A RECORD AND EVALUATION OF TREES ON THE KANSAS STATE UNIVERSITY CAMPUS

by

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B. S. in Forestry, University of Missouri, 1950

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Horticulture

KANSAS STATE UNIVERSITY
OF AGRICULTURE AND APPLIED SCIENCE

1960

TABLE OF CONTENTS

INTRODUCTION

On the border between forest and prairie, Kansans have learned to appreciate the beauty and utility of trees. As a result, there is a constant search or effort to find new species that will serve a variety of needs. The farmstead windbreak, the field shelterbelt, the woodlot and post planting; these serve to strengthen and enhance our farm economy, but there is also a demand for trees that will serve our communities and beautify our homes.

The task is not an easy one. Each use or solution exacts its own set of requirements which limit the choice of trees. The selection of adapted tree species that will most nearly meet our needs is further complicated by the adverse effects of our climate. Occasional extremes in temperature, high winds, low rainfall, low humidity, and other elements of a Great Plains climate all combine to limit the variety of our selections. Marginal growing conditions also tend to aggrevate common insect and disease problems.

To fill this need for basic information regarding adapted species and varieties, Kansas State University scientists have conducted both formal and informal studies from the time of our first administration. Starting with treeless farmland, the campus has literally served as an outdoor laboratory for experimentation with new species of trees and shrubs.

This thesis has been designed to bring these studies up to date, and to summarize and evaluate the findings so that they may provide a much needed source of information on one of our most common problems.

HISTORY

General

The present University traces its origin to territorial days, even before the coming of the railroad. Bluemont Central College, later to become Kansas State Agricultural College, was founded by Manhattan city fathers in the year 1858. Under the original charter they were "empowered to establish an agricultural department with professors to test soils, experiment in the raising of crops, the cultivation of trees, and upon a farm set apart for the purpose," (Willard, 1940). With the passage of the Morrill Act in 1862, the College was offered to the State of Kansas for use as a College of Agriculture and Mechanic Arts.

Accepted by the Legislature and approved by the Governor in 1863, the institution officially became the Kansas State Agricultural College.

Early years were marked by inadequate financial support and it was not until 1867 that the first appropriation was made for agricultural purposes. A portion of this money was used to plant the first forest trees on the old farm, (Willard, 1940).

The present campus came into being in the year 1871, when the township of Manhattan voted bonds to purchase the new college farm. The farm, comprising 155 acres, was purchased at a cost of $29,832.71, (Creager, 1891). Three farms made up the quarter section including the Elbridge Gale forty on which Reverend Gale operated a nursery. In 1875 when the work of the college was transferred to this new farm, the Gale Nursery and plantings became a part of the present campus, (Willard, 1940).

Tree Planting

Along with the acquisition of his land, Reverend Gale was appointed instructor in horticulture and made superintendent of the nursery he had operated. He served the college in this capacity until 1878 and was probably responsible for the first tree planting on the new campus.

H. J. Waters (1914) in his "Record of Alumni" describes the appearance of the campus in its infancy. "In 1879, with the exception of the old cottonwoods and the hackberry on the slope southeast of Anderson, there were no trees of any size on the campus."

The first landscape work of large scope began in 1885 when Professor Maximilian Kern, of Columbia, Missouri, was employed to prepare a general plan for the campus, (Willard, 1940). In his planting plan, Professor Kern grouped different species of the same genus so that the campus might serve as an outdoor laboratory. Many of the trees and shrubs which constituted the early fundamental framework were planted in March of that year.

Following this early work, and throughout much of the college history, the responsibility for the care and development of the campus was assigned to the department of horticulture. Department heads, professors of landscape design, and foresters; a succession of devoted men, each made a contribution to the campus. Following are some of the men who helped pioneer the early work in the planting at Kansas State University:

1870-78 E. Gale, Professor of Horticulture

1878-79 H. E. Van Deman, Professor of Horticulture

1879-94 E. A. Popenoe, Professor of Horticulture

1897-98 E. E. Faville, Professor of Horticulture

1901-30 Albert Dickens, Professor of Horticulture

EXPLANATION OF PLATE I

Early View of Campus - 1885

PLATE I

State Agricultural College, Manhattan, Kansas 1885

1910-13 C. A. Scott, Kansas State Forester

1913-15 M. F. Ahearn, Professor of Horticulture

1919-20 A. M. Doerner, Professor of Horticulture

1921-24 W. S. Wiedorn, Professor of Horticulture

1924-26 Arthur Helder, Professor of Horticulture

1926-27 W. C. Frost, Professor of Horticulture

1927- L. R. Quinlan, Professor of Horticulture

R. J. Barnett (1945) in his notes, states that "the man who will leave the deepest imprint on the design and plants of our campus is L. R. Quinlan." Certainly, he has, during his long term of service, made many outstanding contributions to the campus. Without his basic work, this study would not be possible, for it was he who first began the systematic study of campus plantings.

In order to handle the increasing work load of grounds maintenance at an institution of this size, the administration in 1952 transferred the work of the grounds section from Horticulture to the Physical Plant Department. R. A. Smith, who supervised the building and repair section was given the responsibility for this work.

In January of 1956, the grounds section was reorganized and Thomas Shackleford, a landscape architect, was hired to serve in the newly created position of Supervisor of Campus Maintenance. From 1956 to the present, Mr. Shackleford has been directing the grounds work.

CLIMATE

Under normal climatic conditions, the Kansas State University campus is hospitable to a wide range of genera and species, but sometimes, the

abnormal appears to be the norm. The extremes then often become the limiting factor in establishing certain species.

Merriam (1898), in his study of air temperature zones as affecting tree distribution, concludes that air temperature is an important factor in fixing the limits beyond which particular species can not extend. His studies suggest that the northern distribution of plants in the northern hemisphere is governed by the sum of positive air temperatures for the entire growing season, and that the southern distribution is governed by the mean temperature of a brief period during the hottest part of the year.

Atmospheric moisture and length of growing season are also critical climatic factors which are of prime importance in determining species which can be established in eastern Kansas.

The annual mean temperature for Kansas is 55.0°F. with a daily range between high and low point of approximately 20.0°F. Afternoon temperatures average around 43.0°F. in January and approximately 94.0°F. in July. Readings of zero, or lower, usually occur on about eight days, and readings of 100.0°F. on about 10 days, each year in the eastern part of the state, (Flora, 1948).

The average date of the last killing frost in the spring at Manhattan, is April 23. The average date of the first killing frost in the fall is October 12, with the average growing season being 172 days long, (Flora, 1948).

The prevailing wind direction in all parts of the state is from the southwest, April to November inclusive. During January, February and March, winds are northerly. Average mid-day and evening relative humidites in July range from 45 to 50 percent in eastern Kansas, (Flora, 1948).

Atmospheric humidity largely governs the absorbing or evaporating capacity of the air and together with air temperature and wind, it affords a reasonably close indication of evaporation and consequently the rate of transpirational water loss. A roughly inverse relation exists between relative humidity and evaporation and transpiration, (Toumey, 1947). Evaporation data for Manhattan (average) are indicated in Table 1.

Table 1. Evaporation data in inches.

	April	July
Mean Monthly	6.19	10.6
Maximum Monthly	8.91	15.2
Minimum Monthly	4.30	7.5

Precipitation, as it affects available soil moisture, also governs tree distribution and the success of introductions. Of particular importance is the distribution of precipitation through the year, especially when total rainfall is not heavy.

Average annual precipitation for Riley County is 32.03 inches. Distribution of rainfall in the eastern third of the state is excellent with 70 to 77 percent of the annual total coming during the six months from April to September, (Flora, 1948). Although precipitation during winter months is necessary, this high proportion of summer rainfall is certainly more effective in promoting tree growth.

The month of least precipitation is January, when only 3 percent of the year's fall of moisture occurs. There is a steady increase in normal precipitation until June, which on the average receives more rain than any

other month, (Flora, 1948). See Table 2.

Table 2. Normal precipitation by months - inches. Riley County.

J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	TOTAL
.71	1.22	1.62	2.66	4.43	4.61	3.73	4.24	3.93	2.25	1.77	.86	32.03

In the east half of the state, there is a decrease of 20 to 40 percent in normal rainfall between the two-week period ending with July 15 and the following two weeks, after which the normal again rises through August. This period of deficiency could seriously affect the establishment of trees.

In 1936, (the driest year on record) average rainfall was only 18.31 inches. Also during that period, in 1934, average mean maximum temperatures in July were 100.0°F. to 105.0°F. (Flora, 1948).

In 1956, the total annual precipitation again dropped to a low of 22 inches. These periodic dry cycles have been responsible for a high rate of mortality, particularly among genera and species not well adapted to dry land conditions.

PROCEDURES

Soil Studies

Soil properties, particularly as the affect available soil moisture and drainage, have an important bearing on the selection and establishment of tree species. Although some trees such as Siberian Elm and Honey Locust are able to adapt to many situations, others are restricted to a rather narrow range of soil conditions.

A number of factors, or soil characteristics, are important in their

effect on tree growth. Depth of the soil to a limiting layer or substratum such as bedrock, compact horizons and claypans, for example, has a significant effect on both growth and survival. Tree growth often is closely related to the thickness of friable soil above such layers (Stone and Lemon, 1957). Shallow soils with storage capacities of less than a few inches often cannot supply moisture long enough to maintain growth through periods of drought.

Soil texture is also highly important as it affects the storage capacity and drainage conditions. Together with soil depth, these factors largely govern the quality of a particular soil for tree growth.

Soils in the original campus study area vary largely by their topographic situation. The higher terrace, or bench, which makes up the western portion of the square consists of loess-like soils, while the lower terrace consists of alluvial deposits.

In the spring of 1960 an extensive soil reconnaissance survey was made on the campus in order to identify predominant soil types and determine the range of site conditions. Preliminary observation led first to a general subdivision of the campus into three areas, based largely upon topographic position and surface soil conditions.

Random soil profile samples to a depth of 72 inches were then taken within each of these areas. A total of thirteen samples were taken, including six in Area I, five in Area II and two in Area III. With the exception of disturbed sites, the soil analysis was rather uniform within each area, but there was a distinct variation between areas.

Although excavation and backfill resulting from extensive construction has often changed the profile near foundation lines, this study indicates

that there are three distinct soil series on the campus. The three areas mentioned above and the soil series associated with each can be described as follows:

Area I. This area consists of the higher terrace and includes most of the west half of the campus together with the hill in the northeast corner. (See Plate II). In this area, the GEARY SOIL SERIES is predominant. However, stratified sands and buried A horizons were encountered which indicate that this area is by no means completely uniform.

The Geary series includes the well drained, moderately dark colored, moderately fine textured, Reddish Prairie soils which have developed in reddish brown loess or loess-like materials. These soils occur in the transition belt between the Chernozem and Prairie Zones.

Soil Profile: Geary Silty Clay Loam.

A_1	0 - 8"	Grayish to dark grayish brown, light silty clay loam; moderate very fine granular structure; non calcareous, acid.
AB	8 - 14"	Dark gray, silty clay loam, strong very fine subangular blocky structure; firm, extremely hard, non calcareous, acid.
B_2	14 - 42"	Gray brown to dark brown, silty clay; moderate to weak blocky structure; very firm, very hard; non calcareous, acid.
B_3	42 - 52"	Pale brown and yellow brown, many fine distinct mottles; silty clay; massive structure; very firm extremely hard, non calcareous, acid.
C	52 - 60"+	Pale brown and yellowish red, silty clay; many fine distinct mottles; massive structure; firm, extremely hard; non calcareous, acid.

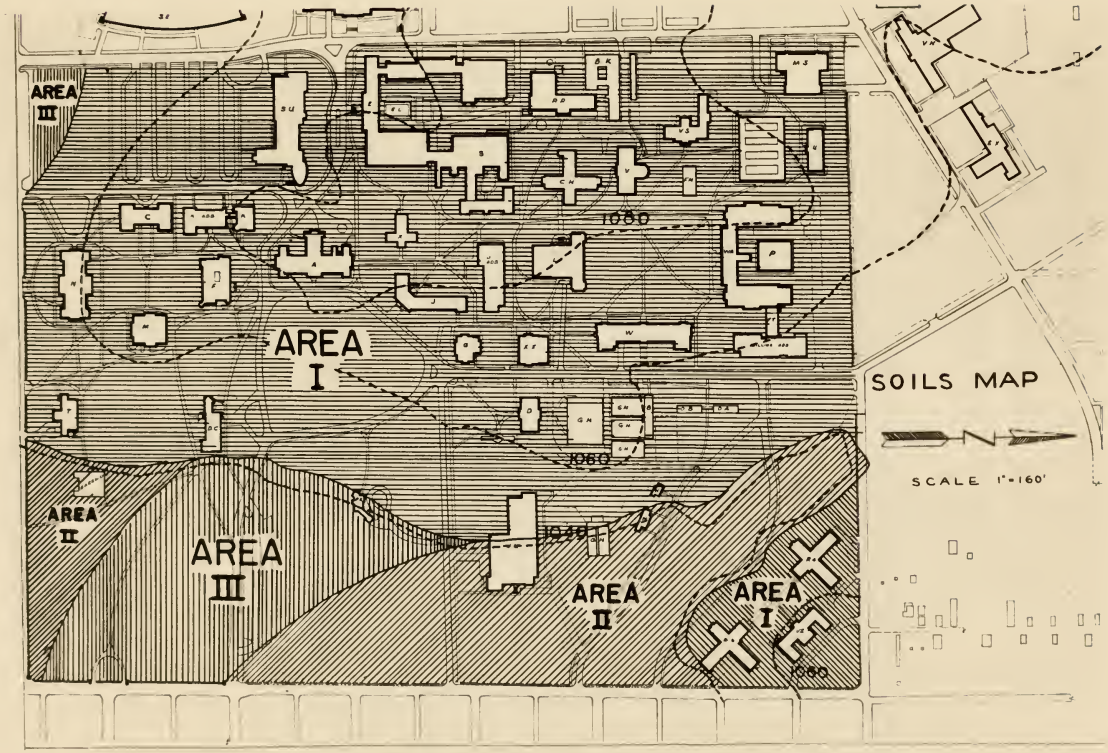
Area II. This area consists of that portion of the lower terrace now covered by recent alluvial deposits. It includes the small drainage area at the northeast corner of the square and fans out to include most of the

EXPLANATION OF PLATE II

Map of Soil Areas

Kansas State University Campus

PLATE II


AREA III
AREA I
AREA II
AREA III
AREA II
AREA I
1080
1060
1040
1060
SOILS MAP
SCALE 1"=160'

east central portion of the campus. It also occurs again in the southeast corner. There has been less disturbance in this area and consequently profiles were more uniform. However, probing on April 11, 1960 revealed a high water table (at 36") along the stream in this area.

Soil Profile: Un-named Series 1.

A_1	0 - 9"	Very dark gray, silty clay loam, very fine subangular blocky structure; non calcareous, neutral.
C	9 - 26"	Dark grayish brown and dark gray, silt loam, weak subangular blocky structure; non calcareous, neutral.
A_b	26 - 35"	Black, silty clay loam, weak subangular blocky structure; non calcareous, alkaline.
AC_b	35 - 43"+	Very dark gray, silty clay loam, weak subangular blocky structure; non calcareous, alkaline.

Area III. This area consists of the heavier "gumbo-like" soils which occur in the southeastern portion of the campus on the lower terrace. They were also found in the extreme southwestern corner. The un-named series which occurs in this area is similar to the preceding soils but the subsoil is more clayey. The high clay content causes these soils to drain slowly.

Soil Profile: Un-named Series 2. (Similar to SUTPHEN Soil Series)

A_{1p}	0 - 6"	Very dark gray, silty clay loam; moderate very fine subangular blocky structure; non calcareous, acid.
A_1	6 - 14"	Black silty clay; moderate very fine subangular blocky structure; non calcareous, acid.
AC	14 - 28"	Very dark gray, silty clay loam; massive structure; non calcareous, acid.
D	28 - 72"	Very dark gray, clay, weak subangular blocky to massive structure; non calcareous, acid.

Tree Records

A permanent record system of campus plantings was initiated in 1931

when Quinlan began mapping and recording information on then existing trees.

He divided the campus into twelve sections (see Plate III) utilizing physical features, such as roads and walks, for convenient boundaries. A map was made on tracing cloth of each section at a forty scale. These maps show the location of each tree on the campus including specimen trees which were tagged. (See Plate IV).

Representative trees of each species were selected and tagged with a small pear-shaped label tacked to the trunk. Each genus, each species and each specimen tree were given numbers so that a record could be kept of each labeled tree. The first number in each series represents the genus, the second the species, and the third the specimen on which a record is being kept. Data regarding establishment and performance are recorded on 4 X 6 cross index file cards.

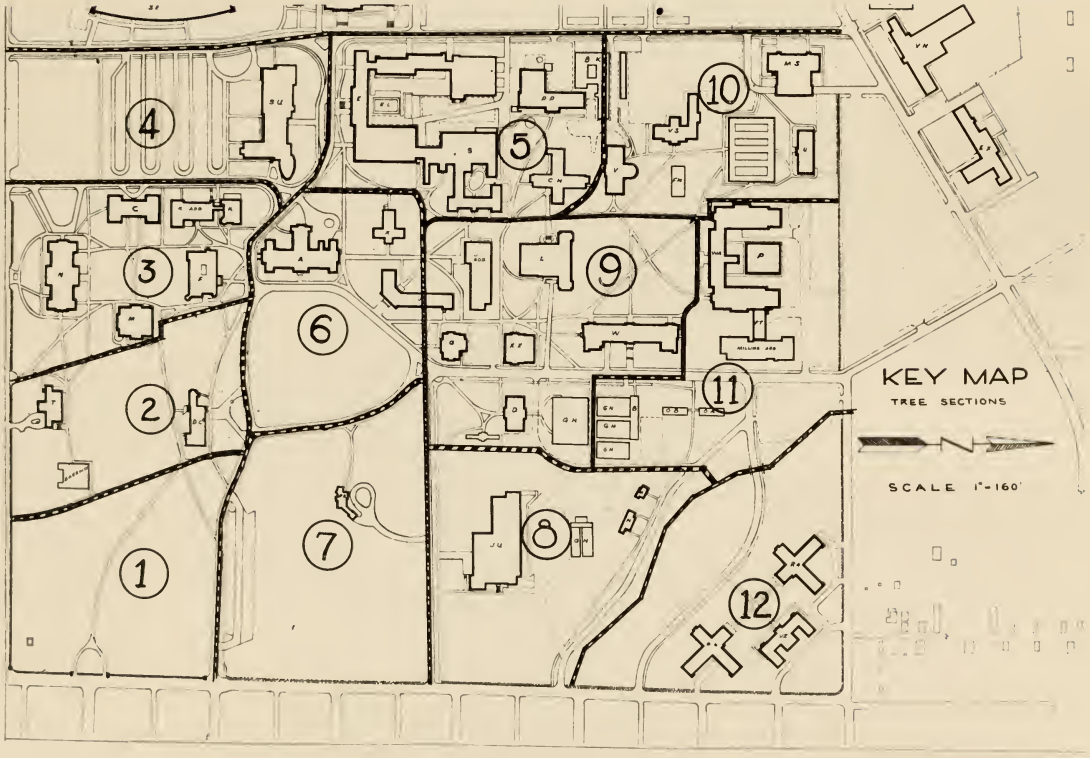
In addition to field records, Quinlan also established in 1939 a trial nursery. In that first year seventy-two species of trees and shrubs were planted in this experimental plot. Additional trials were made over a twenty year period in order to test new species and varieties prior to field planting.

Mortality, due to both natural and climatic factors, made it necessary periodically to revise the tree maps. The first such revision was made in 1939. Accelerated construction in recent years has been responsible for removal of many additional trees making further revision necessary. In 1959-60 a complete review of the maps for each of the twelve sections was completed. Specimen trees were also re-examined and records brought up to date. These records have been analyzed and the results and evaluation of the various species recorded and summarized.

EXPLANATION OF PLATE III

Key Map Showing Location of Campus Tree Sections

PLATE III

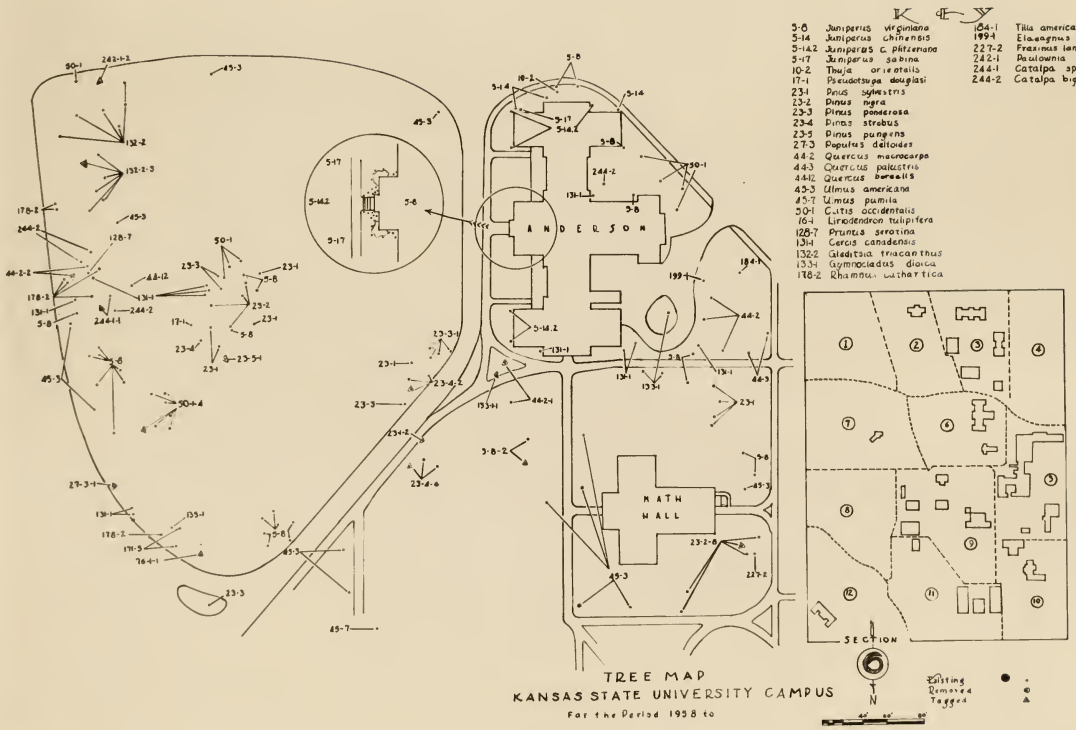


EXPLANATION OF PLATE IV

Typical Campus Tree Map Section 6

Showing Method Used to Locate Tree Specimens

PLATE IV


KEY
5-8 Juniperus virginiana
5-14 Juniperus chinensis
5-14.2 Juniperus C. pfitzeriana
5-17 Juniperus sabina
10-2 Thuja orientalis
17-1 Pseudotsuga douglasi
23-1 Pinus sylvestris
23-2 Pinus nigra
23-3 Pinus ponderosa
23-4 Pinus strobus
23-5 Pinus pungens
27-3 Populus deltoides
44-2 Quercus macrocarpa
44-3 Quercus palustris
44-12 Quercus borealis
45-3 Ulmus americana
45-7 Ulmus pumila
50-1 Celtis occidentalis
76-1 Liriodendron tulipifera
128-7 Prunus serotina
131-1 Carya canadensis
132-2 Gleditsia triacanthus
133-1 Gymnocladus dioica
178-2 Rhamnus cathartica
184-1 Tilia americana
199-1 Elaeagnus angustifolia
227-2 Fraxinus lanceolata
242-1 Paulownia tomentosa
244-1 Catalpa speciosa
244-2 Catalpa bignonioides
ANDERSON
MATH HALL
SECTION
Existing
Removed
Tagged
N
TREE MAP
KANSAS STATE UNIVERSITY CAMPUS
For the Period 1958 to

EVALUATION OF GENERA AND SPECIES

In this section an attempt is made to evaluate the adaptability of the many genera and species which have been tested and grown on the campus at Manhattan. The evaluation and recommendations are based on a recorded study of survival, growth rate, hardiness and general adaptability to the climatic and soil conditions at the University. In addition to campus observations, an effort has been made to include recommendations regarding a general planting range within the state. Although comments on outstanding or undesirable features are included, no attempt has been made to list detailed landscape uses.

Unless otherwise indicated, each of the species listed has been under observation for a period of thirty years or more. Some species were growing on the campus several decades prior to the establishment of systematic trials and the record system. Wherever possible, comments on these species by earlier authors have been included.

For convenience, the various genera and species have been grouped under the classification Coniferous (Gymnosperms) or Deciduous (Angiosperms), and listed alphabetically. They have also been separated according to their adaptability. Successful introductions and species represented on the campus that have demonstrated at least moderate adaptability are listed first under the heading Trees on Campus. These are followed by the list of attempted species introductions that have failed. In some cases the line between success and failure is rather fine. Certain species have received only limited testing and where evidence is not sufficient to warrant a positive decision, this has been indicated, with the probable grouping only a tentative one.

Coniferous

Trees on Campus

Abies (The Firs). Ten species and many varieties of Abies are included in the coniferous flora of the United States. The majority of the species are indigenous to colder regions of the north and west. When found in southern latitudes, they are usually restricted to upper mountain slopes above 3,000 feet (Harlow, 1941). Only one species has been tried on the campus, with moderate success.

Abies concolor WHITE FIR.[1] A beautiful conical evergreen, dense in growth; with slender graceful branches. It is native to the Rocky Mountains where it attains a height of 75 to 100 feet. It has the ability to survive on thin dry soils. Average height for Kansas is 25 to 40 feet.

Number of years on trial: 20

Average growth rate: .2 inch in d.b.h.[2] per year

Number of specimens on campus: 3

Remarks: A hardy tree but it should be planted in sheltered areas, preferably a north exposure where it is protected from hot dry southwest winds. Two specimens died during the drought of the thirties; three remaining trees are thrifty. Recommended for eastern Kansas only.

Juniperus (The Junipers). The junipers constitute a rather large group of some forty to sixty species of trees and shrubs scattered throughout many

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[1]All nomenclature is according to Standardized Plant Names.

[2]Diameter breast height, 4 1/2 feet above ground.

parts of the world. Thirteen species are native to the United States, including the well-known EASTERN REDCEDAR, J. virginiana (Harlow, 1941). Over a thirty year period, thirteen species, eight subspecies and thirty horticultural varieties have been tested at the university.

Juniperus chinensis CHINESE JUNIPER. A pyramidal juniper with coarse gray-green foliage, J. chinensis attains a height of 15 to 20 feet. This species contains one of the larger groups of ornamental cultivars, including both upright and horizontal forms. It is probably chiefly known for the clon PFITZER.

Number of specimens on campus:

Juniperus chinensis	 3
japonica JAPANESE J.	 2
sargenti SARGENT C. J.	 2
ARMSTRONG	 2
WHITELEAF	 2
GOLDEN VARIEGATED	 2
BLUE COLUMNAR	 2
REEVES	 2
CONICAL	 2
PFITZER	 19

Remarks: J. chinensis and its varieties have, in general, proven to be well adapted to Riley County conditions. Approximately 90 per cent of all varieties tested have survived and made satisfactory growth. Field observations indicate that it can be recommended for the entire state.

Juniperus communis COMMON JUNIPER. J. communis is a small

sprawling or bushy circumpolar shrub and is common to many sections of the northeastern and northwestern United States (Harlow, 1941). This species and its varieties (some upright) is also a favorite ornamental in many areas.

Number of specimens on campus:

Juniperus communis	 2
erecta UPRIGHT C. J.	 1
suecica SWEDISH J.	 2

Remarks: This species and the subspecies have received only limited testing. However, none of these have had any widespread usage in the state.

Juniperus excelsa GREEK JUNIPER. This species, which has two horticultural varieties, received only limited testing. Two plants of J. excelsa were planted in 1941 with one surviving to date. Three plants of the clon SPINY were tried in 1930 and 1938 with only one surviving. However, these limited tests are rather inconclusive as to the potential for this species.

Juniperus horizontalis CREEPING JUNIPER. This species includes two subspecies, douglasi WAUKEGAN C. J. and plumosa ANDORRA C. J., which have been used rather widely in Kansas. Both are excellent creepers with steel blue and silver green foliage respectively, and attain a height of 8 to 15 inches.

Number of specimens on campus:

Juniperus horizontalis	 2
douglasi WAUKEGAN C. J.	 2
plumosa ANDORRA C. J.	 8

Remarks: These subspecies have made excellent growth on the campus with a minimum of frost and drought injury. Both can be recommended for east and central Kansas.

Juniperus monosperma ONE SEED JUNIPER. Native to the southern Rocky Mountain region, J. monosperma essentially is a spreading shrub. On favorable sites, it occasionally reaches the proportion of a small and profusely branched tree (Harlow, 1941). It occurs in abundance on dry, sterile, rocky soils and is usually found at an altitudinal range from 3500 to 7000 feet. A total of 21 plants were tested in the trial nursery over a period of twelve years with only limited success. This plant is of only minor value as an ornamental.

Juniperus procumbens JAPGARDEN JUNIPER. Only two specimens on trial. These were planted in the spring of 1931 and both have performed satisfactorily. On the basis of this very limited testing, it appears that the species may be adapted for use in this area.

Juniperus sabina SAVIN JUNIPER. This species and two clons, TAMARIX and VONEHRON, were given a limited number of trials with moderate to good results. Both have been accepted by the nursery trade and on the basis of observation seem to be well adapted to Kansas.

Juniperus scopulorum ROCKY MOUNTAIN JUNIPER. This species has the largest range of all the western junipers; extending throughout the length of the 'Rockies' as well as scattered locations to the west coast (Harlow, 1941). A pyramidal conifer with gray-green foliage, it attains an average height of 15 to 20 feet under Kansas

conditions.

Number of specimens on campus:

Juniperus scopulorum	 2
CHANDLER BLUE	 1
MOONLIGHT	 2

Remarks: With a large native range that includes climatic conditions similar to ours, J. scopulorum is a 'natural' selection for introduction to Kansas. Although campus testing has been limited, observation of field plantings throughout the state indicates that this species and its varieties are well adapted to Kansas conditions. It is, however, not shade tolerant and seems to perform better in the western part of the state.

Juniperus squamata SINGLE SEED JUNIPER. One subspecies, meyeri MEYER S. J., has had limited testing on the campus. In November 1931, two plants were started in the arboretum. Both have survived and made satisfactory growth.

Juniperus utahensis UTAH JUNIPER. A small rather scrubby juniper native to the arid regions of the southwest, J. utahensis has been tested on the campus with only limited success. Five plants, started in the trial nursery in 1939, died in 1940. Ten plants were started in 1940, and of these, only two survive.

Juniperus virginiana EASTERN REDCEDAR. A small to medium sized tree (30 to 40 feet in Kansas) with a dense pyramidal crown and green foliage. The species is widely distributed throughout the entire United States and is found on many types of soil. Although best growth is made on light loam of limestone origin, it will

perform satisfactorily on extremely poor soils.

This tree is the only coniferous evergreen native to the state of Kansas and is highly prized for its value in windbreak and post plantings, as well as an ornamental. The species is characterized by rather pronounced seedling variations and as a result has become a source for much ornamental propagation work. In fact, the cedar and its many varieties and forms are among the largest and best known group of ornamentals in the United States.

Average growth rate: .8 foot in height per year.

Number of specimens on campus:

Juniperus virginiana	 320
BURK	 2
CANAERT	 47
HILL DUNDEE	 2
KETELEER	 2
KOSTER	 2
SCHOTT	 2
WEEPING	 1
NEVINS BLUE	 1

Remarks: As would be expected, this species and nearly all of the clons have proven to be an unqualified success in a large number of trials. J. virginiana can be recommended for all purpose planting throughout the state.

Picea (The Spruces). The genus Picea contains nearly forty species of trees, most of which are native to the cooler regions of the Northern Hemisphere. The most important European species is Picea abies, the NORWAY

SPRUCE. Six species, including P. abies, were tested on the campus. However, only three proved moderately successful.

Picea abies NORWAY SPRUCE. A pyramidal conifer with spreading branches and pendent branchlets, P. abies is moderately fast in growth and attains a height of approximately fifty feet in Kansas. Its dark green foliage and graceful habit make it highly prized as an ornamental (Rehder, 1940).

Average growth rate: .6 inch in c.b.h. per year

Number of specimens on campus: 6

Remarks: Successful introductions of this species have been very limited. A number of thirty to forty year old specimens died during the drought of the thirties. Ten seedlings, started in the trial nursery in 1940, died the following year. Six older specimens are still growing on campus. However only two of these appear vigorous. This species can be recommended, with reservations, for eastern Kansas only. Limit planting to moist soils in sheltered locations.

Picea glauca WHITE SPRUCE. Native to Canada, the Lake States and New England, P. glauca is a widely used ornamental. Trials were made in 1929, 1938 and 1940 and in each case all specimens died during the first or second growing season. However, one tree planted prior to 1900 lived for several decades before its loss in the drought of the thirties. The subspecies densata, BLACK HILLS SPRUCE, which is native to South Dakota is generally accepted in the nursery trade and seems to be fairly well adapted to Kansas conditions.

Picea pungens COLORADO SPRUCE. A symmetrical and typically conical evergreen with stout horizontal branches, P. pungens, particularly in its bluish and silver forms, is a highly popular ornamental. Native to the central Rockies, it has the ability to withstand drought and temperature extremes (Harlow, 1941). However, it is rather slow growing.

Number of years on trial: 20

Number of specimens on campus: 4

Remarks: Limited campus trials indicate that this species is well adapted to Kansas climatic conditions. Certainly, it has performed well in general planting throughout the state.

Picea smithiana HIMALAYAN SPRUCE. A beautiful tree of broad-pyramidal habit with pendulous branches, P. smithiana was started in the trial nursery in 1941 and again in 1942 with negative results. Although no specimens are living, the number of trials were insufficient to class this species as a failure.

Pinus (The Pines). The largest and most important of the coniferous genera, the pines include some ninety species widely scattered throughout the northern hemisphere from the Artic Circle to Guatemala (Harrar, 1946). Although principally known for their value in the timer industry, a number of species are widely used as ornamentals. A total of twenty-five species have been tested on the campus including four notably successful introductions; P. nigra, P. sylvestris, P. ponderosa and P. strobus.

Pinus banksiana JACK PINE. This tree is native principally to Canada and the Lake States, where the growing season is very short and temperature extremes are pronounced (Harlow, 1941). A small

tree, sixty to eighty feet in its native range, this pine is rather scrubby in habit and of only minor value as an ornamental.

Average growth rate: .25 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: Limited seedling trials were made with this species. Observations of older specimens planted about 1910 indicate that it is fairly well adapted to Kansas conditions. Recommended for eastern Kansas only.

Pinus densiflora JAPANESE RED PINE. Native to Japan, this pine is a popular ornamental, with horizontal branches forming an irregular, rather broad head. A total of ten plants were placed in the trial nursery from 1931 to 1942 with only limited success. Can be recommended for limited planting in extreme eastern Kansas only.

Pinus cembroides NUT PINE. A small tree (20 to 30 feet) with stout, spreading branches forming a round topped head. This species, which is native to the mountainous regions of the southwest, was included in campus trials from 1938 to 1942 with very limited success. It is rather slow in growth but should receive further testing.

Pinus mugo SWISS MOUNTAIN PINE. Native to central and southern Europe, P. mugo seldom attains tree-like proportions, but rather is more often a low or prostrate shrub. The subspecies, P. mugo mughus, is globose in form, with bright green foliage, and attains a height of four to ten feet. Records kept on this plant since 1930 indicate that it is well adapted to Kansas. It is widely used

in the nursery trade and can be recommended for the entire state.

Pinus nigra AUSTRIAN PINE. A large tree, with dark green foliage and spreading branches which form a broad pyramidal head. An introduction from central and southern Europe, this tree attains a height of 40 to 60 feet in Kansas.

Average growth rate: .47 inch in d.b.h. per year

Number of specimens on campus: 157

Remarks: One of the first species of this genera to be tested on the campus, P. nigra has proven to be well adapted to Kansas. Several trees, including Specimen 23-2-1 in Section 9, were moved from the old college farm with a frozen ball of earth and planted on the present campus in the 1880's. In addition to its use as an ornamental, this species is popular for windbreak plantings and can be recommended throughout the state.

Pinus ponderosa PONDEROSA PINE. One of the largest and most important pines in western North America, P. ponderosa is found in commercial quantities in every state west of the plains. Cinnamon-red bark, divided into large plates make the older trees of this species somewhat distinctive. Under Kansas conditions, the tree attains a height of 40 to 60 feet.

Average growth rate: .2 inch in d.b.h. per year

Number of specimens on campus: 119

Remarks: This species has proven to be another of the highly successful introductions from the genus Pinus. During the drought of the thirties, both P. ponderosa and P. nigra suffered few ill effects. PONDEROSA PINE is also widely used in both windbreak

and ornamental planting and can be recommended for general planting throughout the state.

Pinus pungens TABLE MOUNTAIN PINE. A small tree, with stout, spreading branches which form a broad, open head. P. pungens is rather distinctive in appearance, with needles that are yellow green; rigid and often twisted. With age this species becomes quite picturesque. It is indigenous to the Appalachian region and has been tested on the campus with limited success. A number of fifty year old specimens died in the drought of the thirties. Subsequent trials which were started in 1939 proved to be failures. However, one specimen estimated to be seventy years old still survives in Section 3. Because of its character and beauty, it is recommended that further trials be conducted.

Pinus resinosa RED PINE. Distinctive for its symmetrically oval crown and tufted dark green foliage, this species is native to southern Canada, the Lake States and the northeast. P. resinosa was planted on the campus in 1934 and again in 1940 with only limited success. One specimen survived for fifteen years but was removed in a construction project. May be used on light sandy soils in eastern Kansas only. This species should also receive further trials.

Pinus rigida PITCH PINE. A small to moderately large tree, P. rigida is a species of great diversity in form, habit and development. A branching habit which forms an open, rather irregular head makes this a picturesque tree, particularly in old age. Native to the northeast and Appalachian areas, this tree is able to live on

dry, rocky soils.

Average growth rate: .36 inch in d.b.h. per year

Remarks: Tests on the campus indicate that this tree is fairly well adapted to eastern Kansas climate. One specimen, Number 23-6-1 in Section 2, which was planted in 1885, still survives and is presently 20.2 inches in d.b.h. Additional trials, made in 1940 also proved moderately successful. Can be used in eastern Kansas but should be protected from southwest winds.

Pinus strobus EASTERN WHITE PINE. The largest of the northeastern conifers, P. strobus is highly prized for both timer and ornamental uses. This tree has a symmetrical and broadly conical crown with long, slender, flexible, blue-green foliage and a graceful plume-like branching habit. It is native to the northeast, Lake States and Appalachian areas where it makes rather rapid growth. In Kansas it attains a height of 50 to 70 feet.

Average growth rate: .40 inch in d.b.h. per year

Number of specimens on campus: 30

Remarks: P. strobus was first introduced to the campus in 1888 and some of these original specimens still survive. Specimen Number 23-4-2 in Section 6 is presently 21.1 inches in d.b.h. and in good condition. Later trials, made in 1939 and 1940, also have proven successful. On the basis of testing and observation, this tree seems well adapted to eastern Kansas.

Pinus sylvestris SCOTCH PINE. A pyramidal conifer with blue-green foliage, P. sylvestris is rather distinctive because of the orange coloration which the bark assumes at an early age. An important

European timber species, this tree has become naturalized in the eastern United States since its introduction there. Under Kansas conditions the tree attains a height of 40 to 50 feet.

Average growth rate: .55 inch in d.b.h. per year

Number of specimens on campus: 130

Remarks: Another of the highly successful coniferous introductions, this tree has proven itself very well adapted to the Kansas conditions. This species was also among the earliest to be planted on the campus. The 1905 class tree in Section 6 (Number 23-1-2) is now 24.3 inches in d.b.h. Excellent for ornamental, Christmas tree and windbreak planting, P. sylvestris can be recommended for the entire state.

Pinus tabulaeformis CHINESE PINE. A small conifer native to northern and western China, this species has had only limited testing with moderate success. Of three specimens started in the trial nursery in 1933, two died the second growing season and the third was lost in 1940. However, one tree planted about 1925 still survives. Recommended for further trial.

Pinus virginiana VIRGINIA PINE. Sometimes called Scrub pine, this species is a small bushy tree with slender horizontal or pendent branches and seldom attains a height of more than 30 to 40 feet. It is native from New York to Georgia and west to Ohio, and has the ability to survive on dry barren soils. On the basis of very limited testing, together with personal observation, it can be recommended for planting in the eastern third of the state.

Pseudotsuga (Douglas Fir). This genus, containing only four or five

species, includes but one that is of any real importance in the United States.

Pseudotsuga taxifolia COMMON DOUGLAS FIR. In its coastal form one of the largest of our American conifers. The Rocky Mountain form attains a height of 50 to 60 feet in Kansas and is distinguished by its blue-green foliage and much exserted and strongly reflexed bracts.

Average growth rate: .35 inch in d.b.h. per year

Number of specimens on campus: 8

Remarks: On the basis of limited numbers, this species seems to be fairly well adapted to eastern Kansas conditions. Specimens planted in 1930 and 1940 are surviving and their condition is good. Recommended for the eastern third of the state, but should be protected from southwest winds.

Taxodium (Baldcypress). This genus, once widely distributed in the prehistoric forests of Europe and North America, now contains but three species; T. distichum, T. ascendens and T. mucronatum (Harlow, 1941). Only one species has been tested at Manhattan.

Taxodium distichum COMMON BALDCYPRESS. A deciduous conifer, BALDCYPRESS is a large tree (100 to 120 feet) with a tapering trunk which is strongly buttressed at the base. It is pyramidal while young, and in old age usually spreading, with a broad, rounded head (Rehder, 1940). A striking ornamental because of its feathery, light-green foliage, this species is native to the Atlantic and Gulf Coastal plains. Although best growth is made on deep, fine, sandy loams, it is usually found in permanent swamp lands where competition from other vegetation is at a minimum.

Average growth rate: .43 inch in d.b.h. per year

Number of specimens on campus: 10

Remarks: Although the number of specimens tried has been limited, T. distichum seems to be fairly well adapted to eastern Kansas. One of the oldest trees on the campus, Specimen Number 11-1-1 was planted about 1880 and is presently 22.5 inches in d.b.h.

Thuja (Arborvitae). A small genus consisting of five species of trees scattered throughout the forests of China, Formosa, Japan and North America. Two species and 19 varieties or clons have received intensive testing since 1930. One of these, T. orientalis has proven to be adapted to Riley County.

Thuja orientalis ORIENTAL ARBORVITAE. A pyramidal or bushy conifer with spreading and ascending branches that arise near the base, and bright green leaves that are closely appressed on the lateral branches. T. orientalis is native to China and Korea. This species and a number of clons have been tested extensively on campus with good results.

Number of specimens on campus: 72

Remarks: T. orientalis is widely planted both on and off the campus and has proven itself to be well adapted in southeast and south central Kansas. It is subject, however, to occasional winter injury, from Manhattan north and west. Although desirable for formal and certain limited landscape use, its exotic appearance makes it undesirable for general landscape planting.

Ginkgo (Ginkgo). Although once represented by a number of species, the unusual order GINKGOALES now consists of only this one monotypic genus. Ginkgo is a deciduous member of the Gymnosperms native to China and Japan

but commonly used in North America as an ornamental.

Ginkgo biloba GINKGO. A small to medium sized deciduous tree with unusual fan-shaped and parallel-veined leaves. Sometimes called the Maidenhair tree, this species has been cultivated in the temple gardens of China and Japan for centuries. It attains a height of 40 to 50 feet.

Average growth rate: .15 inch in d.b.h. per year

Number of specimens on campus: 10

Remarks: This tree has performed well in a limited number of campus plantings. Specimen Number 1-1-2 under observation since 1930 is presently 15.4 inches in diameter and still quite vigorous. All specimens suffered some damage during the drought of the thirties but in general they are rather well adapted. Can be recommended for eastern part of the state.

Trees That Failed

Chamaecyparis (False Cypress). This group includes six species and eighty-four varieties, and is considered by some authors to be a section of the genus Cupressus. The JAPANESE SAWARA TREE and the HINOKI CYPRESS, together with their many varieties are prized as ornamentals in many sections of the United States. The SAWARA TREE, C. pisifora, and the clon GOLDEN were tried on the campus with no success. Seventeen specimens were planted in the spring of 1930. Thirteen died in the fall of that year and the remainder were lost in the 1933-34 drought.

Cupressus (The Cypresses). Several species of Cupressus, including the ITALIAN CYPRESS, are widely used ornamentals in the Mediterranean basin and in warmer portions of other countries. Seven species are native to the western

United States (Harlow, 1941). Two species native to the southwest United States and Mexico, C. arizonica and C. lusitanica, were tried on the campus without success. Trials were made with ARIZONA CYPRESS, C. arizonica, in 1939, 1940 and 1942; a total of twenty specimens being planted. In each case, the plants died within two or three years, often as a result of winter injury.

Juniperus (The Junipers).[1]

Juniperus californica CALIFORNIA JUNIPER. Fifteen plants were placed in the trial nursery in the spring of 1940. All specimens died in 1943 as a result of winter injury.

Juniperus pachyphloea ALLIGATOR JUNIPER. A small tree (30 to 50 feet), ALLIGATOR JUNIPER is often found in association with ONE SEED JUNIPER on dry, sterile sites in the southwestern United States. A total of twenty-five plants were started in the trial nursery from 1939 to 1942. All these trials proved to be failures.

Larix (The Larches). This genus includes ten species of deciduous conifers which for the most part are indigenous to the northern latitudes of the United States, Canada and Europe. Three species, L. gmelini, L. decidua and L. leptolepis, were tried on the campus without success. A total of forty-six plants were started in the trial nursery from 1935 to 1940 and all were complete failures.

Picea (The Spruces).

Picea glehni SAKHALIN SPRUCE. A narrow pyramidal conifer, native to Japan. A number of trials were made in 1932 with no success. Needs further trial to warrant any recommendation.

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[1]Where generic descriptions are absent, refer to comments under section "Trees on Campus".

Picea koyamai KAYAMA SPRUCE. Also a narrow, pyramidal evergreen native to Japan and Korea. Trials made in 1929 and 1930 proved to be complete failures.

Pinus (The Pines).

Pinus attenuata KNOBCONE PINE. This species, which is native to the mountains of southwestern Oregon and northern California, was placed on trial in 1939. All specimens failed during the second growing season.

Pinus bungeana LACEBARK PINE. Slow growing and bushy in habit, the species is native to northwest China. Four trials with a total of fifteen specimens were made from 1935 to 1937 and all proved to be failures.

Pinus contorta-latifolia LODGEPOLE PINE. A slender, pyramidal conifer native to the Rocky Mountains, LODGEPOLE PINE is probably not well adapted to Kansas conditions. During limited testing from 1938 to 1942 all specimens succumbed to diplodia blight.

Pinus coulteri COULTER PINE. A small tree (40 to 50 feet) restricted to the mountains of southern coastal california. Five plants were placed in the trial nursery in 1939. All were dead by 1941.

Pinus echinata SHORTLEAF PINE. One of the southern yellow pines, P. echinata is native in the neighboring states of Missouri and Oklahoma. Although it may be suitable for planting in the southeast corner of the state, it is not recommended for most sections. A total of twenty-five plants were started in the trial nursery in 1939 and 1940 and all of these failed.

Pinus flexilis LIMBER PINE. A small, narrow, pyramidal conifer, LIMBER PINE is native to gravelly slopes at high elevations (5,000 to 10,000 feet) in the Rocky Mountains and west to California. Campus trials on this species met with very limited success. Plants were started in the trial nursery in 1933, 1938 and 1939 but only one specimen survived beyond the second growing season.

Pinus radiata MONTEREY PINE. A small pine, with bright green needles, which is native to the coastal and island forests of central California (Harlow, 1941). The species was placed in the trial nursery in 1939 but all specimens were dead by 1940.

Pinus sabiniana DIGGER PINE. A small to medium sized tree (40 to 50 feet) with a short bole and open irregular crown, the Digger pine is native to the coastal ranges of California. Specimens started in the trial nursery in 1939 failed during the first and second growing seasons.

Pinus taeda LOBLOLLY PINE. Native to the Atlantic and Gulf Coastal plains, this tree is rapid in growth and a highly important timber species. Within its range it is a moderately large tree, attaining a height of 90 to 110 feet (Harlow, 1941). It has been tested on this campus since 1940 with only limited success. A total of twenty plants, in two series, were started in 1940 and only one survived and second growing season. Trials in 1942 and 1947 were also failures.

Pinus thunbergi JAPANESE BLACK PINE. A small tree with spreading and slightly pendulous branches, native to Japan. Trials were made in 1931 and again in 1939 with very limited success. Although

one specimen, planted in 1931, lived for ten years, there are none surviving on the campus to date.

Thuja (Arborvitae).

Thuja occidentalis EASTERN ARBORVITAE. This species and the following clons were tested in the trial nursery from 1931 to 1935:

LITTLE GEM

PYRAMIDAL EASTERN

BODMER

TOM THUMB

DOUGLAS PYRAMIDAL

WOODWARD

WARE GOLD

UMBRELLA

QUEEN VICTORIA

Remarks: All specimens were dead by 1935 due to drought injury. In 1957 three specimens of the clon WOODWARD were planted in the sheltered court at Waters Hall in Sec 11. These are surviving to date. At Manhattan we seem to be at the southern fringe of the range for this species and at the northern edge of the range for T. orientalis. T. occidentalis can be used in extreme eastern Kansas in sheltered locations but is not recommended for general planting.

Tsuga (The Hemlocks). Four species of Tsuga are native to eastern and western North America. One of these Tsuga caroliniana, CAROLINA HEMLOCK, was tried on campus but proved to be a failure. A number of specimens have been observed in the Kansas City area in sheltered locations but this species cannot be recommended for most sections of the state.

Deciduous

Trees on Campus

Acer (The Maples). A rather large genus consisting of 114 species of trees and shrubs which are widely scattered in the Northern Hemisphere, from North America to North Africa. Several species and varieties, both Asiatic and European, are popular as ornamentals chiefly because of their attractive foliage. A total of twenty species and two varieties have been tested over a thirty year period with moderate success.

Acer campestre HEDGE MAPLE. A small, round-headed tree or large shrub native to Europe and western Asia. Characterized by corky, winged twigs and yellow fall color. A. campestre contains four subspecies and four clons or varieties. Seedlings of the true species were first tested in the trial nursery in 1939. Of five specimens started, one died in 1940, three died in 1943 and one survives. Another trial started in 1945 has been highly successful to date with all specimens living and their condition good.

Number of years on trial: 21

Number of specimens on campus: 16

Remarks: On the basis of results to date A. campestre can be recommended for limited planting in the eastern one-third of the state.

Acer ginnala AMUR MAPLE. A small tree or shrub rarely exceeding twenty feet in height, with small, three lobed leaves that turn bright red in the fall. A.ginnala is native to northern China and Japan. This tree has performed moderately well over a recorded period of twenty years. Trial specimens started in 1939 are now 8

inches in diameter. One specimen planted prior to 1900 reached a diameter of 24 inches before dying during the drought of the thirties. Recommended for planting in eastern Kansas.

Acer mono MONO MAPLE. A moderately large tree with bright green leaves, this species is native to China and Korea. Two plants were started in the trial nursery in 1932. One died in the drought of the thirties and the other was removed about 1948 during construction work. A. mono may have some value in Kansas but further trials are necessary to appraise its adaptability.

Acer negundo BOXELDER. A small to medium sized tree with a bushy spreading crown and pinnately compound leaves. Native to the eastern United States, including eastern Kansas, A. negundo is probably one of the best known and most common of the maples (Harlow, 1941). Known for its hardiness and drought resistance, this tree grows rapidly but is short lived.

Average growth rate: .7 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: This tree is hardy and quite vigorous even in western Kansas where it is sometimes used in windbreaks. However, it is of doubtful value as an ornamental.

Acer nigrum BLACK MAPLE. A large tree with a dense, ovoid crown, A. nigrum is quite similar in appearance to the sugar maple. The leaves, however, are usually three lobed and do not produce the brilliant colors associated with A. saccharum. This species is native to the northeastern United States including the bordering states of Missouri and Iowa. It is not much planted as an ornamental

(Harlow, 1941).

Average growth rate: .25 inch in d.b.h. per year

Number of specimens on campus: 11

Remarks: On the basis of a limited number of trials, A. nigrum appears to be only moderately well adapted to conditions at Manhattan. Recommended for planting only in the eastern one-third of the state. It should be protected from southwest winds as it is subject to sunscald.

Acer platanoides NORWAY MAPLE. Native to Europe, A. platanoides is a highly prized ornamental because of its dense, regular habit, bright green leaves and brilliant yellow fall color (Rehder, 1940). This tree attains a height of approximately 40 to 60 feet under Kansas conditions.

Average growth rate: .20 inch in d.b.h. per year

Number of specimens on campus:

Acer platanoides	 11
SCHWEDLER	 2

Remarks: Both the species and the clon SCHWEDLER have performed moderately well in a limited number of campus plantings. SCHWEDLER specimens planted in 1936 are presently six to seven inches in diameter. Both are subject to sunscald and should be placed in a sheltered location. Recommended for eastern Kansas only.

Acer rubrum RED MAPLE. A moderately large tree (40 to 60 feet) with an irregular or rounded crown and shallow, spreading root system (Harlow, 1941). A. rubrum is quite popular as an ornamental particularly in the northeast. It produces conspicuous,

red flowers early in the spring and has fall coloring which ranges from scarlet to yellow. This tree is native in the eastern United States as far west as central Missouri and southeastern Oklahoma.

Average growth rate: .50 inch in d.b.h. per year

Number of specimens on campus: 3

Remarks: Seedlings of this species were planted in the trial nursery in 1929 and again in 1939 with moderate success. Specimens planted in 1929 failed during the period 1938 to 1940 but a later planting still survives. Specimens in this group average ten inches in diameter. Like many of the maples, this species is subject to leaf scorch and sunscald. Recommended for eastern Kansas planting on low ground in sheltered locations.

Acer saccharinum SILVER MAPLE. A moderately large tree, similar to A. rubrum, with a wide spreading crown, slender often pendulous branches and a shallow root system. The leaves are deeply five lobed, bright green above and silvery white below (Rehder, 1940). This tree is indigenous to the entire eastern United States including Kansas, west to about Manhattan.

Average growth rate: .7 inch in d.b.h. per year

Number of specimens on campus: 36

Remarks: Although hardy and often planted for its rapid growth, A. saccharinum is a somewhat doubtful choice for ornamental planting. The tree is subject to wind and ice damage. It is also a heavy feeder and should not be planted near gardens. A number of thirty to fifty year old specimens died during the drought of the thirties. The largest living campus tree (48.9 inches in diameter)

is located in Section 1.

Acer saccharum SUGAR MAPLE. A moderately large tree (60 to 80 feet) with a dense, round or ovoid crown and bright green leaves which turn brilliant shades of yellow to orange or scarlet in the fall. This species is similar to A. nigrum. However, the leaves are usually five lobed and fall colors are more striking. It is native to the eastern United States except for the Gulf Coastal States. The range in Kansas extends west to about Topeka.

Average growth rate: .4 inch in d.b.h. per year

Number of specimens on campus: 17

Remarks: Although relatively slow in growth, A. saccharum is much planted as a street and shade tree. Longer life, dense regular habit, greater durability and beautiful fall coloring make this a better ornamental choice than the 'soft' maples. Campus specimens have made rather rapid growth and appear generally vigorous. Recommended for planting in the eastern one-third of the state. Should be protected from southwest winds. Highly susceptible to sun scald.

Acer tataricum TATARIAN MAPLE. A small tree or shrub with bright green leaves that turn yellow in the fall, this species attains a height of fifteen to twenty feet in Kansas. It is native to Europe and western Asia and is sometimes chosen for the attractive red fruit produced in late summer.

Number of specimens on campus: 7

Remarks: On the basis of a limited number of tests, it appears that this species is well adapted to conditions at Manhattan.

Specimen number 171-5-2 in Section 7 is presently 12.3 inches in diameter and in excellent condition. Recommended for eastern Kansas.

Aesculus (Buckeye; Horsechestnut). This genus includes approximately twenty species of trees and large shrubs native to North America, southeastern Europe and eastern Asia to India (Rehder, 1940). Principally ornamentals, they are often planted for their showy flowers and large handsome foliage.

Aesculus arguta TEXAS BUCKEYE. A shrub or small tree with palmately compound leaves and seven to nine leaflets. The flowers are light yellowish green and bloom in April or May. This species is native from eastern Texas to Kansas. Although campus testing has been very limited, this species can be recommended for the eastern third of the state. One specimen in Sec. 12 is presently 5.0" in diameter breast height. It is rather slow growing but very hardy and can be used in naturalistic planting.

Aesculus glabra OHIO BUCKEYE. A moderately large tree (50 to 80 feet) with palmately compound and five foliate leaves, A. glabra is native from the Appalachian west to Missouri. This species is characterized by the rather large, nonresinous, terminal buds and is fairly rapid in its early growth.

Average growth rate: .48 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: A number of specimens planted about 1900 still survive on the campus. The largest, in Section 1, is presently 24 inches in d.b.h. This tree has proven itself well adapted to eastern Kansas climate and can be recommended for planting in that portion

of the state.

Aesculus hippocastanum COMMON HORSECHESTNUT. One of the most showy of our flowering trees, this species was originally native to the Balkan Peninsula but has since become naturalized in the eastern United States. Like A. glabra it also has palmately compound leaves, but with seven leaflets and resinous, sticky buds. Often planted as a street or shade tree in the east, this tree attains a height of 50 to 60 feet in Kansas.

Average growth rate: .30 inch in d.b.h. per year

Number of specimens on campus: 4

Remarks: This tree has been quite similar to A. glabra in regard to performance on the campus. One specimen in Sec. 1 is presently 30.9" in diameter at 3' above ground line. Also recommended for planting in eastern Kansas.

Ailanthus (Ailanthus). A small genus consisting of eight or nine species which are native to Europe, Asia and northern Australia (Rehder, 1940). Only one species, introduced from Asia, is of importance in the United States.

Ailanthus altissima TREE OF HEAVEN. Introduced to this country from China in 1784, this tree has since become naturalized in the United States and has gained recent fame as the 'tree that grows in Brooklyn'. A. altissima is a small to medium sized tree (40 to 60 feet) with smooth bark and pinnately compound leaves with thirteen to twenty-five leaflets. Very rapid in growth, it is often used in municipal planting because of its tolerance to smoke, gases and other abuse. However, it is also known for the

disagreeable odor of the staminate flowers.

Average growth rate: 2.5 inches in d.b.h. per year[1]

Number of specimens on campus: 6

Remarks: Although campus testing has been limited, this tree is well adapted to Kansas climatic and soil conditions. One specimen, planted about 1920 reached a diameter of 35.5 inches before being removed because of storm damage. Although A. altissima is hardy and well adapted, it is of questionable value as an ornamental as it sprouts badly.

Amelanchier (Serviceberry). A genus consisting largely of ornamental shrubs or small trees. Approximately twenty-five species are found, chiefly in North America and Mexico. Two species were in the campus shrub collection.

Amelanchier alnifolia SASKATOON SERVICEBERRY. A small, shrubby plant with stout branches and white flowers in short, dense racemes. This shrub is native from Saskatchewan to Colorado. A. alnifolia was tested in the trial nursery in 1939 and 1940. Twenty-five plants were started in a two year period and survival was approximately seventy-five per cent. Recommended for eastern Kansas.

Amelanchier canadensis SHADBLOW SERVICEBERRY. A small tree or shrub which attains a height of 10 to 15 feet in Kansas, A. canadensis is a graceful plant with smooth gray bark and pure white flowers disposed in short drooping racemes. It is native

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[1]Growth rate recorded on only one specimen; for ten year period.

in the eastern United States including extreme eastern Kansas, and can be recommended for planting in the eastern one-half of the state. There are 2 specimens on the campus and they have proven to be well adapted.

Betula (The Birches). This genus is widely represented throughout the Northern Hemisphere by approximately forty species. In North America they are native from the Arctic Circle south to Alabama (Harlow, 1941). However, they are essentially northern trees and mostly short lived. Because of their handsome foliage and showy bark they are prized as ornamentals. Fifteen species are indigenous to the cooler regions of North America. Eight species have been tested on the campus and most of these proved to be failures.

Betula nigra RIVER BIRCH. The only really successful species in campus plantings B. nigra is a small to medium sized tree with an ovoid head and slender, graceful branchlets. The bark is reddish brown, exfoliating in papery flakes and the trunk has a tendency to divide into three or more stems a few feet above the ground. This tree is native in the southeastern part of the state.

Average growth rate: .25 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: Although native to moist, sandy river banks and similar sites, this species will also perform satisfactorily on drier sites. Recommended for eastern Kansas only.

Broussonetia (Papermulberry). This small genus includes two species native to eastern Asia. One representative of the species (Broussonetia papyrifera is growing on the campus.

Broussonetia paprifera COMMON PAPERMULBERRY. A small tree with

a broad, rounded head and smooth gray bark, often planted as an ornamental. Naturalized in the East. One specimen in Section 8 is presently 10.4 inches in diameter at the ground.

Bumelia (Bumelia). This genus contains approximately 35 species of trees and shrubs, usually with thorny branches and restricted to the warmer regions of the Western Hemisphere (Rehder, 1940). One species is growing on the campus.

Bumelia lycioides BUCKTHORN BUMELIA. A small tree characterized by elliptical or oblanceolate leaves, 3 to 6 inches long, twigs with stout, curved spines and black, oval fruits (Harrar, 1940). Six specimens located north of the tennis courts in Section 8 are in good condition and quite vigorous. The largest in the group is presently 10 inches in diameter, measured at the ground line.

Caragana (Peashrub). A rather large genus containing in excess of fifty species which are native from southern Russia to China. As indicated by the common name this group consists largely of shrubs. However, one species, C. arborescens, reaches tree-like proportions and is worthy of mention here.

Caragana arborescens SIBERIAN PEASHRUB. A shrub or small tree of upright habit which attains a height of twelve to eighteen feet. C. arborescens is another of the legumes and has even, pinnate leaves with eight to twelve leaflets. It produces profuse yellow flowers. Although known as an ornamental, it is also often used in shelterbelt plantings.

Number of specimens on campus: 20

Remarks: Although campus testing has been limited, this species

has been used throughout the state for both ornamental and windbreak plantings. It is best adapted to light sandy soils and is quite hardy.

Carpinus (Hornbeam). A genus consisting of small or medium sized trees with a short trunk, deliquescent stem and handsome foliage (Rehder, 1940). There are approximately twenty-six species native to the Northern Hemisphere in Europe, Asia and North America. Two species have been tested on the campus. One of these proved moderately successful.

Carpinus caroliniana AMERICAN HORNBEAM. A small bushy tree (20 to 30 feet) with a twisted, fluted trunk and dark bluish-gray bark. It is native in the United States east of the Great Plains. Only one specimen was growing on the campus in 1930. Although it was removed for construction in 1949 it had performed well and was quite vigorous. Probably adapted to eastern Kansas but should be sheltered. It is very shade tolerant.

Carya (The Hickories). A typically American genus, Carya includes twenty species native to the eastern United States and one each in China and Mexico (Harlow, 1941). Many species are noted for timber production while others are of importance as "fruit" or ornamental trees. Two of the "true hickories" as well as several pecan varieties have been tested on the campus.

Carya cordiformis BITTERNUT HICKORY. A medium sized tree (40 to 50 feet) with a broad head and odd pinnately compound leaves with seven to eleven leaflets. One of the smooth or tight barked hickories, C. cordiformis, is easily identified by the sulphur-yellow water buds. It is native in the eastern United States including

Kansas, Nebraska and Iowa.

Average growth rate: .25 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: Although campus planting has been limited, this tree is native to eastern Kansas and is certainly hardy in that area. It is well adapted to poor, thin or gravelly soils. It is not widely accepted as a desirable ornamental however.

Carya laciniosa SHELLBARK HICKORY. A moderately large tree (70 to 90 feet) with pinnate leaves and usually seven leaflets. The bark breaks away in thin plates which curve away from the tree giving it a shaggy appearance. One of the 'loose bark' hickories, it is similar to C. ovata but is usually found in wet, alluvial bottoms. Native to the Ohio, Mississippi and lower Missouri River valleys.

Average growth rate: .15 inch in d.b.h. per year

Number of trees on campus: 5

Remarks: Although campus planting has been limited, this species is well adapted to eastern Kansas. One specimen, Number 35-2-1 in Section 7 has been on the campus since about 1900. Although they seem to be hardy and very drought resistant, they are also slow growing.

Carya illinoensis PECAN. The largest of the hickories (100 to 150 feet), this species is usually found on moist but well drained river bottoms. It is of value chiefly for its fruit and is widely planted in orchards in the South. It is native from Indiana and Iowa south to Alabama and Texas, including part of southeast Kansas.

The species and a number of northern nut varieties have been tried on the campus with moderate success.

Number of specimens on campus: 9

Remarks: Early plantings of this species date back to about 1916 and one such specimen is now 18.6 inches in diameter. This species is not only adapted for eastern Kansas ornamental planting but several of the northern varieties appear promising for nut production in the northern counties.

Catalpa (Catalpa). This genus includes ten species which are native to the West Indies, East Asia and eastern North America. It has also become naturalized elsewhere through cultivation. A number of the species are used as ornamentals because of the large, showy panicles of white or purple tinted flowers. Three species have been tried on the campus with satisfactory results.

Catalpa bignoniodes SOUTHERN CATALPA. A small to medium sized tree (40 to 60 feet) with widespreading branches which form a broad, round head. The leaves are large and opposite or whorled. Often used as an ornamental because of the showy, white flowers, this tree is native to the Southern and Gulf states.

Average growth rate: .40 inch in d.b.h. per year

Number of specimens on campus: 1

Remarks: The species as well as the clon PURPLELEAF have been growing on the campus almost from the beginning of the institution. One specimen, tagged in 1932, was 25 inches in diameter at that time. This species can be recommended as hardy in eastern Kansas.

Catalpa ovata CHINESE CATALPA. A small tree with wide, spreading

branches and yellowish-white and purple tined flowers, C. ovata is native to China. It attains a height of thirty to forty feet.

Number of specimens on campus: 3

Remarks: Campus testing has been too limited to be conclusive. However, this species appears to be hardy at Manhattan.

Catalpa speciosa NORTHERN CATALPA. A moderately large tree of pyramidal habit with large ovate to oval leaves and white flowers, C. speciosa is more vigorous and somewhat hardier than the preceding species. It is highly sensitive to site quality and on rich, moist sites may attain a height of 100 feet or more. Under Kansas conditions it is much smaller. This tree has often been used in both windbreak and post plantings as well as an ornamental.[1]

Native in Indiana, Illinois, Kentucky, Missouri and Arkansas.

Average growth rate: .34 inch in d.b.h. per year

Number of specimens on campus: 5

Remarks: C. speciosa has been growing on the campus since about 1900. Several specimens planted about that time still survive. Number 244-1-1 in Section 6 is presently 32.4 inches in diameter.

Recommended for general planting throughout the state.

Celtis (Hackberry). The genus Celtis with approximately seventy species is found widely distributed throughout the Temperate and Tropical regions of the world (Harlow, 1941). Often used as shade and street trees, the species C. occidentalis is of particular value in Kansas because of its hardiness

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[1]One of the largest post plantations in the world is north of Hutchinson.

and relative freedom from pests. Five species and one subspecies have been tried on the campus.

Celtis laevigata SUGAR HACKBERRY. A small tree with spreading, often pendulous branches which form a broad, round head. C. laevigata is distinguished by the light gray bark and corky, wart-like excrescences. It is native to the southern bottomlands from southern Indiana and Illinois to Texas and Florida where it attains a height of 60 to 80 feet.

Average growth rate: .30 inch in d.b.h. per year

Number of specimens on campus: 13

Remarks: This species has been tested on the campus since the early twenties and has performed satisfactorily. Survival on seedlings placed in the trial nursery in 1940 ran 100 per cent. Although it is not widely planted in the state, it can be recommended as hardy in eastern Kansas.

Celtis occidentalis COMMON HACKBERRY. Usually a small tree with a straight trunk and spreading, rather rigid branches which form a round, topped head. Hackberry attains a height of 40 to 50 feet in Kansas and like C. laevigata is characterized by the corky, warty bark. However, these tend to be more ridged on this species. Indigenous to the eastern United States including the eastern edge of the Great Plains.

Average growth rate: .33 inch in d.b.h. per year

Number of specimens on campus: 211

Remarks: This tree performs best in moist bottoms and develops excellent height and form in eastern Kansas woodlands. However, it will also grow on shallow, dry soils under adverse conditions

and is therefore widely used in the western part of the state in windbreak and ornamental plantings. One of the earliest trees to be planted on the campus, Specimen Number 50-1-2 in Section 2, is now 50.6 inches in diameter. Not recommended for small yards as it is a heavy feeder.

Celtis pumila SMALL HACKBERRY. A small tree or shrub which rarely exceeds twelve to fifteen feet. The subspecies, C. pumila georgiana GEORGIA HACKBERRY, received limited testing on the campus with moderate success. Ten plants were started in the trial nursery in 1940 with 90 per cent survival after two years. Testing has been insufficient to make a recommendation. The subspecies is native from New Jersey to Missouri.

Cercis (Redbud). A genus of small trees or shrubs including seven species which are native to North America and from southern Europe to eastern Asia. Noted for their early showy flowers which appear before the leaves, they are popular as ornamentals. Three species have been tried on the campus.

Cercis canadensis EASTERN REDBUD. One of the most popular and widely planted small ornamental trees in Kansas. C. canadensis is a very attractive tree with a broad, round head, simple, nearly orbicular leaves and conspicuous, bright, pink flowers which appear before the leaves. It is native from New Jersey to Florida and west to Missouri, Texas and New Mexico (Rehder, 1940).

Average growth rate: .27 inch in d.b.h. per year

Number of specimens on campus: 154

Remarks: Existing records indicate that C. canadensis has been planted on the campus since the early twenties. It has also been

used extensively throughout the state. The attractive flowers and its adaptability to a wide range of climatic and soil conditions make it one of the best small ornamental trees.

Chionanthus (Fringetree). This genus consists of two species of small trees or shrubs which are native to North America and China. One species has been tried on the campus with unsatisfactory results.

Chionanthus virginicus WHITE FRINGETREE. A small, slender tree which rarely exceeds ten feet in height, C. virginicus is native to Pennsylvania, Florida and Texas. Pendulous panicles of white flowers make the plant a desirable ornamental. Although it is occasionally planted in the eastern border counties, this species failed in limited campus testing. Although trials were too limited to be conclusive, it appears that the tree is subject to leaf burn or scald.

Cladrastis (Yellowod). This genus consists of four species of trees which are native in North America and eastern Asia. The leaves are odd-pinnate with seven to fifteen leaflets and the white flowers are borne in paniced racemes. One specimen of importance in the United States has been planted on the campus.

Cladrastis lutea AMERICAN YELLOWOOD. A medium sized tree with smooth bark and yellow wood, this species is native to North Carolina, Kentucky and Tennessee where it attains a height of 40 to 60 feet. The fragrant, showy, white flowers which are borne in pendulous panicles make it an attractive ornamental. Campus testing has been too limited to warrant a recommendation. However, there is one specimen (Number 135-1-2) on the campus in Section 2

which is presently 18.5 inches in diameter and in good condition. There are also two other specimens on campus. This tree is highly susceptible to sun scald.

Cornus (Dogwood). A genus of small trees or large shrubs (rarely herbs) numbering approximately fifty species, which are indigenous to the temperate regions of the Northern Hemisphere (Harrar, 1946). Largely ornamentals, they are grown chiefly for their handsome showy flowers. Seven species have been tried on the campus with varying degrees of success. Only five are worthy of mention here.

Cornus coreana KOREAN DOGWOOD. A tree which occasionally attains a maximum height of 60 feet, C. coreana is native to Korea. The bark is deeply divided into square, scaly plates and the twigs are reddish brown or purple. Although testing has been too limited to warrant a recommendation, it appears that this species may be adapted to the campus. One plant of three started in the trial nursery in 1932 survived and was later moved to Section 2. It is presently 10.8 inches in diameter and quite vigorous. Further trials are recommended.

Cornus florida FLOWERING DOGWOOD. One of the most attractive of our small American flowering trees, C. florida is small and bushy with a short trunk and attains a height of fifteen or rarely forty feet. The flowers are surrounded by four large, white, petal-like bracts which are very showy. This tree is shade tolerant and usually blooms as an understory tree about the same time as EASTERN REDBUD. It is native from Maine westward through southern Michigan to eastern Texas and Mexico. Although native in extreme southeastern

Kansas it has not performed satisfactorily at Manhattan. It can be recommended for extreme eastern Kansas only and should be sheltered from sun and wind. Heavy August watering is essential to promote vigor and blooming.

Cornus mas CORNELIANCHERRY DOGWOOD. A small tree or shrub (15 to 20 feet) this species is probably one of the best known of the exotic ornamental Dogwoods. It is chiefly planted for its early, yellow flowers, compact habit of growth and leaves which remain green late in the fall. C. mas is native to Europe and western Asia but it has performed well in campus plantings. Two specimens have reached a diameter at ground level of 15 inches. Recommended for east and central Kansas.

Cornus officinalis JAPANESE CORNEL DOGWOOD. A shrub or small tree which rarely exceeds 25 feet, C. officinalis is similar to the preceding species. It is native to Japan and Korea. First planted in 1939 this species performed well enough to warrant further testings. Two specimens in shrub collection attained a height of 12 feet in 14 years.

Crataegus (The Hawthorns). As a result of continued species hybridization this genus is quite large and somewhat unstable. Various authors list from 100 to 1200 separate species. According to Rehder (1940) there are approximately 800 indigenous to North America and 90 in the Old World. Because of their lustrus foliage, showy blossoms and clusters of brilliant colored fruits, a number of the hawthorns enjoy widespread ornamental use. Nine species have been tested on the campus and four of these have performed satisfactorily. Many species are highly susceptible to cedar-apple rust

fungus, Gymnosporangium juniperi-virginianae.

Crataegus calpodendron PEAR HAWTHORN. A shrub or small tree which rarely exceeds 20 feet with spreading branches which are usually armed with short, thorny, modified branchlets, C. calpodendron is native from Ontario to Georgia and west to Minnesota and eastern Kansas. This species performed moderately well in limited campus testing with one specimen reaching a diameter of 20.3 inches before its removal in 1948. However, it was heavily infested with rust on several occasions and may be a questionable choice for this reason. Further testing is recommended however.

Crataegus crusgalli COCKSPUR HAWTHORN. One of the best species for ornamental planting in Kansas, C. crusgalli is a large shrub or tree with wide spreading, rigid branches and numerous slender thorns. It has attractive, white flowers and bright, red fruit which often remain during the winter months. It is native from Quebec to North Carolina and west to eastern Kansas.

Average growth rate: .17 inch in d.b.h. per year[1]

Number of specimens on campus: 11

Remarks: Although it is rather slow growing this species has performed well in campus plantings. It has the ability to survive on thin soils under dry conditions and has also exhibited a resistance to the rust fungus. Recommended for planting in the east and central part of the state. There are 11 specimens doing well on the campus.

Crataegus mollis DOWNY HAWTHORN. A small tree with bright green

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[1]Based on only one specimen.

foliage, large, white flowers and bright purple fruit, C. mollis is another handsome ornamental for Kansas planting. It is native from southern Ontario to Virginia and west to South Dakota and Kansas where it attains a height of 25 to 30 feet. Five plants were started in the trial nursery in 1939. All but one survived to 1942 when they were moved to Section 4. These performed satisfactorily until removed for construction work. This tree is probably well adapted for planting in east and central Kansas but should receive further testing.

Crataegus phaenopyrum WASHINGTON HAWTHORN. A small tree with a round head, bright green, lustrous foliage, and long, slender spines. This tree is very attractive in the fall, with leaves that turn scarlet to orange and bright scarlet fruit which develops in large clusters. It is about the same size as the preceding species and is native from Virginia to Alabama and Missouri. Survival on trial nursery plantings in 1939 and 1940 was excellent, exceeding 90 per cent. These plants performed well on the campus prior to being removed in construction work. This species, like C. crusgalli, seems to be quite resistant to cedar-apple rust. It is well adapted to east and central Kansas but should receive further campus trials.

Diospyros (Persimmon). The majority of the 200 species included in this genus are native to the tropical and sub-tropical regions of Asia, Africa, the Malay Peninsula and North America. Two species are indigenous to the United States and one, D. virginiana, has been planted on the campus.

Diospyros virginiana COMMON PERSIMMON. A small to medium sized

tree with a broad, rounded, open head, D. virginiana attains a height of 30 to 40 feet in Kansas. It is characterized by the nearly black bark which is broken into thick, square, scaly plates. The fruit is an orange to reddish purple colored berry with a rather stringent taste. This tree is native from Connecticut to Florida and west to extreme eastern Kansas and Texas.

Average growth rate: .26 inch in d.b.h. per year[1]

Number of specimens on campus: 11

Remarks: This species, which commonly invades old fields in the central and eastern states, has also proven itself quite vigorous and hardy in campus plantings. One of the first trees of this species to be planted on campus in 1908, reached a diameter of 13.6 inches before its removal in 1946 for construction. Although it is probably adapted to both east and central Kansas, this tree has no particularly desirable features to recommend it as an ornamental.

Elaeagnus (Elaeagnus). This genus includes approximately forty species of trees and shrubs which are native to southern Europe, Asia and North America. Primarily ornamentals, they are grown for their striking foliage and decorative fruits. Four species have been tested on the campus but to date only one has proven to be well adapted.

Elaeagnus angustifolia RUSSIAN OLIVE. A tree-like shrub, sometimes thorny, which attains a height of 20 to 25 feet in Kansas. Both the leaves and young branchlets are silvery in color giving

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[1]Based on an average of only 2 specimens.

this tree a striking appearance. It is widely used in the state for both ornamental and windbreak plantings. E. angustifolia is native to southern Europe and Asia.

Average growth rate: .25 inch in d.b.h. per year[1]

Number of specimens on campus: 31

Remarks: This tree has proven to be well adapted to Kansas conditions both on and off the campus. One specimen reached a diameter at breast height of 24.5 inches before its removal in 1958. It is widely planted throughout the state and appears to be hardy in all areas. However, recently a number of plantings in various locations have been lost as a result of what appears to be verticillium wilt.

Fraxinum (Ash). The ashes comprise a group of about 65 species of trees, rarely shrubs, which are largely restricted to the Temperate Regions of the Northern Hemisphere; in America, south to Mexico and in Asia south to Java. Several species are important in the timber industry while others because of their showy flowers and handsome, opposite pinnate leaves are valuable ornamentals. Ten species have been tested on the campus but only 2 have proven notably successful.

Fraxinus holotricha A small tree, native to the Balkan Peninsula, F. holotricha received only very limited testing on the campus. In 1937, 6 plants were started in the trial nursery. They were moved to Section 12 in 1941 but with one exception all died as a result of winter injury. This species should receive further testing.

Fraxinus ornus FLOWERING ASH. A medium sized, round headed tree

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[1] On only one specimen.

with smooth, gray bark and fragrant, white showy flowers in dense, terminal panicles. Native to southern Europe and western Asia where it attains a height of 40 to 60 feet. One specimen in Section 12 is presently 10 inches in diameter at ground level and in good condition. This tree is divided at the base into 3 stems and is very attractive. This species should receive further trial.

Fraxinus pennsylvanica lanceolata GREEN ASH. A medium sized tree in many respects similar to both Red and White ash. It is distinguished from F. pennsylvanica by the lustrous-green, sharply serrate, lanceolate leaflets and smooth twigs. This tree is native to most of the eastern United States including Kansas and the Great Plains area. It attains a height of 40 to 60 feet in this state.

Average growth rate: .32 inch in d.b.h. per year

Number of specimens on campus: 61

Remarks: This tree is exceedingly hardy under climatic extremes and has the ability to survive on dry soils. Specimen Number 227-2-2 in Section 3 is presently 26.2 inches in diameter. It is widely used in both ornamental and windbreak plantings. Observations indicate that it can be recommended throughout the state.

Fraxinus quadrangulata BLUE ASH. A medium sized tree (50 to 70 feet) with small spreading branches which form a slender, open, more or less rounded head. This species is characterized by the stout, conspicuously, 4 angled and usually winged twigs. It often occurs on dry limestone uplands in association with species such as CHINKAPIN OAK. It is native to the Ohio and upper Mississippi

River valley.

Average growth rate: .21 inch in d.b.h. per year

Number of specimens on campus: 3

Remarks: This species has performed well in a limited number of campus plantings, probably because of its natural ability to survive on dry, upland soils. The largest specimen (Number 227-3-1) is 17.4 inches in diameter and is located in Section 2. This species should receive further testing. However, it appears to be hardy for east and central Kansas.

Gleditsia (Honeylocust). The genus Gleditsia includes 12 species of trees indigenous to North and South America, eastern and central Asia and tropical Africa. Principally ornamentals, they are medium sized trees with spreading branches which form a loose, fine textured appearance. The branches are usually armed with often branched spines. Three species and several varieties have been planted on the campus.

Gleditsia sinensis CHINESE HONEYLOCUST. A tree with stout, conical, often branched spines and pinnate leaves with 8 to 14 dull, yellowish-green leaflets. This species is also native to China where it attains a height of approximately 40 feet. Two specimens were planted in the trial nursery in 1930. One survived and was moved to Section 12 in 1942. This specimen was also lost about 1942. This species may be hardy but should receive additional trial.

Gleditsia triacanthos COMMON HONEYLOCUST. A medium sized tree characterized by its many stout branched spines which occur on both the trunk and branches. The leaves are both pinnate and bipinnately compound with 20 to 30 leaflets which create a light,

lacy effect. This tree attains a height of 40 to 50 feet and is native to most of the eastern United States, including Kansas, except for the Gulf Coastal states.

Average growth rate: .5 inch in d.b.h. per year[1]

Number of specimens on campus:

Gleditsia triacanthos	 43
THORNLESS	 6

Remarks: This species is native to eastern Kansas and as would be expected is quite hardy in campus plantings. However, it also seems to be well adapted in all sections of the state, and because of the rapid early growth and, the ability to withstand dry weather, is widely planted. The thornless varieties such as MORAINE have also been widely used both on and off the campus in ornamental plantings. Both the species and its varieties can be recommended throughout the state for windbreak and ornamental uses.

Gymnocladus (Coffeetree). This genus consists of 2 species, one a native of China and the other the KENTUCKY COFFEETREE of the eastern United States. The latter species is native to Kansas and has been planted extensively on the campus.

Gymnocladus dioicus KENTUCKY COFFEETREE. A medium to large sized tree characterized by heavy branches and thick gray furrowed bark which forms rough looking, scaly ridges. The large (1 to 3 inches) bipinnate leaves which turn clear yellow in the fall are also somewhat distinctive. This tree is native from New York to Tennessee

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[1]Rate during first 10 years. Later years (age 40 to 60) about .15 inches.

and west to Nebraska. It is also native in eastern Kansas where it attains a height of 50 to 60 feet.

Average growth rate: .28 inch in d.b.h. per year

Number of specimens on campus: 69

Remarks: This species is native to the woodlands of eastern Kansas and has performed well in rather extensive campus planting. It is moderately rapid in growth and seems to be relatively free of insect and disease pest. It is well adapted for east and central Kansas but somewhat undesirable as a shade tree because of the large pods.

Ilex (Holly). This genus includes nearly 300 species of evergreen and deciduous trees and shrubs widely distributed in both hemispheres. Most species are best adapted to moist situations and usually are restricted in their range to the coastal plains and large river basin areas. Six species were tried on the campus but only three approach tree-like porportions. One proved moderately successful.

Ilex decidua POSSUMHAW. A deciduous shrub or small tree with light gray, spreading branches and dark green, lustrous leaves. I. decidua is native from Virginia to Florida and west to Texas where it attains a height of 30 feet. Trial nursery plantings in 1939 made poor survival. However, there are presently 5 clumps on the campus in Section 1. They have reached 10 to 15 feet. This species should receive further trial.

Juglans (Walnut). This genus consists of about 15 species scattered from North and South America to Europe and eastern Asia in the Old World. Two species indigenous to the United States have been grown on the campus.

Juglans major ARIZONA BLACK WALNUT. A small tree, which occasionally reaches a height of 20 feet, with a narrow head and pinnate leaves with 9 to 13 leaflets. This species is native to Colorado, Arizona and New Mexico. Five plants started in the trial nursery in 1939 were later moved to Section 12. The last specimen died in 1946. Although no trees are presently growing on campus, this species should have additional trial before a recommendation is warranted.

Juglans nigra EASTERN BLACK WALNUT. One of the finest hardwood timber species in North America, J. nigra is a large tree which attains a height of 70 to 100 feet. The bark is dark brown and deeply furrowed and the leaves are odd-pinnate and dark green with 15 to 23 leaflets. This tree is native to the entire United States except for the southern Coastal Plains.

Average growth rate: .23 inch in d.b.h. per year

Number of specimens on campus: 30

Remarks; Juglans nigra is native in eastern Kansas and is found considerably west of Manhattan, occurring in the river bottoms. It is quite sensitive to site conditions and prefers deep moist soils. However, the species will adapt to upland soils as evidenced by satisfactory performance of campus plantings. Although it is hardy in east and central Kansas and our most valuable timber species, it is not highly desirable as a shade tree.

Koelreuteria (Goldenraintree). The genus includes 4 species of small trees with alternate odd-pinnate or bipinnately compound leaves and showy, yellow flowers. All are native to eastern Asia. One species widely planted

in the United States has been grown on the campus.

Koelreuteria paniculata PANICLED GOLDENRAINTREE. A small tree with pinnate or bipinnately compound leaves and 7 to 15 leaflets. This tree is widely used as an ornamental for its conspicuous panicles of golden yellow flowers which appear in June. Native to China, Korea and Japan it attains a height of approximately 20 to 30 feet.

Average growth rate: .24 inch in d.b.h. per year

Number of specimens on campus: 37

Remarks: Under observation since 1931, this species has proven to be well adapted to campus climate and soils. One specimen, tagged (Number 174-1-1) in August of 1931, is presently 13.3 inches in diameter. All campus specimens weathered the droughts of the thirties and fifties exceptionally well. K. paniculata is widely planted in the state and is probably hardy throughout east and central Kansas. However, it is occasionally subject to sun scald and should be protected.

Laburnum (Laburnum). A small genus, consisting of 3 species which are native to southern Europe and western Asia. Primarily ornamental trees or shrubs, 2 of the species are characterized by very showy, pendulous racemes of golden yellow flowers. One species has had limited campus testing.

Laburnum anazyroides GOLDENCHAIN LABURNUM. A large shrub or small tree with alternate tricoliate pinnate leaves and striking, golden flowers in long, silky-pubescent racemes. This species is native to southern Europe and attains a height of approximately 20 feet. This plant failed in very limited campus testing. However, it

should receive further trials. It appears to be hardy in extreme eastern Kansas but should be protected from hot sun and southerly winds.

Liquidambar (Sweetgum). This genus comprises 4 species. One is found in Central America, 2 in Asia and one in the eastern United States. The latter species has received limited trial on the campus.

Liquidambar styraciflua AMERICAN SWEETGUM. A typically southern bottomland species, L. styraciflua is a beautiful, symmetrical tree with stout, corky or winged branches and simple, star-shaped palmately lobed leaves. It is native to the coastal plains and lower Mississippi and Ohio River valleys where it reaches a height of 80 ot 120 feet (Harlow, 1941).

Number of years on trial: 27

Average growth rate: .43 inch in d.b.h. per year[1]

Number of specimens on campus: 1

Remarks: Because of its excellent texture and crimson fall color, this tree is widely planted in the southern and eastern United States. It is best adapted to moist, alluvial soils and has performed only moderately well under our atmosphere and soil moisture conditions. However, it seems fairly well adapted to east and southcentral Kansas and should receive additional campus testing.

Liriodendron (Tuliptree). A small genus comprising but 2 species of trees. One is a native of central Asia; the other, Liriodendron tulipifera, is a large tree widely distributed in eastern North America. This species has been grown on the campus with moderate success.

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[1]Based on only one specimen.

Liriodendron tulipifera TULIPTREE. A beautiful tree of broad, pyramidal habit with large leaves of unusual shape which turn yellow in the fall. It is named for the large conspicuous tulip-shaped flowers. The tree, usually called YELLOW POPLAR by foresters, is one of the largest and most valuable of all eastern hardwoods, attaining a height of 100 to 150 feet. It is native from southern New England west to Michigan and south to Louisiana and Florida.

Average growth rate: .26 inch in d.b.h. per year

Number of specimens on campus: 3

Remarks: A number of specimens, planted about 1900, have been under observation for the past thirty years. These trees, as well as more recent plantings on new areas of the campus, seem fairly well adapted. One (Specimen Nomber 76-1-1) in Section 6 is presently 39.9 inches in diameter. The species makes its best growth on deep, moist, well drained soils and is somewhat difficult to transplant. However, pending further trials, it appears that it can be recommended for eastern Kansas on good soils.

Maclura (Osageorange). This genus is monotypic and the single species, Maclura pomifera, originally restricted to southern Arkansas, Oklahoma and northeast Texas, has since become naturalized in many eastern and central states as a result of extensive planting as a hedge.

Maclura pomifera OSAGEORANGE. A medium sized, spiny tree with an open irregular, round-topped head and bright green leaves. It is characterized by the fruit which consists of a compact cluster of green oblong druplets resembling a large green orange. OSAGEORANGE

hedgerows have been a familiar sight in Kansas for many years and the species has now become naturalized in the state.

Average growth rate: .25 inch in d.b.h. per year

Number of specimens on campus: 1

Remarks: Although campus planting has been limited, this species has proven itself well adapted to Kansas conditions in the widespread planting that took place in the early history of the state. In fact, it is so well adapted that many eastern Kansas farmers are battling it with herbicides as a weed in their pastures. The widespread, shallow, root system has caused it to lose favor in both windbreak and ornamental plantings.

Magnolia (Magnolia). The trees in this group are particularly well known ornamentals because of their large showy flowers. The genus includes some thirty-five species, scattered from Asia to southern Mexico and the eastern United States (Harlow, 1941). A few are hardy as far north as Massachusetts but they flourish best in the south. Two species and one hybrid have been planted on the campus, the latter one being the only successful introduction.

*Magnolia soulangeana (denudata x liliflora) SAUCER MAGNOLIA. An upright shrub or small tree with large saucer-shaped purplish white flowers, this plant is one of the most beautiful of our early flowering trees. It is the hardiest of the magnolias and in Kansas attains a height of 12 to 18 feet. Campus plantings have performed well indicating that this plant is probably well

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*Indicates a hybrid cross.

adapted to eastern Kansas. Four specimens on campus, two 8 feet high, two 14 feet high, are doing well.

Malus (Apple; Crabapple). This genus numbers about twenty-five species of deciduous trees or shrubs native to the temperate regions of North America, Europe and Asia. Some species are important fruit trees and others belong to one of the most valuable of our ornamental groups. Many ornamental hybrids and clons have been developed. Nine species and three hybrids have been tested on the campus.

*Malus atrosanquinea (Halliana x sieboldi; Pyrus atrosanquinea). A spreading shrub with nearly glabrous serrate leaves and rose-purple flowers. Two plants of the clon CARMINE are growing on the campus and performing satisfactorily.

Malus baccata SIBERIAN CRABTREE. A small to medium sized tree (30 to 40 feet), pyramidal when young and later with a rounded head. The showy, white flowers and attractive red or yellow fruit made this a popular ornamental. Native to northeast Asia and northern China, this species serves as a parent in many hybrid crosses.

Number of years on trial: 21

Number of specimens on campus: 3

Remarks: This species was planted on the campus in 1939 and has been under observation since that time. On the basis of limited numbers it appears that it is both drought and winter hardy and can be recommended for all sections of the state.

*Malus adstringens (baccata x pumila Niedzwetzkyana) HOPA CRAB. A handsome form of the Siberian crabs with large purple-red flowers,

this tree has been widely planted both on and off the campus. One specimen planted in 1940 (Number 113-7-1) is now 18.6 inches in diameter at 6 inches. This hybrid is well adapted in east and central Kansas.

Malus floribunda JAPANESE FLOWERING CRAB. A shrub or small tree which rarely exceeds 30 feet in height, this species is one of the handsomest of the crabs, with flowers that change from carmine to white. It is native to Japan. This species has also served as parent in a number of crosses. Three specimens on the campus have performed satisfactorily. Recommended for eastern and central Kansas pending further trials.

Malus ioensis PRAIRIE CRAB. The only crab native to Kansas, this species is a small tree which occasionally reaches a height of 30 feet. It is native from Minnesota and Wisconsin to Nebraska, Kansas and Missouri (Rehder, 1940). Two specimens presently on campus have performed moderately well. Although it is hardy, this species is not as attractive as some of the double-flowering forms, such as Bechtels. It is also subject to cedar-apple rust.

*Malus scheideckeri (floribunda x prunifolia; Pyrus pulacerrima scheideckeri) SCHEIDECKER CRAB. A small tree of upright habit with pale pink flowers which are usually semi-double. This hybrid was first planted on the campus in 1941 and still survives. Additional trials are necessary to make a recommendation.

Malus sargenti SARGENT CRAB. A low shrub with horizontally spreading branches, pure white flowers and attractive fruit. This species is native to Japan. Trial nursery plantings in 1939 and

1940 failed to survive past the second growing season. However, further trials should be conducted.

Morus (Mulberry). This genus includes approximately 12 to 15 species of trees and shrubs grown chiefly for their edible fruits. They are also occasionally used in windbreak and ornamental plantings. They are native to the Temperate and Subtropical regions of the Northern Hemisphere.

Morus alba WHITE MULBERRY. A small tree with spreading branches which form a round-topped head, and bright green leaves which serve as the chief food for the silkworm. The subspecies M. alba tatarica RUSSIAN MULBERRY has been widely distributed in the state for windbreak planting and appears to be one of the hardiest forms.

Morus rubra RED MULBERRY. A small to medium sized tree with stout, spreading branches which form a dense, broad, round-topped head. This species is native from Massachusetts to Florida and west to Michigan and Kansas, where it attains a height of 40 to 50 feet.

Average growth rate: .50 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: Although the number of specimens planted has been limited, a number of older trees have been under observation since 1930. These appear to be quite hardy and also proved to be tolerant of drought conditions in the thirties. One tree reached a diameter breast high of 32.8 inches before its removal in 1945. Can be recommended as hardy in east and central Kansas.

Ostrya (Hophornbeam). Of seven known species, two are native to the United States. One, Ostrya virginiana, a widespread eastern and southern species, has been planted on the campus.

Ostrya virginiana AMERICAN HOPHORNBEAM. Ordinarily a small tree (20 to 30 feet) with a small columnar bole and round-topped or vase-like, open crown (Harrar, 1946). It is distinguished by its bark which is broken into small, oblong plates which curve outward giving it a "shreddy" appearance. Native from Ontario and Minnesota to Florida and Texas.

Average growth rate: .10 inch in d.b.h. per year[1]

Number of specimens on campus: 2

Remarks: This species performed well in a number of plantings made in 1928, 1930 and 1939. Nearly all of the specimens which were removed were as the result of construction work. A number of older trees planted about 1900 have also been under observation. One (Specimen Number 39-1-2) in Section 3 is presently 12 inches in diameter. This species can be recommended as hardy in eastern Kansas but is not particularly valuable as an ornamental.

Paulownia (Paulownia). This genus consists of about 10 species of trees native to China and named for a former princess of the Netherlands. One, the ROYAL PAULOWNIA, has been planted on the campus.

Paulownia tomentosa ROYAL PAULOWNIA. A medium sized, round headed tree with stout, spreading branches and large, simple, opposite leaves. The tree is quite attractive in the spring with large, violet, fragrant flowers which appear just before the leaves. Native to China, this species has become naturalized in the eastern states from New York south to Georgia.

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[1]Based on only 2 specimens.

Average growth rate: .59 inch in d.b.h. per year[1]

Number of specimens on campus: 1

Remarks: This species has received only very limited testing on the campus. However, one specimen which survives (Number 242-1-2) in Section 6 is presently 11.7 inches in diameter and in good condition. It appears that this species is not well adapted in eastern Kansas but further trials are recommended.

Pistacia (Pistache). A small genus of deciduous or evergreen trees and shrubs including eight species native to the Mediterranean region, Mexico, Texas and eastern Asia. One species is currently on campus trial.

Pistacia chinensis CHINESE PISTACHE. A medium size deciduous tree which occasionally reaches a height of 80 feet. The leaves are pinnately compound with 10 to 12 leaflets which turn a crimson color in the fall. It is native to China.

Number of years on trial: 6

Number of specimens on campus: 4

Remarks: The trial specimens survived the initial period of establishment and appear quite vigorous as they begin their third growing season. However, it is too early to comment further on this species.

Platanus (Planetree). The only member of a monotypic family, this genus includes six or seven species. Three are native to the United States and the others are found from southeastern Europe to India. They are handsome ornamentals widely planted as city shade and street trees because of

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[1]Based on only 2 specimens.

their ability to withstand smoke, dust and much abuse.

*Platanus acerifolia (occidentalis x orientalis) LONDON PLANETREE. A moderately large tree with a tall upright stem and widespreading branches which form a broad round head. Like AMERICAN PLANETREE, P. occidentalis, the bark has a tendency to peel in large flakes exposing patches of lighter colored, smooth bark. It differs, however, in that the bark has a more olive-green color and the fruit heads or "balls" occur in 2's rather than singularly.

Average growth rate: .66 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: This species has had only limited testing during the past 30 years. However, observation on the older specimens indicate that it is probably well adapted for planting in east and central Kansas. Personal observation indicates that it may be somewhat more difficult than P. occidentalis to transplant successfully. The largest specimen on campus is presently 31.6 inches in diameter.

Platanus occidentalis AMERICAN PLANETREE (SYCAMORE). The most massive and perhaps the tallest deciduous tree in North America, P. occidentalis occasionally reaches a height of 150 feet or more. In Kansas, 70 to 80 feet is about the maximum. It is characterized by the creamy, white bark which later becomes almost brown and scaly. The fruit is borne singly, otherwise it is quite similar to the preceding hybrid. It is native in the eastern United States to Kansas, Oklahoma and Texas.

Average growth rate: .31 inch in d.b.h. per year

Number of specimens on campus: 45

Remarks: This species is native in eastern Kansas and although it occurs naturally as a bottomland species, it performs very well on the upland campus sites. It is moderately rapid in growth, quite hardy, and can be highly recommended for ornamental planting in east and central Kansas. The largest living specimen on the campus (Number 94-2-1) is 25.9 inches in diameter.

Populus (The Poplars). This genus, which includes the aspens, cottonwoods and balsam poplars, consists of about 30 to 35 species widely distributed in North America, Europe, North Africa and Asia. A number of the species are planted as shade and street trees because of their rapid growth rate, and the ease with which they are propagated vegetatively. Some are prized for their use in farm plantings. Seven species, two subspecies, one hybrid and two clons have been planted on the campus.

Populus acuminata LANCELEAF POPLAR. A medium sized, round-topped tree with more or less upright branching habit. Native to Colorado and Nebraska, the species was planted in the trial nursery in 1940. Many of the plants were winter killed and all were dead by 1942. This species should receive further trials.

Populus alba WHITE POPLAR. A moderately large tree of irregular habit with whitish gray bark and leaves that have a white felt appearance below. Native in Europe and Asia, it has since become naturalized in North America and together with several clons is widely planted.

Number of years on trial: 23

Number of specimens on campus: 1

Remarks: This species has been on the campus since its beginning. The present tree is a sprout from the original planting. It is 34.5 inches in diameter at the ground, but in poor condition. The clon BOLLEANA is a tall columnar tree but is highly susceptible to attack by borers and disease. For that reason is not recommended for landscape planting.

*Populus canadensis (deltoides x nigra). The species is a tall tree with more or less ascending branches. A number of forms have developed independently, including P. c. eugeni, CAROLINA POPLAR, which has received limited campus trial. This subspecies is a tree of narrow, pyramidal habit, which is often used in street planting. Ten plants were started in the trial nursery in 1940. Initial survival was good but all specimens were lost by the middle forties. However, one older specimen which died in the drought of the thirties had reached the age of 44 years and a diameter of 38 inches.

Populus deltoides EASTERN POPLAR (COTTONWOOD). Our "State Tree", P. deltoides is the most widely distributed native tree in Kansas. In the western part of the state, this species marks the winding stream courses and is often the only tree of any consequence. It is a moderately large tree (60 to 80 feet) with a wide spreading, somewhat open crown supported by a massive trunk which is often divided near the ground. The species is native from Quebec to North Dakota, Kansas, Texas and Florida.

Average growth rate: .32 inch in d.b.h. per year[1]

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[1]Based on 20 year growth period of 30 to 40 inch specimens. Much faster when young.

Number of specimens on campus: 6

Remarks: Native to the entire state this tree is of course quite hardy in campus plantings. Although best adapted to bottomland, once established it is relatively drought resistant even on upland sites. One specimen (Number 27-3-2) in Section 2 is presently 50.3 inches in diameter. The male or "cottonless" trees are recommended for landscape plantings only in large farm yards and parks.

Populus nigra BLACK POPLAR. The species is a rather large tree with widespreading, stout branches and usually a short trunk. It is native to Europe and western Asia. Campus trials have included only the subspecies P. nigra betulifolia and the clon LOMBARDY. P. n. betulifolia, BIRCHLEAF BLACK POPLAR, was started in the trial nursery in 1935 but all the specimens were lost by 1940. The clon LOMBARDY is a columnar form with closely ascending branches and leaves that are usually narrowly cuneate. This tree attains a height of 50 to 80 feet and is widely used in formal and screen plantings.

Average growth rate: .82 inch in d.b.h. per year

Number of specimens on campus: 5

Remarks: This tree was planted on the campus as early as 1900 and one of these older specimens reached a diameter of 24.2 inches before its death in 1941. Additional plantings in 1930, 1940 and 1941 are under observation and appear to be quite hardy. However, the tree is relatively short-lived, a heavy feeder and its roots often damage shallow sewers.

Populus tremuloides QUAKING ASPEN. A small to medium sized tree

widely distributed in North America from Alaska to Mexico, in the mountains. In this country it is largely restricted to the northern and western state, where it attains a height of 50 to 60 feet. Flattened petioles cause the leaves to move in the slightest breeze, hence the name. It is rapid but short lived. Trial nursery plantings in 1929 and 1930 made very limited survival. There are 4 specimens on the campus that grew from sprouts of plantings made in 1930. The original plantings died in 1937. This species is not well adapted to the state.

Prunus (APRICOT; CHERRY; CHOKECHERRY; LAURELCHERRY; PEACH; PLUM). This is an extremely large and variable genus and the species which follow belong to sections or subgenera of the genus. A few botanists regard them as distinct genera but Rehder (1940) lists them all under Prunus. There are a total of 200 species of trees and shrubs included. About 20 species and their varieties have been planted on the campus.

Prunus americana AMERICAN PLUM. A small tree or shrub with spreading branches which form a broad round-topped head. This species often sprouts from the roots to form rather dense thickets. For this reason it has been used extensively for windbreak, wildlife and erosion control planting in the plains states. It is native from Massachusetts to Manitoba and south to Georgia, New Mexico and Utah, where it attains a height of 20 to 30 feet.

Average growth rate: .14 inch in d.b.h. per year

Number of specimens on campus: 1

Remarks: This species has been planted in limited numbers on the campus. However, as mentioned above, it has been widely planted

in the state and appears hardy in all sections. It has limited value as an ornamental, but is effective when planted near Redbuds.

Prunus besseyi BESSEY CHERRY. A shrub similar to P. pumila, SAND CHERRY, this species seldom exceeds 8 to 10 feet in height. Sometimes cultivated for its sweet purple to black fruit, it is also used in windbreak and wildlife planting. It is native from Manitoba to Wyoming and south to Kansas and Colorado. A total of 35 plants were started in the trial nursery in 1939 and 1940 but none survived beyond the second growing season. However, this species appears to be hardy in off campus plantings. It is recommended for further trial.

Prunus cerasifera MYROBALAN PLUM. A slender branched, sometimes thorny tree which attains a height of approximately 20 feet. It is native to western Asia and is less important than its subspecies and varieties. One specimen planted on the campus about 1930 winterkilled several times and was finally removed.

The clon PISSARD, lised as P. c. atropurpurea by Rehder (1940), has purple leaves and small, pink flowers. This clon, commonly referred to as PURPLELEAF PLUM is widely planted in the state because of the striking foliage and abundance of its early, pink flowers. It has performed moderately well in limited campus planting, but is short lived and occasionally sprouts from its root stock.

Prunus japonica CHINESE BUSHBERRY. A shrub with pink or white flowers that open with the leaves. This species is native to China and attains a height of 4 to 5 feet. This species has been

grown both in the nursery and in the campus since 1930 and appears to be quite hardy. Recommended for east and central Kansas.

Prunus maacki AMUR CHOKECHERRY. A small tree characterized by its brightly colored, yellow, flaky bark. It is native to Manchuria and Korea where it attains a height of 40 feet. Trial nursery planting in 1942 was lost the following year. However, the number of plants were too limited to warrant comment beyond the need for further trials.

Prunus maritima BEACH PLUM. A small shrub sometimes cultivated for its early profuse white flowers. Native from Maine to Vermont, near the coast. Trial nursery plantings in 1940 still remain where planted but have not made normal growth.

Prunus persica PEACH. A small tree, usually 20 to 30 feet in height, with solitary pink flowers and lanceolate leaves. The species is native to China and has been cultivated since ancient times. Many pomological and ornamental forms such as the double flowering varieties have now assumed primary importance. The clon DOUBLERED has been widely planted both on and off the campus and appears hardy for eastern Kansas. However, it is highly susceptible to attack by borers and is short lived.

Prunus salicina JAPANESE PLUM. A small tree with bright green, lustrous leaves and showy white flowers. P. salicina is native to China where it attains a height of 20 to 30 feet. Three plants were started in the trial nursery in 1931 and later moved to Section 12. One died but the other two performed well and one of these still survives on campus. This species should receive further trial.

Prunus sieboldi SIEBOLD CHERRY. One of the Japanese flowering cherries P. sieboldi is a small tree with smooth, gray bark and single or double pink or white flowers. It is native to Japan and attains a height of 25 to 30 feet. One specimen on campus appears quite hardy. This species should also receive further trial.

Prunus serotina BLACK CHERRY. A medium sized tree with smooth bark that later becomes almost black and somewhat scaly. This tree makes its best growth on deep, moist soils. It is native throughout the eastern United States, where it often attains a height of 70 to 80 feet. The range includes the extreme eastern part of Kansas.

Average growth rate: .30 inch in d.b.h. per year

Number of specimens on campus: 7

Remarks: This species was first planted on the campus about 1900 and has been under recorded observation since 1931. One specimen which died during the drought of the thirties attained a diameter of approximately 19 inches at the age of 34 years. Later plantings made in 1931 and 1940 have performed only moderately well. This tree is winter hardy but subject to drought injury at Manhattan. Recommended for eastern Kansas only.

Prunus tomentosa MANCHU CHERRY (NANKING CHERRY). A handsome, free flowering shrub or small tree which rarely exceeds 10 to 12 feet in height. The flowers, which are white, appear slightly before or with the leaves. This species has been widely distributed in Kansas for windbreak and wildlife planting. It is also an attractive ornamental.

Number of specimens on campus: 5

Remarks: A number of plants started in the trial nursery in 1929 and 1931 were lost during the middle thirties. However, recent trials have proven somewhat more successful. This species is hardy for east and central Kansas.

Prunus virginiana COMMON CHOKECHERRY. A shrub or small tree with showy, white flowers which are borne in dense glabrous racemes. This species is native from Newfoundland to Saskatchewan, North Dakota and Nebraska south to North Carolina, Missouri and throughout Kansas. It attains a height of 15 to 25 feet. There are 6 specimens on the campus. Two plants were growing well in the shrub collection for 20 years.

Ptelea (Hoptree). This genus consists of 7 to 10 variable species of aromatic shrubs and small trees native to North America and Mexico. The botanical name is derived from the Greek, meaning elm, because of the similarity in seeds (Rehder, 1940). One species has been grown successfully on the campus.

Ptelea trifoliata COMMON HOPTREE. The Hoptree is an aromatic tree, the foliage, fruits and branches of which, if bruised, exhale an unpleasant hop-like odor. It is grown chiefly for its attractive foliage and fruit. This species is native from Ontario and New York to Florida and west to Minnesota.

Number of specimens on campus: 2

Remarks: This species has received only limited trial on the campus. It appears to be hardy and relatively drought resistant. However, the specimens remaining have had a tendency to develop numerous

stems rather than a single trunk. This species should receive further trial. It appears to be suitable for planting in the eastern half of the state.

Quercus (The Oaks). The oaks comprise a genus which is estimated to contain between 200 and 300 species of deciduous or evergreen trees and shrubs. They are widely distributed throughout the Temperate regions of the Northern Hemisphere and in the Tropics at high altitudes. Their sturdy quality and longevity have made them objects of admiration since ancient times and they continue to be popular ornamentals because of their handsome foliage and brilliant fall colors. There are three subgenera ie: leucobalanus, The White Oaks; Erythrobalanus, The Red Oaks; and Cyclobalanus, which includes certain foreign species. Harlow (1941) also lists the Chestnut Oaks and the Willow Oats as subgroups under the White Oaks and Red Oaks, respectively. However, all species are grouped here alphabetically as with preceding genera. Twenty-one species have received some degree of trial on the campus, about half of these proving successful.

Quercus alba WHITE OAK. One of the noblest of the oaks, Q. alba is a large tree with stout, spreading branches forming a broad, open head and bright, green leaves which turn deep vinous red or violet-purple in the fall. The bark is light, ashy gray and the lobes of the leaves are entire, a feature which distinguishes the White Oaks from the Red Oak group. This species is native to the eastern United States including a portion of extreme eastern Kansas.[1]

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[1]The author has observed an isolated occurrence of this species as far west as Jackson County.

Average growth rate: .29 inch in d.b.h. per year

Number of specimens on campus: 9

Remarks: A number of older specimens planted prior to 1900 have made excellent growth and have shown considerable drought resistance in observations since 1930. The largest, Specimen Number 44-7-7 in Section 3 is presently 21.5 inches in diameter. Later plantings in 1939 and 1940 were only moderately successful. This species can be recommended for the eastern one-third of the state but shallow, dry or poorly drained soils should be avoided.

Quercus bicolor SWAMP WHITE OAK. A moderately large tree (60 to 70 feet) with a rather narrow, round-topped, open head easily recognized by the light, scaly bark and leaves which turn yellow brown or orange red in fall. It is native to the eastern United States except the south Atlantic states and part of the Gulf Coastal Plains. According to Harlow (1941) it is native in extreme eastern Kansas.

Average growth rate: .31 inch in d.b.h. per year

Number of specimens on campus: 12

Remarks: The general performance, growth rate and recommendations for this species are the same as Q. alba.

Quercus borealis NORTHERN RED OAK. A moderately large tree (60 to 80 feet) with a short massive trunk and an extensive, open head. (Under forest conditions a long clear bole and small crown). This species is widely used as an ornamental because of its attractive foliage which turns dark red in Autumn. As with other species in the Red Oak group, the lobes of the leaves are toothed.

It is also relatively rapid in growth compared to the White Oaks. The subspecies Q. borealis maxima which is almost identical except for a variation in acorns is native throughout the eastern United States including eastern Kansas.

Average growth rate: .50 inch in d.b.h. per year

Number of specimens on campus: 94

Remarks: This tree is native west to Manhattan and is widely planted as a shade or street tree. Its rather rapid growth, longevity and attractive foliage make it one of the most desirable shade trees for the eastern half of the state.

Quercus gambeli GAMBEL OAK. This species is similar to Q. novomexicana, a small, sometimes shrubby tree native to Colorado, Utah and New Mexico. Five plants were started in the trial nursery in 1939 and later moved to Section 12. Three are still growing on the campus and appear quite vigorous. The largest specimen measures 15.8 inches in d.b.h. This species should receive further trial.

Quercus imbricaria SHINGLE OAK. Sometimes called "northern laurel oak" this species is a medium sized tree with oblong-lanceolate leaves which turn russet-red in the fall. It is native to the Appalachian Region and the Ohio and central Mississippi River valleys where it attains a height of 50 to 60 feet. Occasionally found in the Kaw River valley in extreme eastern Kansas (Gates, 1928).

Average growth rate: .38 inch in d.b.h. per year

Number of specimens on campus: 9

Remarks: A number of specimens planted prior to 1900 are still

growing on the campus, the largest being 24.4 inches in diameter (Number 44-9-1 in Section 1). The species is best adapted to moist, fertile soils and can be recommended for the eastern third of the state on good soils.

Quercus macrocarpa BUR OAK. Selected as the "Centennial Tree" Q. macrocarpa is the most widely distributed oak in the state. A large tree (70 to 80 feet) which when open grown develops a short trunk and a broad, massive crown. It is characterized by the heavy, often corky, crooked limbs and fringed acorns. The species is native throughout the eastern United States as far west as Mankato in central Kansas.

Average growth rate: .39 inch in d.b.h. per year

Number of specimens on campus: 68

Remarks: Although best adapted to bottomland soils, this species has the ability to survive under a wide variety of soil and climatic conditions. For this reason and because of its longevity and beauty it is excellent for both ornamental and windbreak planting. It is also one of our most valuable timber species.

Quercus muhlenbergi CHINKAPIN OAK (CHINQUAPIN OAK). A medium sized tree with erect, short branches which form a narrow, rounded head. The bark is ashy gray and the leaves are oblong-lanceolate, turning deep yellow and russet in the Autumn. This tree often occurs on dry slopes typically where there are limestone outcrops. It is native in the eastern United States except for the south Atlantic states and Gulf Coastal plains. In Kansas it extends west of Manhattan.

Average growth rate: .18 inch in d.b.h. per year

Number of specimens on campus: 4

Remarks: Although native and widely distributed in eastern Kansas, this species is seldom planted as an ornamental, probably because of its rather slow rate of growth. It is not generally available in the nursery trade.

Quercus palustris PIN OAK. Considered by many to be one of the finest American oaks for street and ornamental planting, Q. palustris is a moderately large tree (70 to 80 feet) characterized by its symmetrical pyramidal head and unusual branching habit. It is native to the eastern United States except for the Atlantic states and Gulf Coastal plains. In Kansas it is restricted to the southeast one-fourth of the state.

Average growth rate: .50 inch in d.b.h. per year

Number of specimens on campus: 136

Remarks: Although this tree tends to be chlorotic on upland, alkaline sites, it is, nevertheless, one of our most popular ornamentals. Beautiful form, rapid growth, fall color and ease of transplanting combine to make it one of the top selections. The largest campus specimen (Number 44-3-2), located in Section 7, is 26.6 inches in diameter.

Quercus phellos WILLOW OAK. A medium sized tree (60 to 80 feet) with a conical, round topped head and linear, oblong-lanceolate, willow-like leaves which turn pale yellow in the fall. This species is a popular street tree in the South. It is native to the Atlantic states and Gulf Coastal plains. There is one specimen on the campus

and one tree was removed in 1934 that had reached a diameter of 12.5 inches. This species should receive further trial.

Quercus prinus SWAMP CHESTNUT OAK. A moderately large tree (60 to 80 feet) with a round topped, compact head and broadly obovate to oblong obovate leaves which turn crimson in the fall. Best growth is made on moist, loamy soils. It is native to the Atlantic states and Gulf Coastal plains and the Mississippi River valley.

Average growth rate: .20 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: Five specimens on campus were planted about 1900. These have proven well adapted to campus conditions. However, this species should receive further trial, prior to recommendation for general planting.

Quercus variabiles ORIENTAL OAK. A medium sized tree (50 to 60 feet) with yellow-gray, corky bark and distinct foliage which resembles that of Castanea crenata. It is native to China, Korea and Japan. One of two plants started in 1932 still survives in Section 7 and is presently 8.3 inches in diameter. This species should also receive further trial.

Rhamnus (Buckthorn). This genus comprises 50 to 60 species of deciduous or evergreen trees and shrubs widely scattered through the Temperate and Tropical regions of both Hemispheres. Three species which attain tree-like proportions have been planted on the campus. One has proven highly successful.

Rhamnus cathartica COMMON BUCKTHORN. A shrub or small tree which rarely exceeds 20 feet in height. This species has elliptic to ovate leaves which are dull green above and light green, glabrous

beneath. Often used in hedging. Introduced from Asia, R. cathartica has since become naturalized in many sections of the eastern United States.

Number of specimens on campus: 145

Remarks: The rather large number of specimens that have re-seeded on the campus have given indication that this species is well adapted to eastern Kansas. It is not widely used as an ornamental as it is not offered by the trade.

Robinia (Locust). This genus includes approximately 20 species of deciduous trees and shrubs found in North America and Mexico (Rehder, 1940). They are planted chiefly for their shown, fragrant flowers. Two species which attain tree size have been planted on the campus.

Robinia pseudoacacia BLACK LOCUST. A medium sized tree (30 to 50 feet) with a narrow, oblong crown of irregular habit. The leaves are odd-pinnate with 7 to 21 leaflets. This tree is characterized by its deeply furrowed, black bark, white, showy, fragrant flowers and short, stipular spines which occur in 2's. Originally native from Pennsylvania to Georgia and west to Iowa and Missouri, it is now naturalized in many other states including Kansas.

Average growth rate: .30 inch in d.b.h. per year

Number of specimens on campus: 17

Remarks: This species has been widely planted in the past for a variety of purposes, including fence posts, erosion control, windbreaks and as an ornamental. Although it grows rapidly in early years, on medium to poor sites it is often subject to attack by the Locust Borer, (Cyllene robiniae). It is less popular now and

questionable in value as an ornamental because it has a tendency to sucker and spread rapidly.

Salix (The Willows). This large and complex genus is variously estimated to contain from 170 to 300 species of trees and shrubs found chiefly in the colder and temperate regions of the Northern Hemisphere. Gates (1928) lists three species as native to Kansas, ie; SANDBAR WILLOW, S. interior (longifolia); PEACHLEAF WILLOW, S. amygdoloides; and BLACK WILLOW, S. nigra. These species, although not planted on the campus, are growing in the vicinity of Manhattan. However, they are of only minor importance as ornamentals. One exotic ornamental has been planted on the campus.

Salix alba vitellina YELLOWSTEM WHITE WILLOW. A moderately large tree (50 to 60 feet) with spreading branches which are pendent at the ends. This subspecies has narrow, lanceolate leaves and yellow branchlets. It is native from Europe and North Africa to central Asia. Several plants were started in Section 12 in 1931 and one of these reached a diameter of 13 inches before its removal in 1941. A second specimen still survives.

Sapindus (Soapberry). A genus of deciduous or evergreen trees and shrubs, containing approximately 15 species found chiefly in the Tropics.

Sapindus drummondi WESTERN SOAPBERRY. An interesting species, and the hardiest of its genus, S. drummondi, is a small tree with scaly, red-brown bark and odd-pinnately compound leaves with 7 to 19 leaflets. It is characterized by its yellow berries with semi-translucent flesh and black seed.[1] This species is native to

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[1]The berries were formerly used as soap by the early settlers.

Missouri, Kansas, New Mexico and Arizona to Louisiana and Texas. In Kansas it extends from the south central border counties north to Riley (Gates, 1923).

Average growth rate: .22 inch in d.b.h. per year

Number of specimens on campus: 6

Remarks: This tree is occasionally planted as an ornamental for its unusual and decorative fruit. It should be used to a greater extent as it is highly recommended as a yard tree.

Sophora (Sophora). A genus consisting of 20 species of trees and shrubs widely distributed in the mild regions of Asia and North America. One species has been grown successfully on the campus.

Sophora japonica JAPANESE PAGODATREE. A beautiful tree with spreading branches which form a round head, glabrous green branchlets and lustrous dark green leaves which remain late in the fall. This species is native to China and Korea where it attains a height of 60 to 70 feet.

Average growth rate: .30 inch in d.b.h. per year

Number of specimens on campus: 8

Remarks: This tree has proven to be fairly hardy and drought resistant in campus trials. Several trees planted prior to 1900 have attained enormous size, the largest (Specimen Number 136-1-3 in Section 7) being 42.9 inches in diameter, measured 3 feet above the ground. Several specimens planted in 1930 have reached the 12 to 15 diameter range, a number of them as the result of natural regeneration.

Sorbus (Mountainash). This genus contains some 80 species of trees and

shrubs widely distributed through the cooler regions of Europe, Asia and North America. They are widely used ornamentals, chiefly for their large clusters of white flowers and showy fruit. Two species have been planted on the campus with limited success.

Sorbus aucuparia EUROPEAN MOUNTAINASH. Usually a small tree with pinnately compound leaves and 9 to 15 oblong-lanceolate leaflets. It is characterized by the showy, bright red fruits which appear in late summer or fall. Native to Europe and western Asia, but long cultivated and naturalized in North America (Rehder, 1940). This species was planted in the trial nursery in 1936, 1939 and 1940. Several specimens were moved to Section 12 and one reached a diameter of 2.8 inches before it died in the drought of 1956. This species is highly susceptible to sunscald and drought injury. However it is recommended for further trial.

Tilia (LINDEN: BASSWOOD). This genus includes 30 species of trees widely distributed in eastern North America, Europe, central China, southern Japan and Mexico. A number of American as well as several exotic species are widely used ornamentals. Two species are growing on the campus.

Tilia americana AMERICAN LINDEN. A moderately large tree with broadly ovate to cordate leaves and characteristic flowers which are borne on long, slender stalks, attached to a leaf-like bract. T. americana is native to the eastern United States, except for the Atlantic states and Gulf Coastal plains, where it attains a height of 70 to 80 feet. In Kansas it extends west to about Manhattan.

Average growth rate: .38 inch in d.b.h. per year

Number of specimens on campus: 25

Remarks: Widely planted on the campus, this tree is quite handsome in appearance. Many of the campus trees are presently in the 12 to 14 inch diameter classes. An excellent shade tree for east and central Kansas. Should be more widely used.

*Tilia europaea (cordata x platyphyllos; intermedia, vulgaris) EUROPEAN LINDEN. A moderately large tree quite similar to the preceding species, with broadly-ovate and dark green leaves. This species is often planted as a street tree. One specimen planted about 1900 is presently 22.5 inches in diameter at 3 feet

Ulmus (The Elms). This genus includes some of the best known forest and ornamental trees of the Northern Hemisphere. There are approximately 15 to 18 species scattered throughout eastern North America, Europe and Asia. Ten species and several clons have been planted on the campus.

Ulmus americana AMERICAN ELM. Easily recognized by its symmetrical vase-shaped form, U. americana is a large tree with a trunk that usually divides near the ground into several erect limbs, strongly arched above and terminating in slender, drooping branches. Although maximum size and rate of growth are attained on moist, bottomland soils, this tree will adapt to a wide variety of soil and climatic conditions. The range includes the entire eastern United States including most of the Great Plains.

Average growth rate: .39 inch in d.b.h. per year

Number of specimens on campus: 294

Remarks: One of our most important shade and ornamental trees, U. americana has been seriously threatened in recent years by the

spread of Dutch Elm disease. This disease was first discovered in Kansas in 1957 and appears to be spreading westward. This and Phloem neucrosis, together with bark beetle and other insect problems have caused nurserymen to turn to other species.

Ulmus carpinifolia SMOOTHLEAF ELM. A medium sized tree with a straight trunk and slender, ascending branches forming a pyramidal head, or spreading and forming a round-topped head. The bark is deeply fissured and gray and the leaves lustrous, bright green. It is native to Europe, North Africa and western Asia. The clon CHRISTINE BUISMAN was planted on the campus in 1946. Two specimen sent direct from the Netherlands by Dr. Buisman growing in Section 11 are quite vigorous. The largest is 9 inches in diameter. It has a high degree of resistance to Dutch Elm disease. Continued trial will be necessary prior to its recommendation.

Ulmus fulva SLIPPERY ELM. A medium sized tree with spreading branches forming usually a broad, open head. It is distinguished from U. americana in several respects including the large, black, pubescent buds and leaves which are very rough on the upper surface. Native from Quebec to Florida and west to South Dakota and Texas. This tree is native in the eastern half of the state. However, there are no specimens presently on the campus.

Ulmus parvifolia CHINESE ELM. A small tree with a broad, round head and rather small leaves (2-5 cm.) which turn red or purple in the fall. This species is native to China, Korea and Japan where it attains a height of 40 to 50 feet.

Average growth rate: .88 inch in d.b.h. per year

Number of specimens on campus: 3

Remarks: This species has been planted in only limited numbers both on and off the campus. (Many people in the state have erroneously termed U. pumila as "Chinese Elm"). In campus plantings U. parvifolia has performed moderately well but does not appear as hardy as SIBERIAN ELM. One specimen in Section 2 is presently 12.8 inches in diameter.

Ulmus procera ENGLISH ELM. A tall tree with straight, nearly excurrent trunk and spreading or ascending branches forming an oval or oblong head. The leaves are dark green and scabrous, sometimes remaining several weeks longer in the fall than American species. Native to England and Europe where it reaches a height of 100 to 150 feet.

Average growth rate: .31 inch in d.b.h. per year

Number of specimens on campus: 2

Remarks: Although this tree has been planted in only limited numbers, several older specimens indicate that it is capable of attaining sizeable proportion on the campus. One specimen reached a diameter of 41.4 inches before its removal in 1948. This species is widely planted east of here as a street tree.

Ulmus pumila SIBERIAN ELM. This tree is widely planted throughout the state under the name CHINESE ELM. It is a small to medium sized tree with a round head and slender gray or gray-brown twigs. The small leaves are slightly pubescent and elliptic to elliptic-lanceolate in shape (Rehder, 1940). It is native to eastern China and northern Siberia.

Average growth rate: .87 inch in d.b.h. per year

Number of specimens on campus: 41

Remarks: This species is widely distributed in the state for both windbreak and ornamental planting. However, its value as a shade tree in ornamental planting is somewhat questionable, particularly where it has been used as the sole species. It is rather short lived and has a tendency to break under ice and wind.

Ulmus thomasi ROCK ELM. A medium sized tree with short, spreading branches which form an oblong, round-topped head. The branchlets usually develop irregular, corky wings. This tree is commonly found on dry, gravelly slopes from Quebec to Tennessee and west to Nebraska.

Average growth rate: .29 inch in d.b.h. per year

Number of specimens on campus: 7

Remarks: Although it is supposedly slow growing and seldom planted, this species has performed well on the campus. Specimen Number 45-6-1 in Section 6 is presently 18.3 inches in diameter. However, it does not have the beauty nor the vigor of the American or English elms.

Zelkova (Zelkova). A small genus of deciduous trees or shrubs consisting of 4 or possibly 5 species found in Asia. Two species have been planted on the campus.

Zelkova serrata JAPANESE ZELKOVA. A moderately large tree with a short trunk which usually divides into many upright and erect-spreading stems forming a broad, round-topped head. This tree is native to Japan, where it grows to a height of 70 to 90 feet.

Planted in the trial nursery in 1931, 1933 and 1942. Several specimens were later moved to Section 12 where one attained a diameter of 6.5 inches. However, they were subsequently lost. This species should receive further trials.

Trees That Failed.

Acer (The Maples).

Acer argutum. A small, graceful tree, rarely exceeding 20 feet in height and native to Japan. A. argutum received very limited testing in 1937 with unsatisfactory results. All specimens planted in 1937 were dead by 1941. However, testing was too limited to be conclusive.

Acer cissifolium. A small tree (20 to 30 feet) which is native to Japan. A. cissifolium produces yellow and red fall coloring and also is characterized by winged twigs. Planted in the spring of 1935 all seedlings died within 5 years as a result of winter injury.

Acer crataegifolium HAWTHORN MAPLE. Similar to A. cissifolium, this tree is also native to Japan. Tests in the trial nursery in 1935 were complete failures.

Acer diabolicum DEVIL MAPLE. Another small tree, similar to the two preceding species and native to Japan, but with much larger leaves (10 to 16 cm. across). Tested in the trial nursery in 1937.

Acer grandidentatum BIGTOOTH MAPLE. A small to medium sized tree (30 to 40 feet), native in the United States from Wyoming to Utah and New Mexico. Ten plants were started in the trial nursery in 1940 with none surviving to date.

Acer micranthum PAGODA MAPLE. Another Japanese maple, A. micranthum is a shrubby tree which rarely exceeds 15 feet. Placed in the trial nursery in 1937 all plants were dead by 1940.

Acer rufinerve REDVEIN MAPLE. Another of the Japanese maples, A. rufinerve is a small tree with large, dark green leaves which turn crimson in the fall (Rehder, 1940). Tested in the trial nursery in 1935 and 1937, all specimens failed.

Acer sieboldianum SIEBOLD MAPLE. The subspecies A. microphyllum was tested in the trial nursery in 1937 but all specimens died the first growing season.

Acer truncatum PURPLEBLOW MAPLE. A small, round headed tree with purple foliage, this species is native to China. Plants started in the trial nursery in 1941 died the first growing season.

Albizzia (Albizzia). This genus consists of approximately 25 species of leguminous trees and shrubs which are native to Tropical and Subtropical regions of Asia, Africa and Australia. One subspecies has been tried on the campus with only limited success.

Albizzia julibrissin SILKTREE ALBIZZIA. A small tree, or large shrub, with broad, spreading head and pink flowers, this species is native to Persia and central China. The subspecies, A. j. rosea, which is somewhat hardier than the species, was tried on the campus without success. Plants were started in the trial nursery in 1940 and moved to Section 2 in 1942. In 1947 all were frozen back to the ground and subsequently removed. Two clumps reached a height of 7 to 8 feet in the shrub collection. Removed in 1956.

Alnus (The Alders). A genus of moisture loving plants, the alders include 30 species of trees and large shrubs which are widely distributed throughout the cooler regions of the Northern Hemisphere from North America to the highlands of Bolivia and Peru (Harlow, 1941). Nine species are native to the United States including the STREAMBANK or SPECKLED ALDER of the northern states and Canada. Two species, A. hirsuta and A. japonica, as well as the subspecies, A. hirsuta sibirica, were tested in the trial nursery and failed. A total of 20 species were started in the trial nursery in 1932, 1933 and 1941. All of these died during the first or second growing season.

Betula (The Birches).

Betula davurica DAHURIAN BIRCH. A small tree with wide spreading branches and purplish brown bark similar to Red birch. This tree, which is native to Asia and Japan, was tested on the campus in 1932-1933 with no success.

Betula fontinalis WATER BIRCH. A small, shrubby tree with slender, spreading and pendulous branches, which often forms clumps in the western mountain ranges. The bark is close and reddish brown. This tree is native from Alaska to Oregon and through the Rocky Mountains (Rehder, 1940). B. fontinalis was tried in the trial nursery in 1940 and failed. Of ten plants, six died the first year and the remaining four were lost in 1942-1944.

Betula fruticosa ALTAI BIRCH. A small leaved shrub which rarely exceeds 10 feet in height, the plant is native to Asia. B. fruticosa received only limited testing in 1929 but on the basis of that work it does not appear to be adapted to Kansas.

Betula pendula EUROPEAN WHITE BIRCH. One of the most commonly

favored of the ornamental birches because of its attractive white bark and beautiful foliage. This species is rather short lived however. Campus testing has been too limited to be conclusive but it appears that this tree is not well adapted to the Manhattan area. Can be planted east of here but should be sheltered.

Betula platyphylla ASIAN WHITE BIRCH. This species and the subspecies B. p. mandshurica and B. p. japonica, which are native to Korea and Japan, received rather extensive campus testing from 1929 to 1935. All plants started in the trial nursery died within the first three growing seasons.

Betula utilis HIMALAYA BIRCH. A small to medium sized tree (30 to 50 feet) with dark brown bark which is native to the Himalayan Mountains of Asia. Tested only once, in 1941, this tree also failed.

Carpinus (Hornbeam).

Carpinus turczaninovi. A small shrubby tree 10 to 15 feet with delicate foliage. Native to China and Korea. Three plants were started in the trial nursery in 1933 but died the first growing season. Testing has been too limited to recommend this species.

Celtis (Hackberry).

Celtis reticulata NETLEAF HACKBERRY. A small tree or spreading shrub which attains a maximum height of 30 feet, C. reticulata is native from Colorado and Texas to Washington and California but is rarely cultivated (Rehder, 1940). A total of 210 seedlings were placed in the trial nursery in 1940 but survival at the end of the first growing season was only thirty-seven per cent. There

are no specimens surviving on the campus.

Celtis sinensis CHINESE HACKBERRY. A medium sized tree with dark green leaves, this species attains a height of 30 to 35 feet and is native to China, Korea and Japan. Tested in the trial nursery in 1932 and again in 1940 with negative results. Most of the plants died as a result of drought or winter injury.

Cercidiphyllum (Katsuratree). A monotypic genus of small trees which are native to eastern Asia. The true species has had limited trial on the campus with negative results.

Cercidiphyllum japonicum KATSURATREE. A small ornamental tree of dense pyramidal habit with slender, ascending and later, spreading branches. The foliage is attractive in fall color which is scarlet. Trials with this species have been too limited to be conclusive. Three specimens were planted in the trial nursery in 1929 and all were dead by 1934.

Cercis (Redbud)

Cercis occidentalis CALIFORNIA REDBUD. A shrub which rarely exceeds 10 to 15 feet. This species has white flowers and is limited in range to California. A total of 25 plants were started in the trial nursery in 1940. All were dead as the result of winter injury by 1943.

Cercis reniformis TEXAS REDBUD. A small tree with broad, ovate leaves which attains a height of 20 to 30 feet. This species is native to Texas and New Mexico. A total of 20 plants were started in the trial nursery in 1940. Fifty per cent of these died the first growing season. Winter injury claimed the remainder of the

specimens in subsequent years.

Chilopsis (Desertwillow). This genus consists of but one species which is native to the southwestern United States and Mexico.

Chilopsis linearis DESERT-WILLOW. A small tree or shrub with white and purple tinged flowers. This tree is native from southern California to Texas and Mexico, where it attains a height of 25 to 30 feet. A total of 25 plants were planted in the trial nursery in 1939 and 1940. All suffered winter injury and survival at the end of the second growing season was less than 10 per cent.

Cornus (Dogwood).

Cornus alternifolia PAGODA DOGWOOD. A small tree (20 to 30 feet) with a short trunk, greenish-brown twigs and blue fruit. Unlike most of the dogwoods, the leaves are alternate. C. alternifolia is valuable as an ornamental because of the showy flowers and brilliant autumn foliage. It is native from Nova Scotia to Minnesota and south to Georgia and Alabama. Best growth is made on rich, moist, bottomland sites. This species was introduced to the trial nursery in 1929 and again in 1939 with negative results. Most of the specimens died during the first to third year usually as a result of winter injury or drougth.

Crataegus (The Hawthorns).

Crataegus douglasi DOUGLAS HAWTHORN. This species is native to the northern and western states from Michigan to British Columbia and northern California. It attains a maximum height of about 35 feet. The branches are slender, pendulous and often unarmed. Limited trials in 1941 proved to be failures.

Crataegus durobrivensis CHRISTMAS HAWTHORN. A shrub which rarely exceeds 15 feet in height, this species is native to New York state. Trial nursery plantings in 1941 failed the first growing season. The plants were heavily infested with rust.

Crataegus kansuensis KANSU HAWTHORN. A shrub or small tree which attains a maximum height of approximately 20 feet, this species is native to northern China. Under observation in the trial nursery from 1932 to 1940, the plants were rust infected. All plants were dead by 1940.

Crataegus lavallei LAVALLE HAWTHORN. A small hybrid tree (C. crusgalli x pubesceno) with spreading branches and stout spines. C. lavallei was under observation in the trial nursery during the same period as C. kansuensis with the same results.

Crataegus lauta FRANKLIN HAWTHORN. The species appeared slightly more hardy than the preceding ones. However, like them it was heavily infested with rust and all plants were lost over a period of 5 years, from 1937 to 1942.

Elaeagnus (Elaeagnus).

Elaeagnus commutata SILVERBERRY. An upright shrub with spreading, often spiny branches, and yellowish-brown to silvery branchlets (Rehder, 1940). E. commutata is native to Korea, China and Japan. It rarely exceeds 12 feet in height. Planted in the trial nursery in 1939 and again in 1940. A total of 15 plants were started during this period but all were dead by 1942.

Elaeagnus pungens THORNY ELAEAGNUS. A spreading usually spiny shrub also native to Japan. The subspecies E. pungens reflexa was tested in the trial nursery in 1939 but all plants died the first year. Testing has been too limited to warrant a recommendation.

Elaeagnus umbellata AUTUMN ELAEAGNUS. Another spreading, usually spiny, shrub quite similar to the preceding species and also native to Japan, Korea and China. Fifteen plants of this species were started in the trial nursery in 1939 and 1940 but all were dead by 1943. Many of them suffered severe winter injury.

Fagus (Beech). This genus is largely restricted to the moist, forest soils of the Northern Hemisphere. Of 10 known species only one F. grandifolia is native to North America. The European species and varieties are widely planted ornamentals with handsome foliage, smooth bark and edible fruit. The American species has received limited campus testing with negative results.

Fagus grandifolia AMERICAN BEECH. This species is characterized by the smooth, bluish-gray bark and long, slender, lance-shaped buds. It is native in the eastern United States west to the Mississippi Valley and is usually restricted to moist, bottomland soils. It does not seem to tolerate soils which have dry surface layers and this is probably one of the reasons for its failure on campus. Trees planted in the trial nursery in 1929 were all dead by 1935.

Fraxinus (Ash).

Fraxinus anomala SINGLELEAF ASH. A shrub or small tree which seldom exceeds 20 feet, F. anomala is somewhat distinct among the ashes because of the usually simple leaves. It is native to Colorado, Utah and southern California. Campus nursery trials in 1939 proved to be failures.

Fraxinus biltmoreana BILTMORE ASH. A small tree to 45 feet, otherwise quite similar to WHITE ASH, this species is native from New Jersey to Georgia, Alabama and southern Missouri. A total of 15 plants were started in the trial nursery from 1940 to 1942 with no success.

Fraxinus cuspidata FRAGRANT ASH. A large shrub (rarely a tree) with slender branches and fragrant, white flowers, F. cuspidata is native from Arizona and New Mexico to Texas. A total of 55 plants were started in the trial nursery in 1939 and 1940 but all were lost by 1942.

Fraxinus longicuspis JAPANESE ASH. A small, graceful tree with white flowers and leaves which turn purple in the fall. This species is native to Japan where it attains a height of approximately 40 feet. This species also failed in trial nursery plantings. However, the number of specimens were too few to be conclusive. Further trials are recommended.

Fraxinus nigra BLACK ASH. A typically northern species, F. nigra is a medium sized tree (40 to 60 feet) with a small, narrow crown. It is found on deep, moist soils from Newfoundland to Lake Winnipeg and south to West Virginia and Iowa. This species failed in limited

campus trials which started in 1931.

Fraxinus velutina VELVET ASH. A small to medium sized tree with velvety-pubescent branchlets, F. velutina attains a height of 30 to 40 feet. It is native to Old Mexico. Both F. velutina and the subspecies F. v. toumeyi were tested in the trial nursery from 1939 to 1942. A total of 60 plants were started but all of these were lost by 1943.

Gleditsia (Honeylocust).

Gleditsia heterophylla FERNLEAF HONEYLOCUST. A shrub or small tree with simple, slender spines and pinnate (sometimes bipinnate) leaves and 10 to 18 leaflets. This species which is native to China, received limited campus testing from 1932 to 1938 with negative results. Further trials should be made in order to warrant any recommendations.

Ilex (Holly)

Ilex montana MOUNTAIN WINTERBERRY. A large deciduous shrub or slender tree which attains a maximum height of approximately 30 feet. This species is native from New York to South Carolina and west to Alabama. Trial nursery plantings in 1929 were a complete failure by 1931.

Ilex pedunculosa LONGSTALK HOLLY. An evergreen tree or large shrub which rarely exceeds 30 feet in height. One of the hardiest evergreen hollies, this plant is native to Japan. Planted in the trial nursery in 1937, this species died the first summer. Possibly warrants additional trials.

Juglans (Walnut).

Juglans rupestris TEXAS BLACK WALNUT. A small, shrubby tree which rarely exceeds 20 to 30 feet. The leaves are pinnate and the leaflets small, narrow and numerous. It is native to Texas and New Mexico. A total of 100 plants were started in the trial nursery in 1942 with negative results.

Magnolia (Magnolia).

Magnolia grandiflora SOUTHERN MAGNOLIA. A beautiful, broadleaf evergreen tree widely planted in the warmer regions of the United States and Europe with large, lustrous leaves and very large, fragrant, white flowers. Planted on the campus in 1929, all specimens died by 1931 as a result of winter injury. It is native from North Carolina to Florida and Texas.

Magnolia virginiana SWEETBAY MAGNOLIA. A handsome, deciduous shrub or small tree with leaves that often persist until spring, and creamy, white, fragrant flowers. Native along the coast from Massachusetts to Georgia. Planted in the trial nursery in the spring of 1929. All specimens winterkilled.

Malus (Apple; Crabapple).

Malus fusca OREGON CRAB. This small tree attains a height of 30 to 40 feet and is native on the west coast from Alaska to California. According to Rehder (1940) it has little ornamental value. Planted on the campus in 1939 all specimens failed.

Malus glaucescens DUNBAR CRAB. A shrub or small tree with branches that are sometimes spiny and leaves that turn yellow and dark purple in the fall. This plant is native from New York to North

Carolina and Alabama. Planted in the trial nursery in 1939, all specimens failed the first year. It is recommended that this plant be given further trials.

Malus hupensis. A small tree with stiff, spreading branches and fragrant, white or pinkish flowers. This species, which is native to China, also failed in 1939 trial nursery plantings.

Malus lancifolia LANCELEAF CRAB. A tree which occasionally reaches a height of 25 feet, with spreading and often spiny branches. Native from Pennsylvania to Virginia and Missouri. Although a number of specimens survived for a period of 7 years in the trial nursery, they were badly infested on numerous occasions with cedar-apple rust.

Malus sieboldi TORINGO CRAB. A shrub with spreading branches and flowers that are pink in bud and later turn white. Another Japanese plant, this species also failed in trial nursery tests. A total of 50 plants were started in 1930 but all were dead by 1932.

Morus (Mulberry)

Morus nigra BLACK MULBERRY. A small tree with a short trunk and widespreading branches which form a broad, rounded, often irregular and picturesque head. This species, which is native in western Asia, was planted in the trial nursery in 1930 and 1931. The specimens suffered winterkilling and died back to the ground in 1931, 1932 and 1934. All were lost by 1940.

Platanus (Planetree).

Platanus orientalis ORIENTAL PLANETREE. A moderately large tree

with a broad, round head and short trunk which often divides near the base. It is native to southeastern Europe and western Asia where it is often planted as a street tree. Limited trials in 1929 and 1930 proved to be a failure. Should receive further trial prior to any recommendation.

Populus (The Poplars).

Populus angustifolia NARROW LEAF POPLAR. A medium sized tree of pyramidal habit with slender branches, P. angustifolia is native to Nevada, Arizona and New Mexico, where it attains a height of 50 to 60 feet. Ten plants started in the trial nursery in 1940 were lost in 1942.

*Populus generosa (angulata x trichocarpa). This hybrid is similar to the parent P. trichocarpa but the leaves are more coarsely serrate. According to Rehder (1940) it is quite vigorous in its growth habit. Trial nursery plantings were made in 1928 and again in 1935 with negative results.

Populus maximowiczi JAPANESE POPLAR. A medium sized tree with wide, spreading branches and deeply fissured gray bark. It is native to northeast Asia and Japan. Limited trials in 1935 failed during the first growing season.

Populus suaveolens MONGOLIAN POPLAR. A medium sized tree with large, attractive leaves, this species is closely related to P. cathayana. It is native to eastern Siberia but is seldom cultivated. Plants placed in the trial nursery in 1935 were dead by 1940.

Prunus (APRICOT; CHERRY; CHOKEBERRY; LAURELCHERRY; PEACH; PLUM).

Prunus angustifolia CHICKASAW PLUM. A small tree or shrub which rarely exceeds 12 feet in height, P. angustifolia also tends to form thickets. It is native from Maryland to Florida and west to Arkansas and Texas. Trial nursery plantings made in 1939 failed the first year.

Prunus armeniaca APRICOT. A small, round headed species native to western Asia and long cultivated for its fruit in many pomological varieties. Trial nursery plantings in 1930 winterkilled the first year.

Prunus hortulana HORTULAN PLUM. A tree which occasionally reaches a height of 30 feet, this species is native from Kentucky and Tennessee to Iowa and Oklahoma. Trial nursery plants started in 1939 failed by the second year.

Prunus sibirica SIBERIAN APRICOT. An upright tree or large shrub with solitary, white or pink flowers. This species is native to Siberia, Manchuria and northern China where it attains a height of 12 to 15 feet. Three plants were started in the trial nursery and later moved to Section 1. All were dead by 1940.

Quercus (The Oaks).

Quercus acutissima SAWTOOTH OAK. A small tree with chestnut-like foliage, native to Japan, Korea and China. Trial nursery plants started in 1930, 1931 and 1932 all failed by 1940.

Quercus dentata DAIMYO OAK. A small, round-headed tree with very large leaves, this species is also native to Japan, Korea and China. Planted in the trial nursery in 1931, 1932 and 1933 with negative

results.

Quercus garryana OREGON WHITE OAK. A medium sized tree with spreading branches forming a broad, compact head. This species is native from British Columbia to California. Trial nursery plants started in 1939 died in 1943 as a result of winter injury.

Quercus ilicifolia SCRUB OAK. A densely branched, spreading shrub or small tree with dull, dark green foliage. This species is native from Maine to Virginia and west to Ohio and Kentucky. Trial nursery plants failed by the second growing season.

Quercus lyrata OVERCUP OAK. A round headed tree of medium size with short leaves somewhat resem ling Q. macrocarpa. Native to the wet, bottomland soils of the Atlantic, and Gulf Coastal Plains and Mississippi River valley. This species was planted in the trial nursery in 1939 and 1940 but all plants were dead by 1942.

Quercus mongolica MONGOLIAN OAK. A moderately large tree distinguished by the very short stalked, nearly glabrous leaves which are clustered at the end of the branchlets. It is native to eastern Siberian, China, Korea and Japan. The subspecies Q. m. grosseserrata was planted in the trial nursery in 1931 but all specimens died by 1940.

Quercus myrsinaefolia. A small evergreen oak with lanceolate leaves. This tree is native to eastern China and Japan. Trial nursery plantings in 1941 and 1942 did not live out the first growing season.

Quercus nigra WATER OAK. A medium sized tree with slender branches which form a conical, round-topped crown. This species is native

from Delaware to Florida and west to Kentucky and Texas, where it attains a height of 50 to 60 feet. Campus nursery trials in 1939 failed the second and third years.

Quercus velutina BLACK OAK. A medium sized tree with slender branches which form an open, narrow head and lustrous leaves which turn dull red or orange brown in the fall. It is native to the eastern United States where it is often found on poor gravelly hillsides. Although it is native to extreme eastern Kansas, limited campus trials have been a failure. Trial nursery plantings in 1931 and 1939 were lost by 1942.

Rhamnus (Buckthorn)

Rhamnus davurica DAHURIAN BUCKTHORN. A large, spreading shrub or small tree similar to R. cathartica but of more vigorous, spreading habit and with larger, lustrous leaves (Rehder, 1940). Limited campus trials in 1929 and 1940 made poor survival. One specimen, however, lived for 10 years.

Rhamnus frangula GLOSSY BUCKTHORN. A shrub or small tree with dark, lustrous, green leaves and numerous, red to purple-black fruit in late summer. Native to Europe, western Asia and North Africa, but like R. cathartica, naturalized in the eastern United States. Limited campus trials in 1942 proved to be a failure. Should receive further trial.

Robinia (Locust).

Robinia viscosa CLAMMY LOCUST. This closely related species is a small to medium sized tree with pinkish flowers. It is native from North Carolina to Alabama, where it attains a height of 25 to 35

feet. Trial nursery plantings in 1936 failed after the fourth season.

Sassafras (Sassafras). This genus consists of only three species. One is found in China another in Formosa and the third, S. albidum, in the eastern United States (Harlow, 1941). The American species is a small tree with deeply furrowed, spicy, aromatic bark, green twigs and leaves which vary from entire to 3 lobed, or mitten shaped. The subspecies, S. a. molle, was planted in the trial nursery in 1932 but lost the following year.

Sorbus (Mountainash).

Sorbus alnifolia DENSEHEAD MOUNTAINASH. A medium sized tree (40 to 60 feet) with a dense, round head and bright green leaves which turn orange and scarlet in the fall. This species, which is native to China, Korea and Japan, was planted in the trial nursery in 1940. A total of 25 plants were lost by 1942.

Ulmus (The Elms).

Ulmus alata WINGED ELM. One of the southern elms, U. alata is a small to medium sized tree often found on gravelly uplands from southeastern Virginia to southern Missouri, south to Florida and east Texas. It is characterized by the corky, winged twigs. Trial nursery specimens planted in 1939 and 1940 winterkilled.

Ulmus crassifolia CEDAR ELM. Another of the small leaved southern elms, this species is native to Mississippi, southern Arkansas and Texas. The twigs are also corky but with smaller wings than U. alata. Campus nursery trials in 1939 were lost the following year.

Ulmus japonica JAPANESE ELM. A medium sized tree (60 to 80 feet) with scabrous leaves and densely pubescent twigs which sometimes

develop corky wings. This species is native to Japan and northeast Asia. Trial nursery plants, started in 1930, were lost by 1940.

Zanthoxylum (Pricklyash). This genus includes about 150 species of deciduous or evergreen aromatic trees or shrubs native to the Tropical and Subtropical regions in both hemispheres. A few species are found in the Temperate regions. Two species, Z. ailanthoides and Z. schinifolium, have been planted on the campus but neither are surviving to date.

Zelkova (Zelkova).

Zelkova sinica CHINESE ZELKOVA. This species is closely related to Z. serrata but is somewhat smaller (40 to 50 feet) with leaves that are ovate-oblong. It is native to central and eastern China. Trial nursery plantings were made in 1930 but they failed to survive.

ACKNOWLEDGMENTS

The author wishes to express sincere appreciation to his major instructor, Professor L. R. Quinlan, for his patience and guidance during the preparation of this thesis. Without his early work, this study would not be possible.

Dr. O. W. Bidwell, Professor of Agronomy, is also due a special thanks for his assistance with the field studies on campus soils and for his suggestions and comments on the manuscript.

Acknowledgments are due also to Dr. Ray A. Keen, Associate Professor of Horticulture, for his helpful criticism and advice on taxonomic questions; to Dr. Wm. F. Pickett, Head of the Department of Horticulture, for comments and suggestions on the historical material; to Mr. Thomas Shackleford, Supervisor of Grounds Maintenance, for his cooperation in the field studies; and to my wife, Laverne, for her patience and help in typing the manuscript.

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A RECORD AND EVALUATION OF TREES ON THE KANSAS STATE UNIVERSITY CAMPUS

by

ROBERT D. RAISCH

B. S. in Forestry, University of Missouri, 1950

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Horticulture

KANSAS STATE UNIVERSITY
OF AGRICULTURE AND APPLIED SCIENCE

1960

The purpose of this thesis is to provide factual information regarding the adaptability and value of tree species and varieties being tested on the Kansas State University campus. The evaluation of species has also been projected beyond the campus in order to fill the need for such information throughout the state. It is hoped that this material will serve as a guide to landscape planners, nurserymen and homeowners who must make decisions regarding a choice of plant materials. To the knowledge of the author, it is the first such study of a comprehensive nature.

The thesis contains five sections, or subdivisions, including History, Climate, Soils, Tree Records and the Evaluation of Genera and Species. An account of early history at the institution indicates that the framework of the present campus tree plantings was begun about 1885 and continued under the direction of the Department of Horticulture until recent years. Climatic conditions in eastern Kansas are described and the adverse effects of high summer temperatures, low humidities and deficient rainfall are described. A basic study of campus soils was also conducted which revealed three separate soil series to be associated with topographic positions on the campus.

In order to evaluate the adaptability of campus trees, a record of each species and variety was entered on cross-index file cards which serve as a permanent record. In the study of this data are presented the results of thirty years of recorded observation on the actual performance of an exhaustive list of trees under nursery and field conditions. Information regarding rate of growth, adaptability and general landscape value has been evaluated and summarized in recommendations for each of the various genera, species and cultivars. A separate discussion of introductions that failed is also included.