

RESEARCH BULLETIN 584

JULY, 1955

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE  
AGRICULTURAL EXPERIMENT STATION

J. H. LONGWELL, *Director*

# Experimental Trials of Wildlife Food and Cover Plants

THOMAS S. BASKETT



(Publication authorized July 1, 1955)

COLUMBIA, MISSOURI

---

## TABLE OF CONTENTS

Introduction .....	3
Missouri's Wildlife Trials .....	5
Locations and Descriptions of Plots .....	6
Results .....	10
Conifers .....	10
Deciduous Trees and Shrubs .....	15
Vines, Roses and Brambles .....	18
Discussion .....	20
Conifers .....	21
Deciduous Trees and Shrubs .....	21
Vines, Roses and Brambles .....	22
Summary .....	22
Literature Cited .....	24

## ACKNOWLEDGMENTS

Project sponsored jointly by the Missouri Cooperative Wildlife Research Unit (U. S. Fish and Wildlife Service, Wildlife Management Institute, Missouri Conservation Commission, Edward K. Love Foundation, and the University of Missouri, cooperating), and the Department of Soils, University of Missouri. The author is indebted to M. E. Springer and C. L. Scrivner, Department of Soils, University of Missouri, for descriptions of soils of the plots. Wallace Anderson, U. S. Soil Conservation Service, and Jack Kopitke, formerly of that agency, made planting records available. Wm. H. Elder, D. Q. Thompson, and C. L. Kucera, University of Missouri, and Cecil Davis, H. V. Terrill, and Kenneth Hicks, Missouri Conservation Commission, all gave valuable suggestions. Several associates aided with survival counts. The bulletin reports on Department of Soils research project No. 206, "Soil Survey."

# Experimental Trials of Wildlife Food and Cover Plants

THOMAS S. BASKETT

## INTRODUCTION

The most pressing problem in the management of farm game, particularly in the mid-western states, is the progressive destruction of food and cover. This destruction results in large measure from more intensive farming and is made possible through greater use of mechanized equipment. Attempts to meet the problem have centered around the encouragement of plants which are compatible with farming practices, which have value as game food and cover, and which aid in conserving the soil.

Often, programs for providing plants useful to wildlife have been hampered by inadequate knowledge of the adaptability of the plants to local field conditions. However, in various localities trials of such plants have been made and data on performance published. In New York, Cook and Edminster (1944) reported on survival and growth of 13 species of trees or shrubs planted for wildlife. The six species which they considered most promising at the end of the third growing season included three of interest to Missouri, multiflora rose, arrow-wood (*Viburnum*), and silky dogwood. The first of these species has been widely distributed in this state for cover restoration and species closely related to the second and third have been tested. Performances of wild plum and black haw, also of interest in Missouri, were moderate to poor. Later, Edminster and May (1951) presented much information on growth and survival of plants tested for wildlife planting in the northeast. They recommended seven shrubs for general use in farm conservation plantings. Three of these, bicolor lespedeza, Tartarian honeysuckle, and multiflora rose, are of particular interest for Missouri.

Cromie and Kienholz (1939) studied survival and growth of exotic game-food shrubs in Connecticut. They concluded that in that state, the planting of exotic shrubs was unprofitable without a tremendous amount of work to free them from competition. They felt that in many spots, native food-bearing plants gave better results with less care. In the lake states, Aldous (1949) stated that planting of browse species for deer is impractical and no more productive than natural regeneration where deer are numerous. A similar thought was expressed by Marshall (1953) when he questioned the wisdom of clearing off or at least ignoring native brush species while planting nursery-raised shrubs.

In Ohio, Dambach (1948) surveyed 33 wildlife-erosion control plantings after at least seven growing seasons. On the basis of their performances, he recommended multiflora rose, Tartarian honeysuckle, and several species of shrubby dogwoods for both erosion control and wildlife food and cover. Coralberry was highly recommended for erosion control in difficult sites.

Aldous (1949) reported on survival and growth of several species planted in Minnesota for wildlife food and cover. Heavy deer browsing greatly affected results both with deciduous plants and conifers, but white and black spruce were recommended for cover plantings. Survival and condition of white spruce and northern white cedar plantings for wildlife made in Minnesota were recorded by Dobie and Marshall (1954); the plantings were made in 1936 and examined in 1952 and 1953. The authors found very low survival of both conifers and attributed the failure mainly to competition in dense stands of aspen and to damage by the snowshoe hare.

Survival in one- and two-year-old wildlife plantings in North Dakota was reported by Schreiner (1953). Twenty-three species were reported on and survival of most was above 70 percent. Conifers gave disappointing results but many deciduous trees and shrubs were successful. Elaborate tests of trees and shrubs for windbreaks and other uses in the northern Great Plains were described by George (1953). These tests included 373 plantings at Mandan, North Dakota, and elsewhere, comprising 215 species. Many of the plantings yielded information for at least 10 years. One result of this study was a list of more than 60 recommended species. Red cedar was among the plants highly recommended for both windbreak and ornamental purposes. Wild plum was recommended for windbreak and wildlife-cover planting on the most moist sites. These two species also showed good survival and growth in shelterbelt plantings in Nebraska, according to Ager (1951).

Rogers (1951) described forest plantings on strip-mined lands in Oklahoma, Kansas and Missouri. Although survival figures were not given, vigor of several tree species sometimes used in wildlife plantings in this region was noted. Some very successful plantings of black locust and one of short-leaf pine on strip-mined lands were described. More recently, Dingle and Fletcher (1955) reported on a survey of forest tree plantings in Missouri. Many of the species for which they had survival data are considered valuable to wildlife. Among nine tree species, the highest average survival reported was for black locust (64 percent), with green ash (57 percent) second. Red cedar, an important species for Missouri's wildlife, showed only 34 percent survival.

The performance of multiflora rose in 895 plantings located in Missouri, Iowa, and the Lake states was analyzed by Anderson (1952). Average survival for all the plantings was 84 percent. For 117 Missouri plantings of various ages, the figure was 93 percent. Heights averaged about 77 inches

in Missouri after 7 to 13 years. The Missouri plantings in this series were mainly for demonstration and many had received special care. Other information collected by personnel of the Missouri Conservation Commission from a series of 90 Missouri plantings after one growing season showed survival of 76 percent. In the latter series, an attempt was made to choose plantings which were more nearly typical. Some of these Missouri data were published previously by Marshall (1953).

### MISSOURI'S "WILDLIFE TRIALS"

A series of plots was established in Missouri in 1939, 1940 and 1941 by the U. S. Soil Conservation Service to test growth, survival, and other characteristics of several plants considered promising for game food or cover on the farm. C.C.C. labor was used in making these plantings which were termed "wildlife trials." In 1941, two similar but more elaborate plots were planted on the University of Missouri's Ashland Wildlife Research Area. Biologists from several conservation agencies have noted gross performance of species in these plots but no systematic check of performance of all the plants has been reported. The writer visited the Ashland plots in 1950 and all the other plantings in 1951 to count survival and to note the vigor of the surviving plants, 10 to 13 growing seasons after the plantings were made. Subsequently, they were revisited with Dr. M. E. Springer or Clarence Scrivner, Soils Department, University of Missouri, to obtain detailed site descriptions.

Evidently, many factors brought about failures. In some instances plants were washed out before they were well rooted. In others they were shaded out by bordering plants, some were heavily browsed by cottontails, and still others may have been inadequately cared for when planted. Thus, it was not possible to specify the causes of failure in most cases but the plots were of real value in permitting a rough comparison of the performance of several species of plants under a variety of conditions of soil quality, erosion, and drainage. About half the plots were located in "odd areas" which had previously been retired from farm use as a result of sheet erosion or gullies.

From 10 to 20 plant species were tested in each plot and 25 plants of each species were usually employed in the tests, except in the Ashland plantings where 50 plants of each species were used. In several plots, 50 plants of gray dogwood (*Cornus racemosa*) were planted, but one row of 25 was mistakenly labeled *C. stolonifera*. Spacings between rows were about 6 feet, and between plants within rows, about 4 feet. Apparently, all the plants were placed in plowed ground but details of treatment thereafter are not known.

All planting stock was supplied by the U. S. Soil Conservation Service Nursery at Elsberry, Mo., except at the Ashland Area (Plots 5 and 6) where some of the stock was supplied by the Missouri Conservation Commission.

## LOCATIONS AND DESCRIPTIONS OF PLOTS

The locations of all wildlife trial plots are shown in the map (Figure 1). It is evident that most of the plots lay in a broad belt extending east and west through the middle of Missouri, but two were located on prairie sites in the southwestern part of the state. Extreme northern Missouri, the Ozarks, and the southeastern sections of the state were not represented.

The plots were numbered (in Figure 1 and below), according to a rough measure of relative site quality. This rating, made by Springer and Scrivner, was based on: (1) natural fertility of the soil involved (2) moisture-supplying capacity, and (3) aeration and drainage. Although the rating was admittedly arbitrary, the lower plot numbers do indicate the better sites, and the higher numbers, the poorer ones.

Detailed descriptions of the plots follow:

### Plot 1:

*Location:* Greene County, 8 miles northwest of Springfield.

*Planting Date:* 1940.

*General Description:* Located on a flat bottom with very slight erosion; soil developed from alluvium under prairie vegetation.

*Soil Type:* Dunning silty clay loam.

*Surface Soil:* Very dark gray, granular, silty clay loam, 10 to 14 inches deep.

*Subsoil:* Very dark gray, silty clay containing some iron and manganese concretions.

*Fertility of Soil:* High.

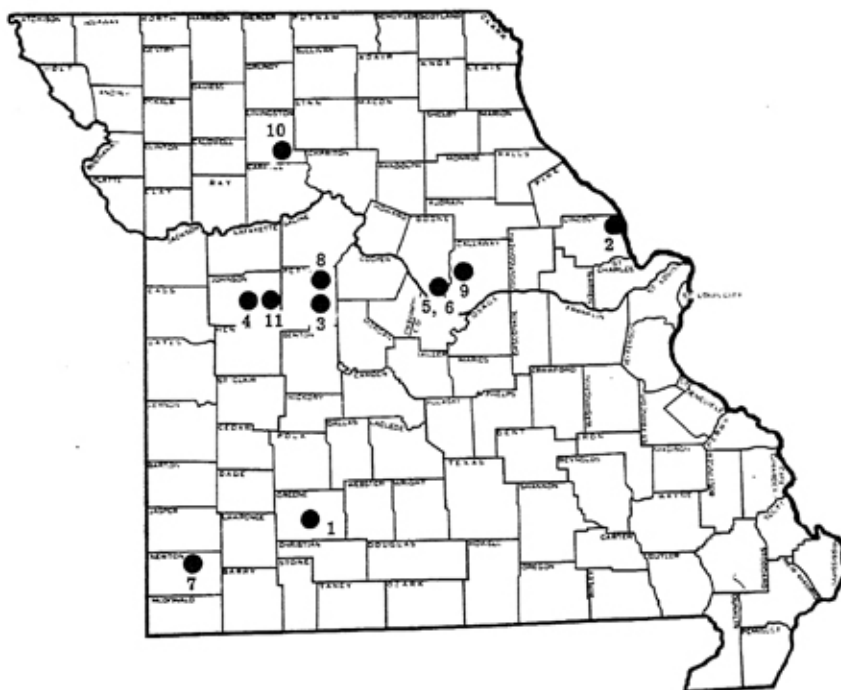


Fig. 1—Locations of plots.

*Moisture-Supplying Capacity:* Good.  
*Internal Drainage and Aeration:* Poor.  
*Slope:* 1%

*Grazing:* None.

*Remarks:* Excellent site except for plants requiring good aeration in root zone.

**Plot 2:**

*Location:* Lincoln County, at south edge of Elsberry.

*Planting Date:* 1941.

*General Description:* Upland slope covered by loess mantle about 8 feet deep.

*Soil Type:* Winfield silt loam on upper half; Whitson silt loam on lower half.

*Surface Soil:* Brown and yellowish brown silty loam to a depth of 16 inches (Winfield); grayish brown and gray silty loams to a depth of 15 inches, containing small iron and manganese concretions (Whitson).

*Subsoil:* Brown silty clay loam becoming gray below 30 inches (Winfield); mottled gray and yellowish brown plastic silty clay containing concretions (Whitson).

*Fertility of Soil:* Moderate.

*Moisture-Supplying Capacity:* Good.

*Internal Drainage and Aeration:* Moderate (Winfield); poor (Whitson).

*Slope:* 5% (Winfield); 3% (Whitson).

*Grazing:* None.

*Remarks:* Both soils should be productive considering their slight erosion and loessial origin.

**Plot 3:**

*Location:* Pettis County, 4 miles northeast of Sedalia.

*Planting Date:* 1940.

*General Description:* Hillside near top of ridge, in area of soils derived from limestone.

*Soil Type:* Reddish brown variant of Union silt loam.

*Surface Soil:* Brown silt loam, 4 to 8 inches deep.

*Subsoil:* Reddish brown silty clay loam, quite friable, grading at 24 to 36 inches into cherty silty clay loam.

*Fertility of Soil:* Moderate.

*Moisture-Supplying Capacity:* Moderate.

*Internal Drainage and Aeration:* Good.

*Slope:* 8-10%.

*Grazing:* None.

*Remarks:* Good site; moderately severe sheet erosion and medium fertility offset by excellent physical properties of subsoil.

**Plot 4:**

*Location:* Johnson County, 2 miles southeast of Warrensburg

*Planting Date:* 1939.

*General Description:* On gently rolling upland in area of soil derived from sandstone.

*Soil Type:* Bates loam.

*Surface Soil:* Dark brown loam, 8-10 inches deep.

*Subsoil:* Brown clay loam grading into loam near 30 inches; at about 40 inches, grading into partly disintegrated sandstone.

*Fertility of Soil:* Fair.

*Moisture-Supply Capacity:* Moderate.

*Internal Drainage and Aeration:* Good.

*Slope:* 3-4%.

*Grazing:* Little at time survival was counted.

*Remarks:* Good site for deep-rooted plants, but with poor moisture supply in dry years.

**Plot 5:**

*Location:* Boone County, 3 miles southeast of Ashland.

*Planting Date:* 1941.

*General Description:* On south-facing slope on edge of ridgetop; soil of loessial origin, erosion slight.

*Soil Type:* Weldon silt loam.

*Surface Soil:* Yellowish brown silty clay and silty clay loam to 24 inches; below this, gray silty clay mottled with yellowish brown.

*Fertility of Soil:* Poor.

*Moisture-Supplying Capacity:* Good.

*Internal Drainage and Aeration:* Poor.

*Slope:* 5%.

*Grazing:* None.

*Remarks:* Even though low fertility and poor drainage of silty clay subsoil limited quality of this site, it was a fairly good one because of deep surface soil.

**Plot 6:**

*Location:* Boone County, 3 miles southeast of Ashland.

*Planting Date:* 1941.

*General Description:* Almost identical with Plot 5 and located within 150 yards of it, but this plot was on a north-facing slope, and soil was slightly more eroded.

**Plot 7:**

*Location:* Newton County, 1 mile west of Diamond.

*Planting Date:* 1941

*General Description:* Located in undulating prairie near crest of low ridge; soil derived from limestone with chert remaining in subsoil; erosion slight.

*Soil Type:* Craig silt loam (east half); Eldon silt loam (west half).

*Surface Soil:* Very dark grayish brown granular silt loam, 12-16 inches deep (both soil types).

*Subsoil:* Mottled gray and reddish-brown silty clay loam to 20-26 inches; below this, cherty silty clay loam (Craig), cherty brown subsoil starting at 14-18 inches (Eldon).

*Fertility of Soil:* Moderate (both soils).

*Moisture-Supplying Capacity:* Moderate (Craig); low (Eldon).

*Internal Drainage and Aeration:* Moderate (Craig); good (Eldon).

*Slope:* 1% (Craig); 3% (Eldon).

*Grazing:* None.

*Remarks:* Fairly good site but with poor moisture supply in dry years.

**Plot 8:**

*Location:* Pettis County, 7½ miles northeast of Sedalia.

*Planting Date:* 1940.

*General Description:* Located near the base of long, gentle slope; moderate to very severe sheet erosion, salty area near one end of plot.

*Soil Type:* Oswego silt loam.

*Surface Soil:* Brownish gray silt loam, 6 to 13 inches deep.

*Subsoil:* Mottled grayish brown and dark gray clay, very compact.

*Fertility of Soil:* Moderate.

*Moisture-Supplying Capacity:* Moderate.

*Internal Drainage and Aeration:* Poor.

*Slope:* 3-4%.

*Grazing:* Heavily grazed when survival counts were made.

*Remarks:* Poor site: because of extremely poor physical properties of subsoil, the shallowness of surface soil was critical in some parts of plot.



**Plot 9:**

*Location:* Callaway County, 6½ miles southwest of Fulton.

*Planting Date:* 1941.

*General Description:* Located on low ridge and slope; slope very severely eroded, with deep gullies.

*Soil Type:* Hatton silt loam (ridge); Lindley loam (slope).

*Surface Soil:* Light yellowish brown silt loam, about 7 inches deep (Hatton); none (Lindley).

*Subsoil:* Yellowish brown silty clay loam and clay to about 24 inches; below this, gray silty clay (Hatton). Pale brown clay to 6 inches; below this, gray sandy clay (Lindley).

*Fertility of Soil:* Low.

*Moisture-Supplying Capacity:* Moderate.

*Internal Drainage and Aeration:* Moderate.

*Slope:* 2% (Hatton); 6% (Lindley).

*Grazing:* None.

*Remarks:* The Lindley portion of the plot was so badly eroded as to test the plants very severely; the Hatton portion, being less eroded, was better, but the fertility level of this soil is very low.

**Plot 10:**

*Location:* Livingston County, 7½ miles south of Chillicothe.

*Planting Date:* 1941.

*General Description:* Northern third of the plot was located on a gentle slope and was slightly eroded; the southern two thirds was on a severely eroded area consisting largely of raw gully banks. Evidence of excessive salinity was found in eroded area.

*Soil Type:* Sampsel silt loam.

*Surface Soil:* Black silt loam about 12 inches deep in northern third, none in most of southern two thirds.

*Subsoil:* Gray mottled silty clay with shaly materials beneath; in southern part of plot, shaly materials were exposed.

*Fertility of Soil:* Low.

*Moisture-Supplying Capacity:* Moderate.

*Internal Drainage and Aeration:* Poor.

*Slope:* 3% on portion not in gullies.

*Grazing:* Heavily grazed for four years before survival counts were made.

*Remarks:* Only the northern third of plot was suitable for most plants; in the eroded portion, some of the plants evidently washed out before they were well rooted.

**Plot 11:**

*Location:* Johnson County, 1½ miles southeast of Knob Noster.

*Planting Date:* 1939.

*General Description:* Located at bottom of slope at contact of loessial material and Pennsylvanian shales; evidences of saline seepage throughout plot.

*Soil Type:* Carytown silt loam.

*Surface Soil:* Brown and grayish brown silt loam 3 to 6 inches deep.

*Subsoil:* Heavy gray and yellowish brown silty clay and silty clay loams.

*Fertility of Soil:* Low.

*Moisture-Supplying Capacity:* Moderate.

*Internal Drainage and Aeration:* Poor.

*Slope:* 2%.

*Grazing:* Heavy.

*Remarks:* This site was extremely poor; apparently, salinity was so high that few plants could survive. Even the annual grass, *Aristida* sp., was stunted and sparse.

## RESULTS

Survival percentages and relative vigor of conifers in the plots are shown in Table 1; of deciduous trees and shrubs in Table 2; and of vines, roses, and brambles in Table 3. In the tables, complete failure of a plant species within a plot was shown as 0 percent survival. When a species was not planted in a plot, the corresponding rectangle in the tables was left empty.

For the most part, survival percentages were based on accurate counts of the original plants remaining alive in 1950 and 1951. However, it was impossible to count original plants of the blackberry, the raspberry, and Japanese honeysuckle and the percentages shown for them in Table 3 are approximations of the fractions of their respective rows covered by plants of these species when the survival counts were made. The original plants of coralberry were difficult to identify in some of the plots, and the percentages shown for this plant (Table 2) are also approximations.

The relative vigor ratings (good, fair, or poor) in the tables were based on comparisons of the growth and condition of the plants involved with that of the better examples of these plants or others with similar growth form in the plantations. These ratings are far from objective, but they do furnish a means of comparing vitality.

Scientific names employed in Tables 1, 2, and 3 were those given in the Eighth Edition of Gray's Manual of Botany (Fernald, 1950) or Bailey (1949). Common names were taken from the same sources plus Martin, Zim, and Nelson (1951).

Performance of the various species of plants is discussed in detail below.

### CONIFERS

**RED CEDAR:** Survival and growth in most of the good sites were substantial and some of the best trees were more than 20 feet tall. Nevertheless, volunteer cedars of the same age or younger were much more vigorous than the planted ones in several plots. One-seed juniper (*J. mexicana*) was planted in two of the plots. It was moderately successful in one, but was inferior to red cedar both in survival and growth.

**ORIENTAL ARBOR-VITAE:** In the best sites growth was good and heights of nearly 20 feet, which is near the maximum for this species (Bailey, 1949), were attained in about 10 years. Rows of arbor-vitae were always adjacent to red cedar. Together, the two species often afforded dense cover and a good windbreak (Figure 2). Although survival arbor-vitae was not clearly related to site quality (Table 1), vigor was excellent in the four best sites, with some trees reaching 15 feet or more in each.

TABLE 1 -- PERCENT SURVIVAL AND RELATIVE VIGOR OF CONIFERS

SPECIES	PLOT NUMBERS (Higher Plot Numbers Indicate Poorer Sites)											Average Survival
	1	2	3	4	5	6	7	8	9	10	11	
Red cedar ( <u>Juniperus virginiana</u> )	40% Good Vigor	84% Good Vigor	32% Poor Vigor	76% Good Vigor	58%* Good Vigor	62%* Good Vigor	4% Poor Vigor	56% Fair Vigor	36% Fair Vigor	0% --	4% Poor Vigor	44%
Oriental arbor-vitae ( <u>Thuja orientalis</u> )	20 Good	36 Good	52 Good	60 Good	46 * Fair	72 * Good	0 --	52 Good	44 Fair	8 Poor	0 --	39
Short-leaf pine ( <u>Pinus echinata</u> )		64 Good			48 * Poor	40 * Poor	8 Poor		40 Fair	0 --		36

\* Sample size = 50; all others = 25.

TABLE 2 -- PERCENT SURVIVAL AND RELATIVE VIGOR OF DECIDUOUS TREES AND SHRUBS

SPECIES	PLOT NUMBERS (Higher Plot Numbers Indicate Poorer Sites)											Average Survival
	1	2	3	4	5	6	7	8	9	10	11	
Coralberry ( <i>Symphoricarpos orbiculatus</i> )**		52% Fair Vigor			100%* Poor Vigor	96%* Poor Vigor	76% Fair Vigor		64% Fair Vigor	60% Fair Vigor		81%
Gray dogwood ( <i>Cornus racemosa</i> )	80 Good	100 * Good	88 Good		74 * Good	62 * Good	28 * Fair	52 Good	80 * Fair	16 * Fair		63
Wild plum ( <i>Prunus americana</i> )	100 Good	88 Good	56 Fair	60 Good	92 * Good	92 * Good	28 Poor	4 Poor	52 Poor	16 Fair	0 --	51
Tartarian honeysuckle ( <i>Lonicera tatarica</i> )	76 Good	48 Fair	88 Good	80 Good	78 * Good	92 * Good	4 Poor	56 Good	20 Fair	0 --	0 --	48
Southern black-haw ( <i>Viburnum rufidulum</i> )		76 Good	24 Fair		60 * Good	80 * Good	20 Fair	0 --	60 Poor	8 Fair		47
Red haw ( <i>Crataegus</i> spp.)	76 Good	100 Good	36 Good				64 Good	12 Poor	32 Poor	4 Good		46
Wild crab ( <i>Pyrus ioensis</i> )	0 --	88 Fair	48 Fair				56 Good	16 Fair	64 Poor	28 Fair		43
Bicolor lespedeza ( <i>Lespedeza bicolor</i> )	16 Poor	40 Good	72 Good		42 * Fair	48 * Fair	0 --	12 Poor	72 Good	0 --		36
Wahoo ( <i>Euonymus atropurpureus</i> )	68 Good	48 Fair	48 Good		38 * Poor	30 * Poor	16 Poor	8 Fair	16 Poor	0 --		31
Common lilac ( <i>Syringa vulgaris</i> )	16 Fair	40 Good	84 Fair	36 Good	40 * Poor	56 * Poor	0 --	4 Fair	20 Poor	40 Fair	12 Poor	30
Persimmon ( <i>Diospyros virginiana</i> )		0 --					0 --		0 --	0 --		0

\* Sample size = 50; all others = 25.

\*\* Survival percentages approximate.

TABLE 3 -- PERCENT SURVIVAL AND RELATIVE VIGOR OF VINES, ROSES AND BRAMBLES

SPECIES	PLOT NUMBERS (Higher Plot Numbers Indicate Poorer Sites)											Average Survival
	1	2	3	4	5	6	7	8	9	10	11	
<b>A. VINES</b>												
Japanese honeysuckle ( <i>Lonicera japonica</i> )**	100% Good Vigor		100% Good Vigor					0% --				67%
Grape ( <i>Vitis</i> spp.)	40 Good	64 Fair	48 Good		20 * Good	24 * Good	36 Good	0 --	72 Poor	12 Fair		33
Bittersweet ( <i>Celastrus scandens</i> )	16 Fair	64 Poor	48 Poor				28 Good	0 --	4 Poor	8 Poor		24
<b>B. ROSES &amp; BRAMBLES</b>												
Multiflora rose ( <i>Rosa multiflora</i> )	100 Good	100 Good	96 Good	84 Fair	90 * Good	88 * Good	80 Good	88 Good	84 Fair	48 Fair	0 --	69
Black raspberry ( <i>Rubus occidentalis</i> )**	100 Good		100 Good	52 Good				32 Good			0 --	54
Prairie rose ( <i>Rosa setigera</i> )	20 Poor		20 Fair	0 --				68 Poor			4 Fair	30
Blackberry ( <i>Rubus allegheniensis</i> )**		12 Fair					40 Fair		20 Poor	16 Fair		22

\* Sample size = 50; all others = 25.

\*\* Survival percentages approximate.



Fig. 2—Dense growth of oriental arbor-vitae (left) and red cedar (right) formed windbreaks.

**SHORT-LEAF PINE:** Survival was variable but averaged 36 percent. In a series of 274 forest tree plantings containing short-leaf pine, Dingle and Fletcher (1955) found an average survival of 40 percent for this species. None of the wildlife trial plantings were within the range of the short-leaf pine in Missouri as shown by Liming (1946).

### **OTHER CONIFERS**

Several conifers not included in Table 1 were tested in the two Ashland plots (5 and 6); 100 plants of each species were planted. Average survival percentages for these species were as follows: jack pine (*P. banksiana*), 72 percent; pitch pine (*P. rigida*), 49 percent; Scotch pine (*P. sylvestris*), 43 percent; ponderosa pine (*P. ponderosa*), 42 percent; and Jersey pine (*P. virginiana*), 37 percent.

Although in these two plots several pines survived at least moderately well, the average survival of red cedar and oriental arbor-vitae (60 percent and 59 percent, respectively) in these two plots was exceeded by none of the pines except jack pine. It should be noted that more elaborate survival data for some of these pines were presented by Dingle and Fletcher (1955).

Bald cypress (*Taxodium distichum*) was tried in upland sites on the Ashland plots. Survival averaged 41 percent and growth of some of the trees was good.

### DECIDUOUS TREES AND SHRUBS

**CORALBERRY:** This species, often known in Missouri as "buckbrush", showed the best average survival (81 percent) of all plants tested. As was pointed out above, the survival counts for this species were only approximate, because it was often impossible to identify the original plants. Nevertheless, coralberry was tenacious even on the shallow soils of plots 9 and 10. Spreading occurred, but it was confined to the vicinity of the original rows.

**GRAY DOGWOOD:** Survival and growth of this plant were very good; apparently it is well adapted to a wide variety of site conditions in Missouri. Survival was high on the deep loess of Plot 1 on the one extreme, and on the eroded soil of Plot 9 on the other. Trees were as much as 10 feet tall in several plots. Gray dogwood had spread in most of the plots (Figure 3), but it posed no real threat to agricultural lands.

**WILD PLUM:** Like gray dogwood, wild plum survived well, had considerable vigor, and was spreading within the plantings. No plants were seen in the agricultural lands surrounding several of the plots, but the plum's habit of sprouting from roots is well-known (Van Dersal, 1938b:201). In



Fig. 3—Gray dogwood spread on most plots, though it posed no real threat to agricultural lands. The man's hands are on trees of original rows.



Fig. 4—Hedge of Tartarian honeysuckle.

the more fertile sites, wild plum reached heights of 12 feet. Survival was highest in the four plots having soils with the best moisture-supplying capacity (Plots 1, 2, 5, and 6).

**TARTARIAN HONEYSUCKLE:** Apparently, site requirements for this species are higher than those for many deciduous trees and shrubs tested. Survival and vigor were good in the better sites with plants forming dense hedges 10 feet or more in height (Figure 4). In most of the sites with extremely shallow soils, survival was low. No spreading was noted.

**BLACK HAW, RED HAW, WILD CRAB:** These three species had average survival rates slightly less than 50 percent. In general, they grew more slowly than did wild plum, having attained maximum heights of about 8 feet when the survival counts were made. Figure 5 pictures red haw in Plot 1 in 1955, 15 years after planting.

**BICOLOR LESPEDEZA:** Although survival was quite variable, this plant showed good growth, up to 10 feet in one plot. Apparently, seed production was low.

**WAHOO:** Survival was low and growth poor in most cases, but both survival and vigor corresponded very closely with site quality. In plots 5 and 6, cottontails browsed it repeatedly, and doubtless contributed greatly to its poor performance there.





Fig. 5—Red haw in plot 1, fifteen years after planting. Tartarian honeysuckle row at left; multiflora rose now at right.



Fig. 6—Volunteer persimmon trees invading plot (left center); all planted persimmon trees died.

COMMON LILAC: Survival and growth were generally poor, especially where the plants were shaded or grazed.

PERSIMMON: This plant was of interest primarily because planting attempts resulted in complete failure; yet volunteer persimmons were aggressive in invasion of some plots (Figure 6).

### OTHER DECIDUOUS TREES AND SHRUBS

Several deciduous species not included in the other plots (and hence omitted from Table 2) were tested in the Ashland Area plantings (plots 5 and 6). These species and the average survival in the two plots, based on a total of 100 plants, were:

Green ash (*Fraxinus pennsylvanica* var. *subintegerrina*), 95 percent

White ash (*Fraxinus americana*), 94 percent

Osage orange (*Maclura pomifera*), 79 percent

Black locust (*Robinia Pseudo-Acacia*), 72 percent

Black cherry (*Prunus serotina*), 54 percent

Northern red oak (*Quercus rubra* var. *borealis*), 41 percent

Black walnut (*Juglans nigra*), 40 percent

Tulip-poplar (*Liriodendron Tulipifera*), 35 percent

White mulberry (*Morus alba*), 20 percent

In plots 5 and 6, the growth of the two species of ash was very good, but the trees, being tall and with relatively little branching, afforded almost no cover in winter. Black cherry, with 54 percent survival, showed considerable vigor. Most of the other trees of this group performed poorly in these plots. Black locust was riddled by borers, and in most cases, the "survivors" were actually sprouts. Osage orange and black walnut grew poorly, and northern red oak was extremely slow-growing. Only a third of the tulip-poplars survived 10 years after planting, and many of these succumbed later, in the drouth year of 1954.

Survival of Osage orange, black walnut, and green ash in the Ashland plots may have been unusually high, as the survival percentages for the same species reported by Dingle and Fletcher (1955), based on examination of about 120 plots, were much lower. However, their figure for black locust, 64 percent, (based on 250 plots) was similar to the Ashland percentage, 72 percent.

### VINES, ROSES AND BRAMBLES

JAPANESE HONEYSUCKLE: This species was planted in only three plots; in two of these, it afforded dense cover in the planted rows and immediate vicinity; in the third, it failed completely. This plant can be very aggressive, and though it is often useful to wildlife it is regarded as a pest in the south (Warbach, 1953).



Fig. 7—Multiflora rose persisted on steep raw gully banks.

**BITTERSWEET AND WILD GRAPE:** These plants performed rather poorly in the trials, but in several plots there was no satisfactory upright support for them. In such cases, the vines were sometimes suppressed by dense growth of herbaceous species. Probably most of the wild grape plants tested were *Vitis vulpina*; in some trials they were so labeled.

**MULTIFLORA ROSE:** Aside from coralberry, this rose had the highest average survival percentage of any species in the plots and as was pointed out above, the survival percentages for coralberry were often approximations. Multiflora rose had high survival percentages except in plot 11, a site with saline seepage, where it failed completely. Vigor was generally good and, after about 10 years, many plots had rose hedges up to 8 or 10 feet tall. Multiflora rose was able to cope with adverse sites, and in plot 10, remained alive, though rooted on steep, raw, gully banks (Figure 7).

Some spreading in the plots and in unimproved pastures in their immediate vicinity was noted in Livingston County (Plot 10) and at the Ashland Plots (5 and 6), Boone County. Within the two plots in southwest Missouri, (1 and 7) there was so much spreading that it was difficult to walk through them (Figure 8). Dispersal of seed by birds and water drainage evidently accounted for much of the spreading, as was also found in the southeastern U. S. by Rosene (1950). No spreading was noted in hay or crop lands adjacent to these plots.

In idle lands near some study plots, native species such as persimmon, red cedar, and sassafras were spreading more vigorously than multiflora rose; moreover, this rose usually did not grow too large for small farm tractors to combat it mechanically.

**BLACK RASPBERRY:** The variant of *Rubus occidentalis*\* tested in several plots (labeled "*Rubus sp.*") formed dense ground cover in summer in moist or partly shaded positions where surface soil was rather deep.

\*Specimens were sent to the Bailey Hortorium.



Fig. 8—Tangle of multiflora rose invading plum row (left foreground).

**PRAIRIE ROSE:** Many plants of this species had flourished for a time in the plots, but had died by the time the survival counts were made.

**BLACKBERRY:** Counts of the native blackberry (*Rubus allegheniensis*) could be only rough approximations; nevertheless, it was clear that survival of this species was generally poor. Near the plantings, vigorous natural thickets of blackberry were frequently found.

## DISCUSSION

The most impressive performance in the trials of wildlife food and cover plants was that of multiflora rose, with its adaptability to a wide range of site conditions. Only in dense shade or on exceedingly shallow soils did it show anything short of good vigor. Survival was good except under extremely adverse site conditions involving shallow soil with high salinity. Average survival of the rose was exceeded only by that of coralberry, for which counts were approximate and tests limited to six of the 11 plots. The only other plant with an average survival percentage approaching that of the rose was Japanese honeysuckle, which was impossible to count accurately and which was placed only in three of the plots.

High survival rates for multiflora rose are not unusual, particularly following good early cultural practices (Anderson, 1952). Indeed, the survival rates in the present trials were somewhat lower than those reported for other (mainly demonstration) plantings which doubtless received more early care. The important fact is the excellent performance of the rose in comparison with the other plant species in the plots of this study. Even though much remains to be learned about the utility of multiflora rose to wildlife (Marshall, 1953), the results of this study affirm that as far as survival, vigor, and permanence of planting are concerned, action agencies have chosen one of the best species yet tested for cover restoration work in Missouri.

It is obvious that the encouragement to be given a plant species for game food and cover planting on the farm should depend upon several features besides its adaptability to local site conditions. Among these are: (1) the plant's utility to wildlife (2) its acceptability to the farmer, (3) the plant's utility in soil conservation and (4) its resistance to grazing.

Species showing the best performance (in addition to multiflora rose) are discussed below.

### *Conifers*

Red cedar and oriental arbor-vitae both have the disadvantage of only moderate survival in the plots. On the other hand, both showed generally good vigor and provided dense cover throughout the year. Red cedar has an extremely long list of consumers among North American birds and mammals (Van Dersal, 1938a). It occurred in about 16 percent of 440 Missouri deer stomachs examined by Korschgen (1954) but it is generally regarded as inferior forage for deer.

American arbor-vitae or white cedar (*Thuja occidentalis*) is recognized as a staple deer food in northern states. (For example, see Nelson, 1951: v,vii). The closely related oriental species was browsed by deer in the Ashland Area plots, and some trees showed distinct browse lines.

Because of the cedar-apple rust, red cedar cannot be encouraged near apple orchards. Planting this tree in areas where it is already present in quantity has questionable virtue, particularly since naturally seeded trees often outstrip the planted ones. In other situations, both red cedar and oriental arbor-vitae may have real value. Red cedar has been included for several years in wildlife bundles distributed by the Missouri Conservation Commission.

### *Deciduous Trees and Shrubs*

Among the small deciduous trees, gray dogwood and wild plum survived and grew well. Fruits of both are used to some extent as food by wild animals (Van Dersal, 1938b:110, 201; Korschgen, 1955a, 1955b) and both provide thickets which are used as cover, particularly in summer. Both species spread within the plots and, although they seem to constitute no real threat to agriculture, the plum is sometimes regarded as a nuisance. Both plants have the obvious disadvantages of affording little cover for game in the winter and of failing to provide low-growing ground cover.

Coralberry has some of the attributes these plants lack: it furnishes good protection close to the ground, it is a *very* important food plant, especially for Missouri deer (Korschgen, 1954), and it had the highest survival rate of any plant in the trials. It forms thickets by means of decumbent stems and is said to be an excellent plant for erosion control (Van Dersal, 1938b:268; Dambach, 1948). Its habit of spreading by these stems also makes it undesirable in some places, particularly near pastures.

Tartarian honeysuckle formed excellent hedges in the better sites and,

as also noted in the northeast by Edminster and May (1951), it withstood browsing by cattle better than did most of the non-thorny plants tested. Only one Tartarian honeysuckle plant was observed out of place in or near any of the plots and even this one may have been planted there. At the University of Wisconsin Arboretum, this plant is spreading very badly but it is much used for food or cover by cottontails, pheasants, and songbirds (R. A. McCabe, letter).

### *Vines, Roses, and Brambles*

At least in summer, black raspberry provided desirable, dense, low-growing cover in the Missouri plots. It probably is useful as food for many wild animals, if like other members of its genus. (See Martin, Zim, and Nelson, 1951:325-326.) When several of these plants were transplanted from a distant plot to the Ashland Wildlife Research Area, they were immediately eaten to the ground by cottontails. Raspberry was promising for soil-holding in the better sites and, in general, seemed worth further trials. It appeared unlikely that this plant would become a nuisance through spreading.

Although survival of wild grapes in the plots was rather poor, these plants are perhaps worthy of further trials because of their great use by wild animals as food. Grapes are taken in quantity by quail, deer, and many species of ducks in Missouri, particularly the wood duck (Korschgen, 1952, 1954, 1955b). If grapes were planted at the edges of "odd areas" or abandoned fields where they had ample upright support, they might show better survival and provide both food and tangled cover for wildlife.

In general, it is unfortunately true that most of the plants which were aggressive enough to survive and grow best in these wildlife trials also had some tendency to spread. This was true of coralberry, multiflora rose, gray dogwood, wild plum, and other small deciduous trees, but apparently not of Tartarian honeysuckle under Missouri conditions. The only intensive observations of spreading were made in the wildlife trial plantings or in their immediate environs; here none of these plants seemed to be a real threat to cropped fields, hayfields, or to improved pastures. Multiflora rose was seen spreading along fence rows and in portions of pastures not reached with the mower but was absent wherever there was cultivation or repeated mowing.

The sizeable number of native species like red cedar, coralberry, gray dogwood, and wild plum, which performed at least moderately well in the wildlife trials, serves as a reminder that often "odd areas" on the farm contain at least part of their own potential planting stock for wildlife food and cover. In such cases, simple protective measures for these plants would go far toward accomplishing habitat restoration.

### SUMMARY

One attempt to meet the problem of diminished game food and cover on the farm has been the provision of plants which fill these needs and yet are compatible with modern farming. In Missouri, one of the earlier tests

of plants which might be promising in this connection was made by the U. S. Soil Conservation Service. This agency sponsored several small plantings called "wildlife trials" on farmland in central and southwest Missouri in the late 1930's and early 1940's. In addition, similar plantings were made on the University of Missouri's Ashland Wildlife Research Area in 1941.

All these plantings were visited in 1950 and 1951. Survival counts were made and notes on vigor recorded. This bulletin is an analysis of performance of the plants after 10 to 13 growing seasons.

Of the 21 species for which survival data were available in more than two of the plots, three were conifers; 11, deciduous trees and shrubs; and seven were vines, roses or brambles. Among these, coralberry ("buckbrush") showed the highest average survival rate (81 percent) of any plant tested in more than two plots; however, counts for this species were approximate, and the plant was present in but six of the 11 plots. Vigor of coralberry plants was moderate in most plots.

Multiflora rose had an average survival rate of 67 percent, and vigor was generally good. It was planted in all the plots. These results demonstrated once more the great hardiness of multiflora rose under a wide range of site conditions. The results also showed that for survival, vigor, and permanence, this rose was a good choice for the widespread distribution it is receiving from conservation agencies.

Other plants which showed good survival and growth over a wide variety of conditions included gray dogwood and wild plum. Tartarian honeysuckle and a variant of black raspberry showed good survival and growth in moderate or good sites. These plants seem to merit further trial in Missouri. Red cedar and oriental arbor-vitae showed only moderate survival but provided dense, rather durable cover.

Failures of plants were due to many causes and, for the most part, records were not detailed enough to assess them accurately. As a consequence, this study showed only the relative performance of the plants tested.

Most of the plants which were aggressive enough to grow well under the varied and often severe conditions which they met in these trials, tended to spread within the plantations. In the immediate vicinity of the plots, none of these plants were threatening cropped land, hayfields, or improved pastures, but several multiflora rose plants were established in fence rows and in portions of adjacent pastures which could not be mowed. In idle lands near some plots, multiflora rose was spreading less vigorously than such native species as persimmon, sassafras and red cedar, and the rose usually did not grow too large for small farm tractors to combat it mechanically.

The sizeable number of native species which performed at least moderately well in the wildlife trials serves as a reminder that odd areas on the farm often contain at least part of their own planting stock for wildlife food and cover.

## LITERATURE CITED

- Ager, J. 1951. Habitat development plantings... how patterns determined. *Oudoor Nebraska*. 29(4):17-18, 41.
- Aldous, S. E. 1949. Experimental planting of food and cover for deer. U. S. Fish and Wildl. Ser. Wildl. Leaflet 320. 9 pp.
- Anderson, W. L. 1952. Facts about multiflora rose. U. S. D. A. Soil Cons. Ser. Upper Miss. Reg. Tech. Note No. 20. Biol. No. 12. 8 pp. (mimeo).
- Bailey, L. H. 1949. Manual of cultivated plants. Macmillan, N. Y. 1116 pp. (Rev. Edit.)
- Cook, D. B., and F. C. Edminster. 1944. Survival and growth of shrubs planted for wildlife in New York. *Jour. Wildl. Mgt.* 8:185-191.
- Cromie, G. A., and R. Kienholz. 1939.\* Survival and growth of exotic game-food shrubs. Conn. Agr. Exp. Sta. and Conn. For. Dept. Rept. Prog. Cir. 6.2 pp. (mimeo.)
- Dambach, C. A. 1948. New lessons from old plantings. *Jour. Soil and Water Cons.* 3:165-169.
- Dingle, R. W., and P. W. Fletcher. 1955. A survey of forest tree plantings in Missouri. Univ. of Mo. Coll. of Agr. Exp. Sta. Bul. 640. 20 pp.
- Dobie, J. G., and W. H. Marshall. 1954. Notes on the results of certain CCC plantings on the Paul Bunyan State Forest, Minnesota. *Jour. Wildl. Mgt.* 18:531-533.
- Edminster, F. C., and R. M. May. 1951. Shrub plantings for soil conservation and wildlife cover in the northeast. U. S. D. A. Cir. No 887. 68 pp.
- Fernald, M. L. 1950. Gray's manual of botany. (8th Edit.) American Book Co., N. Y. 1632 pp.
- George, E. J. 1953. Tree and shrub species for the northern Great Plains. U. S. D. A. Cir. No. 912. 46 pp.
- Korschgen, L. J. 1952. Analysis of the food habits of the bobwhite quail in Missouri. Mo. Cons. Comm. Fish and Game Div. P-R Series No. 7. 59 pp.
- Korschgen, L. J. 1954. A study of the food habits of Missouri deer. Mo. Con. Comm. Fish and Game Div. P-R Series No. 11. 43 pp.
- Korschgen, L. J. 1955a. Food habits of the mourning dove in Missouri. Mo. Cons. Comm. Fish and Game Div. P-R Series No. 12. 31 pp.
- Korschgen, L. J. 1955b. The fall food habits of waterfowl in Missouri. Mo. Cons. Comm. Fish and Game Div. P-R Series No 14. 41 pp.
- Liming, F. G. 1946. The range and distribution of shortleaf pine in Missouri. U. S. D. A. For. Ser. Cent. States For. Exp. Sta. Tech. Paper No. 106. 3 pp. (mimeo.)
- Marshall, W. H. 1953. A survey of farm-game habitat restoration programs in fifteen states. *Trans. N. Am. Wildl. Conf.* 18:390-411.
- Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. American wildlife and plants. McGraw-Hill Book Co., N. Y. 500 pp.
- Nelson, T. C. 1951. A reproduction study of northern white cedar. Game Div., Dept. of Cons., Lansing, Mich. 100 pp.
- Rogers, N. F. 1951. Strip-mined lands of the western interior coal province. Univ. of Mo. Coll. of Agr. Exp. Sta. Bul. 475. 55 pp.
- Rosene, W., Jr. 1950. Spreading tendencies of multiflora rose in the southeast. *Jour. Wildl. Mgt.* 14: 315-319.
- Schreiner, K. M. 1953. Survival in wildlife plantings. *North Dakota Outdoors*. 15(11):26.
- Van Dersal, W. R. 1938a. Utilization of woody plants as food by wildlife. *Trans. N. Am. Wildl. Conf.* 3:768-775.
- Van Dersal, W. R. 1938b. Native woody plants of the United States. Their erosion-control and wildlife values. U. S. D. A. Misc. Pub. No. 303. 362 pp.
- Warbach, O. 1953. Control of Japanese honeysuckle in wildlife borders. *Jour. Wildl. Mgt.* 17:301-304.