maris Piper were harvested by hand on 17 September or harvested by elevator digger on 5 October. On both dates two replicate samples of 30–40 tubers were held either in plastic bags or on trays at 5, 10 or 15 °C. Two weeks later all samples were transferred to 5 °C as in 1986. Additional samples of 'Maris Piper' tubers were held at different humidities before storage. Wooden boxes (46×46×46 cm) were lined with plastic and fitted with a 10 cm diameter axial fan giving an air flow of 0.85 m² min⁻¹. Samples of 70–80 tubers of each cultivar were put into plastic nets and placed on open mesh racks in the boxes. Humidities were adjusted by placing plastic trays containing saturated salt solutions on shelves over the tubers. The salts used and humidities required were sodium chloride (75 % rh), potassium chloride (85 % rh) and sodium nitrate (95 % rh). The boxes were sealed and two replicate boxes were held at 5, 10 or 15 °C. After 2 weeks, all samples were removed, placed in individual plastic bags and stored at 5 °C for 26 weeks.

1988. Tubers of cvs Estima and Pentland Crown were harvested by elevator digger on 15 or 29 September or 19 October. Samples of both cultivars were held dry or damp (3 replicates of 20 tubers) or held at different humidities (2 replicates of 40 tubers) as in 1987 and after 2 weeks were stored in plastic bags at 5 °C for 22 weeks. For the experiments with different humidities, untreated tubers were placed in plastic bags and stored at 5 °C immediately after harvest.

Relative humidities in the constant temperature rooms used for drying ranged from 75–80 % rh.

Diseases were assessed on 100-tuber samples of each cultivar after harvest (1987 and 1988 only) and on all samples after storage. Tubers were washed and skin spot, silver scurf (*Helminthosporium solani* Dur. & Mont.), black dot (*Colletotrichum coccodes* (Wallr., Hughes) and black scurf (*Rhizoctonia solani* Kühn) were recorded on each tuber as trace (up to 5 % surface affected), moderate (5–30 %) or severe (> 30 %). For each disease a score was calculated by weighting the number of tubers in each category by respectively 1, 2 or 3 and expressing the sum of these scores as a percentage of the maximum possible (all tubers severely affected).

Results

1986. Drying tubers for 2 weeks at 10 or 15 °C greatly decreased the severity of skin spot and black dot that later developed in humid conditions at 5 °C (Table 1). However, drying significantly increased silver scurf which was also slightly more common after drying at 15 °C than at 10 °C.

Table 1. Effect of drying tubers for 2 weeks after harvest on disease (score %) after storage for 20 weeks at 5 °C. 'Désirée' 1986.

Holding conditions	Skin spot	Silver scurf	Black dot
10 °C dry	11	26	51
damp	36	10	69
15 °C dry	6	32	47
damp	26	12	71
S.E.D. (20 d.f.)	5.4	3.2	3.8

1987. Skin spot on 'Maris Piper' tubers was decreased by drying (Table 2). Less disease developed on tubers held for 2 weeks in plastic-lined boxes probably because humidities, measured regularly throughout storage by a portable humidity indicator (Vaisala (UK) Ltd.) were lower than the treatments were designed to give (respectively 71, 85, 90 % rh). However, severity of skin spot did decrease as the humidity decreased. With tubers harvested on 5 October disease also decreased as the holding temperature increased.

Tubers were affected with black dot at harvest (17 September, disease score 19; 5 October, score 36) and, as in 1986, the disease was greatly decreased by drying tubers before storage (Table 2). However, drying was less effective in October than in September. Silver scurf was also present on tubers harvested on both dates (disease scores

Table 2. Effect of environmental conditions during 2 weeks after harvest on disease (score %) after storage at 5 °C. 'Maris Piper', 1987.

Holding conditions	Skin spot		Black dot	
	Harvest date 17 Sept.	5 Oct.	Harvest date 17 Sept.	5 Oct.
5 °C dry	4	2	9	22
damp	44	33	33	58
10 °C dry	0	4	8	30
damp	58	20	56	48
15 °C dry	3	5	6	27
damp	54	19	57	75
S.E.D. (6 d.f.)	7.1	2.7	8.2	6.6
5 °C 75 % rh	4	7	12	22
85 % rh	4	11	15	32
95 % rh	6	14	13	33
10 °C 75 % rh	4	3	13	28
85 % rh	2	8	11	24
95 % rh	11	10	16	31
15 °C 75 % rh	0	3	13	33
85 % rh	0	3	18	30
95 % rh	3	4	12	35
S.E.D. (27 d.f.)	2.8	2.4	3.7	4.2

20–25) and was prevalent after storage (99 % tubers affected, disease score 75) but was not affected by conditions during the 2-week holding period.

Almost all 'Estima' tubers were affected with silver scurf after storage but severity of the disease was decreased by drying tubers before storage (harvested 5 October: dry, disease score 68; damp, disease score 90). Few tubers were affected with skin spot but results with black dot were similar to those with 'Maris Piper' and showed a large effect of drying.

1988. Increasing amounts of silver scurf were present on 'Pentland Crown' tubers at sequential harvests (scores 36, 44, 56) and, although amounts of disease increased during storage, disease scores were smallest on samples dried after harvest (Table 3). Silver scurf was also decreased by holding tubers for 2 weeks at 75 % rh as compared with 95 % rh or no drying, but with both methods of drying the treatment had less effect on the disease as harvest was delayed.

Very few tubers were affected with black scurf at harvest and, although few were also affected in samples dried before storage, holding tubers damp for 2 weeks increased the amount of disease (Table 3). Severity of black dot increased with harvest date (scores 14, 20, 31) and after storage was decreased by drying especially on tubers harvested in September. Similarly, drying decreased skin spot and was effective on all harvest dates.

Severity of silver scurf and black dot on 'Estima' tubers at harvest increased as harvest was delayed. These diseases and skin spot were decreased by drying especially after early harvest.

Table 3. Effect of environmental conditions during 2 weeks after harvest on disease (score %) after storage at 5 °C. 'Pentland Crown', 1988.

Holding conditions		Silver scurf			Black scurf		
		Harvest date			Harvest date		
		15 Sept.	29 Sept.	19 Oct.	15 Sept.	29 Sept.	19 Oct.
5 °C	dry	62	63	81	0	0	6
	damp	85	90	96	1	10	26
10 °C	dry	70	71	82	1	1	4
	damp	91	93	100	0	5	18
15 °C	dry	65	69	70	0	1	4
	damp	99	100	93	0	12	22
S.E.D. (5 d.f.)		8.6	7.6	6.4	0.7	8.9	2.5
5 °C	75 % rh	60	69	95	1	1	2
	85 % rh	75	73	96	0	6	3
	95 % rh	82	86	96	0	1	6
10 °C	75 % rh	70	82	87	0	1	0
	85 % rh	71	80	98	0	1	9
	95 % rh	83	89	98	1	0	5
15 °C	75 % rh	52	75	85	0	3	8
	85 % rh	67	68	89	2	2	3
	95 % rh	77	73	89	5	2	3
Untreated		92	98	95	1	9	12
S.E.D. (29 d.f.)		8.2	7.6	4.9	1.7	2.4	4.3

Discussion

The severity of four superficial diseases of potatoes after storage was decreased by drying tubers after harvest. Some results, for example with skin spot, suggested that the drying conditions killed conidia or superficial infections because few spots developed when tubers were later stored in cool and damp conditions that encourage this disease. However, other results indicate that it was the damp conditions that increased disease. In 1988, much more black scurf was found on tubers that had been held damp for 2 weeks than on those held dry. Although much disease is often present at harvest, sclerotia can also develop on tubers in damp storage (Spencer & Fox, 1979b; Adams et al., 1980).

It is not known why dry conditions stimulated development of silver scurf in 1988 but also in that year the disease was increased at Sutton Bridge Experimental Station when 500-tonne stores were ventilated to maintain rh at 85–90% (Anon., 1988).

With many tuber diseases, tuber infection or accumulation of inoculum at the tuber surface increases during crop growth and also whilst tubers remain in soil (Hide et al., 1969; Adams & Griffith, 1978; Spencer & Fox, 1979a). Consequently, less disease is likely to develop on tubers harvested early than on those harvested later. Also after early harvesting the infections are probably poorly established in tuber tissues and are therefore susceptible to adverse environmental conditions. Drying tubers before storage was increasingly effective in decreasing disease the earlier tubers were harvested. A similar effect of date of treatment was found using hot water to eradicate tuber infec-

tions (Hide, 1975). Also it is likely that in the current practice of two-stage harvesting, leaving tubers to dry for several hours on the soil surface before collecting them for storage could kill infection and decrease storage disease.

In the UK, growers are advised to allow tuber temperatures to rise to 15 °C during the first 2 weeks of storage to encourage healing of wounds (curing). During this curing period the humidity of air between potatoes also rises because of tuber respiration. Humidity is also increased when there is much wet soil adhering to tubers. However, wounds will heal at humidities as low as 70 % rh (Wigginton, 1974) and recent experiments with dry curing (Anon., 1987) showed that silver scurf and bacterial soft rot were decreased whereas weight loss was unaffected.

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