Preferences by Mourning Doves and Two Granivorous Songbirds for Selected Seeds

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Abstract: We used controlled experiments to assess the preferences and food value of a selection of native and agricultural plant seeds for mourning doves (*Zenaida macroura*), northern cardinals (*Cardinalis cardinalis*), and brown-headed cowbirds (*Molothrus ater*). Foods used in experiments were browntop millet, cracked corn, black-oil sunflower, switchgrass (*Panicum virgatum*), deertongue (*Panicum clandestinum*), pokeberry (*Phytolaca americana*), and croton (*Croton* spp.). Browntop millet and black-oil sunflower were eaten significantly more than all other seeds. Cracked corn consumption was less than expected based on results from previous studies. Although consumption was comparatively low, switchgrass was the most preferred native plant. Planting a combination of switchgrass and browntop millet or sunflower is suggested as a strategy for establishing a native plant stand while holding birds on a site. Field plot trials need to be conducted to determine if inferences obtained from these captive feeding trials are valid under natural feeding conditions.

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Management practices that provide food and cover for specific wildlife species are constrained by limits on time, personnel, and funding. For example, the South Carolina Department of Natural Resources (DNR) annually prepares public dove hunting fields, which are typically planted in combinations of millet, sunflower, and sorghum. These crops provide excellent food and cover for attracting mourning doves, bobwhite quail (*Colinus virginiaus*), and wild turkey (*Meleagris gallopavo*), but they may provide minimal value for nongame bird species (Martin et al. 1951). Further, they require annual inputs of resources, such as fertilizer and herbicides, which may be detrimental to the habitat over time.

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An alternative management practice that has not achieved widespread use is the reintroduction of native plant species to areas where they no longer thrive. These plants may provide a source of food and cover for a variety of bird species over a longer period of time. Reintroduction of native plants would also help fulfill the need for natural diversity in the plant community. If native plant species could be identified that produce sufficient seed for attracting doves for hunting, provide food and cover for nongame birds and other wildlife during the winter months, and are perennials or annuals that reseed efficiently without substantial inputs of pesticides, fertilizer, or mechanical cultivation, then incorporation of these species into management plans would be cost effective and beneficial to the wildlife resource.

The goal of this study was to evaluate seeds of native plant species as a food source for mourning doves and 2 nongame bird species, the northern cardinal and the brown-headed cowbird, all of which have similar fall and winter feeding ecology. Our specific objectives were to compare consumption of seeds of native plants and cultivated plants in multiple choice feeding experiments and to identify the most preferred native plant seed type.

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Methods

Field assessment of native plant use by wildlife can be difficult. Target wildlife species may not be abundant where plants are found, or the plants may be limited in areas where wildlife is plentiful. To obtain reliable data in the field, extensive sampling and replication typically is required (Korschgen 1980). Thus, the time required to conduct studies can be labor intensive and costly. Experiments with captive animals can be used as a cost-effective alternative to field trials. Selected species may be used as indicators for a targeted group of wildlife species. Time and personnel required to conduct the study can be reduced. If cage experiments are planned and conducted correctly, natural conditions may be simulated at a minimal cost. Captive animal testing also has the advantage of true experimental control, with the ability to randomize and replicate test procedures. The use of captive wild birds in cage tests allows the availability and consumption of foods to be accurately measured and controlled.

We therefore chose to use caged experiments with captive birds to evaluate their preferences for a selection of native plant seeds, namely switchgrass, pokeberry, deertongue, and croton, and 3 agricultural plant seeds, browntop millet, corn, and black-oil sunflower. Native seeds were compared directly with seeds from traditional agricultural crops, so that relative costs and effectiveness of current management practices could be compared to alternatives.

Research Facilities

An outdoor bird research complex was constructed at the Clemson University Wildlife Research Facility, 5 miles north of the Clemson campus. This site was easily accessible, isolated, and protected from significant human disturbance. The site contained several small open areas (<1 ha) with intermittent hedge rows surrounded by pine and mixed pine forest. The complex consisted of 10 individual holding or testing cages in an isolated corner inside a fenced area. Cages were constructed out of 1.3 cm galvanized mesh hardware cloth, approximately 1 m^3. All 10 cages were suspended 1 m above ground on a 2.5 cm pvc pipe frame to protect the birds from ground predators. Cages were separated by approximately 0.3 m with visual barriers placed between cages. A galvanized metal roof was attached to the top of the pvc frame to protect the birds from inclimate weather. Small mesh plastic bird exclusion netting was placed around the outside of the cage complex to deter avian predators. The entire cage complex was surrounded by a double-strand electric fence to provide protection from climbing predators.

Trapping

In September 1996 and April 1997, Kniffin modified funnel traps (Reeves et al. 1968) were used to capture mourning doves near Clemson, South Carolina. Trap locations were pre-baited with a mixture of cracked corn and Japanese millet (1996), or commercial birdseed (1997), approximately 2 weeks prior to the start of trapping. One week before trapping began, the traps were placed open at the site next to the bait piles. Traps were set twice per day, early morning and late evening. Upon capture, birds were banded with U.S. Fish and Wildlife Service (USFWS) aluminum bands, and species, age, sex, weight, and location of capture were recorded. Techniques described by the U.S. Fish and Wildlife Service and the Canadian Wildlife Service (1977) were used for banding and age and sex determination.

In April and May 1997, Kniffin funnel traps and mist nets were used to capture cardinals and cowbirds. Two mist nets (30- and 36-mm mesh) were located between hedge rows at the Wildlife Research Facility and opened twice daily, morning and evening.

Experimental Design

We used a balanced incomplete block (BIB) experimental design (Cochran and Cox 1957) to test for food preferences in these seed selection experiments. The same design was used for mourning dove and songbird experiments. In the BIB design, 4 foods were tested in all possible paired combinations using 6 consecutive trial periods for each bird. In each trial, a different paired combination of the 4 foods was presented. The 6 food trials were conducted during a 3-day period, 2 trials each day, early morning and late evening, during the normal times of most active feeding. The 2 seed types were placed in separate bowls, weighed to the nearest 0.01 g, and placed haphazardly in the cage to avoid any potential location bias. Trays were placed under

each cage to collect seed spillage. Bowls of control food were weighed, placed under testing conditions outside the cage, then re-weighed to adjust for change in weight due to atmospheric conditions. After each trial, spillage was sorted and returned to each bowl. The remaining food was re-weighed to the nearest 0.01 g, adjusted for environmental weight change, if necessary, and recorded.

Mourning Dove Experiments

After acclimation, a group of 6 mourning doves was randomly selected from the captive population, and each bird was assigned to an individual testing cage. Birds were allowed to acclimate to the testing cages and test procedure for 3 days prior to the start of the experiments. Doves were fed their normal maintenance diet, either Purina game bird chow combined with sunflower seeds (1996) or cracked corn (1997), for the first 2 days. On the day before testing began, a mixture of the seeds to be used in the experiments was presented. This allowed the doves to become slightly familiar with the experimental foods. Food was removed from the cages 12 hours prior to the start of testing, allowing for the crop contents to clear and assure consumption during testing (Mason et al. 1989). The order of presentation of the 6 possible pairs of seeds was randomly chosen for the test group. Doves were allowed to feed for 40 minutes during each experimental trial, after which the food deprivation scheme was continued. After all 6 food trials had been conducted, the birds were released, and the protocol was repeated for a new group of 6 birds.

Foods used in the 1996 experiments were browntop millet, cracked corn, pokeberry, and switchgrass. The agricultural and native seeds found to be preferred in the 1996 experiments, browntop millet and switchgrass, were used again in the 1997 experiments, along with black oil sunflower seeds and deertongue.

Croton Experiments

Because a limited amount of croton was available for testing, a separate testing procedure was required. Two croton experiments were conducted after the BIB experiments were completed in 1997. In each of the 2 experiments, croton was paired with either browntop millet or switchgrass and presented to individual doves in 2 choice trials. The food deprivation scheme, trial length, and weighing process were identical to those of the other dove tests. A paired t-test was used to test the equality of mean weight eaten between the 2 seed species.

Songbird Experiments

The same 4 foods used in the 1997 dove experiments were used in the songbird experiments. The design of the songbird experiments was similar to the dove experiments, with 2 exceptions. Songbirds have a smaller food storage capacity than doves and their smaller size dictates that their energy requirements are much higher. Therefore, each trial lasted for 11 hours, and food was withheld for only 1 hour before and between trials.

Statistical Analysis

A balanced incomplete block ANOVA (Cochran and Cox 1957, Kuehl 1994) was performed on the weight of each food (g) eaten for each individual bird experiment using PROC GLM in SAS (SAS Inst. 1996). Seed species (treatment) and trial (block) were the factors in this analysis. For each species in each year, a similar analysis was done on a data set constructed by pooling results from individual birds. Factors for the combined analysis were seed species, bird, bird × seed species interaction, and blocks (trials) nested within bird. This analysis assumes that the responses of a given bird to the sequence of trials are mutually independent, i.e., there is no carryover effect between trials. We believe that the time between trials and the food deprivation scheme makes this assumption reasonable. Randomization of the order of presentation for each group served as a check against familiarity bias caused by a tendency for birds to choose seed types that are presented early in the sequence.

Bonferroni multiple comparison procedures were calculated with each pooled ANOVA to determine significant differences among average consumption of seed types. The Bonferroni procedure was chosen over other multiple comparison procedures because it is a conservative test that controls experiment error rates (SAS Inst. 1996). Least square means of weight eaten were used in the Bonferroni procedure to provide unbiased estimates for comparison between foods (Kuehl 1994). Type I error rates for all tests were set at 0.05.

Results

Mourning Doves

Twenty-four doves, 21 juvenile and 3 adult, were captured and used in our preference tests in 1996. Significant differences in seed species consumption were detected in 7 out of 24 individual doves (Fig. 1*a*). Browntop millet consumption was greatest in 5 of these trials, and switchgrass and cracked corn were each consumed most in 1 trial. Analysis of the pooled results of the 21 juvenile doves (the 3 adult doves were deleted from pooled analysis so that inferences apply to juvenile doves only), indicated that seed type ($F = 62.5$; df = 3,63; $P < 0.001$) and bird × seed interaction ($F = 2.2$; df = 60,63; $P < 0.001$) were significant. The multiple comparison procedure indicated that average consumption of each food was significantly different than all others (Fig. 2*a*), with browntop (5.65; SE = 4.65; $N = 63$) preferred over the other seeds, followed by switchgrass (3.67; SE = 4.65; $N = 63$), cracked corn (2.71; SE = 4.65; $N = 63$), and pokeberry (−0.65; SE = 4.65; $N = 63$). The significant bird × seed interaction is a consequence of the heterogeneity in relative consumption of seed types among the 21 individual juvenile birds. Thus, main effect differences among seed types do not imply a consistent ranking of preference among individuals, but rather a pooled assessment of general preference. Inferences made from this test, and for all tests with significant interactions reported subsequently, should be interpreted accordingly.

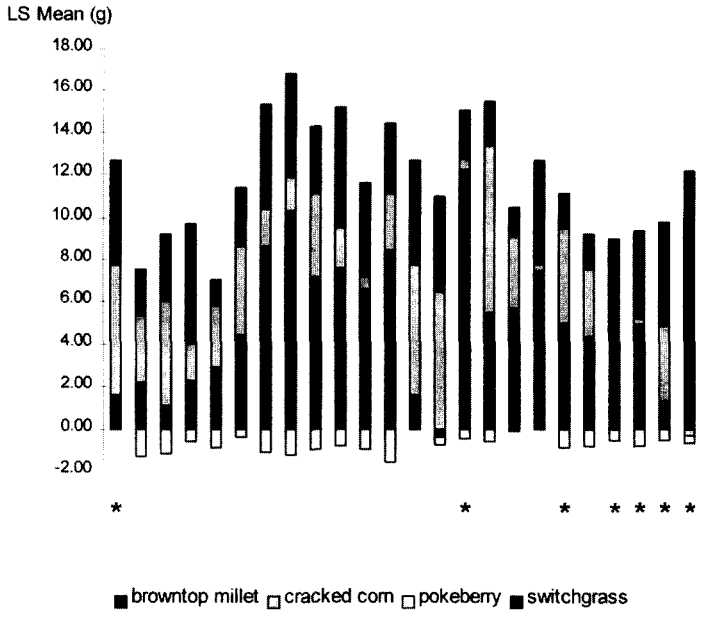

Figure 1a. Average consumption by each dove in 1996 preference experiments. Birds with significant differences among seed types are represented by an * on the x axis.

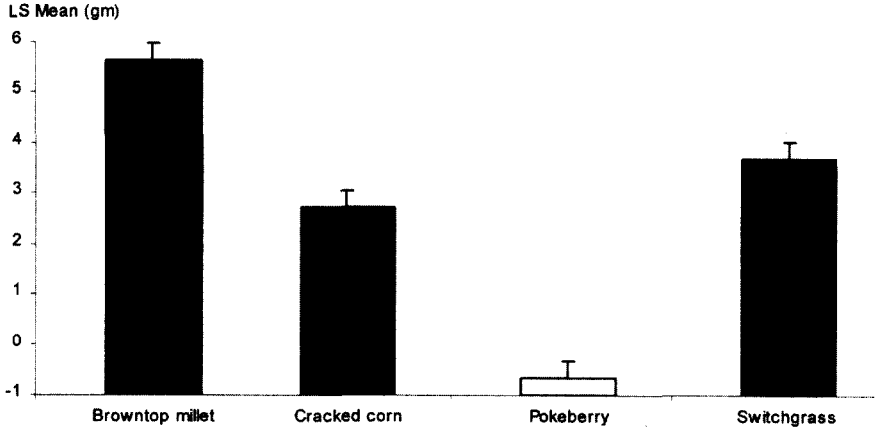

Figure 2a. Average consumption of seed types in pooled 1996 mourning dove experiments. Error bars represent 1 standard error of the mean.

In 1997, 24 adult doves were captured and used in our seed preference tests. Differences in seed species consumption were found for 8 of the 24 doves (Fig. 1*b*). In 6 of these trials, sunflower consumption was greatest, and browntop and switchgrass were each consumed most in 1 trial. Analysis of the pooled results indicated that seed type ($F = 31.4$; df = 3,72; $P < 0.001$), and bird × seed interaction ($F = 3.6$; df = 69,72; $P < 0.001$) were significant. The multiple comparison procedure indicated that gm consumption of browntop millet (3.31; SE = 2.61; $N = 72$) and black-oil sunflower (2.94; SE = 2.61; $N = 72$) were greater than switchgrass (1.33; SE = 2.61; $N = 72$) and deertongue (0.56; SE = 2.61; $N = 72$; Fig. 2*b*).

Croton Experiments

Eleven adult doves were used for the croton experiments. Average gm consumption of browntop millet (2.23; SE = 0.50) was significantly greater ($t = 2.49$; df = 10; $P = 0.03$) than croton (0.97; SE = 0.50). There was no difference in consumption ($t = 1.57$; df = 10; $P = 0.15$) between croton (1.35; SE = 0.89) and switchgrass (2.76; SE = 0.89).

Northern Cardinals

Twenty-two cardinals were captured and used in our seed preference tests. Differences in seed type consumption were found for 14 of the 22 cardinals (Fig. 1*c*). Browntop and sunflower were each eaten most in 7 of these trials. Analysis of the pooled results indicated that seed type ($F = 109.6$; df = 3,66; $P < 0.01$) and bird ×

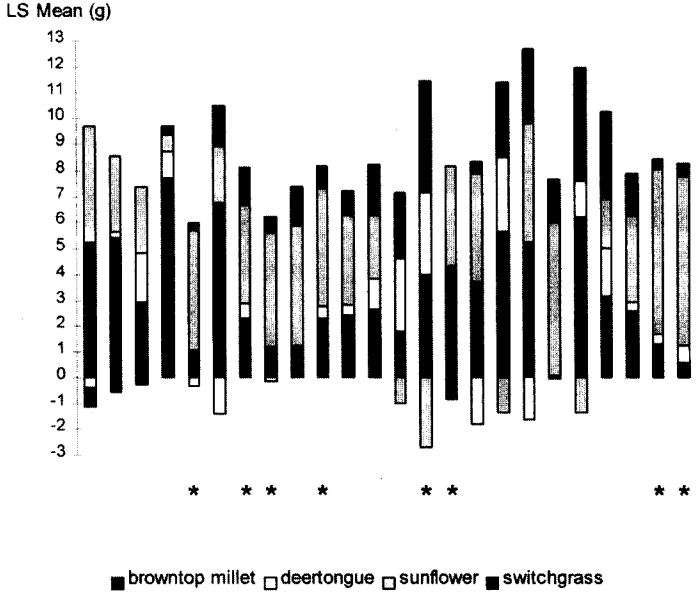

Figure 1b. Average consumption by each dove in 1997 preference experiments. Birds with significant differences among seed types are represented by an * on the x axis.

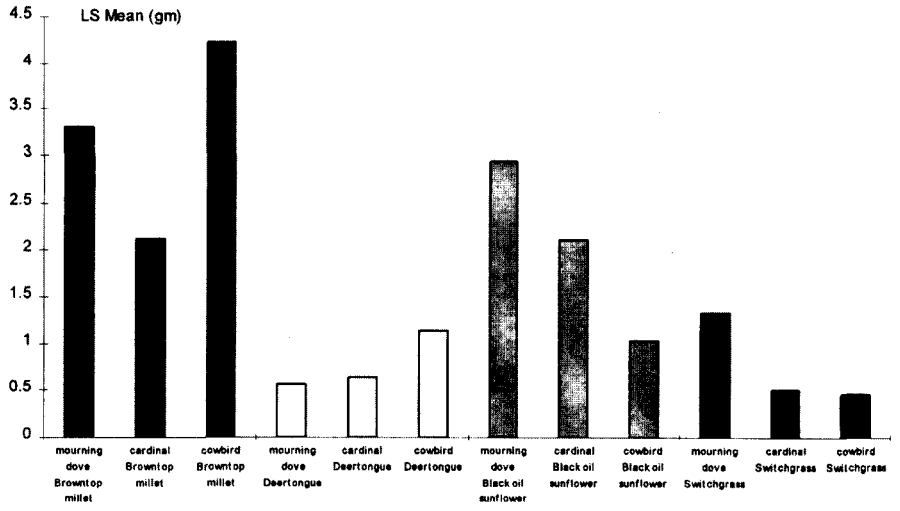

Figure 2b. Average consumption of seed types in pooled 1997 mourning dove, northern cardinal, and brown-headed cowbird experiments.

seed interaction (F = 3.45; df = 63,66; $P < 0.001$) were significant. The multiple comparison procedure indicated that gm consumption of browntop millet (2.12; SE = 0.32; $N = 66$) and black-oil sunflower (2.11; SE = 0.32; $N = 66$) were greater than switchgrass (0.50; SE = 0.32; $N = 66$) and deertongue (0.65; SE = 0.32; $N = 66$; Fig. 2*b*).

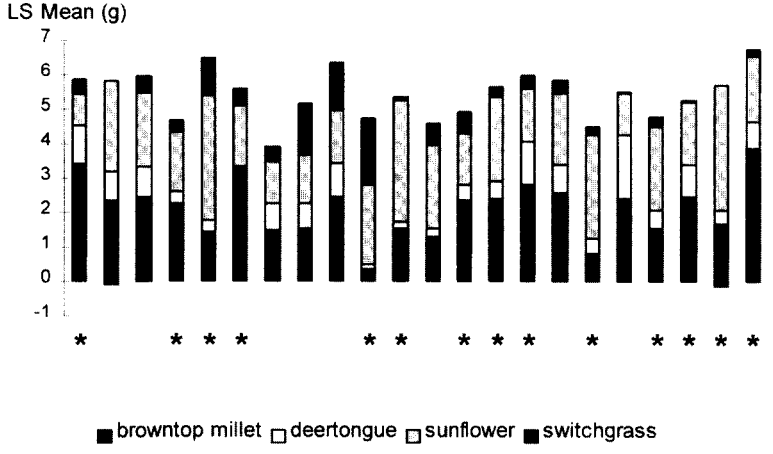

Figure 1c. Average consumption by each cardinal in preference experiments. Birds with significant differences among seed types are represented by an * on the x axis.

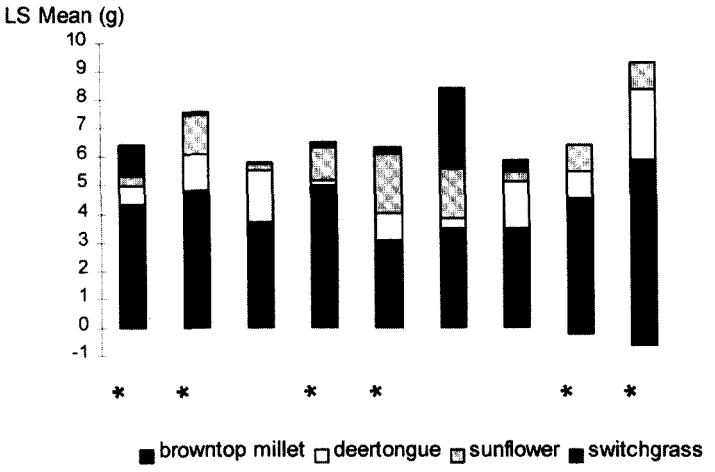

Figure 1d. Average consumption by each cowbird in preference experiments. Birds with significant differences among seed types are represented by an * on the x axis.

Brown-headed Cowbirds

Nine cowbirds were captured and used in our seed preference tests. Differences in seed species consumption were found for 6 of the 9 cowbirds (Fig. 1*d*). Browntop millet was eaten most in all of these trials. Analysis of the pooled results indicated that seed type ($F = 90.7$; df = 3,27; $P < 0.001$) and bird × seed interaction ($F = 2.97$; df = 24,27; $P < 0.004$) were significant. The multiple comparison procedure indicated that average browntop millet consumption (4.22; SE = 0.58; $N = 27$) was greater than black-oil sunflower (1.02; SE = 0.58; $N = 27$), switchgrass (0.46; SE = 0.58; $N = 27$), and deertongue (1.14; SE = 0.58; $N = 27$; Fig. 2*b*).

Discussion

Seed Preferences

Seeds of browntop millet were eaten significantly more than all other seeds by juvenile doves and cowbirds and seeds of browntop millet and black-oil sunflower were eaten significantly more than all other seeds by adults doves and cardinals. These results confirm the highly desirable qualities of browntop millet and sunflowers for attracting doves. Cracked corn was not preferred, although corn has been documented as a preferred mourning dove food (Martin et al. 1951, Knappen 1958, Korschgen 1958, Beckwith 1959, Lewis 1993).

Among the native plants, no consistent preference was exhibited. Pokeberry was not consumed in measurable amounts by any bird, primarily due to berries and seed rosettes being used in experiments, rather than individual seeds. However, individual seeds do not become available until later in the fall, and due to the timing of our experiments, we were forced to present pokeberry in an apparently unpalatable form. Thus, this species arguable was not given a fair evaluation in our experiments.

Juvenile doves ate considerable amounts of switchgrass in the 1996 experiments, and it was preferred over cracked corn. However, it was seldom eaten by adult doves in 1997. The inconsistency between experiments could be due to low consumption of pokeberry and cracked corn in 1996 and the greater preference for browntop and sunflower in 1997. Croton was comparable to switchgrass, but more extensive testing must be conducted before reliable conclusions can be drawn. Cowbird consumption of native plant seeds was approximately 10%–25% of browntop millet, and cardinal consumption of switchgrass was approximately 25% of agricultural seed consumption.

Van't Hull and Jenks (1992) examined dove food habits in South Dakota, where large stands of switchgrass still occur naturally, and found switchgrass occurred in approximately 30% of the doves examined. It is unknown whether any of the birds used in our experiments had prior experience with the seeds used, or how that experience might effect preference. Doves collected from areas where significant patches of the native plant species used in our experiments already are established may have generated different results.

Conclusions

Although consumption of switchgrass was less than traditional crops, it has the highest potential value of the species tested for both mourning dove management and other game and nongame bird species. Other investigators have advocated that switchgrass be used as food or cover (George et al. 1979, Manske and Baker 1981, Capel 1995), as an erosion control measure (Duebbert 1987, Isaacs and Howell 1988), and as cattle forage (Capel 1995). Stand establishment can be difficult, especially if management personnel are unfamiliar with switchgrass and its cultivation requirements (Duebbert et al. 1981). Also, for the first year of development, switchgrass devotes all of its energy into vegetative growth, so it may take several years to produce seeds (Tober and Chamrad 1992). In 1996, the South Carolina DNR planted an experimental field with switchgrass, pokeberry, deertongue, and croton, the same native plants we tested in this study. Prior to planting, the field was twice treated with herbicide, then burned. Seeds were no-till planted in early May. By the summer of 1997, switchgrass was the only species producing a viable stand.

The overall cost for planting switchgrass may be comparable to agricultural crops such as browntop millet, although the cost of seeds ($100 for 9 kg/ha pure live seed in 1998) is high compared to browntop ($15 for 28 kg/ha in 1998). Because browntop is an annual, it requires extensive field preparation each growing season (Skip Still, pers. commun.). Browntop fields must be disced prior to seeding to incorporate fertilizer ($55 for 560 kg/ha in 1988) into the soil. Estimated cost of producing browntop millet is $90/ha per year.

Switchgrass, a perennial, can be planted using a no-till drilling method (Duebbert et al. 1981, Capel 1995). Prior to planting, the field should be treated with a herbicide to control competing vegetation (Duebbert et al. 1981) and a fertilizer that does not contain nitrogen should be applied ($75 for 560 kg/ha) if soil pH < 5 (Capel 1995). Initial establishment of a switchgrass stand should cost approximately

$200/ha with only minimal expenses thereafter. Therefore, the cost for repeated production of browntop millet would surpass the cost of producing swtichgrass by the third year of stand establishment. Once a switchgrass stand is established, the only management requirements would be creating openings for feeding and nesting sites (Davison and Sullivan 1963), which can be accomplished by discing or mowing strips in the field, and occasional burning to control competing vegetation and enhance stand vigor (Duebbert et al. 1981, Capel 1995). Seeds could be made available to the birds by mowing or haying the field after several years of growth.

It is probable that agricultural crops will always be an important tool in mourning dove management. Corn, browntop millet, and sunflower are commonly used in dove management, whether they are grown specifically for doves or in association with commercial farming. Browntop millet is planted by wildlife management professionals, farmers, and hunters to attract mourning doves (Bourne 1991, Baskett 1993), and is recommended for attracting doves in South Carolina (Neely 1961). However, browntop millet was preferred by brown-headed cowbirds in our experiments and therefore it may be inappropriate to use in areas managed to attract migratory breeding songbirds. No native plant species consistently rivaled the agricultural crops in consumption, although all 3 bird species clearly demonstrated that switchgrass would be used. As usual, management decisions involve tradeoffs, and if one is willing to trade dove benefits for benefits to other songbirds, native plants such as switchgrass should be given further consideration.

Combining native and agricultural plants, such as switchgrass and sunflower, for dove fields may be an appropriate management method to establish native plants and supply a seed source for future use, while providing immediate benefits for mourning doves and other wildlife. Interspersing areas with switchgrass and an agricultural crop would allow for dove use during the planting year, while allowing the switchgrass to become established.

Additional research is needed to determine bird use of switchgrass plots, the number of growing seasons required to produce seed, and cost effectiveness compared to traditional mourning dove fields. Plots also should be monitored to determine winter use by other wildlife species and summer use by breeding birds for ground nesting and brood-rearing. Additional data should be collected to determine if the costs and benefits of using native plants for doves and other wildlife species is comparable to traditionally managed dove fields. Future captive experimental trials should be conducted to determine if other native plants, such as *Seteria* sp. or *Croton* sp., show promise for use in mourning dove management.

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