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Bumpy Tuber - A Post Harvest Disease on Potato Associated with the Black Dot Fungus

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OVERVIEW

A new tuber disease, appearing as raised dark brown "bumpy" lesions, covering up to 60% of the tuber surface, was first observed on the epidermis of Ranger Russet tubers and has since been found on Russet Burbank, Shepody, and Russet Norkotah tubers from storages in 2002 through 2005 (Fig 1). The pulp under the bumpy lesion usually demonstrated brownish discoloration reaching to a depth of 1-2mm with a corky texture (Fig 2). The height of the swollen tissue gradually decreased over a 10 to 20 days period when affected tubers were removed from a storage environment with high relative humidity (>90%) to room temperature with reduced relative humidity (≤ 50%). *Colletotrichum coccodes*, causal agent of potato black dot, and *Helminthosporium solani*, causal agent of silver scurf were suspected to cause these symptoms, based on visual identity of these fungi associated with the affected tissue. The present report summarizes the results of a survey conducted in 2004 in order to help identify the causal agent of these symptoms.

MATERIALS & METHODS

Russet Burbank and Ranger Russet tubers from 49 lots (5 Ranger Russet, 44 Russet Burbank) were sampled. Isolations were attempted from 5 randomly selected tubers expressing bumpy symptoms from each lot, except for 2 lots from which only 3 tubers were sampled (total of 241 tubers). A segment of epidermis with periderm (~ 0.5mm) from 3 different bumpy lesions per tuber was sampled as was the vascular tissue from stolon-ends of all tubers. In addition, sub-epidermal tissue (1-2mm depth) with corky texture was sampled from 14 randomly selected tubers from 3 different lots. Tissue samples were placed onto modified potato dextrose agar, and incubated for 21 days at 22°C to promote growth of both the black dot and silver scurf fungi.

Additionally, 5 tubers from each of the 49 lots were washed and placed wet into a single plastic bag (10 lb potato bag) in the dark, at 70° F. The tubers were rewetted weekly for 3 weeks after which they were removed. A single tuber with bumps was randomly selected and observed for the presence of silver scurf to determine whether this fungus was associated with the raised areas on the tuber.

RESULTS

No other potato pathogen, fungal, bacterial or nematode, was found associated with this damage besides *C. coccodes* (black dot) and *H. solani* (silver scurf). *C. coccodes* (black dot) was isolated and most frequently found from both epidermis, sub-epidermal, and stolon-end tissues.

On Russet Burbank, the black dot fungus was isolated directly from 360 of 654 (55%) of the “bumpy lesions”, representing 141 of 218 (65%) tubers showing bumps. The black dot fungus was isolated from 12 of 14 (86%) sub-epidermal tissues, 49 out of 218 (22.4%) from stolon end isolations, and jointly on the epidermis and stolon end 36 out of 218 (16.5%) attempts (Table 1).

On Ranger Russet, the black dot fungus was isolated directly from 46 of 69 “bumpy lesions” (67%), representing 16 of 23 (70%) tubers showing bumps. The number of Ranger Russet tubers where the black dot fungus was isolated from their stolon-end was 4 of 23 (17.4%), and was found jointly infecting the epidermis and stolon end in 3 of 23 (13%) tubers (Table 2). Sub-epidermal tissues were not sampled from Ranger Russet tubers.

The silver scurf fungus was isolated from epidermal tissues but not from either sub-epidermal or stolon-end tissues. From epidermis tissues of Russet Burbank, the silver scurf fungus was isolated 98 of 654 (15%) tuber pieces, whereas this fungus was found on the epidermis from 32 of 218 (14.7%) tuber pieces (Table 1). As for Ranger Russet, the silver scurf fungus was isolated from the epidermis 4 of 69 (5.8%) times and from infected tubers epidermis only from 2 of 23 (4.3%, Table 2).

The black dot and silver scurf fungi were isolated jointly from 19 of 218 (8.7%) and 5 of 23 (21.7%) tubers from symptomatic Russet Burbank and Ranger Russet, respectively (Tables 1 & 2). The number of epidermis tissues from which the two pathogens were isolated jointly was not recorded. Twenty-six Russet Burbank tubers (12%) did not show symptoms and no pathogens were recovered, whereas Ranger Russet tubers were all infected with either the black dot or silver scurf fungus.

After three weeks storage at high humidity, the silver scurf fungus was present on 66 and 80% of the Russet Burbank and Russet Ranger tubers, respectively (Table 3). The silver scurf fungus was found associated with bumps 32 and 60%, respectively for Russet Burbank and Russet Ranger, but was found most often not associated with bumpy areas (59 and 60% for Russet Burbank and Russet Ranger respectively). Some tubers had silver scurf infection associated with and without the bumps.

DISCUSSION

The cause of bumpy and/or darken epidermis areas on tubers is currently unknown. Inoculation tests with both the black dot and silver scurf fungi did not result in typical tuber symptoms. However, the black dot fungus was most often associated with the tubers that exhibited discolored and/or raised areas and this fungus is

reported to cause similar symptoms in other potato growing areas. It is possible that the black dot fungus is interacting with an environmental factor not yet recognized to cause the bumpy tuber disease. *C. coccodes* (black dot) has been reported to cause latent infections on tubers and to cause severe epidermis blemishes on different potato cultivars during storage (41F, 90% relative humidity). The symptoms could be confused with those of silver scurf, with the semi typical brown-silver discoloration on both white and red skin potatoes. However on close observation, these areas lack the typical production of conidiophores with dark conidia characteristic of silver scurf and nearly always have small dark sclerotia typical of those produced by *C. coccodes*.

If the black dot fungus is involved, we hypothesize that infection occurs either in soil prior to skin set, or during harvest as tubers are injured, allowing infection by conidia and/or sclerotia. Then symptoms develop in storage when relative humidity is high (>90%). The time required for symptom development in storage is unknown as are any control measures. Currently, additional attempts are being made to reproduce symptoms by artificially inoculating nuclear aged tubers with *C. coccodes* and incubating them in a storage environment.

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Fig1. Epidermal bumpy tuber symptoms.



Fig2. Sub-epidermal bumpy tuber symptoms (arrows).

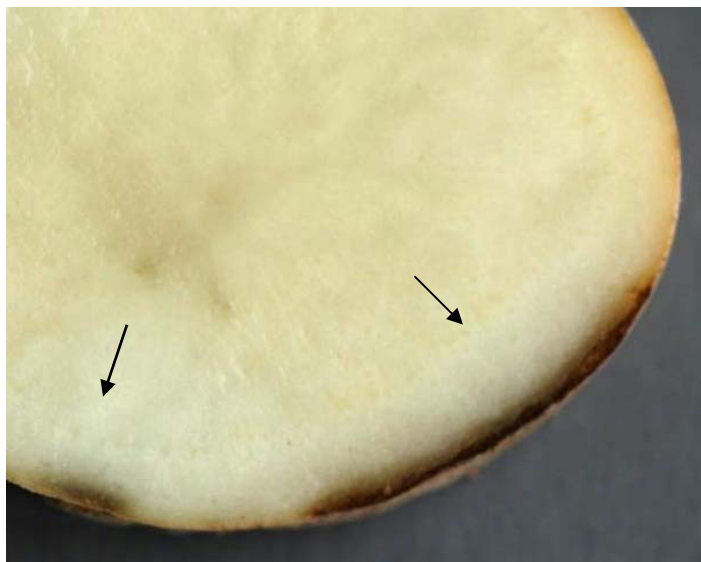


Table 1. Isolation frequency of *C. coccodes* (black dot) and *H. solani* (silver scurf) from epidermis, sub-epidermis and stolon-end vascular tissues of Russet Burbank tubers showing bumpy tuber symptoms.

| <u>Pathogen/disease</u> | <u>Bumpy Lesions¹</u> | | <u>Infected Tubers²</u> | | |
|---------------------------------------|----------------------------------|----------------------|------------------------------------|----------------------|-----------------------------------|
| | <u>Epidermis</u> | <u>Sub-epidermal</u> | <u>Epidermis</u> | <u>In stolon-end</u> | <u>Epidermis & stolon-end</u> |
| <i>C. coccodes</i> (Black dot) | 360/654 (55%) | 12/14 (86%) | 141/218 (65%) | 49/218 (22.4%) | 36/218 (16.5%) |
| <i>H. solani</i> (Silver scurf) | 98/654 (15%) | 0 | 32/218 (14.7%) | 0 | 0 |
| <i>C. coccodes</i> & <i>H. solani</i> | not recorded | 0 | 19/218 (8.7%) | 0 | 0 |

¹ Data under bumpy lesions represent the isolation success directly from lesions on tubers with that symptom. Three isolation attempts were tried from each ‘bump lesion’ from each tuber.

² Data listed under infected tubers represent overall isolation success. A tuber was positive on the epidermis if one or more of the three isolation attempts from a ‘bump lesion’ were positive.

Table 2. Isolation frequency of *C. coccodes* (black dot) and *H. solani* (silver scurf) from epidermis, sub-epidermis and stolon-end vascular tissues of Russet Ranger tubers showing bumpy tuber symptoms.

| <u>Pathogen/disease</u> | <u>Bumpy Lesions¹</u> | | <u>Infected Tubers²</u> | | |
|---------------------------------------|----------------------------------|----------------------|------------------------------------|----------------------|-----------------------------------|
| | <u>Epidermis</u> | <u>Sub-epidermal</u> | <u>Epidermis</u> | <u>In stolon-end</u> | <u>Epidermis & stolon-end</u> |
| <i>C. coccodes</i> (Black dot) | 46/69 (67%) | not recorded | 16/23 (70%) | 4/23 (17.4%) | 3/23 (13%) |
| <i>H. solani</i> (Silver scurf) | 4/69 (5.8%) | 0 | 2/23 (4.3%) | 0 | 0 |
| <i>C. coccodes</i> & <i>H. solani</i> | not recorded | 0 | 5/23 (21.7%) | 0 | 0 |

¹ Data under bumpy lesions represent the isolation success directly from lesions on tubers with that symptom. Three isolation attempts were tried from each ‘bump lesion’ from each tuber.

² Data listed under infected tubers represent overall isolation success. A tuber was positive on the epidermis if one or more of the three isolation attempts from a ‘bump lesion’ were positive.

Table 3. Incidence of *Helminthosporium solani* on Russet Burbank and Ranger Russet potato tubers stored in humid plastic bags for 3 weeks.

| | <u>Potato cultivar</u> | |
|---|------------------------|----------------------|
| | <u>Russet Burbank</u> | <u>Ranger Russet</u> |
| Tubers infected with <i>H. solani</i> | 66% | 80% |
| Bumpy symptoms associated with <i>H. solani</i> infection | 32% | 60% |
| <i>H. solani</i> not associated with bumpy symptoms | 59% | 60% |