Quail Food Plot Evaluation on Regenerated Pine Stands, Sandhills Region

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Abstract: Food plots for quail (*Colinus virginianus*) were established on 2 regenerated pine plantations in the Sandhills Region of South Carolina during 1976 and 1977. Bicolor (*Lespedeza bicolor*), Japonica (*L. japonica*), Thunberg (*L. thunbergii*), Kobe (*L. striata*), Korean (*L. stipulaceae*) lespedezas, and a reseeding variety of soybean (*Glycine max*) were evaluated along with various planting methods. The planting methods included combinations of broadcast seeding, dibbling seedlings, disking, inoculating seeds, covering seeds, and fertilizing. All plant materials tested were successfully established in persistent food plots except for reseeding soybean which failed to reestablish itself. A legume mixture of an annual and perennial lespedeza was recommended so that seed would be available to quail throughout the 5 to 7 years that newly regenerated pine stands could successfully support hunting. All planting techniques were successful in establishing food plots of the planted materials. Therefore, broadcasting seed without additional treatment was recommended since it required the least cost.

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High populations of bobwhite quail have habitually utilized open type ranges with intermittent or limited cover. The bobwhite's greatest abundance occurred during periods when farming activities included small fields with associated fence rows and wooded areas, as well as in mature or maturing pine stands within which the ground vegetation could be controlled or manipulated to supply adequate cover and food (Goodrum and Reid undated, McTeer undated, Miller 1959).

During the last several decades, the land use patterns within the southeastern states have changed periodically, with each change affecting the quality and quantity of habitat available. Major changes included the abandonment of much farmland which succeeded to second growth timberland and, subsequently, the expansion of small fields into much larger fields. These changes decreased the amount of cover and diversity of areas and thereby decreased the amount of good quail habitat. In more recent years, the use of much upland timberland within the Southeast has changed from that of producing sawtimber and pole products requiring a long rotation, to growing pure pulpwood stands on a short rotation of 25–35 years, after which the entire area is clear-cut and reforested as an even-aged pine (*Pinus* sp.) plantation. Management for pulpwood practically eliminates good quail habitat with the exception of the first few years following clear-cutting.

Various pulp and paper companies use different techniques in site preparation for establishing pine plantations. One technique includes piling residual debris into windrows (which are burned), root raking, and disking before planting. This method was used on the study areas by Catawba Timber Company, a subsidiary of Bowater Carolina Corporation. The preparation of sites for pine regeneration by disking usually results in a limited amount of ground vegetation for the first year, and quite often food and cover may not be of sufficient quality or quantity to support high quail populations.

This study was begun in March, 1976 with the following objectives: (1) to determine which reseeding annual and/or perennial quail food plant materials could be established in food plots to supplement native quail foods, and (2) to determine which methods would be most practical in establishing such food plots within regenerated pine stands in the Sandhills Region of South Carolina.

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Methods

Study Areas

The study areas consisted of 2 clear-cut and regenerated pine plantations in Aiken County. These sites were owned by Catawba Timber Company.

One area, the Hazel Scott tract, comprised 162 ha and was located north of Perry, S.C., on County Road 337. Before regeneration to loblolly pine (*Pinus taeda*), the area consisted of a slash pine (*P. elliottii*) stand. The slash pine, which was planted in 1958, suffered 60% mortality from a severe ice storm in 1973. Before 1958 the area was used primarily for farming. The adjacent lands were either cultivated fields, pasture, or woodlands.

Another area, the 64-ha Albert L. Brodie tract, was located near Wagener, S.C. Prior to clearing for loblolly pine regeneration the tract comprised 25% slash pine and 75% mixed scrub oak (*Quercus* spp.)/pine. The slash pine, planted in 1959, also suffered about 60% mortality from the 1973 ice storm. Mixed hardwood/pine, a 1-year-old pine stand, a 3-year-old pine stand, and pasture made up the adjacent lands.

The soils of these areas were of the Lakeland-Norfolk-Vauclause association. Drainage ranged from well drained to excessively drained with characteristic gently sloping to strongly sloping topography (Craddock and Ellerbe 1965).

Both areas underwent the same type of site preparation and pine regeneration procedures. After the harvestable trees were removed, the area was cleared using a K-G blade and root rake mounted on crawler tractors. The debris was piled into windrows and burned. The areas were then disked using a 3,856-kg disk harrow. A mechanical transplanter was used to plant the loblolly pine seedlings spaced 2.4 m by 2.4 m apart. Pine regeneration was completed by winter, 1976 on the Scott tract and by winter, 1977 on the Brodie tract.

Food Plots

Food plots for quail were established on both study areas. Several planting techniques and test plant materials were used to provide information to help determine recommendations for establishing food plots on other regenerated pine stands. Plots of each plant material tested were replicated 3 times.

Seed and/or seedlings of 6 plant materials were evaluated because of their availability and general acceptance for quail food plantings (Martin 1935, Landers and Johnson 1976). These included (1) seeds of Kobe lespedeza, reseeding soybean, and a legume seed mixture used in North Carolina—which included Japonica lespedeza, Korean lespedeza, partridge pea (*Cassia fasciculata*), cowpea (*Vigna unquiculata*), and soybean; (2) seeds and seedlings of bicolor lespedeza and Japonica lespedeza; and (3) seedlings of Thunberg lespedeza.

The seed component intended for testing in the North Carolina mixture was Korean lespedeza. Japonica lespedeza plots were established and evaluated separately. Other components of the mixture were too small a proportion for testing. Korean lespedeza seeds made up 32% of the mixture weight. Since 1 kg/0.04 ha of the mixture was planted as the single rate and 2 kg/

0.04 ha were planted for the double rate, the actual volumes of Korean lespedeza planted were 0.32 kg/0.04 ha and 0.64 kg/0.04 ha, respectively.

The bicolor, Japonica, and Kobe lespedezas were planted in March, 1976. The reseeding soybean was planted during May, 1976. These plantings were done on the Scott tract.

The North Carolina mixture was first planted in 1976. Dry weather killed a large percentage of the pine seedlings, and they were replanted. The replanting operation destroyed the North Carolina mixture food plots, and they were replanted on the Brodie tract in March, 1977. Thunberg lespedeza seedlings, which were not available in 1976, were also planted on the Brodie tract in March, 1977.

Seedlings of bicolor, Japonica, and Thunberg lespedezas were planted manually using either a dibble or spade in strips 82 m long. The strips consisted of 2 rows of seedlings spaced 0.6 m apart on either side of a pine row.

A disk harrow, pulled behind a small farm tractor, was used to prepare the areas for seeding. The outer disks were removed from the harrow to permit disking within the 2.4-m-wide strips between adjacent rows of pines. This prevented damage to the pine seedlings.

Between the disked areas was an approximately 1.2-m-wide nondisked area where the pine seedlings occurred. This nondisked zone also served as a treatment, which was also planted. Therefore, each test strip comprised 2 disked areas separated by a nondisked zone. These strips were approximately 0.04 ha with dimensions of 4.9 m by 82.3 m.

After the seed beds were prepared, seeds were sown with a cyclone seeder. Each seeding test strip was planted by 1 of 3 seeding variations. On 1 of the 0.04-ha strips, seeds were broadcast at the following rates: Kobe lespedeza–1.4 kg/0.04 ha, Korean lespedeza–0.32 kg/0.04 ha, and all other seed materials–0.9 kg/0.04 ha. These seeds were inoculated manually with nitrogen fixing bacteria. The seeds on the disked portion of the strip were covered by dragging a tree top over the area. The second and third 0.04-ha strips were seeded at double the rate of the previous treatment with inoculated and noninoculated seeds, respectively. The seeds on both of these strips were left uncovered. Lime and fertilizer (0–14–14) were applied to a portion of each strip at rates of 567 kg/ha and 227 kg/ha, respectively.

Food Plot Evaluation

Stem counts were used to evaluate the planting treatments. Two circular plots (each 0.456 m^2) were established for each treatment in each food plot. A metal rod with a free-swinging metal arm marked at 38 cm was used to delineate the sample plot boundary. All plants rooted within the plot were counted. When extremely numerous plants were encountered, a fraction of the circular quadrat was counted and multiplied times the fraction's reciprocal to obtain a total count. The stem counts were made during late summer each year. Percent survival of the shrub lespedezas was also determined.

Planting treatment densities were compared to density values considered adequate for establishing each of the plant materials. The stocking rate for the shrub lespedezas (bicolor, Japonica, and Thunberg) was 800 plants/0.04 ha as recommended by the Soil Conservation Service and the South Carolina Wildlife and Marine Resources Department. Seeding techniques for bicolor and Japonica lespedezas (no seeds were available for Thunberg lespedeza) were considered to be adequate for establishing food plots if the average density was greater than 800 plants/0.04 ha. The shrub lespedezas do not normally begin producing seeds until the second or third year; consequently, the second year stem count data, taken in 1977, were used in the evaluation.

The density figure used to evaluate planting procedures for Kobe and Korean lespedezas was 17,424 stems/0.04 ha. This standard was based on the density of naturally-growing Kobe that occurred in the area. For a planting technique to be considered successful, the estimated density had to exceed this standard density in all years for which estimates were available. Data for each year were evaluated separately because these plants were annuals.

The comparison density for reseeding soybean was arbitrarily set at 4,356 plants/0.04 ha, or 1 plant/0.09 m^2. Each year's data also were evaluated independently for this plant.

Those treatments judged successful based on density comparisons were further evaluated relative to cost and involvement. The successful treatment requiring the least expense was finally recommended.

All vegetation, litter, and loose soil within 0.218 m^2 circular plots were collected for each treatment and food plot to evaluate seed production. But the data were inconclusive concerning accurate seed production estimates. However, general observations on seed production rates and times were used to derive final recommendations.

Treatment comparisons were made using an analysis of variance (ANOVA) with a critical value of P 0.10.

Results

Bicolor Lespedeza

The average number of stems/0.04 ha for all the treatments in the 3 plots of bicolor lespedeza (2 samples/treatment) ranged from 1,185 to 14,494 in 1977 (Fig. 1). The density of viable plants after 2 years' growth was greater for each of the seeding treatments than the 800 plants/0.04 ha standard. Disking seemed to increase density; however, it should be noted

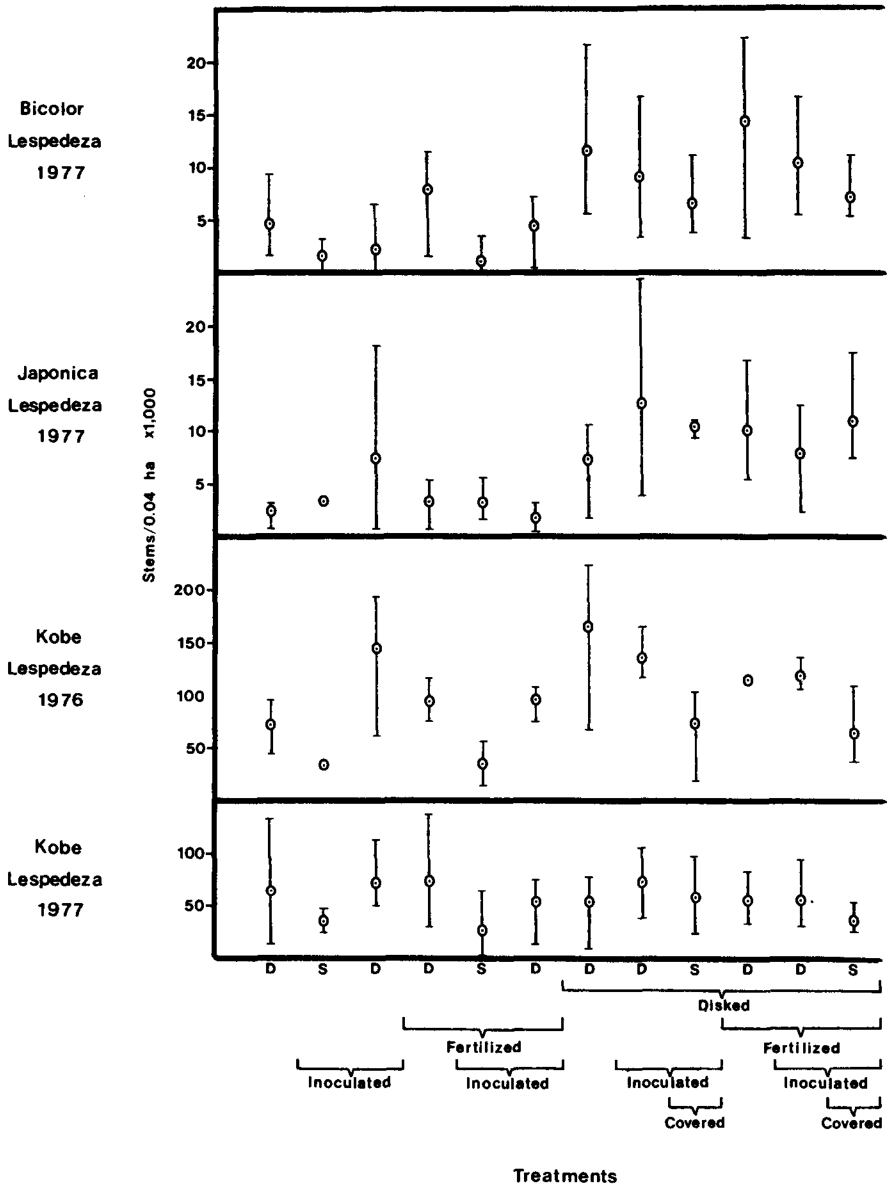

Figure 1. Average stem densities with high and low ranges for seeding treatments from least to most expensive for Bicolor, Japonica, and Kobe Lespedezas. The letters S and D indicate single and double seeding rates, respectively.

that relative treatment density was not a criterion used to determine a treatment's success. Furthermore, ANOVA did not indicate any significant differences between treatments. Therefore, seeding a double rate (1.8 kg/.04 ha) of noninoculated seeds without prior disking, fertilizing, or covering the seeds was the recommended planting procedure because it required the least expense in time and money. The average density attained in 1977 by this planting technique was 4,881 (range 1,744 to 9,317) stems/0.04 ha (Fig. 1).

Although ANOVA did not indicate stem density benefits from fertilization, visual differences were observed in the vigor of plants in the fertilized versus nonfertilized portions of the plots. The plants in the fertilized portions seemed to grow larger and were in better condition. This seemed most noticeable on sites where soil fertility was low as judged by the relative sparseness of native vegetation. There seemed to be little influence from fertilization where soil fertility seemed high.

Survival of bicolor lespedeza seedlings was 85% or greater in all plots except for the nonfertilized portion of 1 plot. In that plot survival of about 5% of the plants likely reflected poor seedling stock instead of unfavorable planting conditions (Table 1).

Japonica Lespedeza

The average stem densities of the treatments after 2 years' growth for Japonica lespedeza ranged from 1,923 to 12,867/0.04 ha in 1977 (Fig. 1).

Table 1. Percent Survival of Bicolor, Japonica, and Thunberg Lespedezas in Quail Food Test Plots

	Nonfertilized		Fertilized	
Test Plant	1976	1977	1976	1977
Bicolor Lespedeza				
Plot 1	85	85	85	85
Plot 2	5[a]	5[a]	95	90
Plot 3	95	90	95	95
Average	62	60	92	90
Japonica Lespedeza				
Plot 1	90	80	95	90
Plot 2	90	90	90	85
Plot 3	40	35	40	35
Average	73	68	75	70
Thunberg Lespedeza				
Plot 1		80		85
Plot 2		75		75
Plot 3		90		95
Average		82		85

[a] Low survival probably resulted because seedling stock was root stock of older bicolor lespedeza plants.

All planting techniques were considered successful because their second year density estimates exceeded 800 plant/0.04 ha. Therefore, the simplest planting method, which involved broadcasting a double rate of noninoculated seeds without disking, covering, or fertilizing, was determined to be most desirable. The average density obtained with this planting method was 2,366 (range 887 to 3,106) stems/0.04 ha (Fig. 1). It should be noted that disking resulted in an apparent increase in density even though this was not a criterion set for evaluating planting treatments. ANOVA did not indicate significant differences between the treatments.

Observations concerning fertilization of the Japonica lespedeza plots were similar to those for bicolor lespedea. Dibbled seedling survival exceeded 80% except for 35% in 1 plot (Table 1). A reason for the low survival in the 1 plot was not apparent.

Thunberg Lespedeza

Seeds for this species were not available for testing. Dibbled seedlings after 1 year's growth indicated 75% survival or greater in all plots (Table 1).

Kobe Lespedeza

Kobe lespedeza stem density averages ranged from 33,129 to 166,535 stems/0.04 ha in 1976 and from 28,545 to 74,393 stems/0.04 ha in 1977 (Fig. 1). Average densities of all planting treatments exceeded 17,424 plants/0.04 ha; therefore, all treatments were considered successful in establishing quail food plots. No significant differences were detected using ANOVA. The most desirable of these was seeding a double rate of noninoculated seeds over nondisked soil without covering or fertilizing because it was the least expensive. The average density obtained with this planting method was 70,992 (range 43,093 to 94,951) stems/0.04 ha in 1976 and 65,520 (range 13,755 to 133,110) stems/0.04 ha in 1977. The observed effects of fertilization were similar to those for other plant materials.

Korean Lespedeza

The range of the average stem densities for all the seeding methods was 24,847 to 81,788 stems/0.04 ha for Korean lespedeza (Fig. 2). All treatments had average densities that exceeded 17,424 stems/0.04 ha for the 1 year that data were available. Therefore, direct seeding after pine planting, without further seed or seedbed preparation, was considered the best technique because it required the least effort and expense. The average density obtained with this planting method was 77,647 (range 22,629 to 173,930) stems/0.04 ha. An ANOVA did not indicate any differences between treatments.

The effects of fertilization were also similar to those for other plant materials.

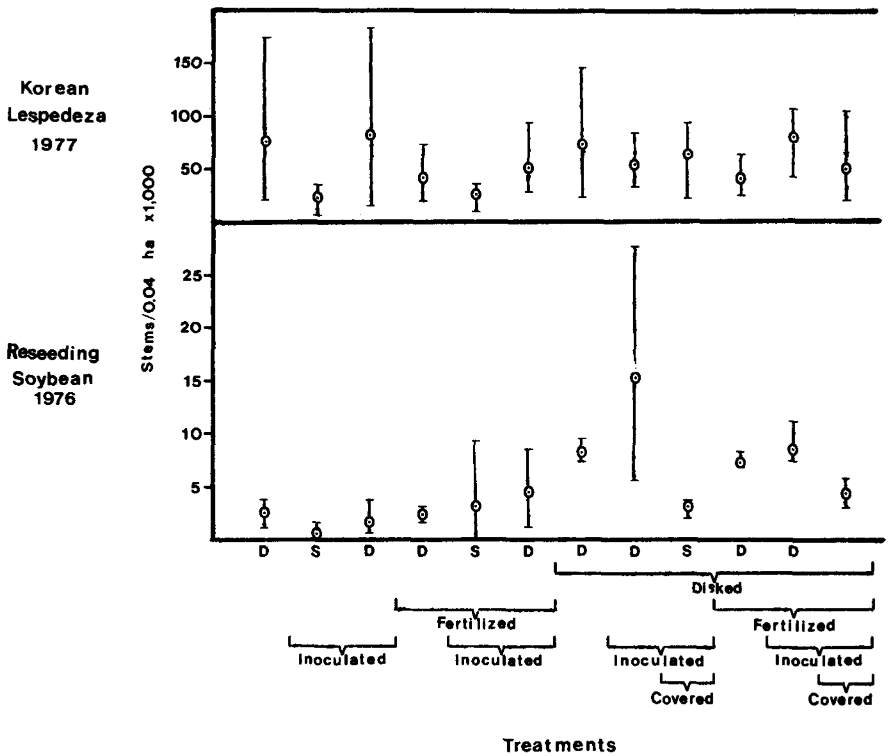

Figure 2. Average stem densities with high and low ranges for seeding treatments from least to most expensive for Korean Lespedeza and Reseeding Soybean. The letters S and D indicate single and double seeding rates, respectively.

Reseeding Soybean

The reseeding soybean failed to reestablish itself the second year; therefore, it was not considered successful in establishing a persistent food plot. However, soybean might be considered for establishing temporary food plots.

The average densities ranged from 740 to 15,592 plants/0.04 ha (Fig. 1). The treatments that had densities exceeding the comparison density of 4,356 stems/0.04 ha required seeding at a double rate, and/or disking, and/or fertilizing (Fig. 2). The expense of these treatments further reduced the value of this plant as a food plot candidate.

Seed Production

The annual plants, Kobe and Korean lespedezas, and reseeding soybean, produced seeds the first year. Kobe lespedeza also reestablished itself the next year. As mentioned previously, the reseeding soybean failed to re-establish. Only 1 year's data were available for Korean lespedeza.

Competition from wild plants was greater and seed production seemed lower the second year for Kobe lespedeza. This would probably hold true for Korean lespedeza. Reduction of seed production was expected to be more substantial in succeeding years as competition from native plants increased.

The perennial lespedezas, bicolor, Japonica, and Thunberg, had no seed production the first year and very little the second year except for the dibbled seedlings. Judging from observed onset of seed production of the dibbled seedlings and from the literature (Pearson and Howell 1943, Davison 1945, Edminster 1950, and Blackwell 1955), the perennial lespedezas first begin producing a heavy seed crop the third year. Perennial lespedezas ars generally persistent and should continue producing seed crops until the pine trees outcompete them for light and space.

Conclusions and Recommendations

The most economical treatment was seeding a double rate of noninoculated seeds without disking the seedbed, not covering the seeds, and not fertilizing. Although light disking before seeding seemed to increase the density of plants that germinated, high density was not the basis for selecting one treatment over another. Also, the high cost associated with disking greatly reduced the value of this treatment.

This study did not show inoculation to be essential. However, this treatment costs very little and should be considered as a precautionary measure.

Except for the reseeding soybean, which failed to reestablish itself after the first year, all the seeded plant materials tested were successfully established.

Observations of seed production led to a recommendation of a combination planting including an annual and a perennial lespedeza as being most satisfactory for quail food plots. The annual lespedezas, Kobe and/or Korean, would provide food for quail after the first and second growing seasons. The perennial lespedezas, bicolor and/or Japonica, begin their first heavy seed production during the third year when the annual lespedeza seed production declines due to competition with native plants. The above combination should provide a supplementary source of food for quail throughout the first 5 to 7 years after pine regeneration when quail hunting would be practical.

The densities obtained with the above treatment or the density values used in the evaluations may not be the best for maximum seed production. An excessive density would result in high interspecific competition which would reduce seed production. A low density would fail to take advantage of all the space in the plot and would also allow greater competition from native plants. Further work should be done to determine seeding rates to provide optimum densities which would maximize seed production and minimize seed costs.

Literature Cited

Blackwell, W. P. 1955. The use of annuals in Virginia's farm game program. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 9:1–5.

Craddock, G. R., and C. M. Ellerbe. 1965. General soil map of Aiken County, South Carolina. Clemson Univ. Agric. Exp. Sta. Soil Map Leaflet 2.

Davison, V. E. 1945. Wildlife values of the lespedezas. J. Wildl. Manage. 9:1–9.

Edminster, F. C. 1950. Use of shrubs in developing farm wildlife habitat. Trans. North Am. Wildl. Conf. 15:519–548.

Goodrum, P., and V. H. Reid. undated. Quail management on forested land. USDI Fish and Wildl. Serv. Information Leaflet. 4pp.

Landers, J. L., and A. S. Johnson. 1976. Bobwhite quail food habits in the southeastern United States with a seed key to important foods. Tall Timbers Res. Sta., Misc. Publ. 4. 90pp.

Martin, A. C. 1935. Quail-food plants of the southeastern states. USDA Circ. 348. 16pp.

McTeer, W. undated. Bobwhite quail. S. C. Wildl. and Marine Resour. Dept. Wildl. Notes, 2(3). 6pp.

Miller, H. A. 1959. Pineland possibilities for more quail seen. S. C. Wildl. 3(3) 10–11.

Pearson, A. M., and H. H. Howell. 1943. Quail of the limestone valleys like legumes. Ala. Conserv. (January):5–6.