

RADIOGRAPHIC ANALYSIS OF SHORTLEAF PINE SEEDS FROM THE OUACHITA AND OZARK NATIONAL FORESTS

Alex C. Mangini, William W. Bruce, and James L. Hanula¹

Abstract—Shortleaf pine, *Pinus echinata* Mill., is indigenous to the Ouachita Mountains and the Magazine Mountain area of Arkansas. Natural regeneration of shortleaf pine is a priority on National Forest lands in this area. Insects infesting cones and seeds of shortleaf pine reduce the healthy seeds available for natural regeneration. Two species of seed bug, the leaffooted pine seed bug, *Leptoglossus corculus* (Say) (Hemiptera: Coreidae) and the shieldbacked pine seed bug, *Tetyra bipunctata* (Herrich-Schaffer) (Hemiptera: Pentatomidae) damage pine seeds. We collected cones on or near twenty Ecosystem Management Phase II wildlife sites during late October-early November from 1995 through 1998. In 1998, cone production was too low to include in the analyses. Cones were kiln-dried to open them. Seeds were extracted, dewinged and radiographed. Radiography allows accurate evaluation of healthy and damaged seed. Seed bug damage was consistent with that recorded at the Ouachita Seed Orchard in Mt. Ida, AR. Seed bugs were responsible for about 30 percent damage for combined collections from 1995-97.

INTRODUCTION

Insects feeding on cones and seeds of pines reduce seed and cone production of southern pines. Seed bugs were first recognized as pests of seeds when tree improvement pine seed orchards were established in the South in the late 1960's (DeBarr 1967, DeBarr and Ebel 1974). Two species of seed bugs damage to seeds, the leaffooted pine seed bug, *Leptoglossus corculus* (Say) (Hemiptera: Coreidae) and the shieldbacked pine seed bug, *Tetyra bipunctata* (Herrich-Schaffer) (Hemiptera: Pentatomidae) (DeBarr 1967, Ebel and others 1980). Seed bug damage has been extensive in Arkansas shortleaf pines; for example, at a seed orchard in Mt. Ida, seed bug damage was 43 percent in 1981 (J.C. Weatherby, H.N. Wallace, 1985. Post-treatment evaluations of the 1981, 1982, 1983, and 1984 pest management programs at the Ouachita seed orchard, Mt. Ida, Arkansas. Unpublished report 85-2-10. USDA Forest Service, State and Private Forestry, Southern Region, Alexandria Field Office, Atlanta, GA).

Seed bugs are important considering that natural seed production is highly variable from year to year (Wittwer and Shelton, in press). This becomes all the more important given the desire for natural regeneration on the Ouachita and Ozark National Forests.

In this study, we too estimated the amount of damage caused by seed bugs in natural stands of shortleaf pine on the Ouachita and Ozark National Forests. This is consistent with the Ecosystem Management Phase II goals because seed bugs are endemmic to these areas and we need to estimate their impact in the ecosystem (Mangini and others 1974).

MATERIALS AND METHODS

We collected shortleaf pine cones on or near the twenty Ecosystem Management Phase II Wildlife sites (Logan, Montgomery, Polk, Scott and Yell Counties, AR; LeFlore

County, OK) (Baker 1993) during late October-early November from 1995 through 1998. In stands which had been clear-cut, we sampled shortleaf pines adjacent to the site.

Collections were made by shooting cone-bearing branches from the trees using a rifle, either a "243" bolt-action rifle or a "22" magnum rifle. Twenty cones were collected at each site from one or more trees. When cones were sparse at a given site, we collected as many as possible within a 30 minute period.

Cones were placed in paper bags and left in an air-conditioned room for 4-6 weeks to dry. The bags of cones were then placed in a drying kiln at 45°C for 24-36 hours in order to open the cones. Seeds were extracted from the opened cones, dewinged by hand and placed in 7.6 x 12.6 kraft-paper envelopes. These were radiographed to determine the number of healthy and damaged seeds and the causes of damage. Each seed was tallied according to appearance (Bramlett and others 1977, DeBarr 1970) and placed into one of the following seed quality categories: full (healthy), empty, seed bug, abort, seedworm and other.

Data were summarized using standard procedures in SAS (SAS Institute 1989). Means and percentages for each seed quality category were calculated by year and site.

RESULTS AND DISCUSSION

Although we sampled from 1995 through 1998, the 1998 cone crop was extremely sparse so those data are not included in the results. When data from the three years are taken as a whole, we found that 67 percent of the seeds were healthy (fig. 1). Only 4 percent of the damage could be attributed to insects. When the insect damage is further broken down, only 11 percent of the damage was due directly to seed bugs (fig. 2). On the other hand, seedworm caused 38 percent of the insect damage. Three species of

¹ Entomologist and Biological Technician, USDA Forest Service, Forest Health Protection, Pineville, LA 71360; and Research Entomologist, USDA Forest Service, Southern Research Station, Athens, GA 30602, respectively.

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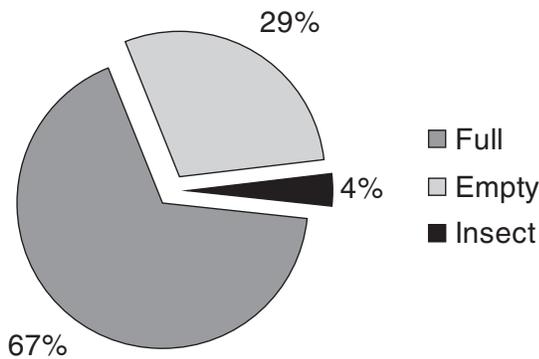


Figure 1—Seed quality as percent of total seeds for shortleaf pine from the 20 Ecosystem Management Phase II wildlife stands on the Ouachita and Ozark National Forests in Arkansas. Data represent combined counts of collections made in 1995 through 1997. Quality determined by radiographic examination.

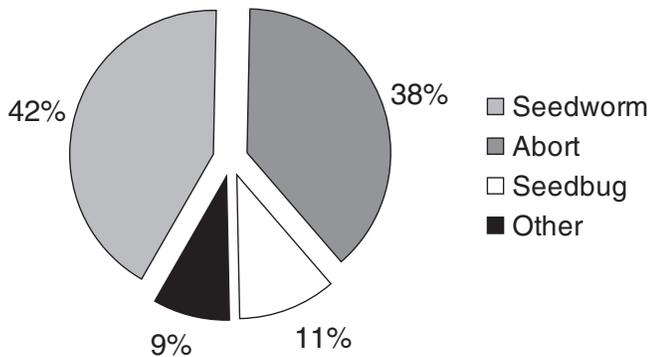


Figure 2—Categorization of "insect" damaged seeds of shortleaf pine collected from the 20 Ecosystem Management Phase II wildlife stands on the Ouachita and Ozark National Forests in Arkansas. Data represent combined counts of collections made in 1995 through 1997. Quality determined by radiographic examination.

seedworm (*Cydia* spp. = *Laspeyresia* spp.) commonly infest seeds of southern pines (Ebel and others 1980).

These results may be misleading if the empty (fig. 1) and aborted (fig. 2) categories are not considered. Radiographs of seeds can clearly show effects of late-season feeding by seed bugs (Bramlett and others 1977); however, earlier feeding on second-year cones or seed bug feeding on first-year cones can cause aborted or empty seeds.

There are two causes of ovule abortion in the first year of cone development: poor pollination and seed bug damage. If pollen is not present when flowers are receptive or if the pollen does not germinate, the ovules abort early in the first year (Bramlett and Johnson 1975). Nymphs of *L. corculus* are known to feed on the flowers of shortleaf pine and destroy ovules (DeBarr and Kormanik 1975, Ebel and Yates 1974); but the damage is difficult to distinguish from those aborted by lack of pollen (Bramlett and others 1977).

Consequently, the empty and abort categories in figures 1 and 2, respectively, when added to the radiographically-confirmed seedbug damage are likely a more accurate estimate of the effects of the two seed bug species. This is consistent with estimated damage in the Ouachita seed orchard from 1981-84 where the proportion of empty seeds ranged from 23-70 percent and the confirmed seed bug damage ranged from 2-43 percent ((J.C. Weatherby, H.N. Wallace, 1985. Post-treatment evaluations of the 1981, 1982, 1983, and 1984 pest management programs at the Ouachita seed orchard, Mt. Ida, Arkansas. Unpublished report 85-2-10. USDA Forest Service, State and Private Forestry, Southern Region, Alexandria Field Office, Atlanta, GA).

Our results are consistent with Shelton and Wittwer (1996) in that the quantity of sound seeds produced is positively related to total seeds produced. In 1996, shortleaf cone production was much greater than that in 1995 and 1997 (fig. 3). Healthy seed was substantially higher in 1996 (fig. 4) at 62.5 percent, near the maximum indicated by Wittwer and Shelton (in press). They demonstrate a positive response of healthy seeds as a function of total seeds produced up to an asymptotic limit at about 60 percent healthy seeds for the largest seed crops.

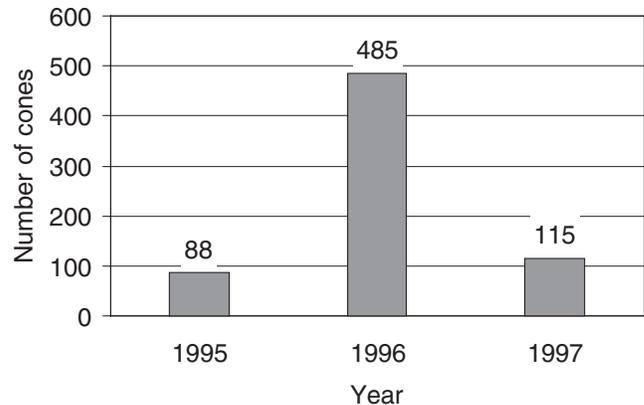


Figure 3—Shortleaf pine cones collected from the 20 Ecosystem Management Phase II wildlife stands on the Ouachita and Ozark National Forests in Arkansas.

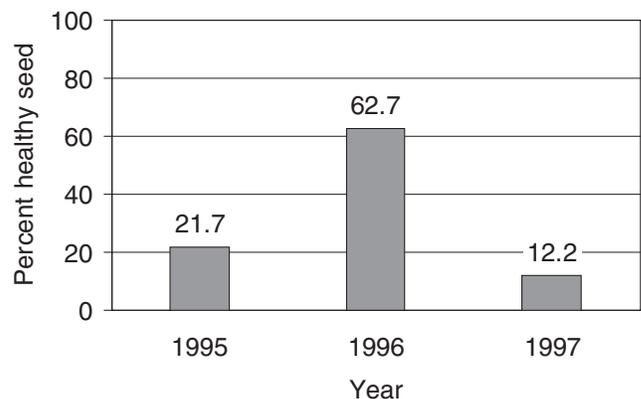


Figure 4—Healthy seeds as a percentage of total seeds collected for shortleaf pine from the 20 Ecosystem Management Phase II wildlife stands on the Ouachita and Ozark National Forests in Arkansas.

It is apparent that managers should monitor the shortleaf seed crop in its first year of development to determine crop estimates. For natural regeneration, site preparation efforts can be timed to coincide with large seed crops. This will also minimize damage due to seed bugs and seedworms.

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