DETERIORATION RATES OF 35 BOBWHITE QUAIL FOODS AND THEIR PREFERENTIAL USE

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Abstract: Deterioration of 35 bobwhite quail (*Colinus virginianus*) foods was measured during the fall and winters of 1974-1976 in the Coastal Plains of South Carolina. Poison ivy (*Rhus radicans*) and pokeberry (*Phytolacca americana*) seeds resisted deterioration, while soybeans (*Glycine max*) and mungbeans (*Phaseolus sinuatus*) deteriorated rapidly. Browntop millet (*Panicum ramosum*), proso millet (*P. miliaceum*), pearl millet (*Pennisetum glaucum*), and three *Pinus* sp. sprouted during winter. Quail preference for the 35 seeds was determined before and after 120 days of ground contact. Quail were selective among food items offered concurrently. Sorghum (*Sorghum vulgare*), poison ivy and chocolate weed (*Melochia corchorifolia*) were preferred. Quail selected against deteriorated seeds. Chocolate weed seemingly offers promise as a managed quail food.

Proc. Ann. Conf. S.E. Assoc. Fish & Wild. Agencies 32: 356-363

The bobwhite quail is a major game species in the Southeast. Quail management has intensified due in part to a change in agricultural practices (Davison 1949, Rosene 1956). The shift from "patch farming" to mechanized agriculture has contributed to extensive quail food plantings. The emphasis in planting has been to produce an abundance of preferred quail food.

Although a variety of quail food plants are managed, little is known about deterioration of these foods. There is limited value in growing foods which might produce high yields but which deteriorate within a few weeks. Several investigators (Haugen and Fitch 1955, Bookhout 1958, Robel and Slade 1965) have studied seasonal availability of quail foods. However, a literature review failed to find investigative studies on deterioration of quail foods.

The purpose of this study was to determine comparative deterioration rates of 35 selected quail foods which are native or cultivated in the Southeast. A second objective was to determine quail preferences among the 35 seeds and measure changes in preference as seeds deteriorated.

I would like to express appreciation to W. W. Neely for helpful suggestions made during the study. Special thanks are due Mount Holly Plantation for supplying quail. PoCo Sabo Plantation and J P Farm provided use of their land for seed deterioration tests.

MATERIALS AND METHODS

Thirty-five foods were selected for study (Table 1). Seeds included 21 commonly cultured quail food plants. In addition, chocolate weed, four o'clock (*Mirabillis jalapa*), maypop (*Passiflora incarnata*), and joint vetch (*Aeschynomene indica*) were selected because of their potential use as quail foods. Other seeds selected included 9 native plants. Crotalaria (*Crotalaria spectabilis*) was selected for testing because it has been reported toxic to quail (Nestler and Bailey 1941, Michael and Beckwith 1955).

Deterioration

A modification of the techniques developed by Neely (1956) was used to measure seed deterioration. Seeds were collected from respective plants by hand at the time of maturity. Collected seeds were offered in the form quail would find them. Exceptions were seeds of pokeberry and maypop, which were removed from the fruit. Seeds were screened and cleaned with a seed cleaner to develop sound, uniform samples.

Samples were enclosed in 15 x 15 cm fiberglass screen envelopes made by folding a 15 x 30 cm piece of 1 mm mesh fiberglass screen. The edges were sealed with a soldering iron and seed identification was coded on the envelope. A 30 cc sample of each seed species was weighed to the nearest 0.1 g and placed in each envelope.

Table 1. Seeds[a] used in the deterioration and quail preference study during the fall and winters 1974-1976, South Carolina.

Aeschynomene indica L.	Joint vetch
Cassia fasiculata Michaux.	Partridgepea
Crotalaria spectabilis Roth.	Showy crotalaria
Desmodium tortuosum (Swartz) DC.	Florida beggarweed
Echinochloa colonum L.	Junglerice
E. crusgalli var. *frumentacea* L.	Japanese millet
E. frumentacea (Roxb.) Link.	Chiwapa millet
Glycine max (L.) Merrill.	Soybean
Helianthus sp.	Sunflower
Lespedeza bicolor Turcz.	Bicolor lespedeza
L. japonica Bailey.	Japonica lespedeza
L. striata (Thunberg) H. & A.	Kobe lespedeza
L. thunbergii Nakai.	Thunberg lespedeza
Liquidambar styraciflua L.	Sweetgum
Melochia corchorifolia L.	Chocolate weed
Mirabilis jalapa L.	Four o'clock
Panicum miliaceum L.	Proso millet
P. ramosum L.	Browntop millet
Paspalum notatum var. *saurae* Parodi.	Pensacola bahiagrass
Passiflora incarnata L.	Maypop
Pennisetum glaucum (L.) R. Brown.	Cattail millet
P. glaucum (L.) R. Brown.	Pearl millet
Phaseolus sinuatus Nuttall ex T. & G.	Mungbean
Phytolacca americana L.	Pokeberry
Pinus elliotti Engelm.	Slash pine
P. palustris Miller.	Longleaf pine
P. taeda L.	Loblolly pine
Rhus radicans L.	Poison ivy
Sesamum indicum	Sesame
Sesbania exaltata (Raf.) Rydberg ex A. W. Hill	Sesbania (red strain)
S. exaltata (Raf.) Rydberg ex A. W. Hill	Sesbania (white strain)
Sorghum vulgare Persoon.	Sorghum
Vigna sativum	Reseeding pea
V. sativum var. *arvense*	Field pea
Zea mays L.	Corn

[a]Authority: U. S. Department of Agriculture. 1971.

Deterioration was determined by subjecting the 35 seed species to identical field conditions. Deterioration tests were conducted at 2 harvested corn fields in Colleton County, South Carolina. Tests ran for 120 days from fall when quail foods are abundant until late winter when foods are scarce (Stoddard 1931). Eight envelopes of each seed species were placed on the ground at each deterioration site on 15 November 1974, and 15 November 1975. Envelopes provided protection against birds and rodents while exposing seeds to the elements.

To determine the effect fiberglass envelopes had on seed deterioration, 30 cc samples of seeds were placed directly on the ground during the 1974-1975 test. Seeds on the ground deteriorated less than 3% faster than seeds in fiberglass envelopes. Therefore, during the 1975-1976 test only the fiberglass envelopes were used.

Two envelopes of each seed were removed every 30 days from both fields during December to March. Samples were taken to the lab and rinsed to removed soil and debris. Rinsed seeds were dried with a heated blow drier, then air dried for 2 weeks. Seeds which sprouted were removed prior to weighing a sample. Sprouted seeds were considered deteriorated.

Dried seeds were removed from the envelope and weighed to the nearest 0.1 g. Weight loss divided by original seed dry weight determined deterioration (Neely 1956).

Food Preference

Twelve pen-reared quail were used to determine preferences among 35 selected seeds and measure changes in preference as seed deteriorated.

Quail were housed in 2 m x 1 m x 3 dm wire pens. Pens were divided into 3 compartments. Each compartment contained 3 quail. Trays were placed beneath pens during feeding trials to retain fallen seeds. Quail were supplied with a dusting pan and fresh water daily.

Feed trays were 3 dm x 1 dm. Trays contained 12 numbered, removable compartments. Each compartment had a 60 ml capacity. Placement of food items was randomly varied during feeding trials.

During a 3 week introductory period, quail were offered concurrently 35 tested seed species. The introductory period allowed quail to become familiar with the seed species, feed trays and feeding procedures.

A total of 180 feeding trials was carried out from December 1975 through March 1976. When quail were not on experimental diets, they were fed commercial (15% protein) chicken feed.

Equal volumes of 35 tested seeds were offered to quail for a 24 hour period as suggested by Michael and Beckwith (1955) who determined that quail consume 10 g of food during a 24 hour period. Therefore, 0.85 g of seed of each of 35 species was offered to the 3 quail in each pen during each trial.

Feeding trials began at 0700 and ended at 0700 the following day. Utilization was determined by examining feed trays at specified times and making a notation only when a given seed was completely consumed. Nine examinations were made at 90 minute intervals from 0830 until 1900 and at 0700 the following day. Quail preference was indicated by which of the 9 time periods all seeds of a species were consumed. Seeds remaining after the 24 hour period were weighed to the nearest 0.01 g. Use of each of the 35 species was recorded by 10 preferences, including unused seed.

Ranking of quail preference for seeds was determined by averaging the frequency of occurrence for each seed within the 10 preference groups during 180 trials (Michael and Beckwith 1955). Seeds were ranked in accordance with quail preference, whereby, the smaller numbers are preferred species.

RESULTS

Deterioration

Poison ivy and pokeberry seeds resisted deterioration, while soybeans and mungbeans deteriorated rapidly (Table 2). Sunflower seeds began germinating during December (the second 30-day period). Browntop millet, pearl millet, proso millet, and 3 species of pine began sprouting during March (the final 30-day period).

Sesame seeds became moldy during the initial 30-day period. Soybeans, cowpeas, sesame, and mungbeans fermented after 60 days.

Of 10 species deteriorating least, 2 (bahiagrass, sesbania-white strain) were cultivated. The 10 species deteriorating most rapidly included 8 cultivated species (cattail millet, corn, Kobe lespedeza, field pea, sesame, soybean, mungbean, sunflower).

Table 2. Average percentage of deterioration of 35 species of seed after 30, 60, 90, and 120 days on the ground, Colleton county, South Carolina.

Seed species[a]	*Number of days*			
	30	*60*	*90*	*120*
	Percent deterioration			
Poison ivy	1	1	2	3
Pokeberry	2	3	3	5
Sesbania (red)	2	4	5	6
Sesbania (white)	2	5	5	7
Bahiagrass	3	3	4	7
Partridgepea	5	7	7	9
Joint vetch	7	7	8	10
Maypop	8	8	10	11
Four o'clock	10	11	11	12
Beggarweed	9	10	11	12
Bicolor lespedeza	2	5	9	13
Junglerice	7	9	10	13
Thunberg lespedeza	9	11	11	14
Japonica lespedeza	10	13	15	16
Chiwapa millet	13	15	16	18
Proso millet	5	9	15	19[b]
Sorghum	6	10	15	21
Browntop millet	1	3	5	24[b]
Japanese millet	8	14	22	24
Pearl millet	5	11	11	25[b]
Sweetgum	9	17	21	25
Reseeding pea	5	16	18	25
Slash pine	9	14	21	36[b]
Chocolate weed	17	23	28	38
Loblolly pine	10	15	28	39[b]
Longleaf pine	8	22	33	42[b]
Cattail millet	10	20	31	42
Corn	7	16	31	47
Kobe lespedeza	18	30	33	47
Field pea	22	32	35	49
Sesame	9	26	31	54
Crotalaria	16	26	46	58
Soybean	16	37	48	64
Mungbean	23	62	64	71
Sunflower	65	100b	100[b]	100[b]

[a]No significant deterioration rate ($P < 0.05$) for seeds at 2 deterioration sites.

[b]Seeds began germinating during study.

Food Preference

During 180 feeding trials, penned quail were selective in food preferences (Table 3). In every fresh seed trial, sorghum, chocolate weed and poison ivy were consumed first. Crotalaria and joint vetch were seldom eaten.

Table 3. Bobwhite quail preference (ranked 1 to 35) of seeds used in feeding trials, December 1975 to March 1976.

Preference[a] *rank*	*Food item*	*Preference*[a] *rank*	*Food item*
1	Sorghum	19	Sesbania (red)
2	Poison ivy	20	Four o'clock
3	Chocolate weed	21	Pokeberry
4	Pearl millet	22	Kobe lespedeza
5	Sesame	23	Sesbania (white)
6	Japanese millet	24	Reseeding pea
7	Soybean	25	Longleaf pine
8	Browntop millet	26	Sunflower
9	Chiwapa millet	27	Loblolly pine
10	Corn	28	Thunberg lespedeza
11	Bahiagrass	29	Partridgepea
12	Field pea	30	Bicolor lespedeza
13	Mungbean	31	Japonica lespedeza
14	Cattail millet	32	Florida beggarweed
15	Maypop	33	Sweetgum
16	Junglerice	34	Crotalaria
17	Slash pine	35	Joint vetch
18	Proso millet		

[a]Significant test of r ($P < 0.10$) based on Kendall's coefficient of rank correlation, $r = \frac{N}{n(n-1)}$

Randomly switching the placement of seeds during feeding trials had no apparent effect on quail preferences. Michael and Beckwith (1955) also found placement did not affect quail preferences. The 10 most preferred species included 8 cultivated species and 2 native species (poison ivy, chocolate weed).

Preferences of Deteriorating Seeds

Preferences shown by quail for seeds lying on the ground for 60 days and 120 days changed relative to the preference for the same fresh seeds (Tables 3 and 4). Sorghum and poison ivy remained preferred items. Chocolate weed, sesame, soybean, and corn seeds dropped in preference as they deteriorated. Sunflower seeds sprouted and were unavailable after 60 days.

Six of 10 preferred fresh seeds were also preferred after 120 days on the ground. They included: poison ivy, sorghum, chiwapa millet, pearl millet, browntop millet, and Japanese millet. Although not preferred as fresh seeds, bahia, maypop, thunberg lespedeza, and four o'clock seeds were preferred after 120 days, replacing chocolate weed, sesame, soybean and corn.

DISCUSSION AND CONCLUSIONS

Deterioration of certain seeds reduced quail preference for these seeds. Preferred fresh seeds which deteriorated least remained preferred after 120 days on the ground.

Sorghum, poison ivy and pearl millet were preferred seeds throughout this study. Pearl millet and sorghum, used in food plots for quail in the Southeast, deteriorate at a slight to moderate rate. Newlon et al. (1964) reported that sorghum and pearl millet had a

Table 4. Bobwhite quail preference (ranked 1 to 35) of seeds on the ground 60 days and 120 days, Colleton county, South Carolina.

60 Days		*120 Days*	
Preference[a] *rank*	*Food item*	*Preference*[a] *rank*	*Food item*
1	Sorghum	1	Poison ivy
2	Poison ivy	2	Sorghum
3	Pearl millet	3	Chiwapa millet
4	Japanese millet	4	Bahiagrass
5	Corn	5	Maypop
6	Browntop millet	6	Pearl millet
7	Chiwapa millet	7	Browntop millet
8	Chocolate weed	8	Japanese millet
9	Junglerice	9	Thunberg lespedeza
10	Bahiagrass	10	Four o'clock
11	Cattail millet	11	Sesbania (red)
12	Maypop	12	Bicolor lespedeza
13	Reseeding pea	13	Sesbania (white)
14	Proso millet	14	Reseeding pea
15	Field pea	15	Chocolate weed
16	Sesame	16	Japonica lespedeza
17	Pokeberry	17	Pokeberry
18	Four o'clock	18	Partridgepea
19	Kobe lespedeza	19	Cattail millet
20	Thunberg lespedeza	20	Junglerice
21	Soybean	21	Proso millet
22	Slash pine	22	Slash pine
23	Bicolor lespedeza	23	Field pea
24	Longleaf pine	24	Longleaf pine
25	Japonica lespedeza	25	Loblolly pine
26	Loblolly pine	26	Corn
27	Sesbania (red)	27	Kobe lespedeza
28	Sesbania (white)	28	Florida beggarweed
29	Florida beggarweed	29	Sweetgum
30	Partridgepea	30	Soybean
31	Joint vetch	31	Joint vetch
32	Sweetgum	32	Sesame
33	Mungbean	33	Mungbean
34	Crotalaria	34	Crotalaria
35	Sunflower - germ.	35	Sunflower - germ.

[a]Significant test of r ($P < 0.10$) based on Kendall's coefficient of rank correlation, $r = \frac{N}{n(n-1)}$

high winter sustaining value for quail. The qualities of these 2 species make them important plants for consideration in a quail management program.

Poison ivy, although preferred and slow to deteriorate, is usually not managed as a quail food. Human dermatitis minimizes the usefulness of this plant.

The native chocolate weed, third in preference to sorghum and poison ivy in this study, should be explored as a quail food. Cultural requirements of this plant need to be researched.

The widely cultivated bush lespedezas (thunberg, bicolor, japonica) increased in preference from a 28, 30 and 31 ranking respectively as fresh seed to a ranking of 9, 12 and 16 respectively after 120 days on the ground. Deterioration for the same period of time was 14, 13 and 16% respectively. Investigators of quail food habits (Korschgen 1948, Nestler et al. 1945, Schrader 1955) have shown these legumes to be important foods particularly during late fall and winter. The importance of these legumes as quail foods may reflect a diminishing availability of grass seeds.

This study supports findings by Michael and Beckwith (1955) that competition by other animals reduces the availability of grass seed for quail. In this study, 6 of 10 preferred species after 120 days on the ground were grasses. Michael and Beckwith (1955) reported that harvester ants, and to a lesser degree, rodents were competitors for grass seed.

Under actual field conditions, some plants will provide a more extended period of seed availability than this study suggests. Soybean pods occurring low on stalks are often missed with a harvester. Seeds in pods suspended in the stubble are not subject to rapid deterioration as are seeds on the ground. Bicolor and thunberg lespedeza plants also retain seeds until late winter.

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