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Six-Year Beechnut Production in New Hampshire

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Abstract

Beechnut production and losses were studied over a 6-year period in 41 northern hardwood stands ranging in age from 10 to 140 years. Production increased consistently with stand age or d.b.h. of dominant trees and with percentage of basal area composed of beech. Losses to insects, rodents, and birds before the seed reached the ground ranged from 24 to 100 percent; insects caused the greatest losses. A good seed year occurred about every third year.

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American beech (*Fagus grandifolia* Ehrh.) is a common species in New Hampshire, comprising about 5 percent of the total cubic volume and 11 percent of the volume in the northern hardwood (beech-birch-maple) type. An excellent fuelwood and pulpwood species and of moderate value for sawtimber, beech is highly regarded as a producer of hard mast for wildlife. More than 20 species of vertebrates in New Hampshire commonly eat beechnuts, which account for more than 2 percent of the diet of 12 of these species (Martin et al. 1951).

Studies in the Lake States have documented some aspects of beechnut production and losses over a 10-year period (Gysel 1971), but little information is available for New England except from one old-growth stand (Graber and Leak 1992). The purpose of this paper is to summarize beechnut production and losses over a 6-year period from 41 stands in the White Mountains of New Hampshire, and to relate beechnut crops to stand characteristics. This is part of an overall study of seed production from northern hardwood stands initiated in 1971 by Graber.

The male and female flowers of beech bloom in late May in the study area after the leaves unfold, and are borne separately on the same tree (monoecious). The flowers are considered susceptible to late spring frosts. The fruit, consisting of two or three angular nuts within a prickly husk, ripens in the fall. After maturity, the husk opens, allowing the nuts to fall (Schopmeyer 1974). Dispersal is chiefly by gravity and small mammals; however, more recent evidence indicates that blue jays may transport large quantities of beechnuts several miles and bury them in the ground (Johnson and Adkisson 1985).

Methods

Fifty-five plots were established in evenaged, well-stocked (no evidence of cutting) northern hardwood stands in the southeastern portion of the White Mountain National Forest. Each plot was a uniform 1 hectare in size located within a larger uniform stand. Forty-one of these plots contained sufficient beech to be used in this analysis. Stand age ranged from 10 to 140 years, and the proportion of beech (based on percentage of basal area) ranged from 3 to 70 percent.

Seedfall was measured during the snowfree season using 20 systematically located seed traps per plot. Each trap was a metal cylinder 15.3 cm in diameter and 17.7 cm tall with a metal-screen wind deflector, hardware-cloth cover to eliminate animal depredation, and a cloth bag liner. During winter, the number of seed traps was reduced to 10, and each trap was filled with antifreeze and raised above the maximum snowpack (see Graber and Leak 1992). Seeds were collected at 2-week intervals during the snowfree season and at 6- to 8-week intervals during winter. Seedfall measurements were taken from 1976 through 1980 on most plots, and through 1981 on about half of the plots.

Viability was estimated in the laboratory by cutting tests to determine whether seeds were filled (60 percent or more) or empty. The type of damage (insect, rodent, bird) also was detected and recorded.

The following seed classification was used in this study:

- Filled Seed—More than 60 percent of the seed cavity is filled. Endosperm is creamy white and firm. The embryo is visible and well developed.
- Insect Damage—A small hole through the seed coat usually is visible. Sometimes a seed is empty and insect frass is noted.
- Rodent damage—Seeds are opened and tooth marks are visible. Seed contents usually are consumed.
- Bird Damage—Seeds usually are split open lengthwise; no teeth marks are visible. Part or all of the seed (except the seed coat) is eaten.

The assumption was made that damaged seeds had been filled prior to predation, so the damaged seeds were included with the filled ones. Thus, the study provided estimates of the quantities of nuts that were either damaged or opened and consumed in the trees. Nuts that were removed intact from the trees, by blue jays, for example, were missed by the study. Losses of nuts after they reached the ground were not estimated.

Results

To evaluate the influence of stand age or stand size on annual seed production, average annual beechnut catch per acre over the 5- or 6-year period was plotted over stand age, average diameter of dominant trees, and percentage of basal area composed of beech (Fig. 1). All of these relationships were clearly positive. Seed production was noticeably higher in stands more than 50 years old or with dominants more than 8 inches d.b.h. The best regression equations predicting these relationships were:

$$\text{total seedfall/acre} = -25601 + 9.6(\text{age}^2) + 98.3(\text{percent}^2)$$
$$\text{Adjusted } R^2 = .760$$

$$\text{total seedfall/acre} = -41910 + 798.2(\text{dbh}^2) + 94.9(\text{percent}^2)$$
$$\text{Adjusted } R^2 = .792$$

The same approach was followed for filled seed (including the damaged seed) with similar results (Fig. 2). The comparable regression equations were:

$$\text{filled seed/acre} = -19994 + 7.4(\text{age}^2) + 79.5(\text{percent}^2)$$
$$\text{Adjusted } R^2 = .753$$

$$\text{filled seed/acre} = -35941 + 667.6(\text{dbh}^2) + 74.7(\text{percent}^2)$$
$$\text{Adjusted } R^2 = .801$$

The regressions for total and filled seed/acre based on d.b.h. and percentage of beech are shown in Figure 3.

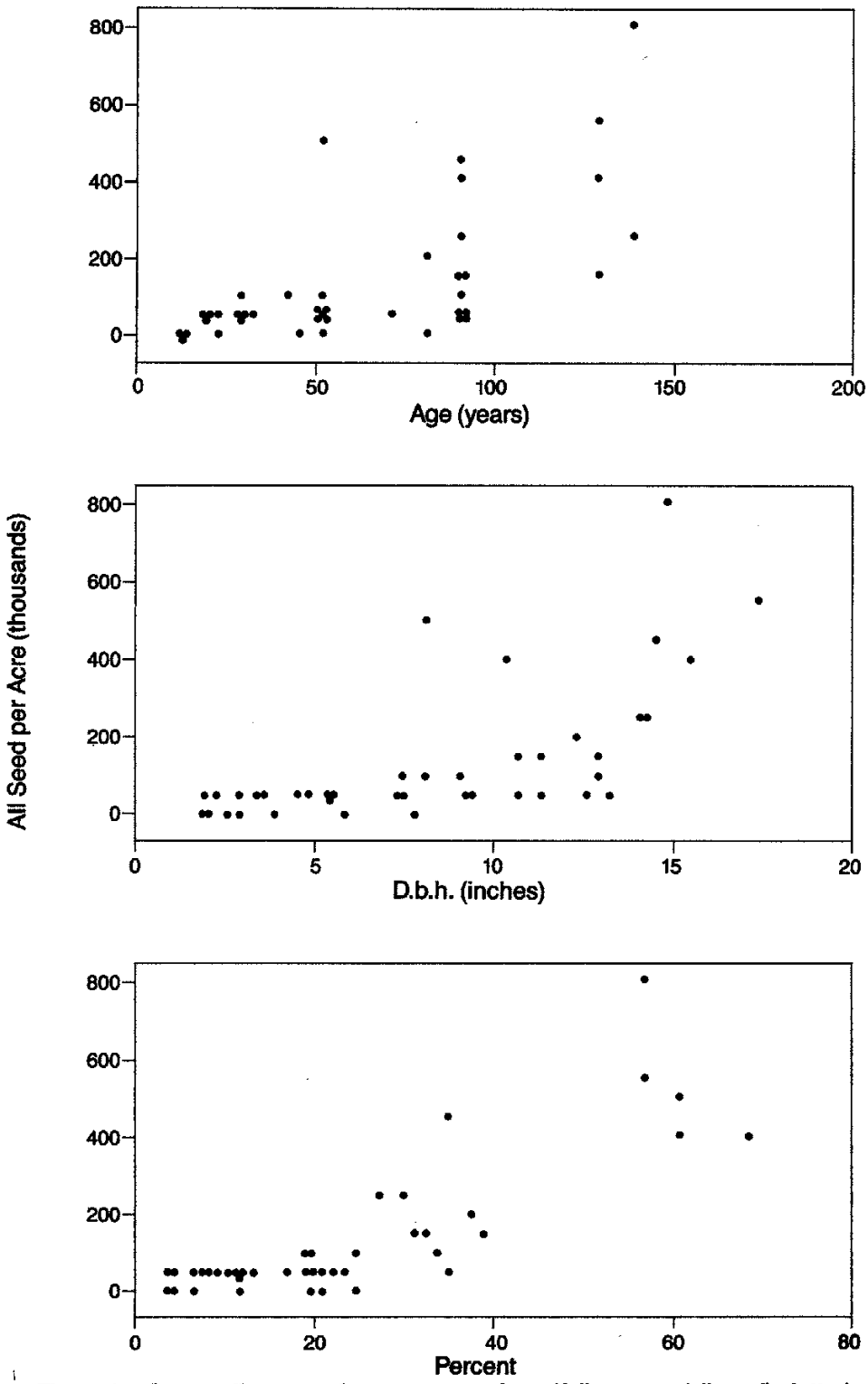

Figure 1.—Scatter diagrams of average annual seedfall per acre (all seed) plotted over stand age, average d.b.h. of dominant trees, and percentage of basal area in beech.

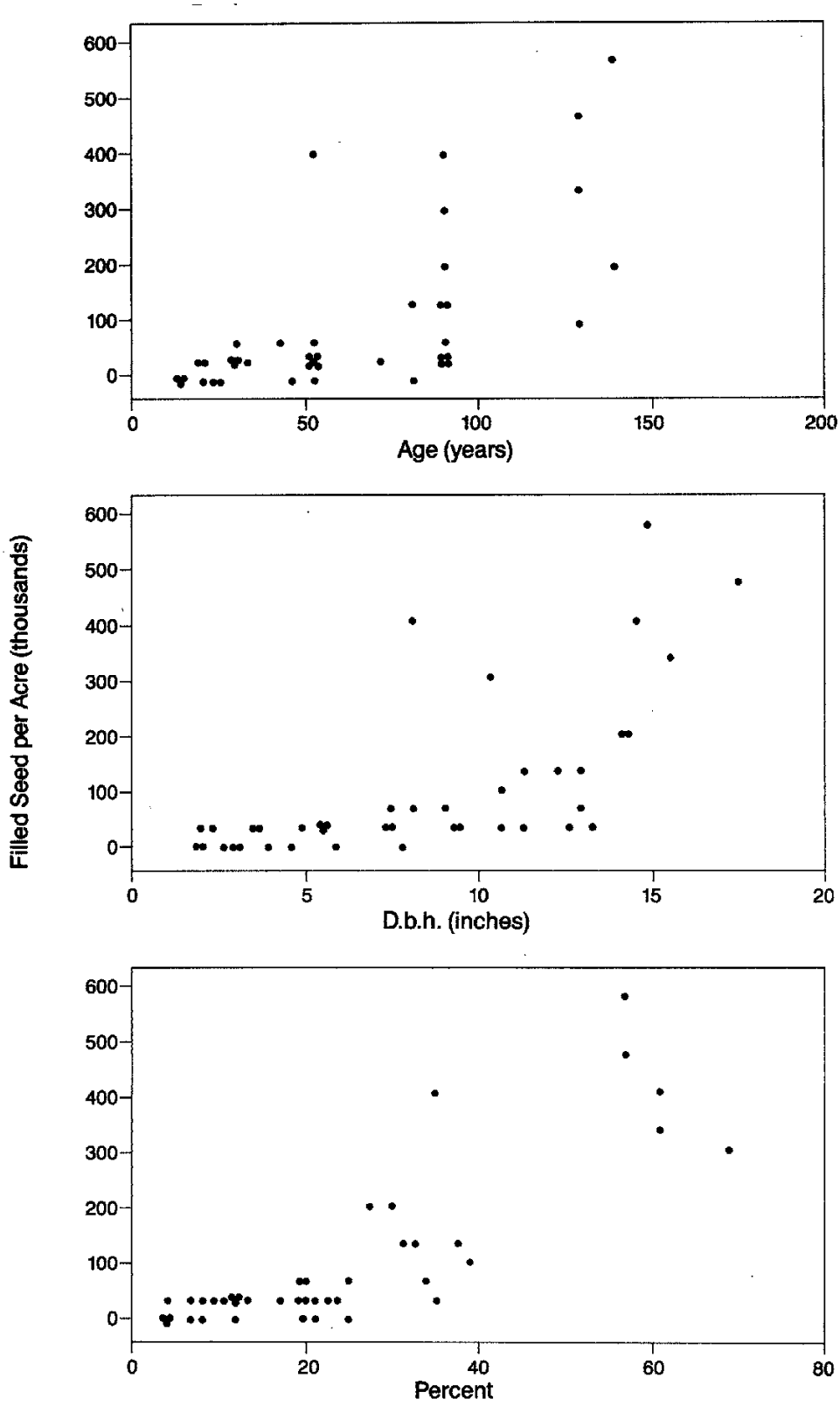

Figure 2.—Scatter diagrams of average annual seedfall per acre (filled seed including seed damage by insects, rodents, or birds) plotted over stand age, average d.b.h of dominant trees, and percentage of basal area in beech.

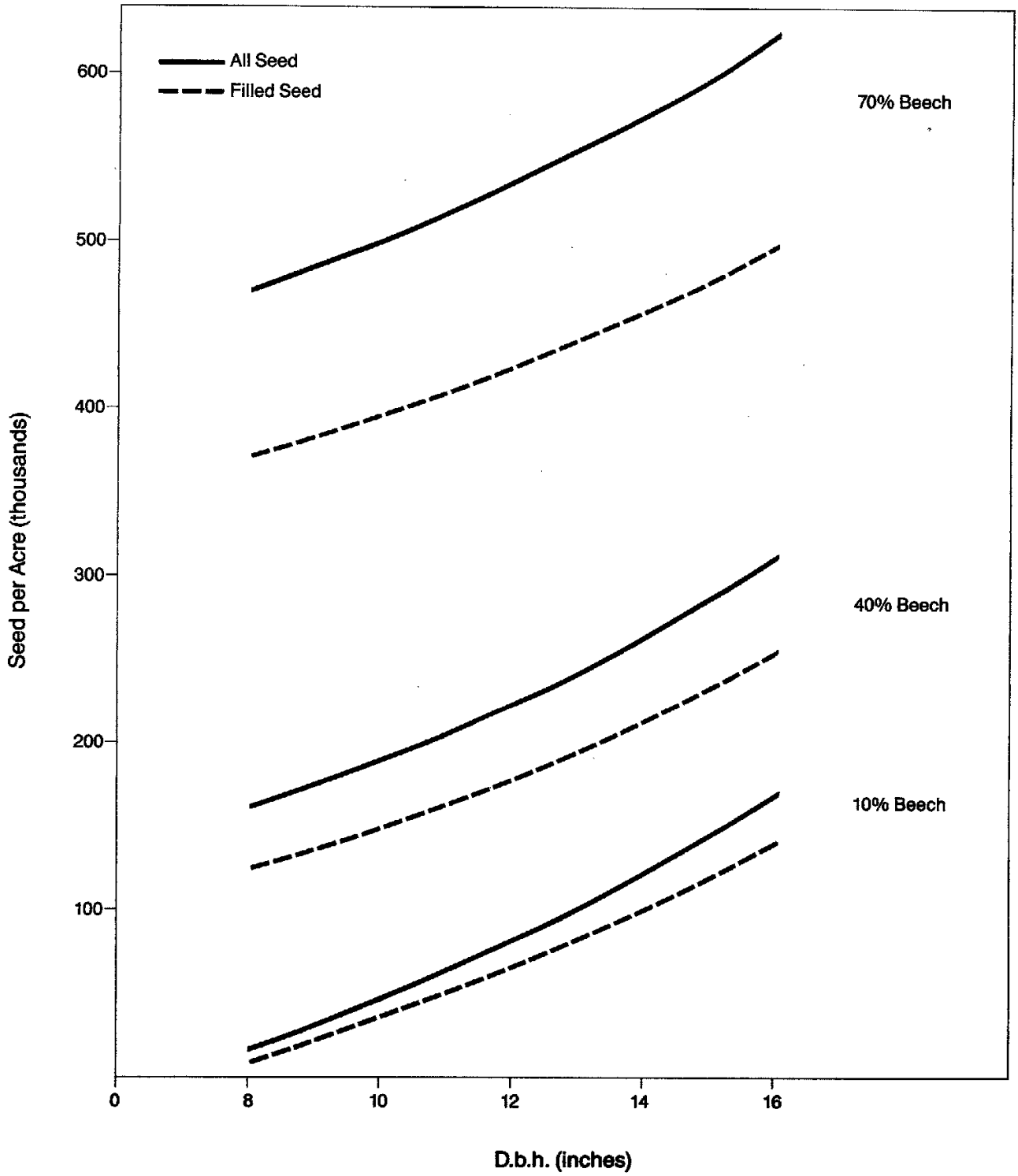

Figure 3.—Predicted average annual seefall (all seed and filled) by d.b.h of dominants and percentage of basal area in beech.

The relationships between stand age or d.b.h and percent losses of seed due to insects, rodents, and birds also were examined but no trends were evident.

Based on stands with dominants averaging 8 inches d.b.h. or larger, average annual seed production ranged from about 18,000 to more than 400,000 per acre (Table 1). Two years were poor seed years (1977 and 1979) that produced fewer than 100,000 nuts per acre. Two were medium (1976 and 1980), with seed production of about 200,000 to 250,000 nuts. Two years were good, i.e., more than 400,000 nuts were produced. The proportion of good years (1:3) is slightly better than experienced in a single old-growth stand in New Hampshire (Graber and Leak 1992), which had 2 or 3 good years in 11.

Results from southern Michigan showed about 3 good years in 10 based on total seed production, but only 1 good year based on the yield of sound, undamaged nuts (Gysel 1971). However, previous work indicates that good or poor seed years for beech do not coincide throughout the species' range (Stalter 1982). The southern Michigan study in which seedfall was measured from selected individual trees suggests that beechnut production could reach 2 1/2 million per acre in the best year. So it is possible that our New Hampshire stands could attain higher production rates than reported here.

The percentage of filled seed was fairly constant among years, ranging from 73 to 87. The percentage of the filled seed damaged by insects, rodents, and birds ranged from 24 to 100. Insect losses were by far the greatest source of damage. However, after seedfall it is almost certain that losses to rodents and other animals are extremely high. Most of the remaining filled seed probably is damaged. Percentage losses tended to be highest during poor seed years, but even good crops suffered losses exceeding 70 percent.

For all years combined, bimonthly seedfall occurred in two peaks (Fig. 4). The first peak, in late June and early July, consisted almost entirely of insect-damaged seed. The later peak occurred in the latter half of September and in October. During the period beginning September 1, only 40 percent of the seedfall (before reaching the ground) was damaged by insects, rodents, or birds.

Table 1.—Average seed production per acre and losses by year for stands with dominant trees 8 inches d.b.h. and larger

Year	No. of plots	All seed	SE	Filled seed	Losses of filled seed to:		
					Insects	Rodents	Birds
		Number		*Percent*	*Percent*		
1976	20	249,147	22	77	16	5	3
1977	21	17,777	34	74	100	0	0
1978	21	401,617	21	79	44	3	2
1979	21	93,737	26	87	81	8	1
1980	21	200,182	21	75	68	9	11
1981	10	435,659	28	88	63	4	5

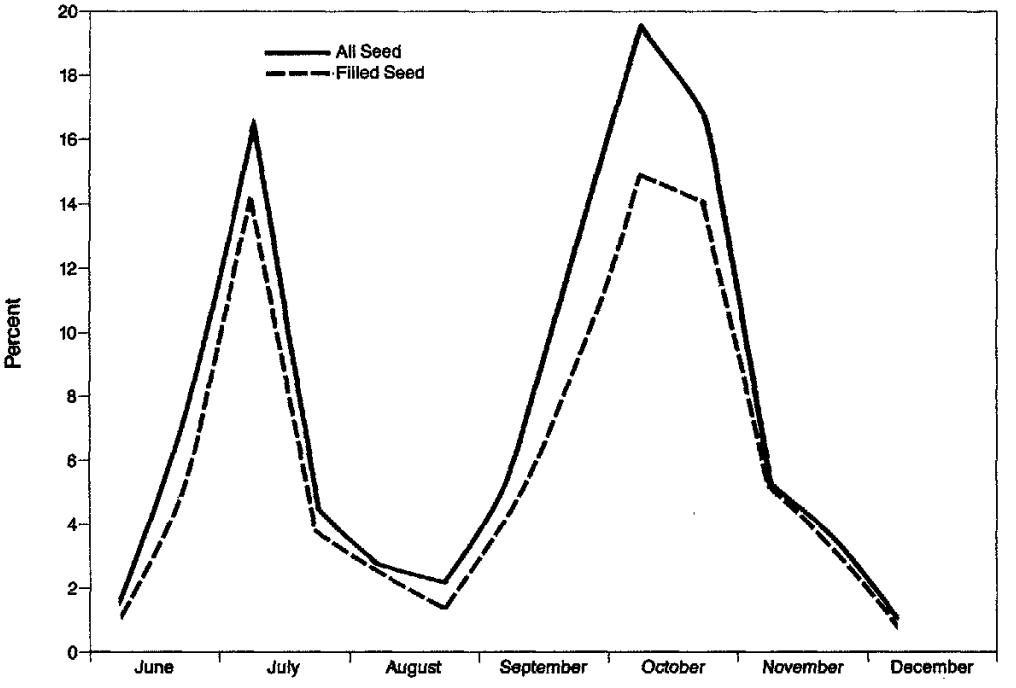

Figure 4.—Percentage of average annual total seedfall (all seed and filled) occurring semimonthly.

Conclusion

This study of beechnut production and losses in the southeastern portion of the White Mountain National Forest indicated that significant seed production did not occur until stands were about 50 years old or dominant trees were 8 inches d.b.h. or larger. Production of seed, total and filled, increased consistently with stand age/size and percentage of beech. Predicted seed production for stands with 16-inch dominant trees and 70 percent beech is about 600,000 nuts per acre and 500,000 filled seed. However, only about 65 percent of the seed falls after September 1 (when it is physiologically ripe), and about 40 percent of this autumn seedfall is damaged by insects, rodents, and birds before it reaches the ground. No doubt, additional heavy predation by rodents occurs on the ground. Heavy seed production occurs about one year in three, and the proportion of filled seed remains about constant each year between 70 to 90 percent.

Acknowledgment

We appreciate the contributions of Donald F. Thompson, retired forestry technician. Don's dedicated efforts on the collection, evaluation, and recording of seed data were essential to the successful completion of this study.

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Keywords: American beech; mast; seedfall; seed production

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