EVALUATION OF STREET TREE SPECIES FOUND IN 67 KANSAS COMMUNITIES

by

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B. S., University of Missouri, 1967

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Horticulture and Forestry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1974

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INTRODUCTION

Trees are important to Kansas communities. Their presence makes life a great deal more pleasant for residents and also provides visitors with lasting impressions.

Probably our first reaction to a community is to its abundance or lack of trees. The shade they give from the sun makes the summer heat more tolerable and filters for grateful eyes the dazzling reflection from masonry and concrete. The landscape architect uses trees to soften hard building lines and accentuate vertical or horizontal detail.

The home owner plants trees to give scale and proportion to desired features and to delight his family and neighbors with spring bloom and fragrance, green coolness in summer, color in autumn, and interesting branch-and-twig patterns in winter.

Trees form vistas, frame views, and define park areas. They can screen out undesirable sights, and separate active from passive recreation. They border our lakes and streams and cast reflections in our pools.(8)

Unfortunately, however, although plantings in public urban areas are particularly desirable, they are difficult to establish and do possess some negative qualities. The combination of limited space, poor growing conditions, pol-

luted air and high cost of maintenance, accentuated by a century of growth on trees chosen, located and planted under 19th century design concepts leaves today's populace in a precarious position.

With the development of society, acquisition of wealth, and increased culture through education and travel, there has come the recognition that urban areas must not only be the sites of manufacture and commerce, but attractive places in which one would enjoy to live. This spirit for betterment is finding expression in a great many ways including renewed interest in the design and planting of trees in public areas. (6)

THE KANSAS COMMUNITY FORESTRY PROGRAM

Approximately one-half of all trees in Kansas towns are on public property; along streets, in parks, and around public buildings. By concerning itself with these trees, through local governments, the Kansas Community Forestry Program can have the maximum influence. The primary objective of the program is to enhance the public environment of Kansas towns. It can also have a substantial secondary influence on trees on private property.

The program idea is simple---to provide for the creation of a local action group and give them all the information and assistance necessary to do the job. The local group can be a board, commission, or a committee. It should be legally constituted, and charged by ordinance with the

responsibility for the development and administration of a comprehensive city tree program. Continuity must be assured, as a comprehensive program can only be accomplished over a period of years.(3)

One of the first steps in a community forestry program is the conduct of a public tree inventory. The inventory method is to drive the streets of a community and record existing trees by species, diameter, and condition class; good, fair, poor and dead and dying, for example Cawker City, Table 1.

The inventories range from a 25 to 100 percent inventory. In all cases where less than a 100% inventory is taken the recorded data is enlarged by the appropriate percentage to bring the inventories up to the 100% level.

With the inventory a local tree board, such as the Cawker City tree board, is able to determine needs and set priorities. With a shortage of some 700 street trees in Cawker City the tree board established tree planting as the first priority. Concurrently the tree board established dead tree removal as an accompanying first priority.

The inventory further served to identify the species which had been over-planted in Cawker City. Consequently, in Cawker City's initial organized street tree planting program relatively new species for Cawker City were used.

TABLE 1 - CITY STREET TREES CAWKER CITY, KANSAS, SEPTEMBER 1973

Species	Number of Trees	Avg. Age	Avg. Dia.	Percent of Species Total				% of Total Trees	Value
				Good(1)	Fair(2)	Poor(3)	D&D(4)		
Chinese Elm	406	30	16	8	38	52	2	49	$102,823
Honey Locust	107	30	12	73	22	5	0	13	87,055
American Elm	62	45	14	31	31	13	25	7	18,032
Hackberry	48	15	6	81	2	17	0	6	8,290
Eastern Red Cedar	34	12	4	71	29	0	0	4	3,073
Fruit	24	10	4	79	8	13	0	3	1,952
Silver Maple	21	8	4	76	19	5	0	3	605
Green Ash	15	18	16	73	20	7	0	2	2,590
Hybrid Elm	15	12	6	87	13	0	0	2	2,057
Black Walnut	14	10	4	86	0	14	0	2	759
Black Locust	13	24	8	15	15	70	0	2	822
Pine	12	15	6	100	0	0	0	1	2,743
Tree-of-heaven	9	15	6	78	0	22	0	1	685
Kentucky Coffee Tree	6	30	12	67	0	33	0	1	3,661
*Misc.	51								
	834								$235,147

(1) GOOD: Healthy vigorous tree. No apparent signs of insect, disease or mechanical injury. Little or no corrective work required. Form representative of species.

(2) FAIR: Average condition and vigor for area. May be in need of some corrective pruning or repair. May lack desirable form characteristic of species. May show minor insect injury, disease or physiological problem.

(3) POOR: General State of decline. May show severe mechanical, insect or disease damage, but death not imminent. May require major repair or renovation. Also, topped trees.

(4) DEAD OR DYING: Dead, or death imminent from Dutch elm disease or other causes.

*Redbud, flowering crab, sycamore, birch, hard maple, cottonwood, white oak, catalpa, mulberry, Osage-orange, goldenraintree, Japanese pagodatree, mimosa, boxelder, Russian olive.

MATERIALS AND METHODS

Objective of Study

Street tree inventories from sixty-seven Kansas communities participating in the Kansas State and Extension Forestry Community Forestry Program were analyzed to determine if any tree quality determining factors could be isolated. In addition the data was analyzed to determine where selected species best performed and if any two or more species had like requirements and thus could conceivably be interchanged on future street tree recommendation list.

Characteristics of Study

1.) Inventory Method:

Street tree inventories conducted in the manner previously discussed served as the materials for this study. Although a number of factors are recorded on the street tree inventories the one most used for this study is that of condition class. For a narrative description of each condition class see Table 1.

2.) Study Areas:

The state was arbitrarily divided into six geographic areas; Northeast, Southeast, Northcentral, Southcentral, Northwest, and Southwest, Figure 1. Four growing season units; 190, 180, 170, and 160

frost free days, Figure 2. Six precipitation belts; 40, 36, 32, 28, 24, and 20 inches of annual precipitation, Figure 3.(1)

The geographic division served as the control division for the state. Growing season units served as the latitudinal division for the state and precipitation belts as the longitudinal division for the state. Thus, the study areas paralleled and disected latitudinal and longitudinal zones of the state, and, because of this arrangement these study areas were chosen. Other study areas or factors considered include soil type, wind velocities, and community ethnic background, but were rejected due to much variation and lack of information.

3.) Tree Species Evaluated:

Thirteen of the sixteen most used street tree species, (Table 5) were evaluated to determine if any quality and distribution patterns could be determined. The species evaluated either constituted a high percentage of the street trees inventoried or are still being used in street tree plantings. Species constituting less than one percent of the street trees inventoried were not evaluated by condition class but are included in the species distribution table.

FIGURE 1: GEOGRAPHIC REGIONS

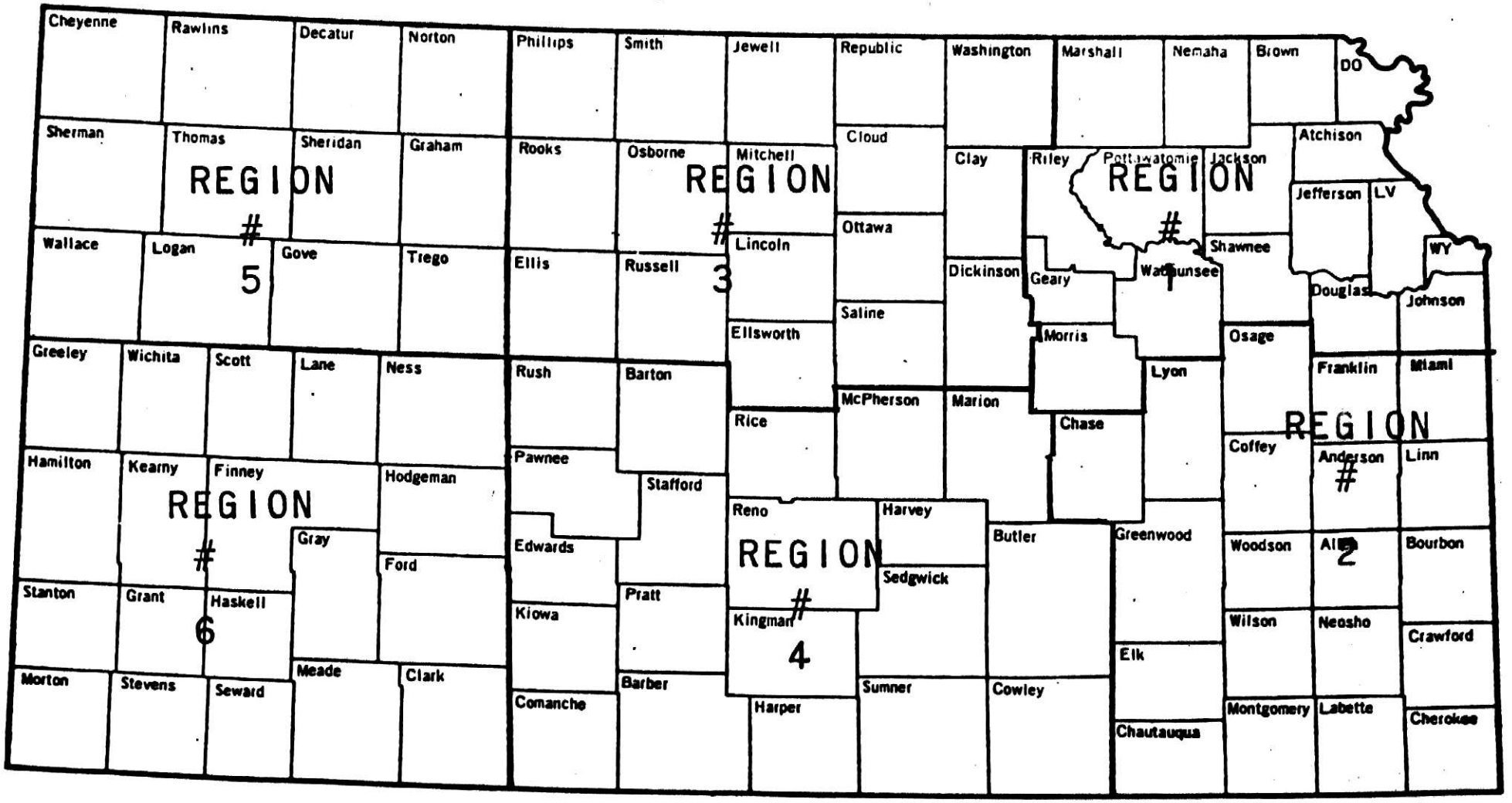


FIGURE 2:

GROWING SEASON REGIONS
(No. of Days)

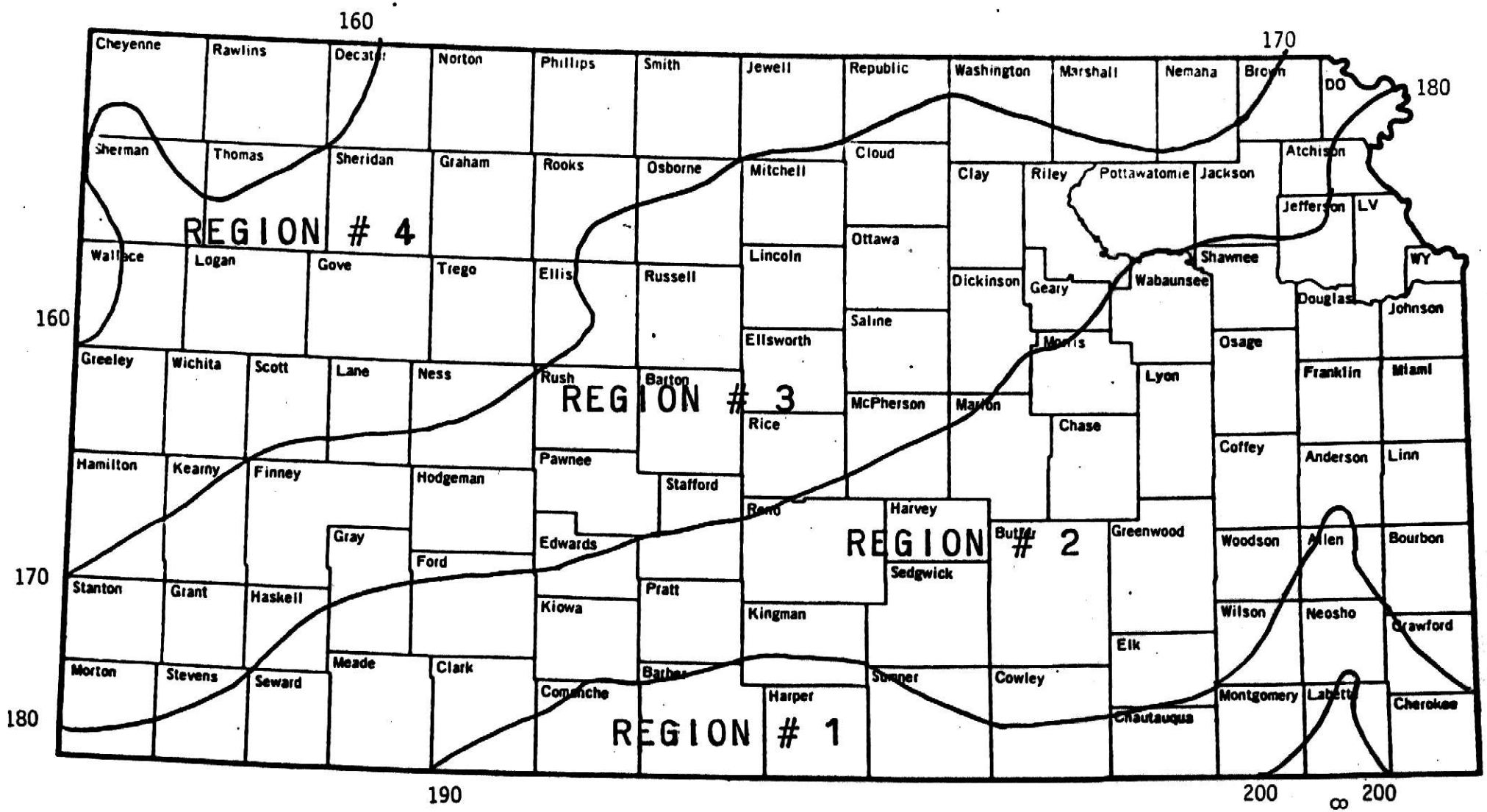
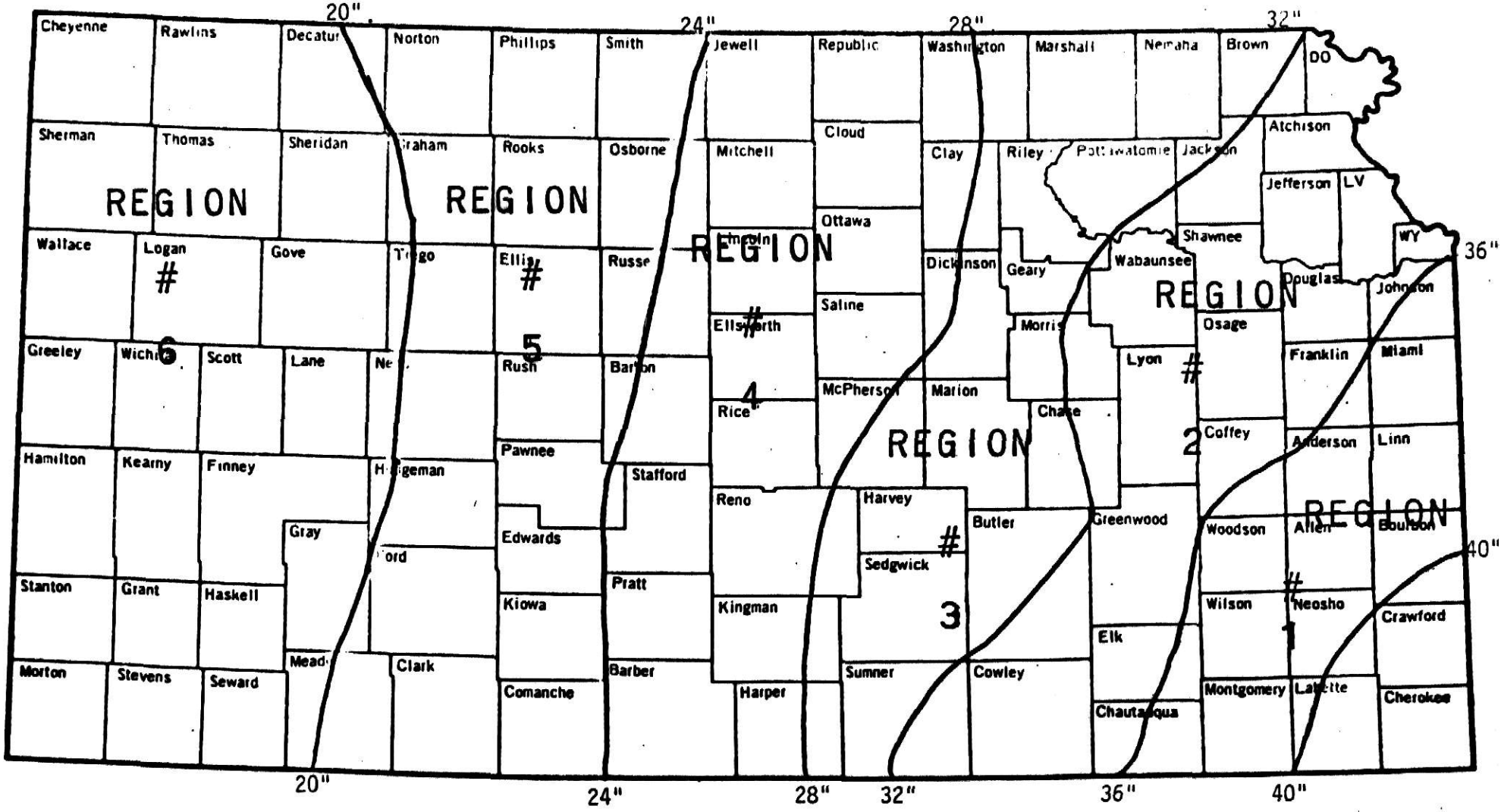


FIGURE 3: PRECIPITATION BELT REGIONS
(No. of Inches)



4.) Statistical Procedure:

The chi-square statistical analysis procedure was used to evaluate the relative condition, by study area, of 13 of the 16 most used Kansas street tree species. In addition to the statistical test each species was numerically ranked according to the species displaying the highest quality for each of the study areas. The objective of this information was to determine if a species maintained a stable ranking with the other species from study area to study area, Table 6. Likewise the species were ranked according to percent occurance in each study area to determine if the species remained uniform in popularity from study area to study area, Table 7.

RESULTS AND DISCUSSION

General

Statistically the results form the various grouping of inventories are significantly different, (see appendix for analysis of hackberry). However, because of the large sample size, the relationships between tree quality and location, or rainbelts, or growing seasons, probably are not of practical importance. For example, for most species the sample sizes enable us to statistically detect 1-3 percent differ-

ences which are not necessarily practical differences.

Generally the growing season area data and precipitation area data served to substantiate the information gathered from the geographic areas. Thus, the discussion will be centered around the geographic area divisions of the state.

Data for each individual tree condition class was generally quite sporadic. However, when data from two condition classes (i.e. good and fair) were grouped the results were generally more uniform within each study area. Consequently, a species may have a low percentage of good trees, a somewhat higher percentage of fair trees with the combined results being extremely high. Thus, a subsequent classification of acceptable, non-acceptable including dead appears more meaningful, Tables 2, 3 and 4.

Species Distribution

Total public trees inventoried in Kansas was 161,167 of which 153,758 were recorded under a particular species and the balance recorded as miscellaneous, Table 5. Miscellaneous was assessed to all species in a community that did not constitute a minimum of one percent of the inventoried trees in that community.

Forty-four species were identifiable in the 153,758 trees with an additional six species never making the minimum distribution requirements necessary for independant identification. Thus, at least fifty different tree species

TABLE 2 - TREE QUALITY BY GEOGRAPHIC REGIONS

Species	Geographic Regions											
	NE		SE		NC		SC		NW		SW	
	(% Acceptable / Nonacceptable)[1]											
	(A)	(NA)	(A)	(NA)	(A)	(NA)	(A)	(NA)	(A)	(NA)	(A)	(NA)
Siberian Elm	85	15	74	26	57	43	60	40	57	43	61	39
American Elm	61	39	40	60	56	44	59	41	54	46	61	39
Hackberry	91	9	87	13	92	8	91	9	94	6	84	16
Silver Maple	91	9	86	14	92	8	81	19	81	19	89	11
Green Ash	80	20	71	29	77	23	73	27	81	19	72	28
Hard Maples	90	10	86	14	96	4	80	20	100	0	0	0
Honeylocust	94	6	83	17	87	13	87	13	91	9	93	7
Redbud	90	10	91	9	94	6	94	6	100	0	100	0
Pin Oak	98	2	83	17	97	3	96	4	0	0	0	0
Fruit	67	33	88	12	92	8	90	10	94	6	93	7
Black Walnut	94	6	86	14	89	11	89	11	92	8	0	0
Sycamore	98	2	93	7	96	4	95	5	0	0	100	0
Cottonwood	85	15	77	23	88	12	82	18	56	44	76	24

[1]Acceptable is the combination of good and fair quality classes. Nonacceptable is the combination of poor and dead quality classes.

TABLE 3 - TREE QUALITY BY GROWING SEASON AREAS

Species	Growing Season Areas							
	# 1		# 2		# 3		# 4	
	(% Acceptable / Nonacceptable)[1]							
	(A)	(NA)	(A)	(NA)	(A)	(NA)	(A)	(NA)
Siberian Elm	63	37	68	32	57	43	59	41
American Elm	48	52	54	46	57	43	55	45
Hackberry	79	21	88	12	92	8	93	7
Silver Maple	78	22	85	15	88	12	87	13
Green Ash	65	35	73	27	80	20	75	25
Hard Maples	77	23	89	11	98	2	93	7
Honeylocust	65	35	92	8	91	9	89	11
Redbud	90	10	92	8	94	6	100	0
Pin Oak	70	30	93	7	98	2	94	6
Fruit	86	14	91	9	87	13	95	5
Black Walnut	70	13	94	6	94	6	83	17
Sycamore	97	3	95	5	95	5	100	0
Cottonwood	81	19	78	22	84	16	70	30

[1]Acceptable is the combination of good and fair quality classes. Nonacceptable is the combination of poor and dead quality classes.

TABLE 4 - TREE QUALITY BY PRECIPITATION BELTS

Species	Precipitation Belt Areas											
	# 1		# 2		# 3		# 4		# 5		# 6	
	(% Acceptable / Nonacceptable)[1]											
	(A)	(NA)	(A)	(NA)	(A)	(NA)	(A)	(NA)	(A)	(NA)	(A)	(NA)
Siberian Elm	71	29	82	18	71	29	53	47	62	38	60	40
American Elm	30	70	50	50	60	40	58	42	61	39	58	42
Hackberry	81	19	93	7	93	7	91	9	93	7	92	8
Silver Maple	80	20	92	8	86	14	86	14	84	16	85	15
Green Ash	64	36	82	18	74	26	75	25	87	13	74	26
Hard Maples	90	10	86	14	96	4	80	20	100	0	0	0
Honeylocust	74	26	92	8	83	17	93	7	86	14	92	8
Redbud	87	13	94	6	91	9	95	5	98	2	100	0
Pin Oak	75	25	94	6	97	3	95	5	76	24	0	0
Fruit	80	20	89	11	92	8	88	12	93	7	95	5
Black Walnut	81	19	94	6	94	6	89	11	65	35	92	8
Sycamore	97	3	93	7	93	7	96	4	98	2	100	0
Cottonwood	77	23	76	24	90	10	85	15	82	18	60	40

[1]Acceptable is the combination of good and fair quality classes. Nonacceptable is the combination of poor and dead quality classes.

TABLE 5 - DISTRIBUTION OF SPECIES

Species	No. of Trees
Siberian Elm	60,470
American Elm	36,599
Hackberry	7,513
Silver Maple	7,609
Green Ash	6,024
Honeylocust	4,580
Hard Maple	4,525
Eastern Red Cedar	3,140
Redbud	2,779
Pin Oak	2,561
Fruit	1,814
Black Walnut	1,624
Sycamore	1,545
Red Mulberry	1,527
Eastern Cottonwood	1,437
Catalpa	1,425
Pine	1,255
Hybrid Elm	992
Flowering Crabapples	872
White Oaks	791
Black Locust	740
Mimosa	720
Sweetgum	603
Tree-of-heaven	541
Poplar	373
Basswood	246
Boxelder	232
Red Oak	229
Osage-orange	223
Papermulberry	146
Spruce	140
Birch	100
Pecan	74
Goldenraintree	66
Kentucky Coffeetree	51
Japanese Pagodatree	41
Russian Olive	34
Tulip Poplar	31
Mountainash	28
Bradford Pear	28
Baldcypress	9
Hawthorne	8
Soapberry	8
Arborvitae	5
Willow	0
Persimmon	0
Buckeye	0
Hickory	0
Ginko	0
Pistachio	0
Total	153,758

were identified as being used for street tree plantings in Kansas. All pine; spruce, hard maples, white oaks, honeylocust, poplar, and fruit species and/or varieties were recorded by genus and/or family rather than separate species. Thus, the fifty species identified includes, in some cases, more than one variety or species per recorded species.

Surprisingly, and yet disappointing, sixteen species constituted 94 percent of the street trees inventoried. Even more surprising and disappointing, the two elm species, Siberian and American, constituted 63 percent of the street trees inventoried.

In terms of distribution, communities in Southern Kansas had forty species represented whereas communities in Northern Kansas only had thirty-six species represented. Longitudinally, Central Kansas communities contained forty-one identifiable species, Eastern Kansas thirty-six and Western Kansas twenty-nine.

Of the minor species encountered mimosa, paper mulberry, osage-orange, baldcypress, tulip poplar, pecan, Kentucky coffeetree, and arborvitae were found only in Southern Kansas. Similarly, poplar (Lonbardy and white), Japanese Pagodatree, mountain ash, and soapberry, were found only in Northern Kansas. Longitudinally tulip poplar and pecan were restricted to Eastern Kansas; Bradford pear, hawthorne, baldcypress, and soapberry were restricted to Western Kansas.

Numerical Ranking of Species by Quality by Geographic Areas

A numerical ranking of the thirteen examined species according to the species displaying the highest quality for each geographic study area was made to determine if a species retained a constant position in relation to the other species from geographic area to geographic area, Table 6.

From the ranking it was determined that each species tended to occupy a range (upper, middle and lower one third) in the ranking and generally retained that range position throughout the state. That is, species like sycamore, pin oak, and redbud, generally occupied the upper quality range in each geographic area. Silver maple, hackberry, black walnut and honeylocust generally occupied the middle range for each geographic area. Green ash, Siberian elm and American elm generally occupied the lower range for each geographic area, Table 6.

Numberical Ranking of Species Occurrence by Geographic Areas

A numerical ranking of the thirteen examined species according to the actual number of trees by species by geographic area was made to determine the most used species by geographic area. In addition, the information was evaluated to see if each species retained their numerical ranking from geographic area to geographic area, Table 7. The distribution by each species by percent is presented in Table 8.

Like the quality ranking, it was determined that each species tended to occupy a range (upper, middle and lower

TABLE 6 - NUMERICAL RANKING OF SPECIES BASED ON THE HIGHEST PERCENT OF ACCEPTABLE TREES BY GEOGRAPHIC REGIONS

NORTHEAST	%	SOUTHEAST	%	NORTHCENTRAL	%
Pin Oak	98	Sycamore	93	Pin Oak	97
Sycamore	98	Redbud	91	Sycamore	96
Honeylocust	94	Fruit	88	Hard Maples	96
Black Walnut	94	Hackberry	87	Redbud	94
Hackberry	91	Hard Maples	86	Silver Maple	92
Silver Maple	91	Silver Maple	86	Hackberry	92
Hard Maples	90	Black Walnut	86	Fruit	92
Redbud	90	Pin Oak	83	Black Walnut	89
Siberian Elm	85	Honeylocust	83	E. Cottonwood	88
E. Cottonwood	85	E. Cottonwood	77	Honeylocust	87
Green Ash	80	Siberian Elm	74	Green Ash	77
Fruit	67	Green Ash	71	Siberian Elm	57
American Elm	61	American Elm	40	American Elm	56

SOUTHCENTRAL	%	NORTHWEST	%	SOUTHWEST	%
Pin Oak	96	Redbud	100	Redbud	100
Sycamore	95	Hard Maples	100	Sycamore	100
Redbud	94	Hackberry	94	Honeylocust	93
Hackberry	91	Fruit	94	Fruit	93
Fruit	90	Black Walnut	92	Silver Maple	89
Black Walnut	89	Honeylocust	91	Hackberry	84
Honeylocust	87	Silver Maple	81	E. Cottonwood	76
E. Cottonwood	82	Green Ash	81	Green Ash	72
Silver Maple	81	Siberian Elm	57	Siberian Elm	61
Hard Maples	80	E. Cottonwood	56	American Elm	61
Green Ash	73	American Elm	54	Pin Oak	0
Siberian Elm	60	Pin Oak	0	Black Walnut	0
American Elm	59	Sycamore	0	Hard Maples	0

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TABLE 7 - NUMERICAL RANKING OF SPECIES BASED ON THE NUMBER OF TREES FOR EACH SPECIES FOR EACH GEOGRAPHIC AREA

NORTHEAST	# of Trees	SOUTHEAST	# of Trees	NORTHCENTRAL	# of Trees
American Elm	3,597	American Elm	9,513	Siberian Elm	9,594
Siberian Elm	2,761	Siberian Elm	4,134	American Elm	3,684
Hard Maples	1,994	Green Ash	1,930	Hackberry	1,895
Hackberry	1,897	Hard Maples	1,690	Silver Maple	1,408
Silver Maple	1,178	Hackberry	1,379	Green Ash	1,296
Green Ash	419	Silver Maple	1,365	Honeylocust	1,116
Black Walnut	336	Pin Oak	982	Hard Maples	,490
Pin Oak	329	Redbud	890	Redbud	369
Redbud	248	Black Walnut	745	Fruit	342
Sycamore	132	Sycamore	360	Black Walnut	321
Honeylocust	119	Fruit	358	Cottonwood	315
Fruit	57	Honeylocust	316	Pin Oak	314
Cottonwood	52	Cottonwood	31	Sycamore	227
NORTHWEST	**# of Trees**	**SOUTHWEST**	**# of Trees**	**SOUTHCENTRAL**	**# of Trees**
Siberian Elm	10,202	Siberian Elm	14,362	Siberian Elm	19,417
Honeylocust	1,298	American Elm	1,202	American Elm	17,372
American Elm	1,232	Green Ash	820	Silver Maple	2,927
Hackberry	395	Honeylocust	709	Hackberry	1,842
Silver Maple	230	Silver Maple	501	Green Ash	1,366
Green Ash	193	Cottonwood	227	Redbud	1,115
Cottonwood	166	Fruit	191	Honeylocust	1,022
Fruit	157	Hackberry	105	Pin Oak	936
Black Walnut	62	Sycamore	104	Fruit	737
Redbud	61	Redbud	96	Sycamore	722
Hard Maples	16	Hard Maples	0	Cottonwood	646
Pin Oak	0	Pin Oak	0	Hard Maples	335
Sycamore	0	Black Walnut	0	Black Walnut	160

TABLE 8 - GEOGRAPHIC DISTRIBUTION OF EVALUATED SPECIES

Species	Geographic Regions					
	NE	SE	NC	SC	NW	SW
	(Percent)					
Siberian Elm	5	7	16	32	17	23
American Elm	10	26	10	48	3	3
Hackberry	25	18	25	25	5	2
Silver Maple	16	18	18	38	3	7
Green Ash	7	32	21	22	3	15
Hard Maples	44	37	11	7.7	0.3	0
Honeylocust	3	7	24	22	28	16
Redbud	9	32	13	40	2.5	3.5
Pin Oak	13	38	13	36	0	0
Fruit	3	19	19	40	9	10
Black Walnut	20	46	20	10	4	0
Sycamore	8	23	15	47	0	7
Cottonwood	4	2	22	45	11	16

one third) in the ranking and generally retained that range position throughout the state. Siberian and American elms occupied the top two positions in all but the Northwest geographic area where honeylocust replaced American elm in the number two slot. Hackberry, silver maple and green ash tended to occupy the third, fourth and fifth positions in all but the Eastern two regions where hard maples tended to outrank them. Pin oak, sycamore and cottonwood tended to be the least used species in each region and thus occupied the eleventh, twelfth and thirteenth positions.

Comparison of Tree Recommendation List

Comparatively the results from this study tends to substantiate the writings of a number of Kansas State University Shade and Ornamental Tree Specialists. A street tree recommendation list drafted as a result of the statistical analysis of the 13 examined species closely resembles previously published recommendation list; however, some discrepencies do exist.

Parks (5) and Grey (2) restrict the use of hard maples to Eastern Kansas. This study along with a study by Sell (7) repudiates this recommendation by extending the range of hard maples through Central Kansas and on a selected basis into Northwestern Kansas. Likewise, Keen (4) and Parks (5) generally restrict the use of silver maple to Eastern and Central Kansas. This report shows silver maple quality to be quite acceptable throughout the state.

Conversely, Parks (5) recommends Siberian elm for all of Kansas. This study finds it to be of acceptable quality only in Northeast and Southeast Kansas. Sell (7) refers to Siberian elm as being climatically adapted to the Hutchinson area but does not comment as to the quality displayed.

Cottonwood is proclaimed to be adapted to all of Kansas by Parks (5) and to get progressively better from Eastern to Western Kansas by Keen (4). This study repudiates both of these statements by (1) showing cottonwood to have an unacceptable species quality in Northwest Kansas and; (2) by showing that the highest quality for cottonwood is found in Eastern and Central Kansas.

Results obtained for the remaining examined species tended to agree with previous writings and thus this report can be used as supporting data for past and future tree recommendation list.

Individual Species Discussion

Tree quality relations for the thirteen evaluated species within each study area was statistically significant but in terms of practicality are considered unimportant because of the large sample size which allowed 1 - 3 percent differences to be detected. Even though the statistical information is considered impractical some similarities were evident. For instance, hackberry, green ash, black walnut and hard maple trees tended to display a better quality along the Northern border of Kansas than the Southern border. Redbud trees

tended to increase in quality from east to west and from south to north. Lastly, and as expected, pin oak was not found in the two western geographic areas.

Ulmus pumila

Siberian elm (Ulmus pumila) constituted 37.5 percent of the street trees inventoried. In some communities Siberian elm comprised as high as 87% of the total public tree population and, in most communities Siberian elm was the dominant tree species within the community.

Best quality for Siberian elm trees was exhibited in Northeast and Southeast Kansas, (areas one and two). Siberian elm tree quality among the four remaining geographic areas, (three, four, five and six) was very similar. However, Siberian elm trees in the two southern geographic areas, southcentral and southwest, were, in general, of higher quality than the two northern geographic areas.

Ulmus americana

American elm (Ulmus americana) constituted 22.7 percent of the street trees inventoried. In some communities American elm comprised as high as 52% of the total public tree population and, in most communities American elm was the second most dominant species within the communities.

Best quality for American elm trees was exhibited in Northeast, Southcentral and Southwest Kansas, (areas one, four and six). The incidence of dead American elm trees

was highest in Southeast Kansas and in particular the forty and thirty-six inch annual precipitation belt areas.

Celtis occidentalis

Hackberry (Celtis occidentalis) constituted 4.6 percent of the street trees inventoried. Geographically hackberry tree quality was generally better on the north, (areas one, three and five), then the south (areas two, four and six). Latitudinally, hackberry tree quality increased from south to north. No similarities or patterns were evident within the longitudinal divisions of the state.

Acer saccharinum

Silver maple (Acer saccharinum) constituted 4.7 percent of the street trees inventoried. Geographically silver maple tree quality was best in Northeast, Northcentral and Southwest Kansas, (areas one, three and six). Contrary to common belief silver maple trees were high in quality statewide and thus quite acceptable street trees in the remaining three geographic areas.

Fraxinus pennsylvanica

Green ash (Fraxinus pennsylvanica) constituted 3.7 percent of the street trees inventoried. Best tree quality patterns for green ash tended to parallel those of hackberry. That is, quality of green ash trees was generally better across the northern geographic areas of Kansas than the southern geographic areas. This pattern was somewhat sub-

stantiated by the latitudinal test in that green ash tree quality tended to improve from south to north.

Acer sp.

Hard maples (*Acer* sp.) (sugar maple, Krimson King maple, Norway maple and black maple) constituted 2.8 percent of the street trees inventoried. Best tree quality patterns for hard maples tended to parallel those of hackberry and green ash in that hard maple tree quality was generally better in the northern geographic areas of Kansas than the southern geographic areas. This pattern was somewhat substantiated by the latitudinal test in that hard maple tree quality tended to improve from south to north.

Gleditsia triacanthos

Honeylocust (*Gleditsia triacanthos*) (including improved varieties) constituted 2.8 percent of the street trees inventoried. Best quality for honeylocust trees was found in Northeast, Northwest and Southwest Kansas (areas one, five and six). Honeylocust tree quality in the remaining geographic areas was quite acceptable but nevertheless was somewhat less than the identified geographic areas.

Cercis canadensis

Redbud (*Cercis canadensis*) constituted 1.9 percent of the street trees inventoried. Redbud was the one tree species that tended to display better quality in the west than the east. Likewise, redbud trees tended to display a better

quality in the north than the south. These patterns were substantiated by both the latitudinal division test and the longitudinal division test. That is, the latitudinal division test revealed an increase in redbud tree quality from south to north while the longitudinal division test revealed an increase in redbud tree quality from east to west.

Quercus palustris

Pin oak (Quercus palustris) constituted 1.8 percent of the total street trees inventoried. Other than the pattern that pin oak was not found in the two western-most geographic regions (five and six) of Kansas no particular tree quality patterns were evident. Where found, pin oak tended to be one of the preferred species and generally performed quite well. Pin oak tended to constitute a larger percentage of the trees inventoried in the southern geographic regions but quality was little to none better than in the northern regions.

Malus, pyrus and prunus species

Fruit (Malus, Pyrus and Prunus species) (apple, pear, peach, apricot and plum) constituted 1.3 percent of the street trees inventoried. Tree quality for fruit trees was quite variable across the state, hence, no particular pattern could be distinguished. The species tended to be acceptable in quality across all but the northeast geographic area (area one). Fruit species tended to be one of the most preferred species in Western Kansas although quality was not

particularly better in the west than the east.

Juglans nigra

Black walnut (Juglans nigra) constituted 1.0 percent of the street trees inventoried. Best tree quality patterns for black walnut tended to favor the north but not as distinctly as hackberry, green ash and hard maple. Since all but four percent of the black walnut trees inventoried were found in Eastern and Central Kansas the question arises as to the adaptability of black walnut to Western Kansas. However, an examination of the quality of black walnut in Western Kansas reveals a very high percentage of acceptable trees. Thus, another question arises as to whether black walnut should become more of a recommended street tree species.

Platanus occidentalis

American sycamore (Platanus occidentalis) constituted 0.9 percent of the street trees inventoried. Where found sycamore tended to be one of the preferred species and generally performed quite well. Sycamore tree quality was fairly uniform across the state although the percent usage was generally higher in the southern geographic areas than the northern geographic areas.

Populus deltoides and/or sargentii

Cottonwood (Populus deltoides and/or sargentii constituted 0.8 percent of the street trees inventoried. Tree

quality for cottonwood was quite variable across the state, hence, no particular quality patterns could be distinguished. The species tended to be acceptable in quality across all but Northwest Kansas (geographic area five). Use of cottonwood was higher in Central and Western Kansas but quality was not appreciably different.

SUMMARY AND CONCLUSIONS

Major Species

Based on the statistical information obtained from the thirteen examined species it appears that tree quality for the examined species is different from geographic region to geographic region, as well as the other two tested variables, thus the quality for each species depends upon some factor or factors unique to each particular region and/or unique to each individual species.

Minor Species

While most of the minor species encountered will probably remain as minor species on future street tree recommendation list a number of species will, and should, become more heavily relied upon as primary species for street tree plantings. Especially those with attractive attributes such as pleasing flowers, fruit or foliage that are capable of adapting to restricted spacial requirements.

With emphasis now being placed on creating attractive places in which to live and work, plants, including ornamental

trees offer excellent potential as component parts in creating these attractive places.

One of the limiting problems thus far has been the lack of research on tree adaptability. Accompanying problems include failure of nurseries to offer new tree species and general lack of care and maintenance for trees. Commonly the remark is heard that if a tree requires special attention or treatment it doesn't have applicability in public planting areas.

Hybridization and selection of ornamental trees in the last few years has yielded great rewards. Objectionable qualities of otherwise adaptable tree species have been bred out. Thus, we have thornless-podless honeylocust, seedless ash, dehiscent fruit on flowering crabapple species, and thornless-fruitless osage-orange. In addition, selection of sex in monecious species has provided cottonless (male) cottonwood, male mulberry, male ginko and a host of other pleasing tree species.

Hybridization is not restricted to fruit and thorn characteristics but is expanding to include branching characteristics, foliage size and color, and in some cases resistance to insect and disease problems, transplanting problems, winter hardiness, and a multitude of other tree improvements.

All Species

Future quality of public shade and ornamental trees

can be greatly enhanced if the planter chooses those species most adapted to the planting location; geographic, site and spacial.

Geographic divisions, such as those arbitrarily established for this study, appears to be an adequate means of dividing the state for tree recommendation purposes. Similarly, a geographic division serves to outline a portion of the state that is readily identifiable to the general public, thus, making tree recommendation list more meaningful. However, to avoid confusion and credibility it becomes imperative that future shade and ornamental tree recommendation list (table 9) become more uniform, while still allowing for the addition of newly discovered species and varieties.

TABLE 9 - RECOMMENDED STREET TREES FOR KANSAS

Species	Geographic Regions
Hackberry	All
Silver Maple	All
Redbud	All
Honeylocust	All
Green Ash	All
Fruit	All
Hard Maples	NE, SE, NC, SC, NW
Black Walnut	NE, SE, NC, SC, NW
Sycamore	NE, SE, NC, SC, SW
Cottonwood	NE, SE, NC, SC, SW
Pin Oak	NE, SE, NC, SC
Siberian Elm	NE, SE

ACKNOWLEDGMENTS

The author wishes to express his sincere appreciation to Dr. Wayne A. Geyer, Department of Horticulture and Forestry, for his guidance and encouragement throughout this investigation and in preparing this manuscript.

The author also wants to thank the members of the graduate committee, Dr. Ronald Campbell and Mr. Ray B. Weisenburger for their careful review of this manuscript.

Thanks to Dr. George A. Milliken for his assistance with the statistical design and analyses.

Special thanks to my wife, Sarah, for her patience and encouragement throughout this investigation.

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APPENDIX

An Example of the Statistical Analysis Procedure with Hackberry Quality

Geographic Regions	A.	NA.
1.	91	9
2.	87	13
3.	92	8
4.	91	9
5.	94	6
6.	84	16

Precipitation Belts	A.	NA.
1.	81	19
2.	93	7
3.	93	7
4.	91	9
5.	93	7
6.	92	8

Growing Season	A.	NA.
1.	77	23
2.	88	12
3.	92	8
4.	93	7

Chi Square Value when comparing:

Geographic Regions[1]	Precipitation Belts[2]	Growing Seasons[3]
1 with 2	1 with 2	1 with 2
88.2	116.51	156.75
1 with 3	1 with 3	1 with 3
2.3 (NS)	358.06	381.46
1 with 4	1 with 4	1 with 4
51.9	151.85	188.59
1 with 5	1 with 5	2 with 3
7.42 (NS)	78.12	123.95
1 with 6	1 with 6	2 with 4
8.93	114.16	19.78
2 with 3	2 with 3	3 with 4
94.25	33.24	46.09
2 with 4	2 with 4	
23.47	9.43	
2 with 5	2 with 5	
57.68	17.65	
2 with 6	2 with 6	
3.87 (NS)	10.73	
3 with 4	3 with 4	
47.83	22.49	
3 with 5	3 with 5	
5.22 (NS)	128.7	
3 with 6	3 with 6	
10.1	0.29	
4 with 5	4 with 5	
30.7	50.96	
4 with 6	4 with 6	
8.33	6.62	
5 with 6	5 with 6	
17.87	42.24	

1. Geographic locations 1, 3 and 5 alike.
2. Precipitation Belts 4 and 6 alike. Also, 3 and 6 alike.
3. All growing seasons different.

EVALUATION OF STREET TREE SPECIES FOUND IN 67 KANSAS COMMUNITIES

by

LARRY E. BILES

B. S., University of Missouri, 1967

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Horticulture and Forestry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1974

ABSTRACT

Biles, Larry E., M.S. in Horticulture and Forestry, Kansas State University, May 1974. Evaluation of Street Tree Species Found in 67 Kansas Communities. Major Professor: Wayne A. Geyer.

Street tree inventories from sixty-seven Kansas communities participating in the Kansas State and Extension Forestry Urban Forestry program were analyzed, using the chi-square statistical analysis procedure, to determine:

1. if any tree quality determining factors could be isolated.
2. where selected species best performed and if any two or more species had like requirements and thus could conceivably be interchanged on future street tree recommendation list.
3. if the present method of dividing the state on shade and ornamental tree recommendation list is in fact the best way.

Statistically, every division of the three chosen study areas, (geographic regions, precipitation belt regions, and growing season regions) was determined to be separate and unique. Thus, tree quality for each area is determined by factor(s) unique to the area or to the species.

Quality wise, hackberry, green ash, hard maples, and black walnut exhibited better quality in Northern Kansas than Southern Kansas. Similarly, redbud quality increased from Eastern to Western Kansas and from Southern to Northern Kansas.

Lastly, it was determined that the present method of dividing the state for street tree recommendation purposes

was quite adequate from; 1.) the stand point of associating trees with regions and, 2.) establishing identifiable regions for the general public.