Alternaria alternata: A New Pathogen on Stored Potatoes

S. DROBY and D. PRUSKY, Division of Fruit and Vegetable Storage, Agricultural Research Organization, Volcani Center, P.O.B. 6, Bet Dagan; A. DINOOR, Department of Plant Pathology, Hebrew University of Jerusalem, Faculty of Agriculture, P.O.B. 12, Rehovot 76100; and RIVKA BARKAI-GOLAN, Division of Fruit and Vegetable Storage, Agricultural Research Organization, Volcani Center, P.O.B. 6, Bet Dagan 50250, Israel

ABSTRACT

Droby, S., Prusky, D., Dinoor, A., and Barkai-Golan, R. 1984. *Alternaria alternata*: A new pathogen on stored potatoes. Plant Disease 68:160-161.

The agent responsible for a black pit disease on potato tubers was identified as the fungus *Alternaria alternata*. A significantly greater incidence of disease was observed in mechanically harvested tubers (twofold to sixfold greater than in manually harvested tubers). Iprodione sprays at a concentration of 1,000 μg a.i./ml significantly decreased *Alternaria* incidence on newly harvested tubers after 4 mo of storage. The data support the conclusion that *A. alternata* infestation occurs during harvesting and is enhanced in damaged potato tubers. Fungicide treatment after mechanical harvesting reduces disease incidence during storage.

In recent years, symptoms of black pit disease have become common on stored potato tubers in Israel. Special attention has been given to these lesions because as many as 10% of stored potato tubers have been affected (6). Considerable losses have been recorded in potatoes used in industry, where part of the tuber is wasted during peeling. In preliminary work, the fungus *Alternaria alternata* (Fr.) Keissler was consistently isolated from the black, sunken lesions (6). This fungus is not known as a pathogen of potato tubers (1,10), but recent work done by Droby et al (2,3) described *A. alternata* as a potato leaf pathogen and raised the possibility that the fungus causes tuber disease as well. In this work, the possible infection of *A. alternata* during harvesting was examined; factors affecting fungal infection, as well as possible ways for its control, were studied.

MATERIALS AND METHODS

The pathogen was isolated from characteristic pits appearing on potato tubers (Fig. 1). Tubers were disinfected by rubbing them with 90% ethanol. The peel was removed gently from the surface of the black lesions (1–2 mm deep), and small slices (0.5 mm^2) of the lesions were sampled and incubated at 25 C on potato-dextrose agar (PDA) for 4 days. Single-conidial cultures were prepared for inoculation. Fungal cultures were maintained on PDA at 25 C.

Inoculum was prepared in two ways: 1) by growing the fungus on S-medium (7), which is known to induce the production of huge amounts of aerial conidial chains, and harvesting spores by adding small amounts of water and rubbing gently with a bent-glass rod and 2) by shaking slices (0.5–1 cm^2) of 1-wk-old fungus culture grown on PDA at 25 C in sterile distilled water, then filtering the suspension through cheesecloth to remove the hyphae and PDA remnants. Spores were counted with a hemacytometer and the concentration was adjusted to 10^6 spores per milliliter. Inoculation was done by injecting 50 μl of the spore suspension under the tuber peel, then incubating it at 25 C and 100% RH for 21 days.

Experiments were carried out in commercial fields of 2 ha on cultivars Desirée, Blanka, Spunta, Cardinal, and Up-to-Date during two consecutive

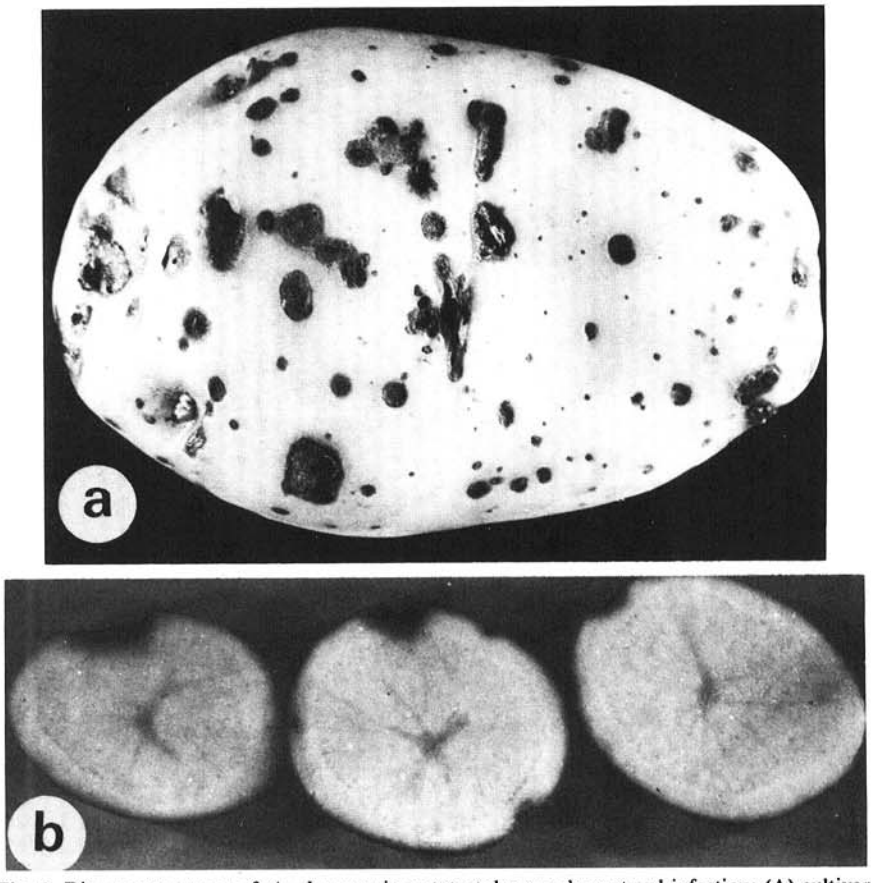

Fig. 1. Disease symptoms of *A. alternata* in potato tubers under natural infection: **(A)** cultivar Up-to-Date and **(B)** cultivar Desirée.

Contribution from the Agricultural Research Organization, Volcani Center, Bet Dagan, Israel. No. 739-E, 1983 Series.

Accepted for publication 30 September 1983.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked "*advertisement*" in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

Table 1. Effect of harvesting method and postharvest fungicide treatment on disease development of *Alternaria alternata* in five potato cultivars

Harvesting method	Desirée		Blanka		Cardinal		Spunta		Up-to-Date	
	Damaged tubers (% total wt)[v]	Disease severity[w]	Damaged tubers (% total wt)	Disease severity	Damaged tubers (% total wt)	Disease severity	Damaged tubers (% total wt)	Disease severity	Damaged tubers (% total wt)	Disease severity
Mechanical lift	12.86 a[x]	0.84 a	12.30 a	0.32 a	17.5 a	0.73 a	10.3 a	0.62 a	6.38 a	0.29 a
Mechanical lift + iprodione[y]	8.62 b	0.22 b	1.90 b	0.30 a	2.6 b	0.28 b	1.0 b	0.04 b	2.26 ab	0.09 b
Manual lift[z]	3.84 c	0.21 b	5.70 b	0.12 ab	1.3 b	0.32 b	0.0 b	0.00 b	7.20 b	0.16 ab
Manual lift + iprodione	2.24 c	0.05 b	0.02 b	0.60 b	0.2 b	0.05 b	0.0 b	0.00 b	0.54 b	0.00 b

[v] Tubers with symptoms of *Alternaria* were considered damaged.
[w] Percentage of area infected by the disease (disease severity) was determined by comparing the diseased tuber with a scale composed of tubers on which different percentages of area were covered with the characteristic symptoms.
[x] Values followed by different letters are significantly ($P = 0.05$) different according to Duncan's multiple range test.
[y] Applied as a spray on a laboratory bench at a concentration of 1,000 μg a.i./ml.
[z] Tubers harvested with the aid of a pitchfork.

growing seasons. Potato tubers were sampled after careful harvesting, either manually with a pitchfork or mechanically with a Dallman Harvester that covered 2.5–3 km/hr. After harvest, some of the tubers were placed on a laboratory bench and sprayed with 1,000 μg a.i./ml iprodione. Unsprayed tubers were used as control. Ten random samples of 5 kg each were taken for each treatment.

Tubers from all the experiments were held at 14 ± 2 C for 2 wk for curing, then transferred to regular storage at 8 ± 2 C and 80% RH in experimental storage rooms (2 × 2 × 4 m) for 3–4 mo.

RESULTS

Identification of the pathogen. The organism isolated on PDA from black pits on potato tubers (Fig. 1) showed obclavate spores borne in long chains, the majority with 1–7 transversal septa and 1–3 longitudinal septa, within the limits of 11.5–42.9 × 6.6–13.2 μm. This fungus was identified as *A. alternata* according to morphological comparisons of *Alternaria* isolates from the potato tubers with the published descriptions of *A. alternata* (4,5,9).

Inoculation by injecting 50 μl of the spore suspension under the tuber skin followed by incubation at 25 C for more than 3 wk yielded a black spot similar to the characteristic symptoms. The fungus *A. alternata* was reisolated from inoculated infected tubers, demonstrating its involvement in the disease according to Koch's postulates.

Effect of mechanical harvest and postharvest fungicide treatment on disease development. Disease incidence in manually and mechanically harvested tubers indicated that the mode of harvesting is directly involved in tuber infection. In all the cultivars tested, mechanical lift significantly increased the percentage of blemished tubers (Table 1). It also increased the disease severity on infected tubers, indicating that both fungal infection and its development are favored in injured tissues. Treatment with iprodione after manual or mechanical harvesting markedly reduced the percentage of damaged tubers in all the cultivars tested (Cardinal, Spunta, Up-to-Date, Blanka, and Desirée) (Table 1). The effect of iprodione in reducing the incidence of damaged tubers was always significant in mechanically lifted tubers, whereas in manually lifted tubers, the effect was never significant, probably because of the low incidence of disease in this treatment (Table 1). Fungicide treatments were effective not only in reducing the percentage of damaged tubers but also in reducing disease severity in infected tubers.

DISCUSSION

The fungus isolated from the black pits on potato tubers was identified as *A. alternata*. This fungus has not been known as a pathogen of potato tubers (1,10) but it has been described previously as a leaf pathogen in potato (2,3). The modern mechanical harvesting of tubers usually results in 33% damage by the time tubers leave the farm (8). Wounds produced during harvesting represent a simple port of entry for the large amount of viable inoculum of *Alternaria* present in the field (3).

The significant effect of mechanical harvesting on incidence of diseased tubers and the erradicative effect of iprodione on newly harvested tubers indicate that the tuber infestation occurs in the field, possibly as a result of the mechanically wounded tubers being mixed with the soil and plant debris during harvesting. The direct penetration of *Alternaria* through the tuber skin under field conditions seems to be less likely.

No conclusions can be drawn concerning the differential susceptibility of the cultivars because variability in disease incidence was observed from one season to another. Furthermore, many factors may be involved in the rate of wound production during harvesting, such as season, temperature during harvesting, soil type, and the harvester itself (8). However, the cultivar Up-to-Date showed a certain reduction in the percentage of damaged tubers and in the severity of disease, in accordance with the reduced incidence of *A. alternata* described in the canopy (2). Our results indicate that the proper time for control of black pit disease on newly harvested tubers should be before storage.

The pathogenicity of *A. alternata* on potato plants has become a serious problem in recent years in Israel (2). Although the percentage of affected area in our experiments never exceeded 1%, in certain cases, it has covered as much as 10% of the tuber. One possible reason for the appearance of black pit disease on tubers could be climatic conditions in the potato-growing regions—high temperatures, long dew periods, and sand storms—which might predispose the crop to infestation by *Alternaria*, resulting in a good source of infection for the mechanically damaged harvested tubers.

LITERATURE CITED

1. Boyd, A. E. W. 1972. Potato storage diseases. Rev. Plant Pathol. 51:297-319.
2. Droby, S., Dinoor, A., Prusky, D., and Barkai-Golan, R. 1984. Pathogenicity of *Alternaria alternata* in the potato crop. Phytopathology 74:In press.
3. Droby, S., Prusky, D., Dinoor, A., and Barkai-Golan, R. 1981. Leaf spots and tuber lesions in potatoes caused by *Alternaria alternata*. (Abstr.) Phytoparasitica 9:3.
4. Giha, O. H. 1973. Distribution and morphology of *Alternaria tenuis* associated with leaf spots in Sudan. Trans. Br. Mycol. Soc. 61:265-275.
5. Grogan, R. G., Kimble, K. A., and Misaghi, I. 1975. A stem canker disease of tomato caused by *Alternaria alternata* f. sp. *lycopersici*. Phytopathology 65:880-886.
6. Prusky, D., and Apelbaum, A. 1980. Storage disease of potato. Agric. Res. Organ. Div. Storage of Agric. Prod., Volcani Center, Bet Dagan, Israel. 19 pp. (In Hebrew)
7. Shahin, E. A., and Shepard, J. E. 1979. An efficient technique for inducing profuse sporulation of *Alternaria* species. Phytopathology 65:618-620.
8. Shotton, F. G. 1980. The reduction of damage to potato tubers during mechanical harvesting. Ann. Appl. Biol. 96:357-360.
9. Simmons, E. G. 1967. Typification of *Alternaria, Stemphylium* and *Ulocladium*. Mycologia 59:67-92.
10. Smith, W. L., and Wilson, J. B. 1978. Market diseases of potatoes. Handb. U.S. Dep. Agric. 479.