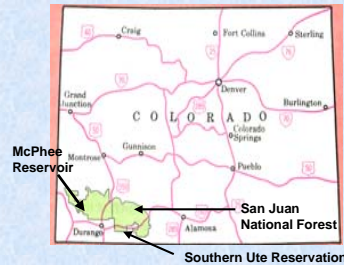


# Impacts of Black Stain Root Disease in Recently Formed Pinyon-juniper Mortality Centers

H.S.J Kearns and W.R. Jacobi

Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO, 80523



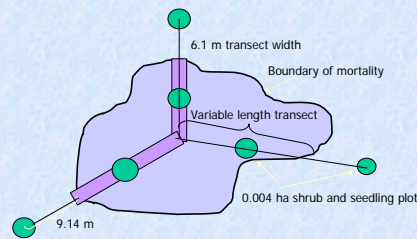
## Introduction:

- Pinyon-juniper woodland is the largest forest cover type in Colorado, covering over 1.8 million ha.
- Primary mortality agents associated with pinyon mortality are black stain root disease (BSRD) and Ips bark beetles.
- Black stain root disease, a vascular wilt disease of pinyon pine caused by the fungal pathogen *Leptographium wageneri* var. *wageneri* (Kendr.) Wingf., was first identified in Colorado at Mesa Verde National Park in 1942.
- Local spread of the pathogen occurs through root contacts and grafts between infected individuals and healthy trees.
- Insects may act as the vector across larger distances.
- Mortality attributable to BSRD can at times appear as discrete mortality centers, or, in areas where mortality centers have merged, create a mosaic of mortality across the landscape.
- Pinyon affected by black stain are often attacked by Ips bark beetles *Ips confusus*.

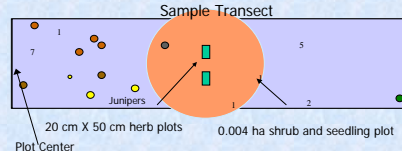
## Methods and Materials

- Thirty discrete mortality centers with visually confirmed black stain were located on the San Juan NF and Southern Ute Reservation in SW Colorado. All boundaries and plot centers were delineated by GPS.
- Three transects were established within each mortality center.
- For every tree within each transect we recorded location, species, height, diameter at root crown, tree status, decline agents, and presence of black stain and Ips.
- 40 m<sup>2</sup> shrub and seedling plots were established at the mid-point of the transect and 9.14 m beyond the transect in which the percent shrub cover by species and the number of tree seedlings were recorded.
- Two - twenty by fifty centimeter plots were established at both the mid-point of the transect and 9.14 m beyond the transect in which the percent herbaceous cover by species and the percent cover by bare soil, litter, and rock were recorded.
- Root samples and stem disks taken from older dead pinyon were isolated from to determine viability of the pathogen.

Plot Sampling Scheme



Location of Trees and Their Status



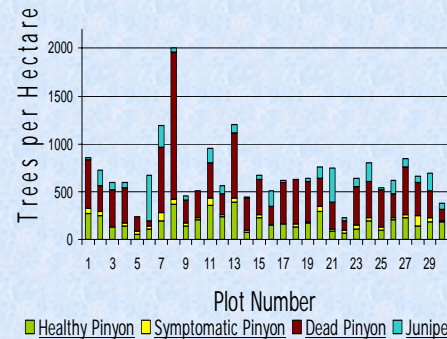
## Study Objectives

In the summer of 1999, this study was undertaken to examine the effects of Black stain root disease areas of mortality (mortality centers) by answering the following questions:

- Does BSRD impact the composition and structure of pinyon-juniper woodlands at the tree, shrub, or herbaceous plant levels?
- Is BSRD altering tree regeneration?
- How long can the pathogen remain viable within the roots of dead pinyon?
- What is the expansion rate of discrete BSRD mortality centers?
- Are there site characteristics that influence expansion rates?

## Results:

- Discrete BSRD mortality centers had a mean area of 0.28 ha.
- 86% of all trees within mortality centers were pinyon
- Pinyon ranged from 26 to 375 years old.
- 68% of all pinyon were dead; 76% were affected by BSRD and 70% had evidence of Ips bark beetle attack.
- 25.1% of pinyon were healthy, 6.6% were chlorotic, 46.4% were standing dead, and 21.0% were downed dead.
- Shrub density, percent cover or diversity did not differ within mortality centers vs. outside the centers.
- Four herbaceous cover types had significantly higher frequency of occurrence within mortality centers.
- Mean percent cover of grasses were significantly higher within mortality centers (10.8%), than in surrounding areas (3.9%).
- The pathogen was isolated from samples:
  - Regularly from samples dead for 5 years
  - Occasionally from samples dead 8 years
  - Once from the sound root dead for 16 years
- Radial expansion of mortality centers averaged 1.1 m/yr (0.07 SE).
- Mortality center expansion was not significantly related to available water capacity, percent organic matter, or pH of soils; pinyon density; nor any other site data recorded.



Seedling, Shrub, and Herb Data

	Inside Mortality Centers	Outside Mortality Centers
Pinyon Seedlings	552 / ha	612 / ha
Juniper Seedlings	67 / ha *	33 / ha
Percent Shrub Cover	20.8	23.5
Number of Shrub Species	4.7	4.4
Percent Herbaceous Cover	20.2 **	9.4
Number of Herbaceous Species	6.6	5.4



## Conclusions:

- BSRD significantly affected both the structure and composition of the woodlands, reducing live pinyon density by 63% and creating stands dominated by pinyon snags and logs.
- Mortality centers contain both pinyon regeneration and surviving pinyon.
- BSRD did not significantly impact shrub composition, percent cover, or diversity.
- Herbaceous percent cover was significantly higher within mortality centers.
- Pinyon regeneration was not significantly altered; juniper regeneration was significantly higher within mortality centers than surrounding areas.
- The pathogen was regularly isolated from pinyon roots dead for 5 to 8 years and, once, from the root of a pinyon estimated to have been dead for 16 years indicating that the pathogen may persist on site to infect subsequent pinyon populations.
- Expansion rates of mortality centers averaged 1.1 m/yr and were not related to site or soil attributes.

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