THE BIOLOGY OF *CUSCUTA*
ATTENUATA WATERFALL

By

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Bachelor of Science

The University of Tulsa

Tulsa, Oklahoma

1987

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
July, 1990

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ATTENUATA WATERFALL

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ACKNOWLEDGMENTS

I express sincere appreciation to Dr. Ronald Tyrl for his guidance throughout my graduate program. Thanks are also extended to Dr. Paul Buck, Dr. Jim McPherson, and Dr. Bill Warde for their time and effort involved in serving on my graduate committee. Their advice and encouragement was much appreciated.

My sincere thanks are also extended to Dr. Warde for his all of his time spent and advice given during the morphological analyses; to Dr. Sira Dabo and Dr. Charles Taliaferro for their advice and use of their lab facilities for the electrophoretic analysis; to Mike Silva for his time and skill involved in producing the figures for the univariate analysis; and to the curators of all the herbaria utilized in this study for their cooperation.

Much appreciation is extended to the Fish & Wildlife Service for funding this investigation (Project Number 20181-89-00420). Without this support the study would not have been possible.

Finally I would like to thank my family and friends for their encouragement and support throughout the past two years. Special thanks are extended to my parents, Jim and Donna Prather, for their confidence and unfailing support.

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INTRODUCTION

Cuscuta attenuata Waterfall was first collected in 1964 by U. T. Waterfall in southeastern McCurtain County, Oklahoma, and was described as a species by him in 1971 (Waterfall, 1971). Prior to this study, *C. attenuata* was known only from three populations in McCurtain County. Because of its limited geographical distribution, *C. attenuata* has been considered to warrant possible designation as an endangered species under the guidelines of the 1973 Threatened and Endangered Species Act (PL 93-205). It was originally proposed as an endangered species in 1978 (Ayensu and DeFilipps, 1978). On the basis of status reports prepared by Tyrl et al. (1978) and Taylor and Taylor (1980), the taxon was designated a Category 1 species by the Fish and Wildlife Service's Office of Endangered Species (1980 FR 45:82500; 1985 FR 50:39526). Species designated Category 1 are those for which enough information has been gathered to warrant their listing as threatened or endangered, but more work is considered to be needed to determine critical habitat, if any, and to establish final rules for them.

A detailed study of the biology of *C. attenuata* and its relationship to other species of *Cuscuta* has not been conducted. This investigation was conducted to obtain information needed to determine the appropriateness of listing the taxon as threatened or endangered. Specific objectives were to determine its geographical distribution; to describe its host specificity and habitat; describe its population biology, including its phenology, requirements for seed germination, reproductive biology, and cytology; and to elucidate its relationships to other species of Cuscuta by means of electrophoresis, interspecific hybridizations, and morphological studies of floral characters. Support for this undertaking was provided by the U. S. Fish and Wildlife Service (Project Number 201811-89-00420).

MATERIALS AND METHODS

Geographical Distribution. To determine the geographical distribution of C. attenuata, all herbarium specimens of Cuscuta from all Oklahoma herbaria and the herbaria at Southern Methodist University, Texas A & M University, the University of Texas at Austin, Northeast Louisiana University, and the University of Arkansas were examined. The locations of all specimens which were identified as C. attenuata were visited if possible and the areas searched for plants. The Red River floodplain in southeastern McCurtain County was also thoroughly searched. Thirteen field trips to 19 areas in Oklahoma, Kansas, and Texas were conducted during the growing season to search for populations of C. attenuata.

Description of Host and Host's Habitat. Herbarium specimens were examined and careful observations were made both in the field and in the laboratory to determine the host specificity of C. attenuata. Musselman (1986) suggested that Coleus hybridus (coleus) could serve as a host for many species of Cuscuta and thus attempts were made to establish C. attenuata on Coleus hybridus, Pelargonium sp. (florist's geranium), Ambrosia psilostachya (western ragweed), A. trifida (giant ragweed), and Plectranthus australis (swedish ivy). Seedlings germinated in a petri dish were placed on the moist soil near the base of the young prospective host plant and a moist environment was maintained by watering daily.

To examine the habitat of _C_. _attenuata_ and its host plant, the McCurtain County site was visited eight times throughout the 1989 growing season. The South Canadian River and the Quanah Parker Lake sites were visited three times, and the Sabine River site was visited once (Table 1). Detailed observations of the habitat at each of the four sites were made. Soil samples from the Waterfall Creek, Quanah Parker Lake, and the two South Canadian River populations were collected and soil reports were prepared by the Oklahoma State University Cooperative Extension Service Water & Soil Salinity Testing Laboratory. Mean yearly temperature and precipitation data were gathered from the weather reporting station nearest the site.

Phenology. Detailed observations of the phenology of _C_. _attenuata_ at the Waterfall Creek site were made throughout the 1989 growing season. These observations included those of its vegetative growth, attachment to the host, flowering, and fruiting. Observations of the phenology of _C_. _attenuata_ at the other three sites were made as possible. At the Waterfall Creek site, observations were made at all hours for several days throughout the flowering period. Observations were made

Table 1. Locality information for four populations of _Cuscuta_ _attenuata_ Waterfall studied in this investigation.

State	County	Range, Township, Section	Locality Information
Oklahoma	McCurtain	R24E, T9S, Sec 10, SW 1/4, SW 1/4 R24E, T9S, Sec 10, SE 1/4, SW 1/4 R24E, T9S, Sec 15, NW 1/4, NW 1/4	Along Waterfall Creek where US Hwy 259 crosses, 12.9 km south and 3.2 km east of Idabel.
Oklahoma	Comanche	R14W, T3N, Sec 23, SE 1/4, SE 1/4 R14W, T3N, Sec 23, NE 1/4, SE 1/4	Along the banks of the eastern end of Quanah Parker Lake in the Wichita Mountains Wildlife Refuge about 0.4 km north and 0.4 km west of the junction of OK Hwys 49 and 115.
Oklahoma	Cleveland	R2W, T8N, Sec 7, SW 1/4, SE 1/4	Two populations about 0.4 km apart in right-of-way of a county road connecting Chautauqua and Jenkins streets at the south edge of the city of Norman; on the floodplain of the South Canadian River approximately 0.4 km north of the river channel.
Texas	Rains	not applicable	Along the north-side bank of the Sabine River on east-side of TX Hwy 19 bridge.

at the Quanah Parker Lake site and the South Canadian River site as possible. No observations were made at the Sabine River site because the landowner denied access. Fourteen plants from the Waterfall Creek site, four from the Sabine River site, four from the South Canadian River site, and six from the Quanah Parker Lake site were transferred from the field to the laboratory by carefully digging up infected hosts and potting them in six-inch plastic pots. They were kept at 24°C and placed near windows where they received sunlight under natural daylengths. Detailed observations and a photographic record of the flowering and fruiting of _C. attenuata_ were made from these plants.

Seed Germination. In order to determine the requirements for seed germination, seeds of _C. attenuata_ were tested using four scarification regimes. Seeds used were collected from the Waterfall Creek population on 3 January 1989 unless otherwise noted. Lots of 25 seeds were immersed in concentrated sulfuric acid for 15, 30, 45, or 60 min to achieve scarification. The seeds were then rinsed in a 10% sodium bicarbonate solution, followed by a rinse in tap water (Gaertner, 1950). They were placed on filter paper covering 15 ml of sand in a petri dish and both the filter paper and the sand were saturated with distilled water (Hutchison and Ashton, 1980). The seeds were placed in an incubator at 30-33°C and the number which germinated during each five-day interval was counted for a period of 30 days. Four replications of each treatment were performed. To examine the effects of mechanical scarification, fifty seeds of _C_. _attenuata_ were placed on a flat surface and a sheet of sandpaper was rolled over the surface of the seeds until the seed coats were visibly scratched. The seeds were otherwise treated as above.

Four temperature regimes were also tested. Four samples of 25 seedlings were acid-scarified for 30 min, placed on petri dishes using the technique described above, placed in incubators at 20-22°C, 25-28°C, 30-33° C, or 35-38°C, and the number which germinated during each five-day interval was counted for a period of 30 days. Four replications of each treatment were performed.

Capsules of _C_. _attenuata_ were collected in early fall of 1989 from the Waterfall Creek, Quanah Parker Lake, and South Canadian River populations to determine if the capsules collected in January 1989 had been affected by cold weather exposure and to see if germination rates varied from population to population or year to year. The seeds were acid-scarified for 30 min, incubated at 30-33°C, and otherwise treated as above.

Reproductive Biology. In order to examine the reproductive biology of _C_. _attenuata_, observations of its pollination mechanisms were made both in the field and in the laboratory. To determine natural seed set, 100 flowers each were collected from the Waterfall Creek population in 1988 and 1989, and from the Quanah Parker Lake and South Canadian River populations in 1989. No observations were made at the Sabine River site because the landowner denied access. To test for autogamy, seven parasitized plants of Iva annua from the Waterfall Creek population were enclosed in insect-exclusion cages (31 cm x 31 cm x 17 cm) prior to flower opening. A sample of 100 flowers from these plants and 100 flowers from plants transplanted to the laboratory (see Materials and Methods: Phenology) were collected and seed set was determined. Other manipulations of the laboratory plants from the Waterfall Creek population were performed in order to examine other aspects of reproductive biology. To test for autogamy, 45 flowers were self-pollinated by hand. To test for intrapopulational allogamy, 30 flowers of one individual were hand-pollinated with pollen from another. Seven individuals were involved in these manipulations. To test for interpopulational allogamy, 51 crosses were made between individuals from the Waterfall Creek and Quanah Parker Lake populations, 23 between the Waterfall Creek and South Canadian River populations, and 16 between the Waterfall Creek and Sabine River populations. To test for agamospermy, 40 flowers of five individuals were emasculated. Seed set from all manipulations was determined. The seeds were scarified in concentrated sulfuric acid for 30 min, placed in an incubation oven at 30-33 C for 30 days, and the number germinating during five-day intervals was counted.

Pollen stainability of _C_. _attenuata_ was determined for all four populations (Table 1), and for one population each of _C_. _indecora_ var. _indecora_, _C_. _indecora_ var. _longisepala_, _C_. _cuspidata_, and _C_. _compacta_ (Table 2). Pollen stainability is assumed to be an estimation of viability (Radford, et al., 1974). Anthers with mature pollen were removed from dried specimens collected the previous fall and squashed in cotton blue in lactophenol. Pollen grains stained a dark blue or remained unstained. Five plants from each population were examined except for the Sabine River and _C_. _indecora_ var. _longisepala_ populations, for which only one suitable specimen was available. Two hundred pollen grains per plant were examined.

Cytology. Mitotic chromosome counts of plants of _C_. _attenuata_ from the populations at Waterfall Creek, Quanah Parker Lake, and the South Canadian River were obtained from squashed anthers of young flower buds. The best squashes obtained were from flowers about 1 mm long. The flowers were collected, immediately fixed in a modified Carnoy's Solution (chloroform: ethanol: acetic acid; 3:6:1 v/v) for 48 hours, rinsed three times

Table 2. Locality information for populations of Cuscuta species used in this investigation.

Species	State	County	Range, Township, Section	Locality Information
C. indecora var. indecora	Oklahoma	Comanche	R12W, T3N, Sec 18, NE 1/4, NW1/4	West-facing slope of Medicine Park Mountain, just east of the Lake Lawtonka Dam on Medicine Creek.
C. indecora var. longisepala	Oklahoma	Latimer	R18E, T3N, Sec 23, SW 1/4, SW 1/4	Along the north side of a county road 7.2 km west of Yanush near Sardis Lake.
C. cuspidata	Oklahoma	McCurtain	R24E, T9S, Sec 10, SW 1/4, SW 1/4	Along Waterfall Creek where US Hwy 259 crosses, 12.9 km south and 3.2 km east of Idabel.
C. compacta	Oklahoma	McCurtain	R25E, T5S, Sec 10, SW 1/4, NE 1/4	In Beaver's Bend State Park, along Mountain Fork River, just west of US Hwy 259A.

in 70% ethanol for 1 hour, and stored in 70% ethanol at 4°C until use. The anthers were then extracted from the flowers and squashed in aceto-carmine and the chromosomes examined with phase contrast optics (Radford, et al., 1974). Two individuals per population were counted and two counts per individual were made.

Analyses of Morphological Variation. A total of 44 quantitative and qualitative floral characters were examined and scored on herbarium specimens of C. attenuata and other morphologically similar species. Only floral characters were examined because all species of Cuscuta lack roots and leaves and stem features could not be measured consistently on dried herbarium specimens. A total of 186 herbarium specimens were examined: 10 specimens of C. attenuata, 50 each of C. compacta, C. cuspidata, and C. indecora var. indecora, and 26 of C. indecora var. longisepala (Appendix A). All available specimens of C. attenuata and C. indecora var. longisepala which were suitable for study were examined. Five flowers each were examined on several specimens and it was determined that the differences between flowers of the same specimen were negligible, therefore one flower each was used from all specimens and the individual herbarium specimen was treated as an OTU (operational taxonomic unit). Only one individual per population was examined.

One flower with its pedicel and bracts was removed from each specimen with permission of the curator of each herbarium. To insure morphological differences would not be due to differences in development, all flowers selected had dehiscing anthers. All observations were made after boiling each flower in water until its organs were flexible to facilitate examination of the inner floral ones (Yuncker, 1920). All specimens were examined with a dissecting microscope at a magnification of 30x in order to score characters. Measurements were recorded to the nearest 0.1 mm using an ocular micrometer. Many of the measurements were incorporated in the analyses as ratios to minimize the effect of size which may be influenced by environmental factors such as light intensity, moisture availability, or soil conditions (Radford, et al., 1974). Twenty-seven quantitative characters were used in the univariate analysis (Table 3). Twenty-seven quantitative and 17 qualitative characters were used in the multivariate analysis (Table 4). The data recorded for each specimen are presented in Appendix B.

For each character examined in the univariate analysis, the mean and standard deviation were calculated, and the minimum and maximum were recorded. The multivariate analysis comprised six clustering techniques, a principal component analysis, and a discriminant analysis. Only *C. attenuata*, *C. indecora* var. *indecora*, and *C. indecora* var. *longisepala* were

Table 3. Twenty-seven quantitative characters of *Cuscuta* species used in the univariate analysis.

Pedicel Length
Number of Bracts at Base of Pedicel
Number of Bracts Along Pedicel
Number of Bracts at Pedicel Apex
Bract Length/Calyx Length
Bract Length/Bract Width
Calyx Length
Length of Calyx Tube/Total Calyx Length
Calyx Length/Calyx Width
Corolla Length/Calyx Length
Corolla Tube Length/Total Corolla Length
Corolla Length/Corolla Width
Corolla Length
Number of Fringes Per Corolla Appendage
Length of Corolla Appendages
Appendage Length/Length of Corolla Tube
Length of Appendage-Corolla Fusion/Appendage Length
Appendage Length/Appendage Width
Filament Length
Anther Length
Filament Length/Anther Length
Anther Length/Anther Width
Longer Style Length
Longer Style Length/Shorter Style Length
Stigma Length/Stigma Width
Ovary Length
Ovary Length/Ovary Width

Table 4. Forty-four quantitative and qualitative characters of Cuscuta species used in the multivariate analyses.

Bract Orientation
Calyx Orientation
Corolla Orientation
Pedicel Length
Number of Bracts at Base of Pedicel
Number of Bracts Along Pedicel
Number of Bracts at Pedicel Apex
Bract Length/Calyx Length
Bract Length/Bract Width
Shape of Bract Margin
Shape of Bract Apex
Presence of Bract Laticifers
Calyx Length
Length of Calyx Tube/Total Calyx Length
Calyx Length/Calyx Width
Overlap of Calyx Lobes
Shape of Calyx Margin
Shape of Calyx Apex
Presence of Calyx Papillations
Presence of Calyx Laticifers
Corolla Length/Calyx Length
Corolla Tube Length/Total Corolla Length
Corolla Length/Corolla Width
Corolla Length
Shape of Corolla Margin
Shape of Corolla Apex
Presence of Corolla Papillations
Inflexing of Corolla Lobe Tips
Number of Fringes Per Corolla Appendage
Length of Corolla Appendages
Appendage Length/Length of Corolla Tube
Length of Appendage-Corolla Fusion/Appendage Length
Appendage Length/Appendage Width
Filament Length
Anther Length
Filament Length/Anther Length
Anther Length/Anther Width
Longer Style Length
Longer Style Length/Shorter Style Length
Stigma Length/Stigma Width
Ovary Length
Ovary Length/Ovary Width
Style Orientation
Presence of Stylopodium

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examined in the discriminant analysis. The Statistical Analysis System (SAS) was employed to perform these analyses. The clustering techniques used were UPGMA (unweighted pair-group method using arithmetic averages), WPGMA (weighted pair-group method using arithmetic averages), UPGMC (unweighted pair-group method using centroids), WPGMC (weighted pair-group method using centroids), single linkage, and complete linkage. The varimax rotation method was used in the principal component analysis (SAS Institute Inc., 1985). Prior probability of the discriminant analysis was set proportional to the number of specimens of each taxon used in the analysis.

Interspecific Hybridizations. Fourteen plants of *I. annua* parasitized by *C. attenuata* from the Waterfall Creek site, four from the Sabine River site, four from the South Canadian River site, and six from the Quanah Parker Lake site (Table 1) were transported to and maintained in the laboratory at Oklahoma State University (see Materials and Methods: Phenology). One plant of *C. cuspidata*, five of *C. indecora* var. *indecora*, and two of *C. indecora* var. *longisepala* from the sites given in Table 2 were transported to the laboratory and likewise maintained. *C. compacta* could not be maintained in the laboratory because its woody hosts proved impossible to transplant and cuttings did not survive under laboratory conditions. Pollen, however, was collected from five individuals of C. compacta in the field and used immediately in crosses in the laboratory. Crosses were made between individuals of C. attenuata and all other taxa. Individual flowers of C. attenuata were emasculated before anther dehiscence and mature pollen from one of the other taxa was manually transferred to the stigma of the emasculated flower (Radford, et al., 1974). Reciprocal crosses to the other taxa, except C. compacta, were performed in the same manner. Sixteen crosses were performed between C. attenuata and C. indecora var. indecora, 25 between C. attenuata and C. indecora var. longisepala, 20 between C. attenuata and C. compacta, and nine between C. attenuata and C. cuspidata.

Electrophoresis. Flowering plants of C. compacta, C. cuspidata, C. indecora var. indecora, C. indecora var. longisepala, and C. attenuata were collected in the field from the populations given in Tables 1 and 2, except the Sabine River population from which no collection of fresh material could be made. These plants were transported on ice to the laboratory and frozen until used in the electrophoretic analyses. Two samples from one individual of each taxon were prepared using the stems and flowers. Flowers were incorporated in the samples because there was not enough stem material to prepare adequate samples. Polyacrylamide gels were run according to the procedures of Laemmli

(1970). Esterase and benzidine peroxidase enzyme systems were examined (Shaw and Prasad, 1970; Hicks, et al., 1982). Two gels of each enzyme system were run.

RESULTS

Geographical Distribution. Fourteen herbarium specimens were identified as C. attenuata, including seven which had previously been identified as other species of Cuscuta. One specimen which had been previously identified as C. attenuata (J. Taylor & C. Taylor 17011) was identified as C. cuspidata in this study. Three specimens (R. J. Tyrl 1648, J. Taylor 31074, and J. Taylor 28173) were from the location of the holotype (U. T. Waterfall 17157). Labels of two specimens (U. T. Waterfall 17496 and U. T. Waterfall 17191) gave mileages from Idabel, Oklahoma to sites where Waterfall Creek did not occur, although the labels stated that the plants were collected along it. These specimens probably were collected from the type location. The remaining eight specimens were from different locations (Figure 1). Locality information from labels of all herbarium specimens of C. attenuata are given in Table 5.

Four populations of C. attenuata were located in the field searches, including one at the type location along Waterfall Creek in McCurtain County, Oklahoma (Table 1). The South Canadian River population also was relocated. The Sabine River and Quanah Parker Lake populations are new records for the species. All

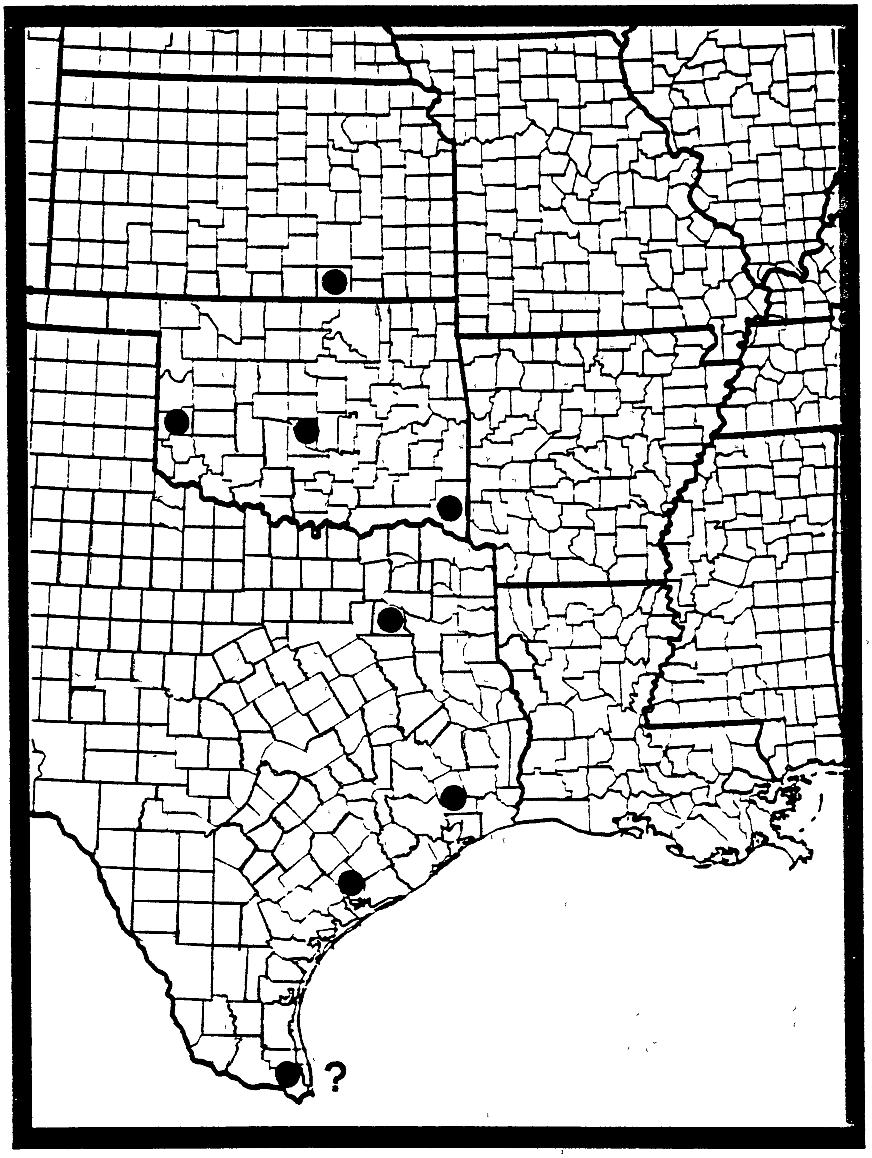


Figure 1. County distribution of _Cuscuta_ _attenuata_ as determined by examination of herbarium specimens. Question mark indicates county location questionable.

Table 5. Locality information from labels of herbarium specimens identified by the author as *Cuscuta attenuata* Waterfall.

State	County	Location	Collection Date	Collector & Number	Herbarium
Oklahoma	McCurtain	Waterfall Creek, 8 miles south and 2 miles east of Idabel.	10 October 1964	U.T. Waterfall 17517	OKLA
Oklahoma	McCurtain	R24E, T9S, Sec 10, SW 1/4, SW 1/4. Banks and pastures adjacent to Waterfall Creek. N-side of US Hwy 259 bridge ca. 8.5 mi S of Idabel. Heavily grazed pasture; creek banks trampled. Roebuck Clay, ponded, over Red River alluvium. Plants numerous on *Iva ciliata* and *Aster* sp. *Bromus japonicus* abundant, no overstory.	16 October 1978	R.J. Tyrl 1648	OKLA
Oklahoma	McCurtain	On *Iva ciliata*, edge of pond in Waterfall Creek, 7 miles south and 1.5 miles east of Idabel.	3 October 1970	U.T. Waterfall 17496	OKLA
Oklahoma	McCurtain	Along Waterfall Creek, 7 miles south and 2 miles east of Idabel.	16 October 1965	U.T. Waterfall 17191	OKLA
Oklahoma	McCurtain	Collected along Waterfall Creek about 8 mi south and 2 mi east of Idabel near highway 259.	24 October 1981	J. Taylor 31074	DUR
Oklahoma	McCurtain	Collected along Waterfall Creek, 8 miles south and 2 miles east of Idabel, near highway 259.	11 September 1979	J. Taylor 28173	DUR
Oklahoma	McCurtain	Along roadside 8 miles south and 0.25 miles west of Idabel.	13 August 1984	J. & C. Taylor 32518	DUR OCLA
Oklahoma	Cleveland	South Canadian River floodplain 2 miles south of Norman, Cleveland County, OK. In ash-elm bottomland forest. On *Iva ciliata*.	5 September 1961	P. Buck 524	OKLA TULS
Oklahoma	Beckam	Sandy soil growing on ragweed, Cedar Top Southeastern Beckam County, OK. Growing on *Iva ciliata*.	12 September 1936	C.J. Eskew 1395	OKL
Kansas	Cowley	Growing on a sp. of Compositae, abandoned field-pasture area; 3 mi. S., 5 mi. W. Arkansas City.	7 September 1966	R.G. Koch 2156B	OKLA
Texas	Van Zandt	Near Ocean Lake, north of Edgewood.	6 September 1946	E. Whitehouse 16472	SMU

Table 5. (Continued)

State	County	Location	Collection Date	Collector & Number	Herbarium
Texas	Jackson	Mouth of Lavaca River.	28 August 1941	B.C. Tharp unnumbered	TEX
Texas	Liberty	Liberty, Texas.	31 August 1923	B.C. Tharp unnumbered	TEX
Texas	*	A parasitic vine on *Iva ciliata*. Cultivated fields. Clay loam. Alt. 10m. Rather scarce, only one colony seen. Collected at Rabb's Ranch, 1/2 mile north of the Ranch house, bordering the road.	10 August 1941	R. Runyon 2873	TEX

*The herbarium label states "Flora of the Lower Rio Grande, by Robert Runyon, Brownsville Texas" There is no mention of a county.

locations extracted from the herbarium specimens were searched except the following which were not visited because the landowner denied access or the locality information was too vague to merit a trip: E. Whitehouse 16472; B. C. Tharp (unnumbered) Jackson County, Texas; B. C. Tharp (unnumbered) Liberty County, Texas; and R. Runyon 2873.

Description of Host and Host's Habitat. Iva annua L. (formerly I. ciliata Willd.). appears to be virtually the only host of C. attenuata. Commonly known as marshelder or rough sumpweed, I. annua is an annual weed of alluvial plains and other wet areas in the eastern half the U. S. All herbarium specimens of C. attenuata examined were parasitizing I. annua except one which was parasitizing an unidentifiable species of Aster (aster). No other hosts were observed during the 1989 growing season at any of the sites. No individuals were parasitizing any of the Aster plants growing at Waterfall Creek or the South Canadian River during the 1989 growing season. Species of Aster were absent at the other two sites. In the laboratory, C. attenuata successfully completed its life cycle on Coleus hybridus but did not establish itself on any of the other prospective hosts.

Habitat descriptions of the four sites occupied by C. attenuata populations are given below and in Table 6.

Waterfall Creek: The floodplain adjacent to

Table 6. Climatological and soil characteristics of four sites at which *Cuscuta attenuata* was collected and studied.

Characteristic	Waterfall Creek	South Canadian River		Quanah Parker Lake	Sabine River
		east	west		
Mean Yearly Precipitation (mm)	1204	842	842	664	1071
Mean Yearly Temperature (°C)	17.1	15.5	15.5	16.1	17.8
Elevation (m)	103.6	332.2	332.2	454.2	115.8
SCS Soil Type	Roebuck Clay, ponded	Roebuck Clay	Reinach Silt Loam	Foard-Slickspot Lawton Loam Rock Land	Gladewater Clay
Texture	Fine	Medium	Medium	Medium	-
Soil pH	7.1	7.7	7.7	6.7	-
Surface NO_3-N (kg ha^{-1})	36	4	7	7	-
Surface SO_4-S (kg ha^{-1})	31	38	39	38	-
Mg (kg ha^{-1})	1119	605	1119	1119	-
Soil Test Index					
P	91	91	149	34	-
K	999	514	803	449	-
Fe (mg l^{-1})	77.6	60.7	87.7	99.9	-
Zn (mg l^{-1})	3.28	33.35	40.48	4.52	
Soil Salinity					
Total Soluble Salts (mg l^{-1})	41.58	1140	2376	4633	-
Sodium Absorption Ratio	3	1	2	9	-
Exhangeable Sodium (%)	2	0	0	10	-
Na (mg l^{-1})	239	63	111	728	-
Ca (mg l^{-1})	461	160	326	326	-
Mg (mg l^{-1})	99	15	48	105	-

Waterfall Creek was occupied by a large population of Iva annua. The plants formed a dense stand and were associated with plants of A. trifida, Toxicodendron radicans (poison ivy), Aster ericoides (heath aster), and Solidago sp. (goldenrod). Cephalanthus occidentalis (buttonbush), T. radicans, and Juncus sp. (rush) lined the banks of the creek. The area was originally bottomland forest and had been cleared for pasture. The SCS soil type was Roebuck Clay, ponded. The soil was saturated until June and afterwards became dry and cracked. There was no litter covering the soil adjacent to the plants.

South Canadian River: On the South Canadian River floodplain 0.4 km north of the river channel, a large population of I. annua occupied an area in the right-of-way along the north side of a county road. The Iva population was shaded by a stand of young Populus deltoides (cottonwood). Other associated species included A. trifida, Cynodon dactylon (bermudagrass), and Solidago sp. This area was once bottomland forest and had been cleared. Four-tenths km west of this population was another population of Iva in the right-of way. This western population of Iva was not shaded by P. deltoides but was associated with A. trifida and C. dactylon. The SCS soil type of the area which the eastern population occupied was Roebuck Clay and that of western population was Reinach Silt Loam. Both of these populations were under standing-water in the spring and early summer and were subject to periodic flooding throughout the year. Two to three cm of litter had accumulated on the surface.

Quanah Parker Lake: Along the banks of the eastern end of Quanah Parker Lake in the Wichita Mountains Wildlife Refuge, there was a dense population of I. annua which was host to a population of C. attenuata, and formed a distinct band between aquatic plants at the water's edge and the upland vegetation in the area. At the edge of the lake, Scirpus sp. (bullrush) and Carex sp. (sedge) formed a band of vegetation. Between these two bands there was a strip of bare soil 1-1 1/2 m wide. Above the Iva population was another strip of bare soil 1-1 1/2 m wide which separated the Iva plants from the dominant vegetation of the area: Schizachyrium scoparium (little bluestem), Andropogon gerardii (big bluestem), Sorghastrum nutans (indiangrass), Aristida oligantha (annual threeawn), A. psilostachya, and Xanthocephalum dracunculoides (annual broomweed). This population of Iva occupied an area which had three SCS soil types: Rock Land, Foard-Slickspots Complex, and Lawton Loam. The population was not subject to flooding because it was above the maximum water level of the lake. There was 4-5 cm of litter under the Iva plants.

Sabine River: In the bottomland along the Sabine River where Texas Highway 19 crosses there was a population of I. annua which was host to a population of C. attenuata. The canopy was closed except for an area adjacent to the highway where C. attenuata was found. In the overstory Quercus spp. (oaks), Ulmus americana (American elm), and Salix nigra (black willow) dominated. In the understory, I. annua dominated and plants of A. trifida were scattered. The SCS soil type at this location was Gladewater Clay. The site was subject to flooding several times a year. There was no litter below the Iva plants.

Phenology. Seedlings first appeared at the Waterfall Creek site when the soil temperature was near 25°C, about 15 May in 1989. The seedlings were slender, orange, and rootless. During the first three weeks after germination, they grew in length until they came in contact with a stem of Iva annua. If they did not attach to I. annua within 2-3 days they usually developed a greenish tinge, presumably indicative of the presence chlorophyll. If they did not come in contact with a host stem within 10 to 15 days, they became dessicated and died. If successful in making contact with a host stem, the Cuscuta stem coiled tightly around it and appeared to stop growth.

In five to seven days, the coil around the stem appeared to develop chlorophyll. The portion that extended to the ground became dessicated and died. At the same time, haustoria formed between the Cuscuta coil and the host plant. There was no change in appearance for three to four weeks, then several new Cuscuta stems appeared and rapidly grew from the initial coil. These new stems radiated from the host stem, came in contact with other I. annua stems, coiled about them, and developed haustoria. Thus many plants surrounding the original host plant were parasitized. The stems connecting host plants usually broke. This sequence of events, excluding seed germination, occurred repeatedly from late May to mid August.

In the field on I. annua and in the laboratory on both I. annua and Coleus hybridus, stems of C. attenuata sometimes appeared to arise directly from the host stem rather than from an older filament of Cuscuta. The host stems at the point of origin were enlarged, scarred, and resembled a gall. On I. annua, three to nine new Cuscuta stems were observed emerging from the swollen area and on C. hybridus as many as 19 were observed.

At Waterfall Creek, flower buds first appeared in the middle of August and sometimes developed to maturity in less than a week. Herbarium records and field observations indicate that C. attenuata flowers from about 10 August to 24 October. On the first day a bud became visible, it was about 1 mm long and only the calyx was apparent (Figure 2A-left). On day two, the corolla had developed and was equal in length to the calyx. Both were about 1 mm long (Figure 2A-center). On day four, the calyx was still about 1 mm long, but the corolla had elongated to about 2 mm (Figure 2A-right). On day six, the flower was about 3 mm long and began to open (Figure 2B-left). Fourteen of the 20 flowers observed opened within four hours of dawn. The remaining six opened throughout the day. No flowers opened at night. The corolla lobes separated and reflexed at a steady rate over a 3-4 hour period until they were horizontal (Figure 2B-right). The stamens arched inward as the lobes separated. Three to four hours after flower opening had commenced, the anthers began to dehisce inward (Figure 2B-right). Dehiscence took about one hour. The pollen was sticky and remained on the anther for several hours before drying and falling. During this period, the two stigmas were carried upward by the elongating styles. The stigmas brushed against the anthers and pollen was transferred. On day seven the corolla lobes were strongly reflexed and the stamens were arched outward (Figure 2C-left). The styles continued to elongate and typically were

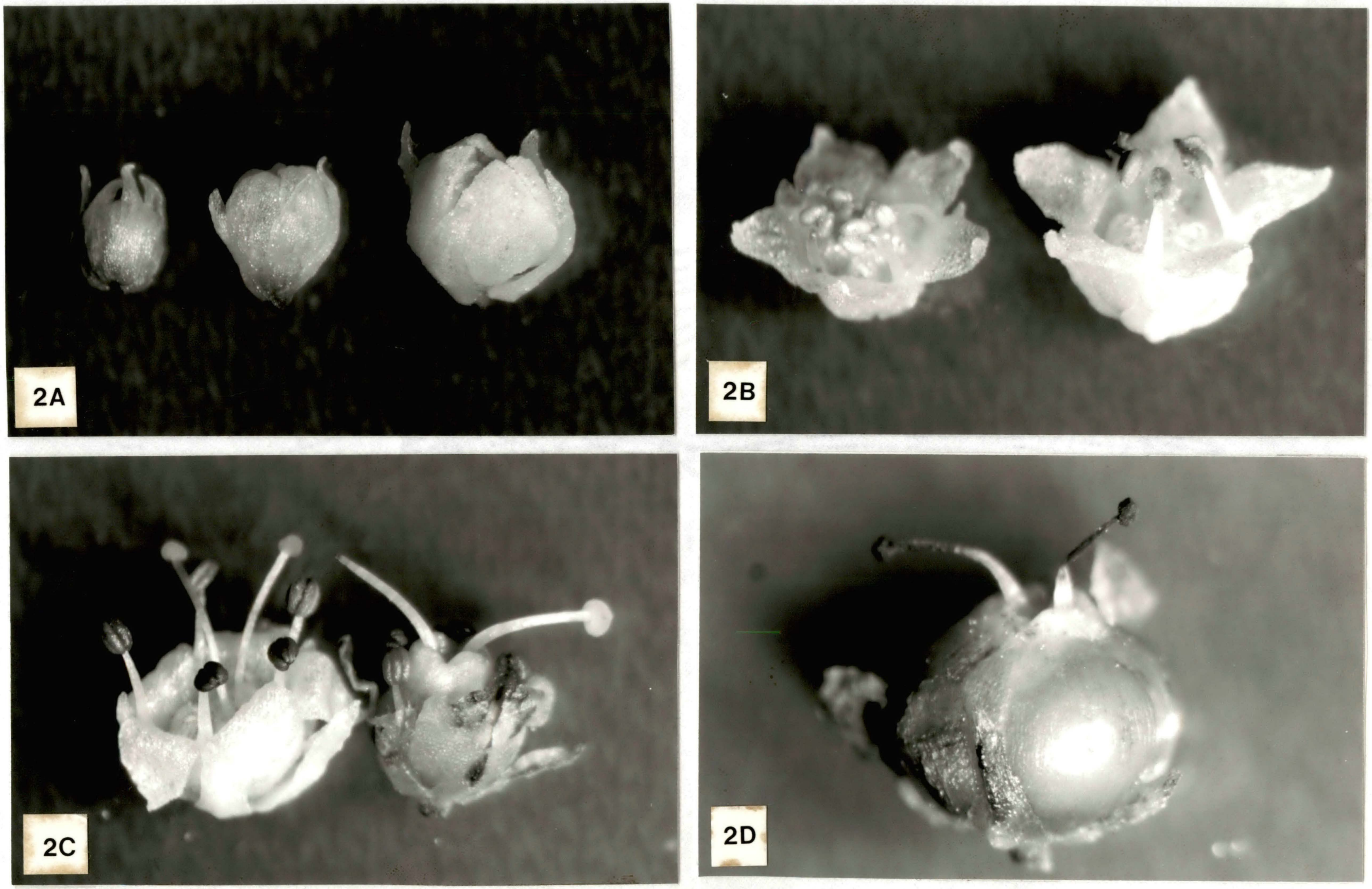


Figure 2. Sequence of floral maturation in *Cuscuta attenuata* Waterfall.

arched outward as well. Because of this arching, a stigma was observed on two occasions to come in contact with the anther of a nearby flower and pollen was transferred.

C. attenuata lacks apparent adaptations for insect pollination. The flowers are not fragrant. No insect visitors were observed at any of the four populations during numerous hours of observation. No cleistogamous flowers were observed in the field or in the laboratory. Self-pollination, as described above, was observed in both the field and the laboratory.

The ovary began to enlarge within a few days of flower opening. On day eleven, the ovary was about 3 mm long and caused the corolla to split (Figure 2C-right). The developing seeds were bright green and could be seen through the translucent capsule wall. The calyx and corolla had begun to dry and wither. The fruit, an irregularly and tardily dehiscent capsule, was mature 14-20 days after the flower bud first appeared (Figure 2D). At maturity, the capsule was about 3 mm in diameter. The corolla had dried and most of it had fallen from the fruit. The calyx had dried as well, but persisted at the base of the capsule. Herbarium records and field observations of *C. attenuata* indicate that mature fruit are present from about 10 September to 24 October.

The capsules of *C. attenuata* were observed to float when placed in water although none were observed floating at any of the sites. The Waterfall Creek site was visited on 3 January 1989 and the South Canadian River and Quanah Parker Lake sites were visited on 27 January 1990. At each site on these dates, intact capsules of C. attenuata were still attached to standing dead stems of Iva well after the growing season of both C. attenuata and I. annua.

Seed Germination. The effects of sulfuric acid-scarification on seed germination of C. attenuata are presented in Table 7. Of the 50 seeds which were mechanically scarified, 39 germinated during the first five-day interval and one germinated during the second five-day interval. The effects of the four different temperature regimes upon germination are presented in Table 8. Germination of seeds collected from the populations at Waterfall Creek, Quanah Parker Lake, and South Canadian River in the fall of 1989 are given in Table 9.

Reproductive Biology. Observations of the pollination mechanisms of C. attenuata were combined with the phenological chronology. Fruit set, seed set, and seed germination from the treatments are given in Table 10. Percentages of stainable pollen are given in Table 11.

Cytology. The chromosomes of C. attenuata were observed at anaphase of the pre-meiotic mitosis.

Table 7. Number of <u>Cuscuta</u> <u>attenuata</u> seeds (n=100) germinating during five-day intervals at 30-33°C using different scarification regimes.

Minutes in conc. sulfuric acid	Days 5	10	15	20	25	30	Total
0	7	2	3	1	0	0	13
15	55	1	3	0	0	0	59
30	80	3	1	0	0	0	84
45	82	1	0	0	0	0	83
60	86	1	0	0	0	0	87

Table 8. Number of <u>Cuscuta</u> <u>attenuata</u> seeds (n=100) germinating during five-day intervals using different temperature regimes following scarification for 30 min in concentrated sulfuric acid.

Temperature in °C	Days 5	10	15	20	25	30	Total
20-22	58	4	0	0	0	0	62
25-28	91	2	1	0	0	0	94
30-33	87	3	0	0	0	0	90
35-38	73	1	0	0	0	0	74

Table 9. Number of <u>Cuscuta</u> <u>attenuata</u> seeds (n=100) collected in fall 1989 from the Waterfall Creek, Quanah Parker Lake, and South Canadian River populations germinating during five-day intervals at 30-33°C after scarification for 30 min in concentrated sulfuric acid.

Population	Days 5	10	15	20	25	30	Total
Waterfall Creek	88	1	0	0	0	0	89
Quanah Parker Lake	92	2	0	0	0	0	94
South Canadian River	82	0	1	0	0	0	83

Table 10. Fruit set, seed set, and seed germination in populations of <u>Cuscuta attenuata</u>.

Condition/Test	Flowers Observed or Crosses Made (No.)	Fruit Set (No.)	Fruit Set (%)	Seed Set/ Ovules Produced	Seed Set (%)	Seed Germination (No.)	(%)
Natural Conditions							
Waterfall Creek 1988	100	87	87	194/400	49	84/100	84
Waterfall Creek 1989	100	96	96	261/400	65	89/100	89
Quanah Parker Lake	100	95	95	266/400	67	94/100	94
South Canadian River	100	98	98	250/400	63	83/100	83
Autogamy							
Waterfall Creek							
field caged	100	88	88	209/400	52	78/100	78
in laboratory	100	90	90	194/400	49	81/100	81
hand pollinated	45	37	82	81/180	45	67/81	83
Intrapopulational Allogamy							
Waterfall Creek	30	27	90	54/120	45	45/54	83
Interpopulational Allogamy							
Waterfall Creek							
x Quanah Parker Lake	51	47	92	77/204	38	62/77	81
x South Canadian River	23	20	87	35/92	38	25/35	71
x Sabine River	16	13	81	25/64	39	20/25	80
Agamospermy							
Waterfall Creek	40	0	0	0/160	0	-	-

Table 11. Pollen stainability of _Cuscuta_ species.

Species/Population	Stainable Pollen (%)
C. attenuata	
Waterfall Creek	97
Quanah Parker Lake	87
South Canadian River	95
Sabine River	96
C. indecora var. _indecora_	92
C. indecora var. _longisepala_	95
C. cuspidata	97
C. compacta	99

Because of small cell size and the relatively large chromosome size, it was difficult to examine meiotic stages, however, the process appeared to be normal. Counts of three populations of C. attenuata revealed that the species had a chromosome number of 2n=30.

Analyses of Morphological Variation. The results of the univariate analysis are presented in Figure 3. The ranges of variation of ten characters of C. attenuata did not overlap those of C. compacta: number of bracts along pedicel, number of bracts at pedicel apex, bract length/bract width, calyx length/calyx width, corolla length/calyx length, corolla length/corolla width, number of fringes per corolla appendage, appendage length/appendage width, filament length, and anther length. The ranges of six characters of C. attenuata did not overlap those of C. cuspidata: bract length/bract width, calyx length, calyx length/calyx width, corolla length, calyx length, and corolla length/corolla width. The ranges of variation of three characters of C. attenuata did not overlap with those of C. indecora var. indecora: calyx length, length of calyx tube/total calyx length, and corolla length/calyx length. The ranges of variation of C. attenuata and C. indecora var. longisepala overlapped for every character examined. There were six characters in which C. attenuata, C. indecora var. indecora, and C. indecora var. longisepala exhibited conspicuous

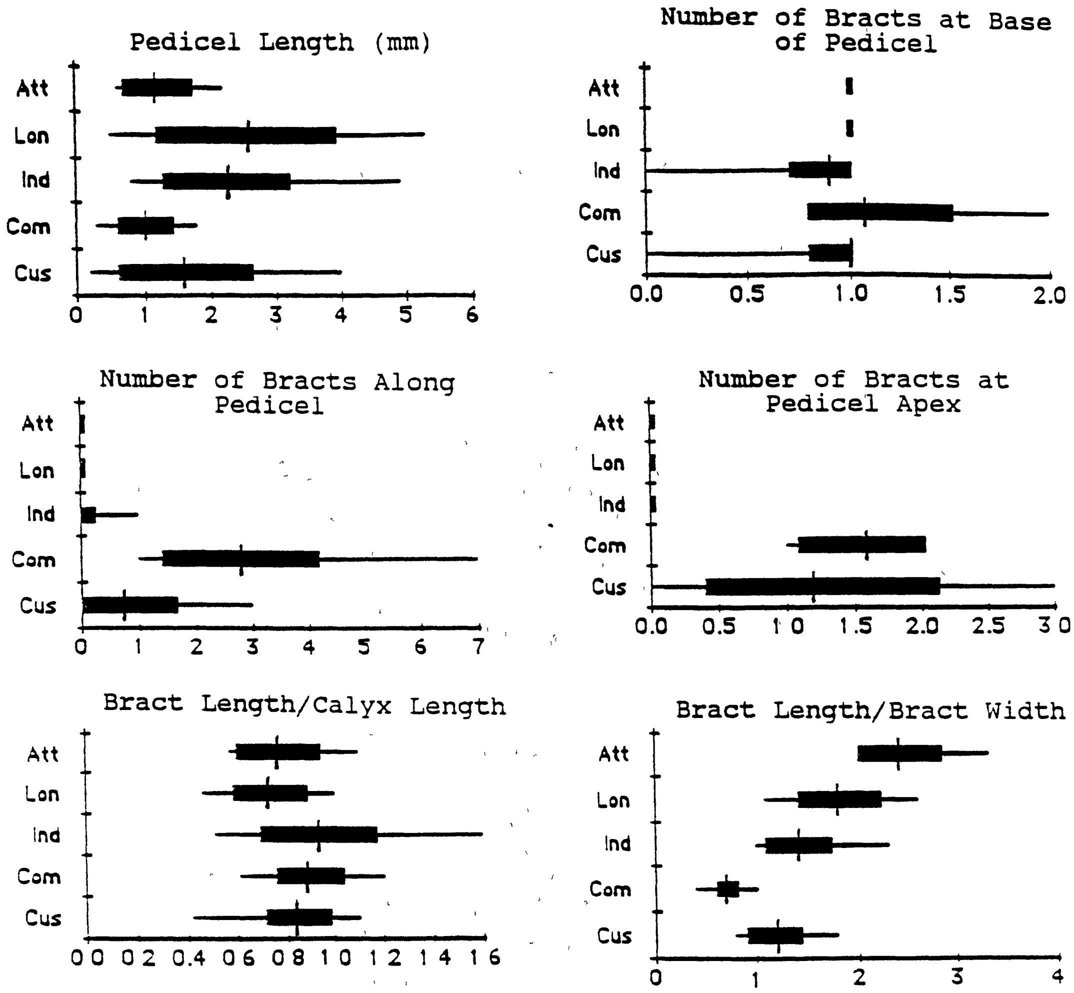
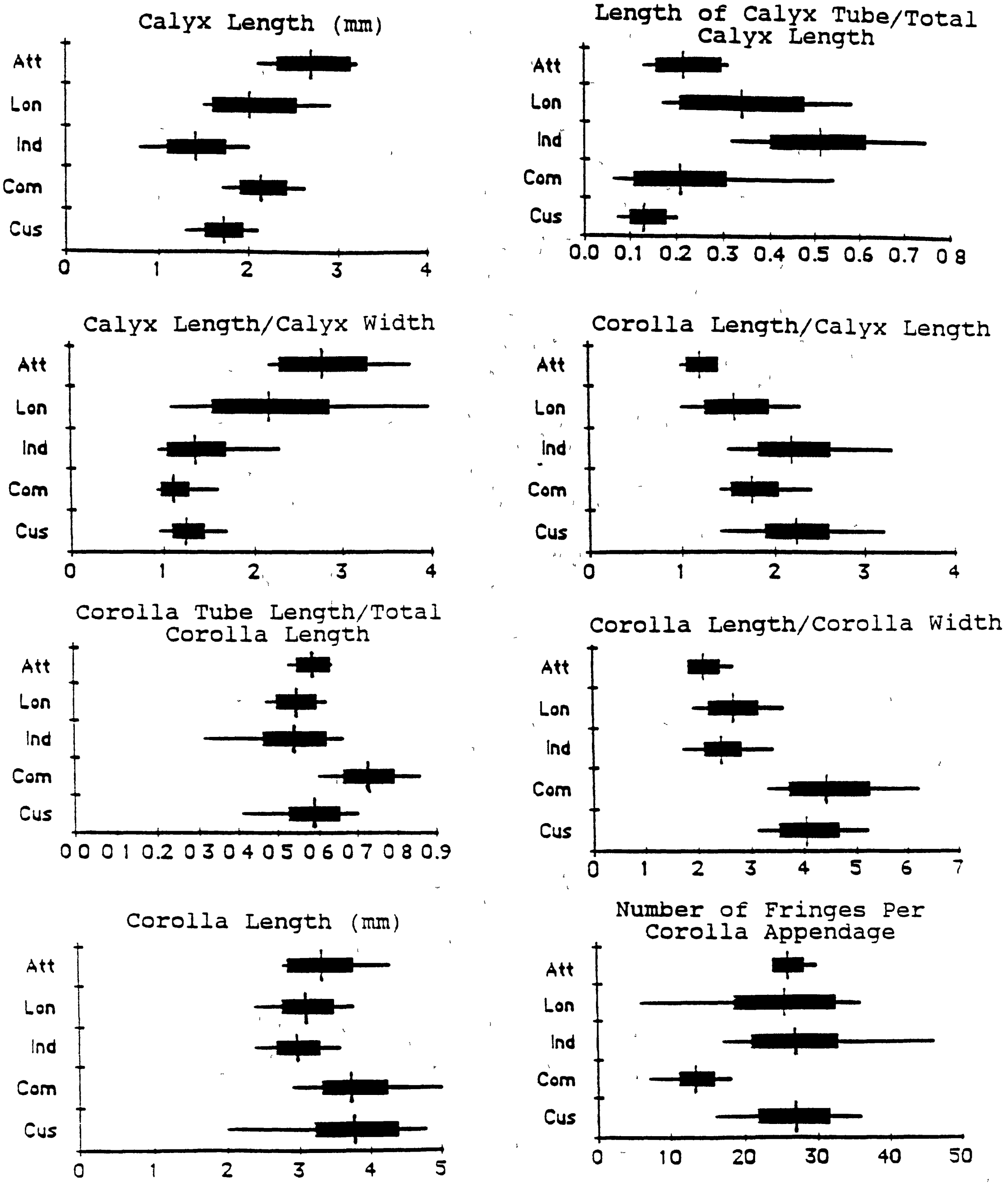


Figure 3. Means, standard deviations, and ranges for 27 morphological characters scored for five *Cuscuta* taxa. Means are indicated by vertical lines, ranges by horizontal lines, and standard deviations by horizontal bars. A single vertical bar indicates no variation in that character. Att = *C. attenuata*, Lon = *C. indecora* var. *longisepala*, Ind = *C. indecora* var. *indecora*, Com = *C. compacta*, and Cus = *C. cuspidata*.



Calyx Length (mm)

Length of Calyx Tube/Total Calyx Length

Calyx Length/Calyx Width

Corolla Length/Calyx Length

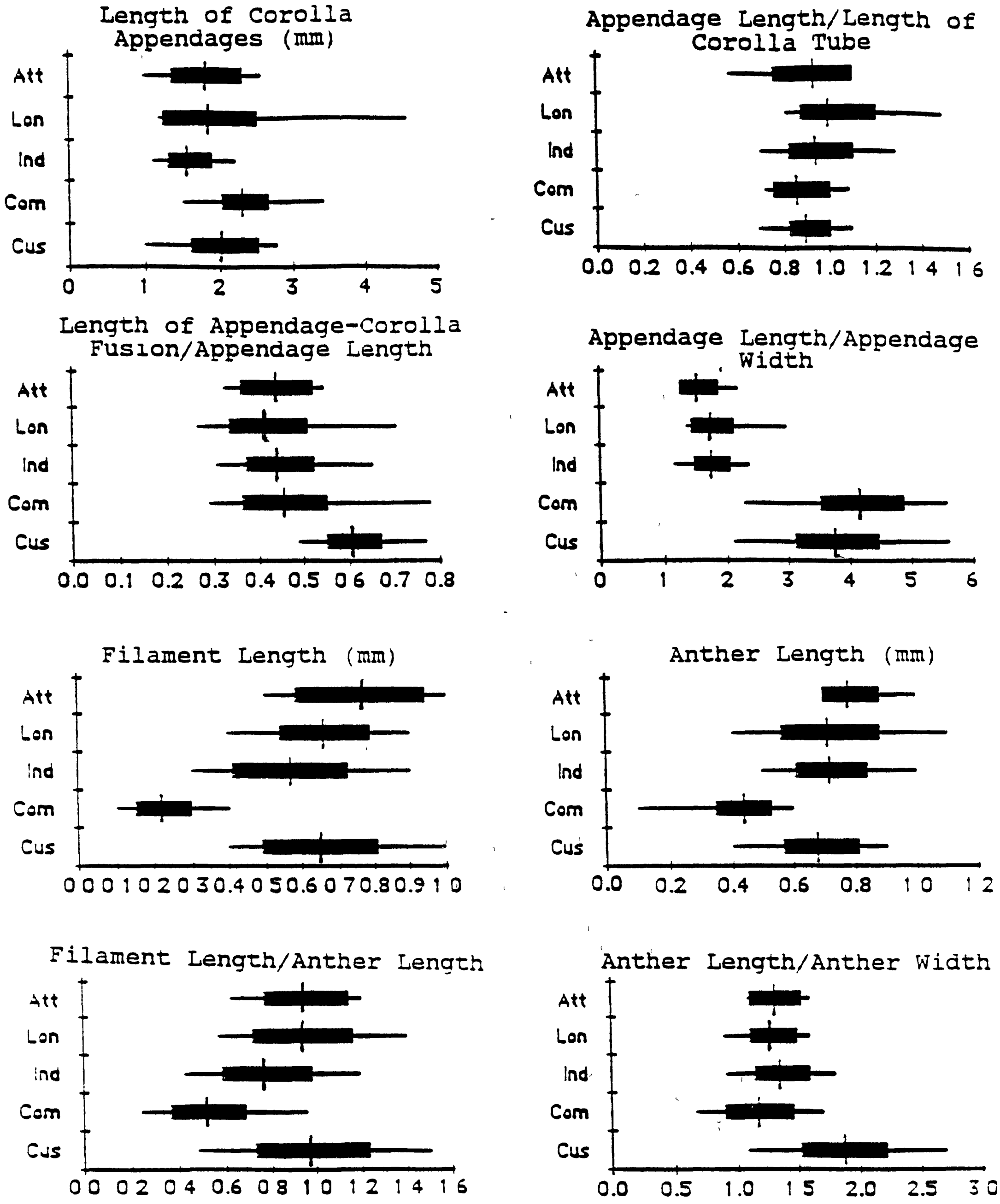
Corolla Tube Length/Total Corolla Length

Corolla Length/Corolla Width

Corolla Length (mm)

Number of Fringes Per Corolla Appendage

Figure 3. (Continued)



Length of Corolla Appendages (mm)

Appendage Length/Length of Corolla Tube

Length of Appendage-Corolla Fusion/Appendage Length

Appendage Length/Appendage Width

Filament Length (mm)

Anther Length (mm)

Filament Length/Anther Length

Anther Length/Anther Width

Figure 3. (Continued)

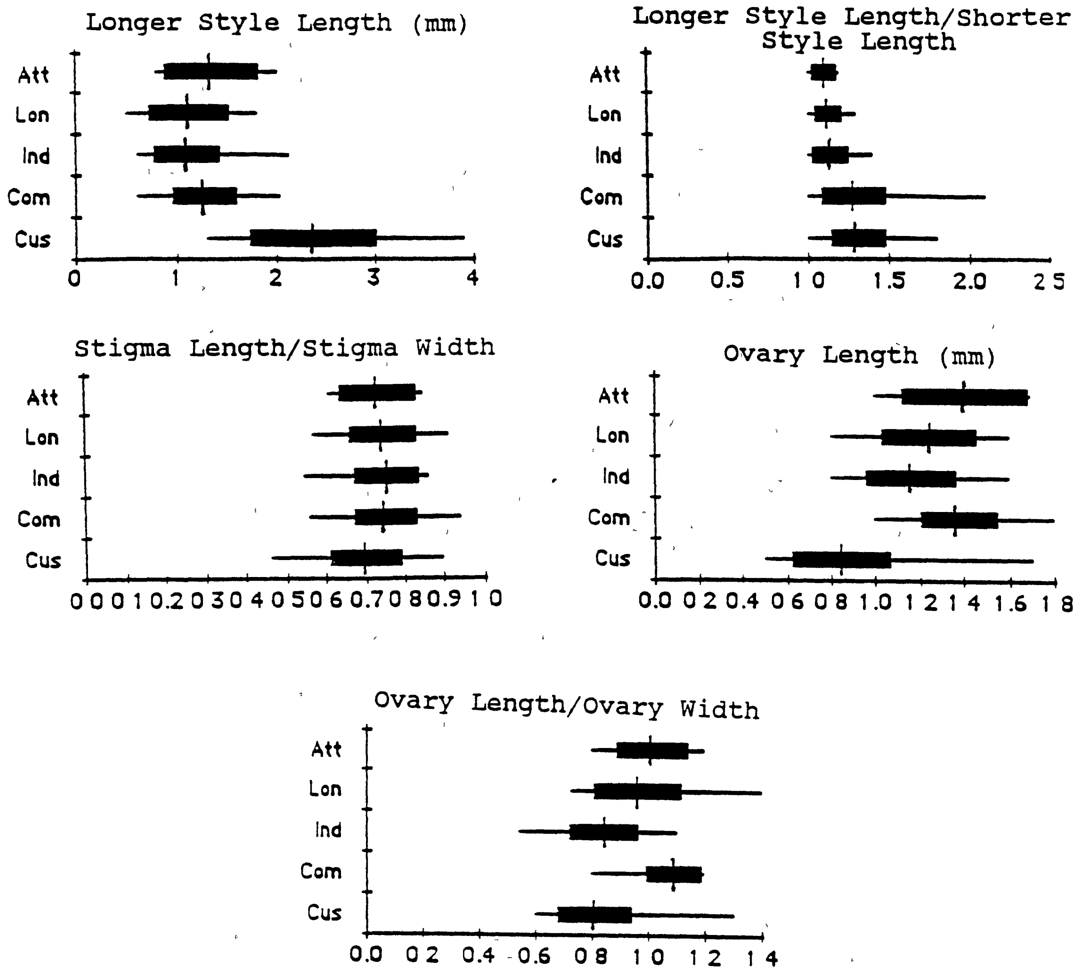


Figure 3. (Continued)

differences: pedicel length, bract length/bract width, calyx length, calyx tube length/total calyx length, calyx length/calyx width, corolla length/calyx length. The means of these characters are given in Table 12.

The results of the clustering techniques are presented in Appendix B. Portions of phenograms from UPGMA, WPGMA, and Complete Linkage techniques are presented in Figures 4-6. In each technique, specimens of *C. compacta* and *C. cuspidata* formed distinct clusters before clustering with the other taxa. *C. indecora* var. *indecora*, *C. indecora* var. *longisepala* and *C. attenuata* did not form distinct clusters but rather formed one large cluster. When the UPGMC, WPGMC, and single linkage techniques were used, distinct clusters were not formed.

In the principal component analysis, the first three components explained 56.4% of the variation. The remaining variation was accounted for by the other factors in 1-4% increments. The first principal component, which accounted for 31.1% of the variation, was weighted for orientation of the bracts, orientation of the calyx, overlap of the calyx lobes, and papillations of the corolla. The second principal component, which accounted for 18.2% of the variation, was weighted for shape of the bract apex, shape of the bract margin, shape of the corolla apex, shape of the corolla margin, filament length/anther length, and

Table 12. Means of characters by which *Cuscuta attenuata*, *Cuscuta indecora* var. *indecora*, and *Cuscuta indecora* var. *longisepala* differ.

Character	*C. attenuata*	*C. indecora* var. indecora	*C. indecora* var. *longisepala*
Pedicel Length	1.2	2.6	2.3
Bract Length/Bract Width	2.4	1.8	1.4
Calyx Length	2.7	2.0	1.4
Length of Calyx Tube/Total Calyx Length	0.2	0.3	0.5
Calyx Length/Calyx Width	2.8	2.2	1.4
Corolla Length/Calyx Length	1.2	1.6	2.2

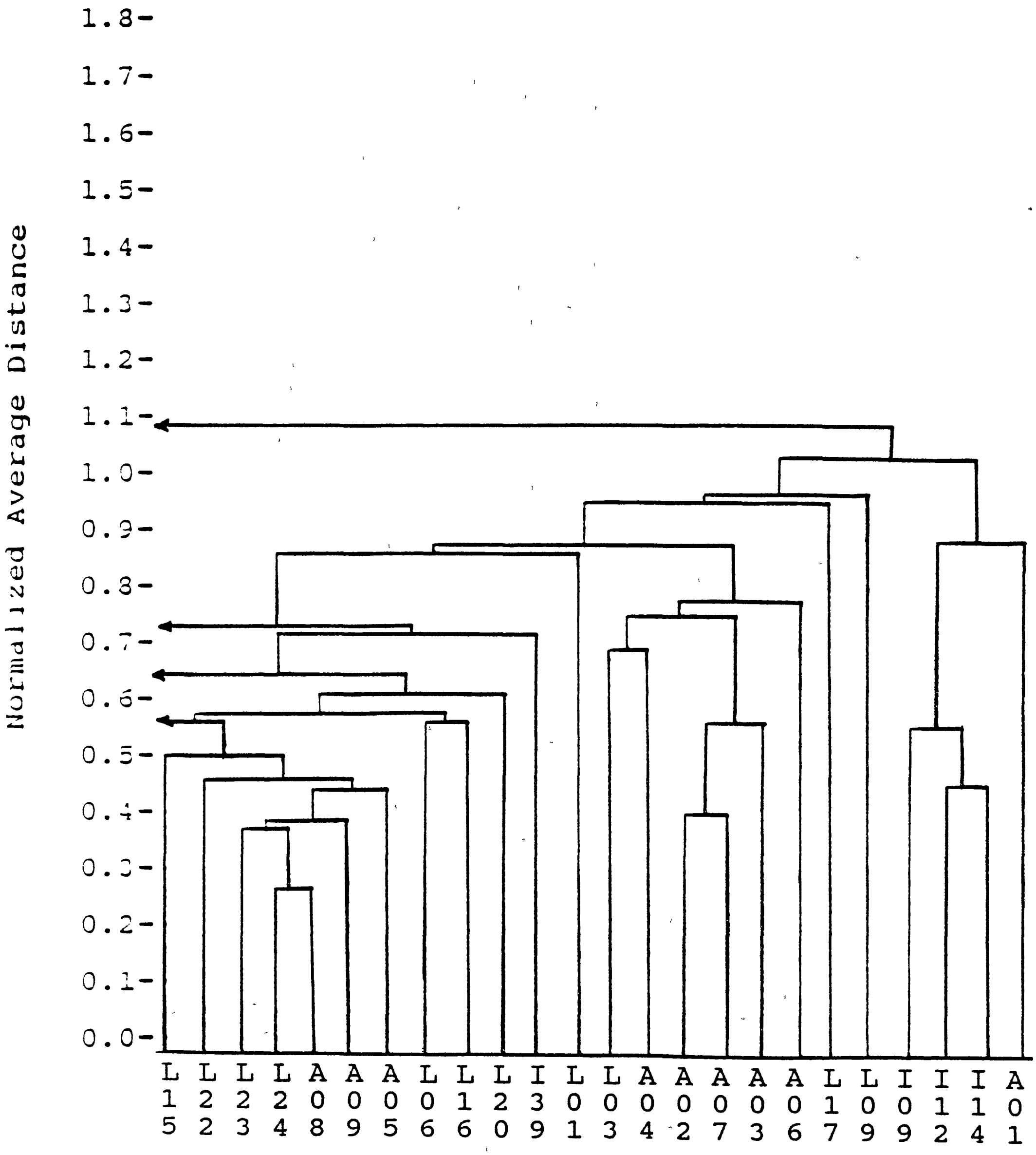


Figure 4. Portion of a phenogram produced by UPGMA clustering technique. This portion contains all of the specimens of Cuscuta attenuata. Specimen identification numbers are printed along the horizontal axis.

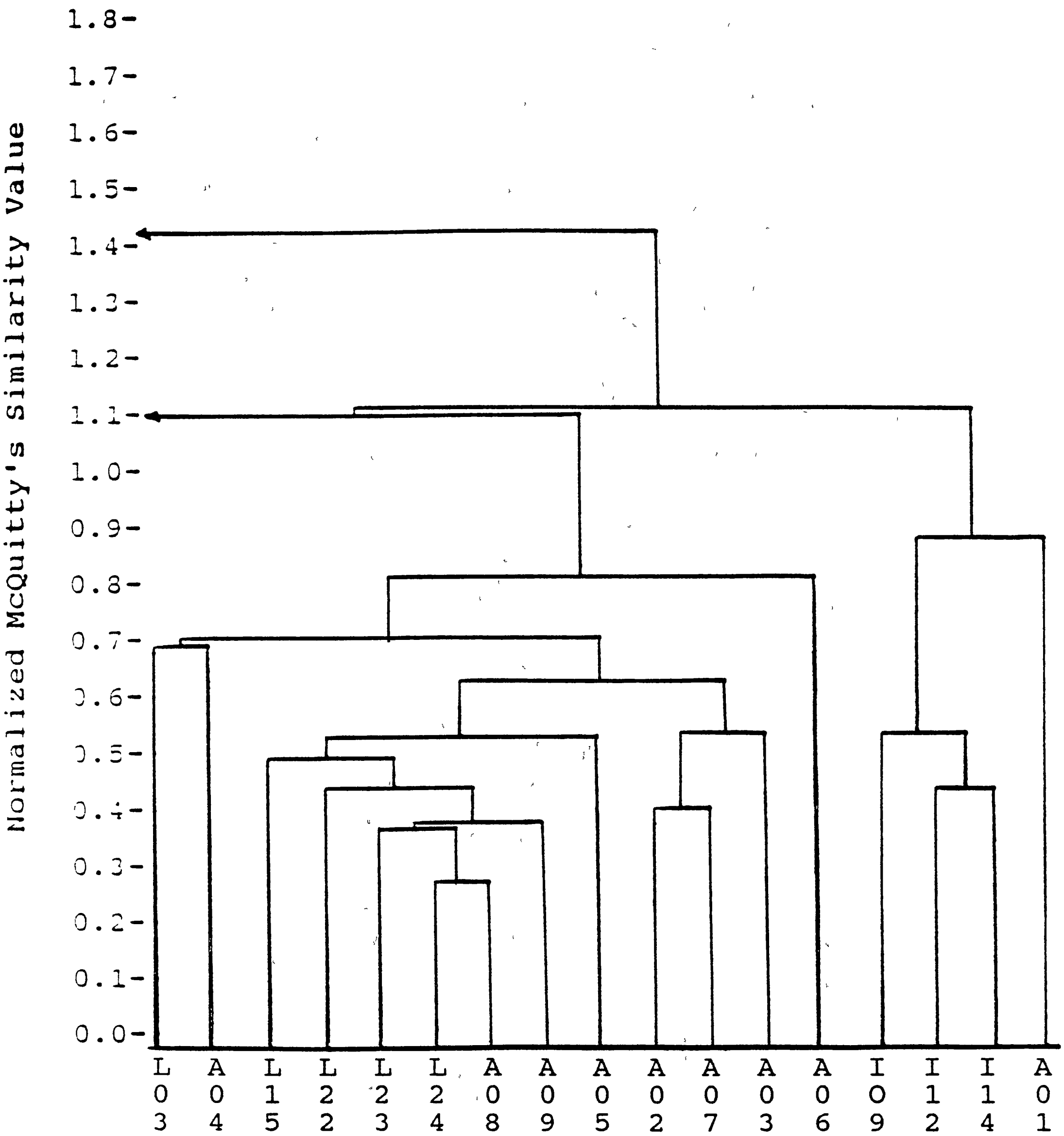


Figure 5. Portion of a phenogram produced by WPGMA clustering technique. This portion contains all of the specimens of Cuscuta attenuata. Specimen identification numbers are printed along the horizontal axis.

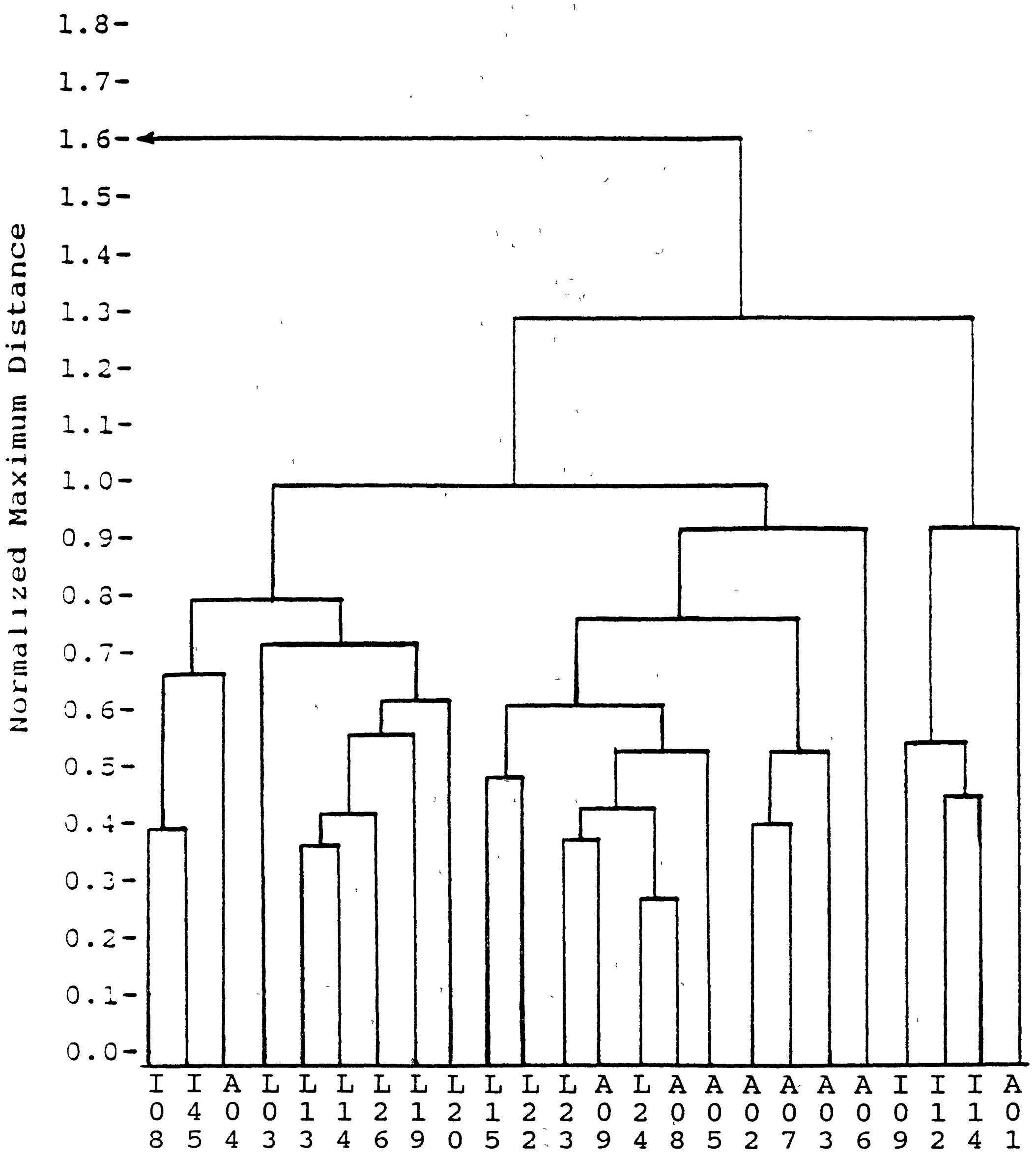


Figure 6. Portion of a phenogram produced by complete linkage clustering technique. This portion contains all of the specimens of _Cuscuta_ _attenuata_. Specimen identification numbers are printed along the horizontal axis.

number of fringes per corolla appendage. The third principal component, which accounted for 7.1% of the variation, was weighted for bract length/calyx length, calyx length, calyx length/calyx width, papillations of the calyx, and corolla length/calyx length. Plots of the first three principal components against one another are given in Figures 7-9. As can be seen in the plot of the first component against the second component (Figure 7), *C. compacta* and *C. cuspidata* formed distinct clusters while *C. attenuata*, *C. indecora* var. *indecora*, and *C. indecora* var. *longisepala* clustered together. Of the characters that the second principal component was weighted for, filament length/anther length was the only one in which *C. attenuata* and *C. indecora* var. *longisepala* differ from *C. indecora* var. *indecora*. The mean of the ratio was .95 for *C. attenuata*, .94 for *C. indecora* var. *longisepala*, and .77 for *C. indecora* var. *indecora*. This probably explains the tendency of *C. attenuata* and *C. indecora* var. *longisepala* to occupy one portion of the cluster. The plot of the first principal component against the third principal component (Figure 8) showed that *C. compacta* and *C. cuspidata* clustered with one another but separately from *C. attenuata*, *C. indecora* var. *longisepala*, and *C. indecora* var. *indecora* which formed a comparatively loose cluster. *C. attenuata* specimens tended to cluster at one extreme of the group, *C. indecora* var. *indecora* tended to cluster

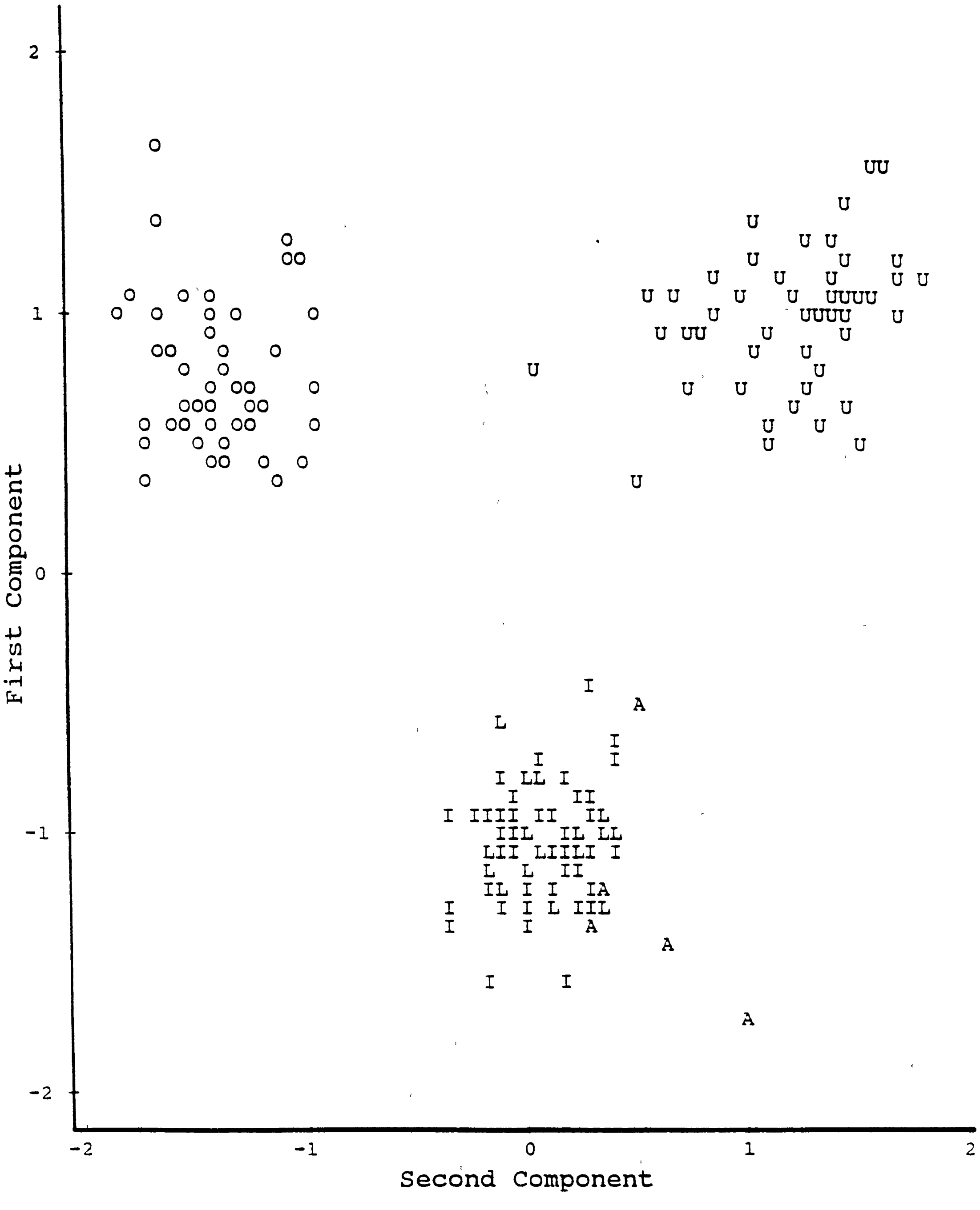


Figure 7. Plot of the first principal component against the second principal component in the analysis of morphological variation in five Cuscuta taxa. Each letter represents one herbarium specimen (OTU): A = C. attenuata, I = C. indecora var. indecora, L = C. indecora var. longisepala, O = C. compacta, and U = C. cuspidata.

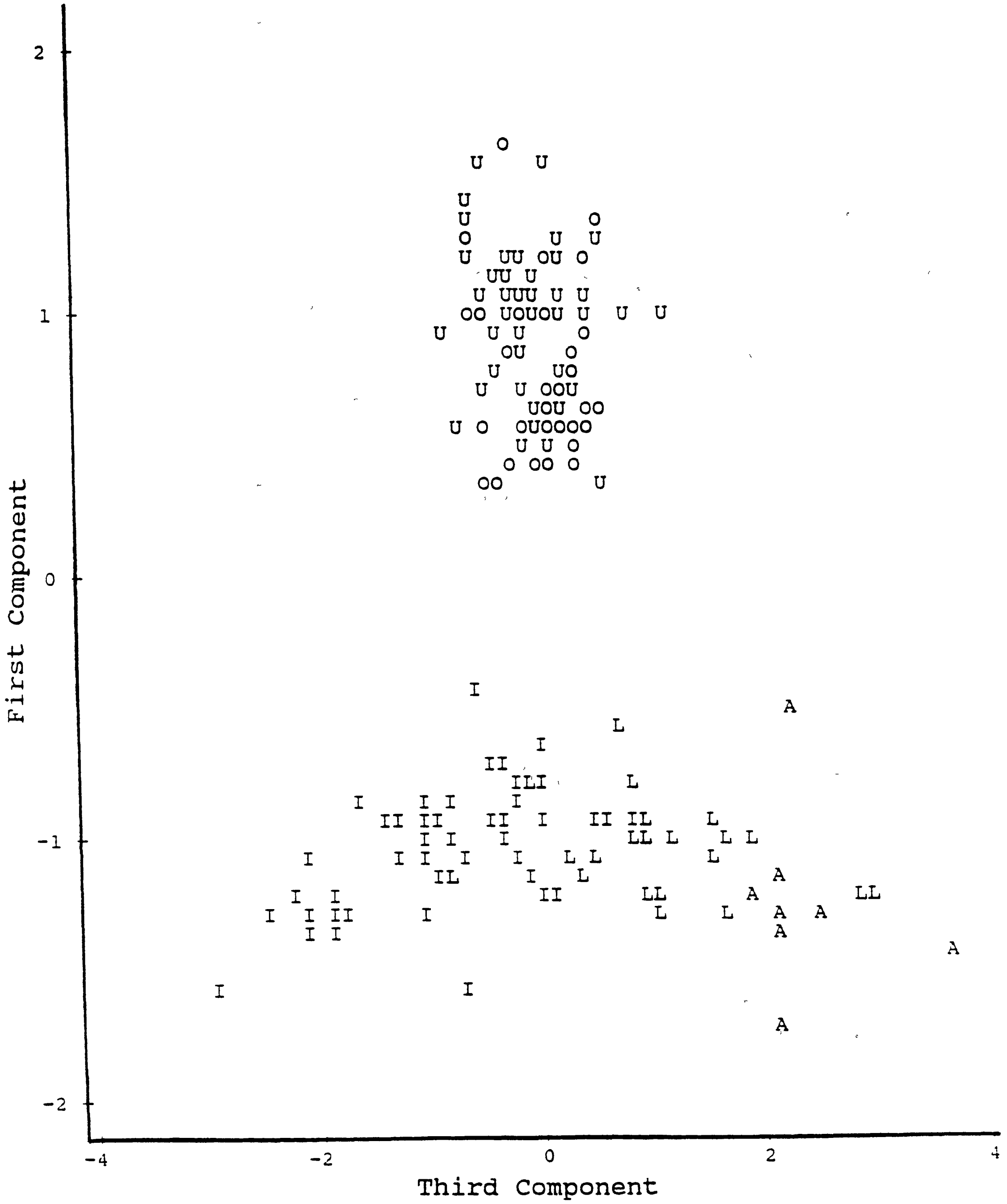


Figure 8. Plot of the first principal component against the third principal component in the analysis of morphological variation in five _Cuscuta_ taxa. Each letter represents one herbarium specimen (OTU): A = _C_. _attenuata_, I = _C_. _indecora_ var. _indecora_, L = _C_. _indecora_ var. _longisepala_, O = _C_. _compacta_, and U = _C_. _cuspidata_.

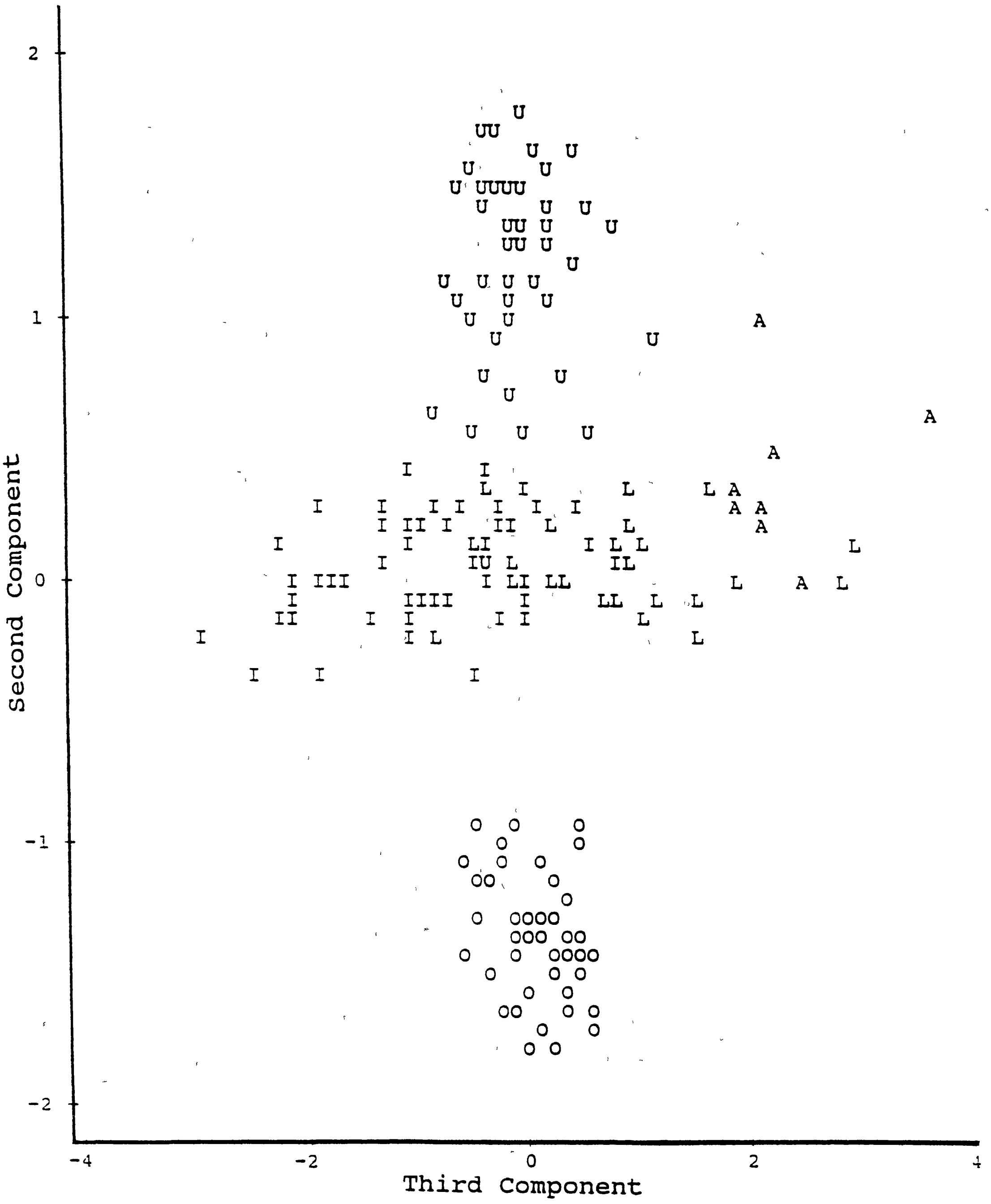


Figure 9. Plot of the second principal component against the third principal component in the analysis of morphological variation in five Cuscuta taxa. Each letter represents one herbarium specimen (OTU): A = C. attenuata, I = C. indecora var. indecora, L = C. indecora var. longisepala, O = C. compacta, and U = C. cuspidata.

at the other extreme, and C. indecora var. longisepala tended to cluster between the two. In the plot of the second component against the third component (Figure 9), C. compacta and C. cuspidata formed distinct clusters while the other three taxa once again were clustered together in the same manner as seen in Figure 8.

The results of the discriminant analysis suggest that only four specimens were misidentified. Those were I29, which had a probability of .518 of being C. indecora var. longisepala rather than C. indecora var. indecora as originally identified; L24, which had a probability of .522 of being C. attenuata rather than C. indecora var. longisepala; L25, which had a probability of .975 of being C. indecora var. indecora rather than C. indecora var. longisepala; and A09, which had a probability of .956 of being C. indecora var. longisepala rather than C. attenuata. With only two exceptions, all of the remaining identifications had a probability of 0.9 or above of being correct. The two exceptions, L03 and A08 had probabilities of .81 and .80, respectively, of being correct. All probabilities from the discriminant analysis are presented in Appendix D.

Specimen A09 was replaced in the data set with another flower (A10) from the same specimen. Specimens L24 and L25 were changed to A24 and I51, respectively. the identification of specimen I29 was not changed. A discriminant analysis was performed on this new data set and all probabilities were >.93 that each specimen was correctly identified.

Interspecific Hybridizations. None of the crosses between *C*. *attenuata* and the other taxa were successful. Neither fruit nor seed were set.

Electrophoresis. Enzyme bands revealed for esterase and benzidine peroxidase are shown in Figures 10 and 11, respectively. The samples of *C*. *indecora* var. *indecora* and *C*. *indecora* var. *longisepala* have the same banding pattern for esterase, they each have bands A, B, and D. Band D is also present in *C*. *attenuata* samples from the populations at Waterfall Creek and Quanah Parker Lake. The *C*. *attenuata* samples from the populations at Waterfall Creek and the South Canadian River share band C, which is unique to those two samples. No band is present in all three samples of *C*. *attenuata*. Three unique bands (E, F, and G) formed for the sample of *C*. *cuspidata* and no esterase bands formed for the sample of *C*. *compacta*.

The samples of *C*. *indecora* var. *indecora* and *C*. *indecora* var. *longisepala* have three bands in common for benzidine peroxidase, A, H, and J. Band H is also present in the samples *C*. *attenuata* from the South Canadian River and Quanah Parker Lake populations. Band J is also present in the samples of *C*. *attenuata* from the Waterfall Creek and Quanah Parker Lake populations.

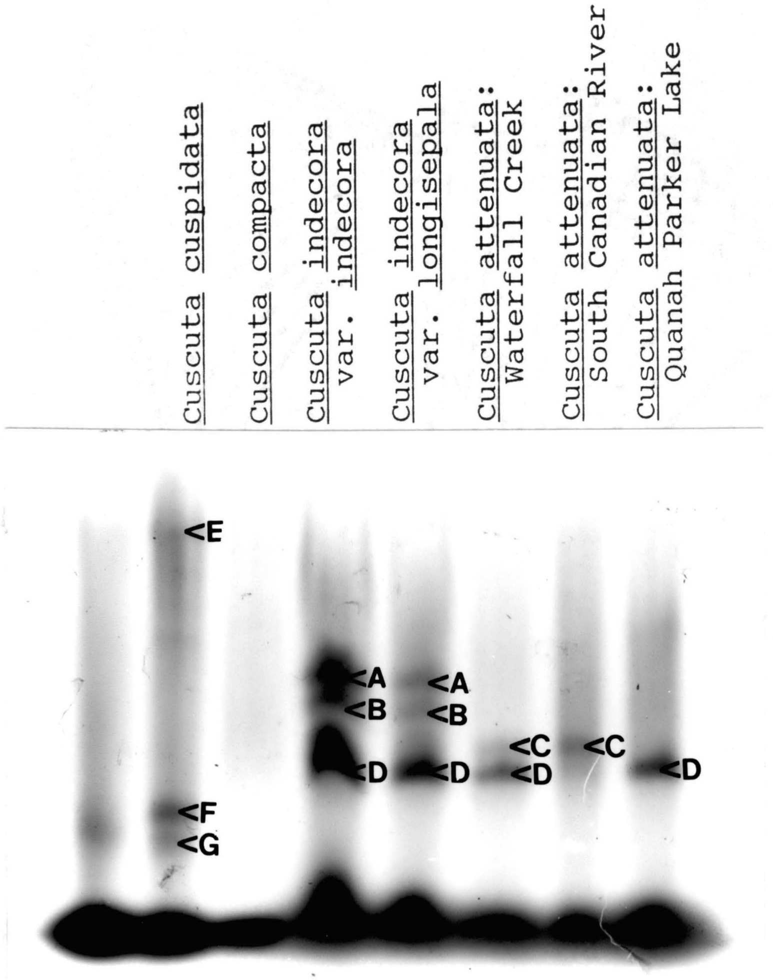


Figure 10. Esterase banding patterns produced by five *Cuscuta* taxa. The first column represents *C. cuspidata* stem material, which was not discussed here. The remaining six columns represent samples of flowers and stems of the taxon indicated above the column.

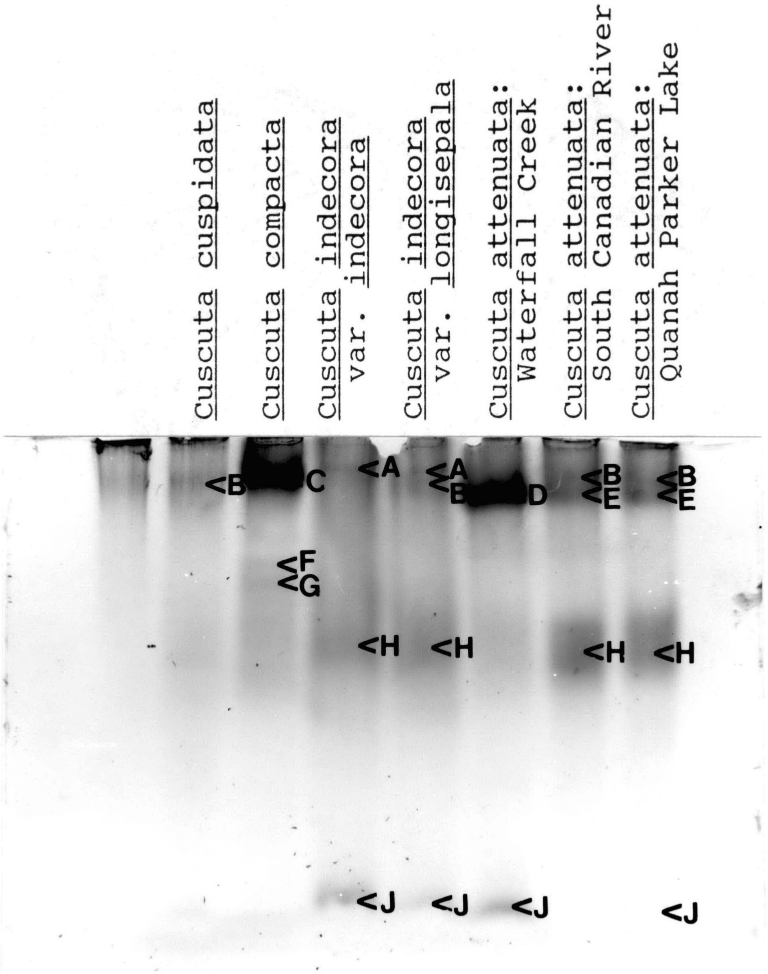


Figure 11. Benzidine peroxidase banding patterns produced by five *Cuscuta* taxa. Column 1 represents *C. cuspidata* stem material, which was not discussed here. The remaining six columns represent samples of flowers and stems of the taxon indicated above the column.

In addition, the sample of *C. indecora* var. *longisepala* has band B in common with the samples of *C. cuspidata*, and *C. attenuata* from the South Canadian River and Quanah Parker Lake populations. Band E is present only in the samples of *C. attenuata* from the South Canadian River and Quanah Parker Lake populations. Band D is unique to the sample of *C. attenuata* from Waterfall Creek. Bands C, F, and G are unique to *C. compacta*.

DISCUSSION

Geographical Distribution. C. attenuata is not restricted to McCurtain County, Oklahoma as was previously thought. The discovery of two additional populations by chance suggests that C. attenuata may be fairly widespread but uncommon. Also, the genus is undercollected because of the difficulty in identifying specimens. In addition, the species is easy to overlook in the field because of its inconspicuous habit. The identification of 14 specimens from Oklahoma, Texas, and Kansas suggests that intensive field searches of sites occupied by I. annua and further herbarium studies might lead to the discovery of other populations. The known geographic range of C. attenuata has been expanded by this study, yet the failure to locate other populations in McCurtain County after extensive searches and the host specificity of the species suggest that populations are widely separated throughout its range.

Description of Host and Host's Habitat. In nature, C. attenuata rarely parasitizes anything but I. annua. Tyrl, et al. (1978) and Taylor and Taylor (1980) reported that C. attenuata also parasitized a species of Aster, but the Cuscuta plant had probably parasitized an I. annua plant initially and subsequently parasitized the Aster plants. The successful cultivation of C.

attenuata on *Coleus hybridus* suggests that further studies may reveal other hosts suitable for cultivation and may determine that *C. attenuata* is not physiologically restricted to *I. annua*. It is widely accepted that some species of *Cuscuta* are adapted to a wide variety of hosts, while others have a preference for one or a few species (Yuncker, 1920; Verdcourt, 1948; and Gaertner, 1950). *Iva* has also been cited as host for *C. compacta*, *C. cuspidata*, and *C. indecora*, by Gandhi, et al. (1987), Musselman (1986), Yuncker (1965).

Except for the presence of a large population of its host, no single habitat feature examined could be correlated with the presence of *C. attenuata*. However, all of the sites reported in this study occur in a region that has a similar climate. Some features such as mean yearly temperature, soil texture, and soil pH varied little between the sites while others such as mean yearly precipitation, surface nitrate, soil zinc, and salinity varied substantially (Table 6).

Phenology. Few observations of the phenology of *C. attenuata* have been made. Tyrl, et al. (1978) and Taylor and Taylor (1980) briefly discussed phenology in their status reports of the species. The observations reported here agree with their observations. Several workers have reported similar germination dates for other species (Hutchison and Ashton, 1980; Allred and Tingey, 1964; Dawson, 1965) and the early development of the seedling and attachment to the host is similar to that described for other species by Kuijt (1969), Zietz (1954), and Verdcourt (1948). Others have also reported the presence of chlorophyll in the seedlings of various *Cuscuta* species (Verdcourt, 1948; Musselman, 1986). Musselman (1986), Austin (1986), and Steyermark (1963) reported similar flowering dates for many species of *Cuscuta* including *C. compacta*, *C. cuspidata*, and *C. indecora*.

Kuijt (1969), Dean (1954), and Visser (1981) reported that some species of *Cuscuta* are capable of perennation inside the host stem. According to their descriptions, the host stem becomes swollen and misshapen at the point of haustorial attachment. This deformation extends completely around the stem and has been referred to as a hypertrophy (Dean, 1937; Kuijt, 1969). Subsequently, the *Cuscuta* stem is broken and usually falls from the host, but the haustoria remain alive inside the host stem and can overwinter. New *Cuscuta* stems emerge from the hypertrophies the following growing season. Dean (1934, 1937) described the formation of hypertrophies on a number of hosts including several annuals. He observed that new *Cuscuta* stems often emerge from haustorial tissue imbedded in the cortical parenchyma and xylem of the host. Kuijt (1969) also discussed this phenomenon and added that flowers which originate endogenously also may develop from the enveloped haustorial coil.

Yuncker (1920) and Verdcourt (1948) failed to observe any insect visitors during numerous hours of observation, although Musselman (1986) observed dipterans pollinating C. rostrata. Yuncker (1920), Verdcourt (1948), Muller (1883), Musselman (1986), and Visser (1981) reported that a few species of Cuscuta are fragrant and probably insect pollinated, but that insect pollination is not the rule. Kuijt (1969) stated that within the genus, pollination lacks a high degree of precision. Verdcourt (1948) stated that self-pollination appears to be the rule. Musselman (1986) stated that autogamy is well developed in C. compacta and C. pentagona. Beliz (1988) reported that C. pentagona and C. salina are autogamous. Both Yuncker (1920) and Verdcourt (1948) have reported instances of cleistogamy. It appears that C. attenuata is strictly autogamous because only self-pollination was observed in the field and laboratory.

Seed dispersal in C. attenuata appears to be unspecialized. Verdcourt (1948) stated that while little evidence is available, water may play a role in seed dispersal in some species. He pointed out that many species of Cuscuta commonly occur near water, and that the seeds will sink but entire capsules will often float. Kuijt (1969) described seed dispersal as haphazard and unspecialized. All four observed populations of _C_. _attenuata_ were located near water but this may reflect the habitat specificity of the host more than a seed dispersal mechanism, although it is not unrealistic to hypothesize that water may play role in dispersal because the capsules float.

Seed Germination. Scarification increases germination rates dramatically. Only 13% of unscarified seeds germinated, whereas an average of 84.7% of those seeds chemically scarified for 30 min or more germinated, a 71.7% increase. Of those which were chemically scarified for 15 min, 59% germinated, a 46% increase over the control. A minimum scarification time of 30 min is required for optimum germination rates. These results are consistent with those reported by other workers. In a similar experiment, Hutchison and Ashton (1979) reported that maximum germination rates for _C_. _campestris_ were achieved after 45 min of treatment with concentrated sulfuric acid. Tingey and Allred (1960) reported highest germination rates for _C_. _approximata_ after treatment for 60 min. Gaertner (1950) concluded that scarification in concentrated sulfuric acid is an efficient method for breaking the dormancy mechanism in a variety of _Cuscuta_ species but that the optimum length of time varies with the age of the seed and the species involved.

Of those seeds which were mechanically scarified, 80% germinated, a 67% increase over the control.

Hutchison and Ashton (1979) reported that mechanical scarification can increase germination by more than 90% in C. campestris. Tingey and Allred (1960) increased germination of C. indecora by 12% by using mechanical means and suggested that the percent increase would be higher if the seeds had been more thoroughly scarified.

Temperature also has an impact on germination rates. The highest germination rate (94%) was achieved with the 25-28 C° temperature range. A slightly lower germination rate (90%) was achieved with the 30-33°C temperature range. Under the 20-22°C and the 35-38°C temperature ranges germination rates of 62% and 74% were achieved, respectively. Allred and Tingey (1964) reported maximum germination rates for scarified seeds at 16°C for C. approximata and C. campestris and 21°C for C. indecora. Hutchison and Ashton (1980) reported 30-33°C as an optimum temperature range for germination of scarified C. campestris seeds.

The soil temperature at the Waterfall Creek site was 25°C on 15 May when seedlings of C. attenuata were first observed. This correlates with the optimum temperature ranges for germination observed in the laboratory, i.e., 25-38°C. This also correlates with the appearance of young seedlings of I. annua in the field, presumably at the time of infection by C. attenuata.

The percent germination of the seeds collected in the fall of 1989 from the Waterfall Creek, Quanah Parker Lake, and South Canadian River populations (89%, 94%, and 83% respectively) are similar to the germination percentage of seeds collected from the Waterfall Creek population in January 1989 (84%, Table 7). This suggests that cold exposure is not required for seed germination as has been shown for C. approximata (Tingey and Allred, 1960), however, the C. attenuata seeds were not moist at the time of exposure as the C. approximata seeds were. The results also suggest that there is not a large difference between germination rates of C. attenuata from different populations or seasons.

Reproductive Biology. Cuscuta attenuata is both autogamous and allogamous. The mechanism of self-pollination was discussed above. The natural seed set and germination and the seed set and germination from both the caged plants and the untreated and manually self pollinated plants in the laboratory (Table 10) are similar. C. attenuata did not exhibit agamospermy; none of the 40 emasculated flowers produced seed.

The success of the crosses between different individuals within a population indicate that C. attenuata is capable of intrapopulational allogamy. As shown by the results from the interpopulational crosses C. attenuata is capable of interpopulational allogamy. This suggests that gene flow within and between populations is possible, although it is unlikely to occur often because no evidence of wind dispersal of pollen was observed in this study or reported in the literature and the distance between populations is too great for insect pollinators to bridge. High percentages of stainable pollen agree with the results of Beliz (1988) who reported 95% to 98% stainability in *Cuscuta* species.

Cytology. The mitotic chromosome count of *C. attenuata* was consistent with the base number of 15 given by Cronquist (1981) and the reported mitotic chromosome number of 2n=30 for *C. indecora* reported by Pinkava, et al. (1974). An interesting aside is that Cronquist also gives 7 as a base number for the genus. No chromosome numbers have been reported for any other of the taxa encompassed by this study.

Analyses of Morphological Variation. When Waterfall first described *C. attenuata* in 1971 (Waterfall, 1971) he tentatively placed it in the subsection *Lepidanche* on the basis of its free sepals. He suggested, however, that formation of a new subsection might be appropriate for the species because its bracteate flowers and capsule shape were not consistent with Yuncker's circumscription of *Lepidanche* (Yuncker, 1965). Other members of this subsection are *C. compacta*, *C. cuspidata*, *C. glomerata*, all native to Oklahoma, and *C. squamata*, native to Mexico and Texas. *C. attenuata* can be distinguished from these taxa primarily on the basis of its attenuate sepals, its pedicellate flowers which have bracts only at the base, and the length of the corolla lobes relative to the length of the corolla tube. Waterfall stated that *C. attenuata* resembled *C. compacta*. He distinguished them on the basis of their differences in pedicel presence (*C. attenuata* has a pedicel, *C. compacta* does not), location and number of floral bracts (*C. attenuata* has only one floral bract which is at the base of the pedicel and *C. compacta* has 1-10 which are situated along the length of the pedicel), and sepal shape (*C. attenuata* has lanceolate, attenuate sepals and *C. compacta* has ovate, obtuse sepals). Waterfall also stated that *C. attenuata* resembled *C. cuspidata* in the presence of pedicels (these are the only two taxa in the subsection *Lepidanche* which have pedicels), but was different in that *C. cuspidata* has a much more open inflorescence; ovate, cuspidate sepals; and usually one or two bracts along the pedicels.

Upon close examination it became apparent that the sepals of *C. attenuata* are fused at the base and not free as Waterfall had stated in his diagnosis. Reexamination of the holotype revealed that its sepals are also fused. Because the free calyx was the character used to place *C. attenuata* in the subsection *Lepidanche* its placement was reevaluated. Interpreting the sepals as fused places *C. attenuata* in the subsection *Indecorae* in Yuncker's 1965 monograph of *Cuscuta* which is the most recent comprehensive treatment.

A comparison of characters of the subsections *Lepidanche* and *Indecorae* described in Yuncker's 1965 monograph is given in Table 13. With the exception of its somewhat dense inflorescence, the characters of *C. attenuata* fall within the circumscription of *Indecorae* better than *Lepidanche.* Within the subsection *Indecorae*, specimens of *C. attenuata* key to the taxon *C. indecora* var. *longisepala*. Table 14 compares *C. attenuata* and *C. indecora* var. *longisepala*. The character states are taken from Waterfall's original description of *C. attenuata* (Waterfall, 1971) and Yuncker's original description of *C. indecora* var. *longisepala* (Yuncker, 1920). The two taxa are similar or identical for every character state listed. In 1965 Yuncker examined one of the specimens identified in this study as *C. attenuata* (C. J. Eskew 1395) and made the following annotation: "*C. indecora* Choisy. The long narrow calyx lobes would make it var. *longisepala* Yuncker. However, the specimen looks teratological and may not be the variety but only an abnormal form." This indicates that the specimen did not fit Yuncker's concept of *C. indecora* var. *longisepala*, yet it was more similar to the taxon than any other.

On the basis of univariate and multivariate

Table 13. Characters used to differentiate _Cuscuta_ subsections Indecorae and Lepidanche from Yuncker's 1965 monograph.

Subsection _Indecorae_	Subsection _Lepidanche_
Gamosepalous	Polysepalous
Not especially bracteate	Much bracteate, flowers surrounded by several closely investing bracts
Inflorescence not especially congested	Inflorescence mostly in dense, compact clusters
Flowers pedicellate	Flowers pedicellate or more commonly sessile
Thickened stylopodium	Stylopodium present or absent
Capsule globose or globose-depressed	Capsule somewhat conic

Table 14. Comparison of _Cuscuta_ _attenuata_ Waterfall and _Cuscuta_ _indecora_ var. _longisepala_ Yuncker, using characters from the original descriptions (Waterfall, 1971; Yuncker, 1920).

_C_. _attenuata_	_C_. _indecora_ var. _longisepala_
Flowers usually pedicellate up to 4 mm long	Flowers on pedicels ≤ calyx length
Corolla lobes deltoid-ovate, about equalling the tube in length, spreading at full anthesis	Corolla lobes triangular-ovate, shorter that the tube in length, upright to spreading
Corolla appendages ovate-oblong, fringed, extending about 1/2 way up the filaments	Corolla appendages oblong to subspathulate, abundantly fringed, fringe reaching the filaments
Capsule slightly depressed-globose, corolla deciduous from the mature capsule	Capsule depressed-globose, surrounded by the corolla which eventually splits
Calyx ovate-lanceolate to narrowly lanceolate, attenuate	Calyx lanceolate, acute

analyses, C. attenuata is a morphologically distinctive taxon albeit very similar to C. indecora, particularly var. longisepala. As revealed by the univariate analysis its distinguishing characters include pedicel length, bract length/bract width, calyx length, length of calyx tube/total calyx length, calyx length/calyx width, and corolla length/calyx length. Cluster analyses revealed that C. attenuata is distinct from C. compacta and C. cuspidata but morphologically very similar to C. indecora. C. compacta and C. cuspidata were also shown to be distinct by the principal component analysis. Once again C. attenuata was not separated from C. indecora. The distribution of specimens along the X-axis in Figures 8 and 9 was determined by the third component which was weighted by characters which dealt with variation in the calyces. For those characters C. indecora var. longisepala is always intermediate between C. attenuata and C. indecora var. indecora, thus producing the distribution exhibited in the figures.

After the original discriminant analysis was performed, specimens A09, L24, L25, and I29 were reexamined to account for the discrepancies. Specimen A09 was grown in the lab on Coleus hybridus from seed collected from the Waterfall Creek plants, and therefore, was definitely C. attenuata. Its flowers were rather small in comparison to other specimens of C.

attenuata. possibly due to cultivation on a host other than I. annua. A large flower from the same specimen was deliberately chosen to replace A09. Specimens L24 and L25 were re-examined and it was determined that they had been misidentified. Specimen I29 was determined to have been correctly identified. Using this new data set the discriminant analysis yielded probabilities of >.93 that each specimen was correctly identified.

Interspecific Hybridizations. The lack of fruit set and seed set from all of the interspecific crosses suggests that C. attenuata is genetically isolated from C. indecora var. indecora, C. indecora var. longisepala, C. compacta and C. cuspidata. Although a small number of crosses were attempted, the techniques utilized were identical to those used for the interpopulational crosses which were successful which indicates that technique was not a factor (Table 10). No hybridizations of Cuscuta species have been reported heretofore (Beliz, 1988). The inability of C. attenuata to hybridize with any of the other taxa studied suggests that C. attenuata is a distinct species.

Electrophoresis. Analysis of the enzymatic proteins of C. attenuata and its relatives, while only preliminary, does show that there are differences in the banding patterns for those individuals which were sampled. Gottlieb (1976) stated that samples from one or a few populations may be an adequate sample of a species, but that the population must be sampled thoroughly before conclusions can be drawn. Further, Buth (1984) and Hurka (1984) maintain that to examine intraspecific relationships all taxa should be sampled throughout their geographic range in order to determine enzymatic variation. The sample size in this study does not fulfill either requirement. The banding patterns for the three populations of C. attenuata sampled, however, are similar.

Status of Cuscuta attenuata Waterfall. Prior to this study C. attenuata was known from only two sites. Herbarium studies revealed nine sites in Oklahoma, Kansas, and Texas where C. attenuata had been collected. Four populations in Oklahoma and Texas were located via field searches. The sites where the populations were located were the type locality along Waterfall Creek in McCurtain County, Oklahoma; the floodplain of the South Canadian River in Cleveland County, Oklahoma; the banks of Quanah Parker Lake in Comanche County, Oklahoma; and along the banks of the Sabine River in Rains County, Texas. C. attenuata had not been collected in Comanche County or Rains County prior to this study. In nature, Iva annua L. was the only host on which C. attenuata was seen, except one collection on a species of Aster, however, it was cultivated on Coleus hybridus in the laboratory. The only feature common to all four study sites was large populations of the host. C. attenuata germinates in mid May, undergoes vegetative growth throughout the summer, flowers in mid August, and produces fruit within two weeks of flowering. Self-pollination usually occurs on the sixth day after appearance of the flower bud. Seed dispersal is unspecialized. Scarification is required for seed germination which occurs at an optimum temperature range of 25-33 C. The species is capable of autogamy and allogamy. It has a chromosome number of 2n=30.

C. attenuata closely resembles *C. compacta*, *C. cuspidata*, *C. indecora* var. *indecora*, and *C. indecora* var. *longisepala*, however, interspecific hybridizations revealed that it is reproductively isolated from these taxa. Analyses of morphological variation, including a univariate analysis and a multivariate analysis involving clustering techniques, a principal component analysis, and a discriminant analysis revealed that *C. attenuata* is distinct from *C. compacta* and *C. cuspidata*, but very similar to *C. indecora*. Enzymatic protein banding patterns of samples of *C. compacta*, *C. cuspidata*, *C. indecora* var. *indecora*, *C. indecora* var. *longisepala*, and three populations of *C. attenuata* showed distinct patterns for each. The evidence presented suggests that *C. attenuata* is a distinct species most closely related to *C. indecora*.

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APPENDICES

APPENDIX A

HERBARIUM SPECIMENS USED IN THE MORPHOLOLGICAL ANALYSES

Appendix A contains a list of all herbarium specimens examined in the analyses of morphological variation. The first column is the specimen identification number used in this study, the second is the abbreviation of the herbarium from which the specimen was obtained, the third is the accession number of the specimen, and the final column is the collector and collection number.

Cuscuta attenuata Waterfall

A01	DUR		J. Taylor 31074
A02	DUR		J. & C. Taylor 32518
A03	SMU		E. Whitehouse 16472
A04	OKL	111199	C. J. Eskew 1395
A05	OKLA	89319	P. Buck 524
A06	OKLA	102503	R. G. Koch 2156B
A07	OKLA		L. A. Prather 222
A08	OKLA		L. A. Prather 216
A09	OKLA		L. A. Prather 231
A10	OKLA		L. A. Prather 231

Cuscuta compacta Juss.

O01	OKL	111332	D. Demaree 15591
O02	OKL	111273	D. Demaree 13669
O03	OKL	111272	D. Demaree 16050
O04	OKL	111267	A. Chase 2571
O05	TEX	114808	A. Lee 90
O06	LL		C. L. & A. A. Lundell 11909
O07	LL		C. L. Lundell & S. W. Geiser 11882

008	LL		C. L. & A. A. Lundell 11767
009	TAES	70369	F. W. Gould & C. Leinweber 6533
010	UARK		D. M. Moore 410-285
011	UARK	18543	E. M. Merill 880
012	OCLA	7158	L. K. McGrath 4750
013	DUR		G. W. Stevens 2641
014	DUR		J. Taylor 20422
015	DUR		D. Beem 286-B
016	DUR		J. & C. Taylor 23549
017	OKLA	102469	D. Demaree 15869
018	SMU		E. Whitehouse 22379
019	SMU		C. L. & A. A. Lundell 11798
020	SMU		C. L. & A. A. Lundell 11965
021	SMU		V. L. Cory 49810
022	SMU		D. Demaree 42922
023	SMU		D. Demaree 8300
024	SMU		D. Demaree 9521
025	SMU		D. Demaree 34295
026	SMU		D. Demaree 18546
027	NLU	113824	R. D. Thomas 47758
028	NLU	106288	R. D. Thomas & C. M. Allen 41486
029	NLU	50002	R. D. Thomas 21247
030	NLU	211212	K. H. Kessler & N. Taylor 2902
031	NLU	174016	C. M. Allen 9695 & K. Vincent 3050
032	NLU	29024	R. D. Thomas & C. Smith 22183
033	NLU	50003	R. D. Thomas, et al. 12432
034	NLU	183276	N. Carroll 1973

O35	NLU	154796	S. E. Schutz 1771
O36	NLU	209088	R. D. Thomas, D. Taylor, & P. Laird 82216
O37	NLU	12522	R. D. Thomas, et al. 12522
O38	NLU	126780	R. D. Thomas 50809 & P. Laird 2949
O39	NLU	224034	R. D. Thomas 86598
O40	NLU	165512	R. D. Thomas, D. Dixon, & T. Briley 68332
O41	NLU	168750	R. D. Thomas 67401, J. McCoy, & N. Carroll 298
O42	NLU	164387	R. D. Thomas 68513 & L. Lewis 2559
O43	NLU	49973	R. D. Thomas 4057
O44	NLU	82732	R. D. Thomas 37120 & P. Marx 1666
O45	NLU	195137	R. D. Thomas & C. M. Allen 79610
O46	NLU	113797	R. D. Thomas & C. M. ALlen 47822
O47	NLU	49980	R. D. Thomas, R. Reid, & J. West 16519
O48	NLU	49988	R. D. Thomas, C. Smith, & R. Reid 12198
O49	NLU	49995	R. D. Thomas 11992
O50	NLU	49999	R. D. Thomas & R. Reid 16614

Cuscuta cuspidata Engelm.

U01	NWOSU		F. H. Means, Jr. 3934
U02	NWOSU	00637	P. Nighswonger 1482
U03	NWOSU	01929	F. H. Means, Jr. 1873
U04	OKL	111248	H. A. Hawk 70
U05	OKL	4792	J. & C. Taylor 17011
U06	OKL	111169	R. Bull 423
U07	OKL	111259	D. Demaree 24628

U08	OKL	111256	D. Demaree 18170
U09	OKL	111258	D. Demaree 34244
U10	OKL	111261	W. H. Horr E476
U11	OKL	111262	B. F. Bush 95
U12	OKL	111178	J. E. McClary 56
U13	OKL	111180	G. T. Robbins 2237
U14	OKL	111181	E. D. Barkley 367
U15	OKL	111182	C. Lawson, J. Massey, & G. J. Goodman 159
U16	OKL	111177	W. A. McAfee 10
U17	TEX	114827	M. S. Young unnumbered
U18	TEX	291517	H. H. Duval 97
U19	TEX	290029	R. J. Fleetwood 9607
U20	LL		D. S. Correll 38056
U21	TEX	114822	C. L. & A. A. Lundell 12039
U22	LL		D. S. Correll 30325
U23	LL		C. L. Lundell 11960
U24	TEX	114823	B. C. Tharp & Miller 51-346
U25	TEX	114829	M. B. M. unnumbered
U26	TEX	192080	C. M. Rowell, Jr. 4247
U27	LL		D. S. & H. B. Correll 39829
U28	UARK	6240	D. M. Moore 400055
U29	UARK	17815	D. Demaree 22623
U30	UARK		P. Anderson unnumbered
U31	UARK	18545	G. M. Merrill 1038
U32	UARK	17814	D. Demaree 22449
U33	UARK		G. Barber 1850
U34	NLU	221048	R. D. Thomas 84856

U35	SMU		D. M. Moore unnumbered
U36	SMU		D. Demaree 34176
U37	SMU		V. L. Cory 50246
U38	SMU		D. M. Moore 350209
U39	SMU		R. L. McGregor 15175
U40	OKLA	102395	C. Pigg 94
U41	OKLA	102393	R. Bruce 58
U42	OKLA	102394	C. S. Wallis 2546
U43	OKLA	102393	C. S. Wallis 976-1
U44	OKLA	102390	F. H. Means, Jr. 4100
U45	OKLA	02003	R. J. Tyrl & S. Barber 890
U46	OKLA	102387	P. R. Harding 537
U47	OKLA	102386	A. R. Purchase 1117
U49	OKLA	102380	R. E. Kilgore 245
U50	OKLA	102474	J. Richardson & K. Robertson 1686
		Cuscuta *indecora* Choisy var. *indecora*	
I01	OKLA	102433	G. W. Stevens 1000
I02	OKLA	102431	D. McCoy 3110
I03	DUR		J. Taylor 29277
I04	DUR		J. Taylor 23767
I05	DUR		C. Taylor & B. Wright 24887
I06	DUR		J. Taylor 29342
I07	Cameron		B. Powers 25
I08	TEX		R. J. Fleetwood 10980
I09	LL		D. S. Correll & I. M. Johnston 18200
I10	TEX	172675	L. J. Bottimer 976
I11	TEX	290722	R. Runyon 3102

I12	TEX	195344	C. M. Rowell 60-38A
I13	TEX	114952	L. C. Hinckley unnumbered
I14	LL		D. S. Correll & I. M. Johnston 19032
I15	TEX	115069	B. L. Turner & B. C. Tharp 3128
I16	TEX	114989	B. C. Tharp unnumbered
I17	TEX	114934	C. L. & A. A. Lundell 7059
I18	TEX	114940	B. C. Tharp 3
I19	LL		B. H. Warnock & W. D. McBryde 15141
I20	TEX	114953	B. C. Tharp 1595
I21	TEX	114859	W. L. Tolstead 7540
I22	TEX	114937	B. C. Tharp unnumbered
I23	TEX	115084	B. H. Warnock 6448
I24	LL		B. H. Warnock 7225
I25	LL		A. R. & H. N. Warnock 27920
I26	LL		J. R. Crutchfield 3474
I27	TAES	65406	O. E. Sperry T1375
I28	TAES	15662	S. E. Wolff 2109
I29	TAES	44846	H. B. Parks & V. L. Cory 29162
I30	TAES	148372	G. Irish 99
I31	TAES	15659	V. L. Cory 17507
I32	TAES	53006	O. E. Sperry 1503
I33	TAES	54543	H. B. Parks 140
I34	UARK	36772	G. J. Goodman 6874
I35	OCLA	14935	L. K. McGrath 16622
I36	OCLA	15025	L. K. McGrath 12204
I37	OCLA	12586	A. Lasseigne 6241
I38	SMU		S. P. Churchill 2455

I39	SMU		A. Traverse 193
I40	SMU		L. C. & L. Hinckely 135
I41	SMU		F. B. Jones 269
I42	SMU		C. L. & A. A. Lundell 9025
I43	SMU		C. L. Lundell & S. W. Geiser 11784
I44	SMU		D. S. & H. B. Correll 12761
I45	SMU		A. E. Orr 468
I46	SMU		W. M. Longnecker 50
I47	SMU		C. L. & A. A. Lundell 11905
I48	OKL	111310	G. J. Goodman 6547
I49	OKL	111361	D. Demaree 13066
I50	OKL	111212	U. T. Waterfall 7245

Cuscuta indecora var. *longisepala* Yuncker

L01	OKLA		L. A. Prather 205
L02	OKLA	102379	F. H. Means 3839
L03	OKLA	102436	U. T. Waterfall 12432
L04	OKLA	102532	D. Demaree 62617
L05	SMU		W. F. Mahler 6991 & J. M. Flook
L06	SMU		C. L. & A. A. Lundell 11673
L07	SMU		V. L. Cory 53360
L08	SMU		J. W. Thieret 8799
L09	SMU		M. C. Johnston, B. C. Tharp, & B. L. Turner 3616
L10	SMU		O. A. Stevens 117
L11	SMU		C. L. Lundell & S. W. Geiser 11907
L12	SMU		V. L. Cory 53367
L13	NLU	260246	A. Lasseigne 6321

L14	NLU	273417	C. Hermann 307
L15	OKL	111369	J. W. Graber unnumbered
L16	TEX	114773	L. D. Smith 164
L17	LL		D. S. Correll 33379
L18	TEX	114982	B. C. Tharp 3162
L19	TEX	268162	R. Runyon 2819
L20	TEX		J. Hendrickson 7927
L21	TEX		F. R. Waller 3203 & J. Bauml
L22	LL		C. L. & A. A. Lundell 11788
L23	TEX	275011	H. M. Pollard unnumbered
L24	TEX	114983	B. C. Tharp unnumbered
L25	DUR		J. & C. Taylor 25096
L26	OKLA		L. A. Prather 207

APPENDIX B

MORPHOLOGICAL DATA USED IN ANALYSES OF VARIATION IN CUSCUTA

Column numbers correspond to list of characters following appendix.

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
A01	4	3	3	1.5	1	0	0	.66	2.2	3	2	1	3.2	.29	2.9	0	3	2	0	1.4	.53	2.6
A02	4	3	2	1.2	1	0	0	.57	2.3	3	2	1	2.5	.30	2.3	0	3	5	0	1.4	.62	2.0
A03	4	3	3	0.6	1	0	0	.57	2.7	3	2	1	3.2	.18	3.8	0	3	5	0	1.0	.61	2.1
A04	4	4	3	0.9	1	0	0	.72	2.3	3	2	1	2.5	.13	3.0	0	3	2	0	1.2	.58	2.4
A05	4	3	3	1.7	1	0	0	.88	2.5	3	2	1	2.7	.31	2.2	0	3	2	0	1.3	.53	1.9
A06	4	3	3	0.8	1	0	0	1.1	3.3	3	5	1	2.4	.22	2.9	0	3	5	0	1.2	.61	2.0
A07	4	3	3	2.2	1	0	0	.78	2.2	3	2	1	3.2	.21	2.6	0	3	5	0	1.0	.64	1.8
A08	4	3	3	1.3	1	0	0	.82	2.0	3	2	1	2.8	.18	2.5	0	3	2	0	1.1	.59	1.8
A09	4	3	3	0.8	1	0	0	.79	2.0	3	2	1	2.1	.20	2.9	0	3	2	0	1.3	.58	2.0
A10	4	3	3	1.3	1	0	0	.77	2.1	3	2	1	2.7	.17	2.7	0	3	2	0	1.4	.55	2.7
001	1	1	4	0.8	1	3	2	.92	.89	4	1	0	2.3	.43	1.6	1	1	1	0	1.5	.68	3.4
002	1	1	4	0.3	1	2	2	.84	.79	5	1	1	2.1	.44	1.2	1	5	1	0	1.8	.75	4.0
003	1	1	4	0.4	1	2	2	.99	.78	1	1	1	1.7	.54	1.2	1	5	1	0	1.9	.73	4.3
004	1	1	3	0.4	1	2	1	.69	.54	4	1	1	1.9	.28	1.1	1	4	1	0	1.9	.81	4.1
005	1	1	5	0.6	1	4	2	.72	.54	5	1	1	2.3	.18	1.1	1	5	1	0	1.6	.79	3.9
006	1	1	4	0.4	1	3	2	.99	.93	5	1	0	2.3	.18	1.0	1	5	1	0	1.9	.81	5.6
007	1	1	5	0.6	1	2	1	1.2	.82	5	1	0	2.5	.18	1.3	1	4	1	0	1.5	.81	4.5
008	1	1	3	1.6	1	4	1	.92	.84	4	1	0	2.2	.13	1.0	1	4	1	0	1.5	.70	4.7
009	1	1	3	0.7	1	2	1	.83	.74	4	1	1	1.9	.23	1.0	1	4	1	0	1.5	.75	3.9
010	1	1	3	0.5	1	2	1	.90	.63	5	1	0	2.1	.17	.97	1	5	1	0	1.6	.60	3.4
011	1	1	3	1.5	2	6	2	.87	.49	4	1	1	1.9	.11	1.0	1	4	1	0	2.0	.85	4.6
012	1	1	3	1.6	1	1	1	.86	.76	4	1	0	2.4	.14	.95	1	4	1	0	1.4	.69	3.4
013	1	1	4	0.7	1	4	2	.65	.53	4	1	1	2.1	.33	1.5	1	5	1	0	1.4	.62	4.0
014	1	1	4	0.9	1	5	2	.95	.86	4	1	0	2.3	.19	1.1	1	4	1	0	1.8	.78	5.2
015	1	1	4	1.0	1	1	1	1.0	.95	5	1	0	2.6	.23	1.2	1	1	1	0	1.7	.75	4.8
016	1	1	4	1.1	1	1	2	.96	.74	4	1	0	2.2	.21	1.0	1	5	1	0	1.9	.74	4.8
017	1	1	5	1.2	1	3	2	.63	.51	4	1	0	1.9	.06	1.3	1	4	1	0	1.9	.77	4.6
018	1	1	4	0.9	1	1	2	1.0	.73	1	1	1	2.0	.13	.95	1	4	1	0	1.9	.68	3.7
019	1	1	5	0.8	1	2	2	.68	.64	4	1	0	2.1	.15	1.1	1	4	1	0	1.7	.67	4.2
020	1	1	3	0.6	1	1	2	1.1	.77	4	1	1	2.0	.12	.95	1	4	1	0	1.9	.74	3.9
021	1	1	4	1.4	1	2	2	.94	.69	5	1	1	2.0	.17	1.3	1	4	1	0	2.4	.86	5.5
022	1	1	4	1.8	1	2	2	.76	.57	4	1	0	1.9	.12	1.1	1	4	1	0	1.9	.77	6.2
023	1	1	4	1.6	1	3	2	.61	.39	1	1	1	1.7	.26	1.1	1	1	1	0	2.3	.71	5.1
024	1	1	3	0.9	1	2	2	.96	.66	4	1	1	2.0	.17	1.1	1	4	1	0	1.8	.75	4.8
025	1	1	4	0.5	1	1	1	1.1	.99	5	1	0	2.0	.30	.92	1	4	1	0	2.2	.71	5.3
026	1	1	4	1.0	1	1	1	.73	.68	1	1	0	2.3	.13	1.2	1	4	1	0	1.8	.70	4.8
027	1	1	3	1.0	1	2	1	.90	.83	4	1	0	2.2	.15	.96	1	4	1	0	1.6	.67	3.7
028	1	1	3	1.8	1	3	2	.78	.73	4	1	1	1.9	.13	.94	1	4	1	0	1.7	.63	3.3
029	1	1	4	0.5	1	4	1	.88	.75	5	1	1	2.6	.17	1.2	1	5	1	0	1.6	.78	4.6
030	1	1	5	0.8	1	2	2	.95	.72	1	1	1	1.8	.37	1.2	1	4	1	0	1.9	.65	3.5
031	1	1	4	0.9	1	3	1	.84	.73	5	1	0	2.2	.18	.99	1	1	1	0	1.4	.60	3.8
032	1	1	4	1.0	1	3	2	.94	.78	4	1	0	2.6	.21	1.2	1	4	1	0	1.6	.76	4.7
033	1	1	4	1.6	1	3	1	.96	.92	4	1	0	2.3	.25	1.1	1	4	1	0	1.8	.77	5.0
034	1	1	4	1.3	1	2	1	.99	.84	4	1	1	2.4	.18	1.1	1	5	1	0	1.7	.80	4.7
035	1	1	5	1.2	1	5	1	.83	.71	4	1	0	2.0	.16	1.0	1	4	1	0	1.5	.70	4.3
036	1	1	3	1.6	1	2	2	.87	.81	5	1	1	2.1	.40	1.2	1	1	1	0	1.9	.71	3.8
037	1	1	4	0.4	2	3	2	.80	.74	4	1	1	1.9	.26	1.2	1	4	1	0	1.9	.70	4.5
038	1	1	4	1.5	1	3	1	.94	.86	5	1	1	2.4	.16	1.0	1	5	1	0	1.6	.73	4.6
039	1	1	3	1.2	2	3	2	.96	.82	5	1	1	2.5	.22	1.2	1	4	1	0	1.6	.71	5.5
040	1	1	4	0.9	1	2	2	.88	.72	4	1	1	2.2	.21	1.0	1	4	1	0	1.5	.67	3.5
041	1	1	5	1.5	2	5	2	.78	.67	1	1	0	2.4	.14	1.0	1	5	1	0	1.7	.74	4.1

ID	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
A01	4.3	1	2	1	1	1	30	2.6	1.1	.33	2.2	1.0	1.0	1.0	1.6	1.6	1.2	.61	1.6	.80	4	1
A02	3.5	1	2	1	1	1	26	2.1	.97	.37	1.8	.7	.7	.91	1.2	1.0	1.0	.85	1.4	1.1	3	1
A03	3.2	1	2	1	1	1	25	1.8	.91	.41	1.5	.8	.8	1.0	1.5	2.0	1.0	.67	1.7	1.1	3	1
A04	3.1	1	2	1	1	1	25	1.0	.57	.54	1.4	.6	.7	.84	1.6	1.1	1.1	.76	1.1	1.0	3	1
A05	3.4	1	2	1	1	1	24	2.0	1.1	.49	1.5	.9	.8	1.1	1.3	2.0	1.1	.62	1.7	1.2	3	1
A06	2.8	1	2	1	1	1	26	1.4	.80	.55	1.3	.6	.8	.79	1.1	0.8	1.1	.71	1.1	.92	3	1
A07	3.3	1	2	1	1	1	24	2.1	1.0	.41	1.6	.5	.7	.63	1.1	0.9	1.1	.85	1.6	.91	3	1
A08	3.3	1	2	1	1	1	27	1.9	1.0	.41	1.4	.9	.8	1.1	1.2	1.2	1.1	.71	1.4	1.0	3	1
A09	2.8	1	2	1	1	1	25	1.5	.94	.46	1.3	.9	.7	1.2	1.2	1.4	1.1	.81	1.0	1.1	3	1
A10	3.7	1	2	1	1	1	28	1.6	.77	.49	1.9	.8	.8	.91	1.4	2.0	1.1	.71	1.6	1.2	3	1
001	3.4	1	1	0	1	1	16	2.3	1.0	.46	4.2	.2	.4	.56	1.1	1.1	1.3	.80	1.3	1.1	3	1
002	3.9	1	1	0	1	1	18	2.4	.85	.61	4.6	.3	.3	.81	.95	1.0	1.5	.83	1.3	1.1	3	1
003	3.2	1	1	0	1	1	07	1.9	.81	.35	4.5	.2	.4	.54	1.5	1.1	1.5	.83	1.3	1.1	3	1
004	3.5	3	1	0	1	1	12	2.4	.85	.35	4.1	.1	.5	.33	1.7	1.2	1.1	.61	1.2	.95	3	1
005	3.6	3	1	0	1	1	11	2.5	.89	.57	5.6	.2	.5	.48	.79	2.0	1.3	.87	1.3	1.0	3	1
006	4.2	5	1	0	1	1	14	2.6	.76	.65	5.6	.2	.4	.46	.90	1.5	1.5	.75	1.8	1.1	3	1
007	3.9	1	1	0	1	1	15	2.4	.76	.45	4.1	.2	.6	.29	1.7	1.6	1.4	.77	1.3	.95	3	1
008	3.3	3	1	0	1	1	17	2.2	.98	.46	5.1	.2	.5	.45	1.3	1.4	1.1	.86	1.1	1.2	3	1
009	3.0	3	1	0	1	1	15	2.1	.96	.41	3.5	.2	.5	.40	1.3	1.1	1.3	.56	1.1	.97	3	1
010	3.3	3	1	0	1	1	12	2.0	1.0	.40	3.5	.2	.4	.42	.92	0.9	1.3	.70	1.3	.80	3	1
011	3.9	5	1	0	1	1	14	2.8	.84	.45	5.0	.1	.5	.24	1.5	1.6	1.5	.77	1.4	1.2	3	1
012	3.3	3	1	0	1	1	16	2.2	.97	.43	4.3	.2	.5	.47	1.3	1.1	1.4	.85	1.4	1.2	3	1
013	2.9	1	1	0	1	1	13	1.5	.83	.29	3.1	.1	.4	.35	1.4	0.6	1.3	.68	1.5	1.1	3	1
014	4.0	3	1	0	1	1	15	2.6	.82	.43	4.8	.2	.4	.65	1.0	1.9	1.4	.63	1.3	1.1	3	1
015	4.5	3	1	0	1	1	10	2.6	.78	.49	3.8	.2	.4	.56	1.2	1.4	1.2	.65	1.7	1.2	3	1
016	4.3	3	1	0	0	0	11	2.4	.77	.45	3.5	.3	.5	.69	1.5	1.1	1.0	.73	1.6	1.2	3	1
017	3.6	1	1	0	1	0	12	2.0	.74	.47	4.6	.1	.4	.36	1.1	1.4	1.6	.74	1.5	1.1	3	1
018	3.8	1	1	0	1	1	13	2.7	1.1	.42	4.4	.3	.3	.95	.74	1.1	1.2	.67	1.3	.89	3	1
019	3.5	1	1	0	1	1	11	2.3	.97	.43	3.8	.3	.5	.64	1.2	0.8	1.1	.89	1.5	1.1	3	1
020	3.7	1	1	0	1	1	13	2.2	.80	.60	5.0	.1	.4	.36	.79	1.2	1.0	.78	1.3	.89	3	1
021	5.0	1	1	0	1	1	10	3.4	.79	.78	5.0	.2	.3	.74	.76	1.8	1.5	.67	1.5	.95	3	1
022	3.7	1	1	0	1	1	12	2.1	.75	.53	3.8	.2	.4	.46	1.1	1.4	1.4	.72	1.2	1.0	3	1
023	3.9	1	1	0	1	1	15	2.1	.76	.37	4.2	.2	.5	.50	1.0	1.3	2.1	.94	1.4	1.2	3	1
024	3.7	1	1	0	1	1	11	2.5	.90	.35	4.9	.2	.4	.42	.89	1.3	1.2	.80	1.3	1.1	3	1
025	4.3	1	2	0	1	1	14	2.5	.81	.51	4.1	.4	.5	.76	.91	1.2	1.3	.69	1.5	1.2	3	1
026	4.1	1	1	0	1	1	11	2.5	.87	.40	2.3	.3	.4	.74	1.0	1.6	1.1	.68	1.5	1.0	3	1
027	3.4	5	1	0	1	1	16	2.2	.98	.47	4.2	.3	.5	.55	1.2	1.2	1.3	.72	1.4	1.1	3	1
028	3.3	1	1	0	1	1	13	2.1	1.0	.41	3.6	.2	.5	.42	1.3	0.7	1.1	.77	1.2	1.1	3	1
029	4.2	5	1	0	1	1	12	2.5	.76	.48	4.0	.2	.5	.42	1.3	0.7	1.4	.79	1.3	1.1	3	1
030	3.4	5	1	0	1	0	10	1.9	.88	.44	3.3	.2	.4	.46	.93	1.1	1.2	.68	1.1	1.2	3	1
031	3.1	1	1	0	1	1	12	1.8	.95	.44	3.2	.2	.5	.41	1.5	1.1	1.4	.82	1.5	1.2	3	1
032	4.3	1	1	0	1	1	13	2.5	.77	.48	3.9	.2	.4	.54	.89	1.3	1.1	.74	1.3	1.1	3	1
033	4.2	1	1	0	1	1	15	2.5	.80	.40	5.3	.2	.1	.58	1.0	1.5	1.1	.83	1.4	1.2	3	1
034	4.0	1	1	0	1	0	14	2.5	.78	.35	4.5	.2	.5	.41	1.3	1.2	1.2	.77	1.2	1.0	3	1
035	3.0	5	1	0	1	1	14	2.3	1.1	.42	3.9	.2	.5	.31	1.3	1.0	1.2	.74	1.3	1.1	3	1
036	3.8	1	1	0	1	1	16	2.4	.88	.58	3.6	.2	.5	.38	1.3	1.5	1.1	.78	1.5	1.1	3	1
037	3.6	5	1	0	1	0	13	2.2	.89	.49	3.7	.3	.5	.60	1.2	1.5	1.3	.71	1.3	1.0	3	1
038	3.8	1	1	0	1	1	12	2.5	.90	.58	4.8	.2	.3	.62	.91	1.2	1.1	.70	1.6	1.2	3	1
039	4.0	1	1	0	1	1	14	2.4	.85	.36	4.2	.2	.5	.38	1.3	1.4	1.2	.71	1.2	1.1	3	1
040	3.4	1	1	0	1	1	15	2.1	.92	.43	4.4	.3	.4	.59	1.2	1.4	1.1	.67	1.5	1.2	3	1
041	4.0	1	1	0	1	1	16	2.6	.87	.42	4.2	.3	.5	.60	1.3	1.6	1.3	.78	1.5	1.2	3	1

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
042	1	1	5	0.6	1	3	2	1.0	.70	4	1	0	2.0	.16	1.1	1	4	1	0	2.1	.68	4.6
043	1	1	3	0.7	2	2	1	.83	.59	4	1	1	1.9	.19	1.1	1	4	1	0	1.6	.76	3.7
044	1	1	3	0.9	2	3	1	.92	.74	1	1	1	2.6	.23	1.2	1	1	1	0	1.6	.75	4.6
045	1	1	3	1.4	1	3	2	1.1	.75	5	1	0	2.1	.15	1.1	1	4	1	0	1.8	.71	3.9
046	1	1	4	0.6	1	3	2	1.1	.73	5	1	1	2.0	.22	.98	1	5	1	0	2.2	.67	4.7
047	1	1	5	0.7	1	4	2	.81	.63	5	1	0	1.9	.19	1.1	1	5	1	0	2.0	.74	6.2
048	1	1	3	1.4	1	3	1	.85	.72	4	1	1	2.3	.21	1.2	1	4	1	0	1.7	.76	5.6
049	1	1	3	1.1	2	7	2	.92	.65	5	1	0	1.9	.14	1.1	1	5	1	0	1.9	.73	4.7
050	1	1	3	1.1	1	3	1	.89	.62	4	1	0	1.9	.12	.95	1	4	1	0	1.6	.60	3.4
U01	1	1	4	0.7	1	1	2	.86	1.0	2	3	1	1.5	.07	1.4	1	1	3	0	2.1	.51	3.8
U02	1	1	4	0.8	1	1	1	.76	1.3	1	3	1	1.6	.15	1.3	1	1	2	0	2.4	.64	4.2
U03	1	1	4	1.8	0	1	0	.80	1.2	1	3	1	1.6	.08	1.4	1	2	3	0	2.1	.61	3.9
U04	1	1	3	2.9	1	1	2	.93	1.6	1	2	1	1.7	.14	1.1	1	1	2	0	2.3	.58	4.2
U05	1	1	4	0.9	1	0	3	.68	1.0	1	3	1	1.8	.15	1.3	1	1	2	0	2.4	.60	4.3
U06	1	1	4	3.9	1	3	1	.73	1.2	1	2	1	1.5	.20	1.1	1	1	2	0	2.1	.55	3.1
U07	1	1	3	1.4	1	2	1	.70	.84	1	2	1	1.6	.20	1.3	1	1	2	0	2.2	.66	4.0
U08	1	1	3	0.6	1	1	2	.85	1.1	1	3	1	1.7	.13	1.1	1	1	3	0	1.6	.52	3.9
U09	1	1	4	1.8	1	0	2	.92	1.5	1	3	1	1.7	.14	1.2	1	1	3	0	2.7	.70	4.9
U10	1	1	4	1.0	1	0	2	.85	1.1	3	3	1	1.5	.08	1.1	1	3	2	0	2.1	.60	4.4
U11	1	1	5	0.5	1	0	2	.86	.98	1	3	1	1.7	.11	1.1	1	1	4	0	2.4	.63	4.1
U12	1	1	3	0.7	1	0	0	.91	1.3	1	3	1	1.7	.16	1.3	1	1	3	0	2.1	.46	4.4
U13	1	1	4	1.3	1	1	0	.96	1.1	1	3	1	1.7	.19	1.6	1	1	3	0	2.4	.41	4.9
U14	1	1	3	0.6	1	0	2	.75	1.1	1	3	1	1.4	.07	1.2	1	1	3	0	1.4	.56	3.4
U15	1	1	3	0.6	1	0	1	.83	1.3	1	3	1	1.6	.12	.99	1	1	3	0	2.5	.63	4.2
U16	1	1	3	1.0	1	0	1	.71	1.0	2	2	1	1.7	.18	1.2	1	1	3	0	2.3	.58	4.0
U17	1	1	3	1.2	1	2	1	.72	1.1	1	2	1	1.8	.18	1.6	1	1	2	0	1.6	.56	3.4
U18	1	4	3	1.1	1	0	2	1.0	1.4	1	3	1	1.6	.11	1.7	1	1	3	0	2.3	.58	4.2
U19	1	1	4	0.7	1	0	2	.75	.97	1	2	1	1.6	.10	1.1	1	1	2	0	2.2	.63	3.3
U20	1	1	3	1.2	1	0	0	.98	1.5	1	3	1	1.7	.12	1.1	1	1	2	0	2.6	.55	4.4
U21	1	1	4	2.3	1	1	2	.65	1.5	1	2	1	1.7	.14	1.2	1	1	2	0	2.5	.65	4.9
U22	1	1	4	2.1	1	0	2	.94	1.1	1	3	1	1.3	.08	1.2	1	3	1	0	2.5	.67	3.4
U23	1	1	3	4.0	1	2	2	.93	1.4	1	3	1	1.7	.13	1.3	1	1	3	0	2.4	.63	4.2
U24	1	1	5	3.2	1	2	1	.42	1.2	3	2	1	1.8	.15	1.2	1	1	2	0	2.2	.65	3.9
U25	1	1	3	1.4	1	1	1	.93	.84	3	3	1	1.8	.15	1.1	1	1	3	0	2.7	.64	5.1
U26	1	1	3	2.3	1	0	0	.66	1.2	1	3	1	2.1	.15	1.4	1	1	3	0	1.7	.47	3.7
U27	1	1	3	0.5	1	0	2	.89	1.2	2	3	1	1.8	.17	1.3	1	1	3	0	1.9	.55	3.3
U28	1	1	3	0.5	1	0	2	1.1	1.8	1	4	1	1.5	.14	1.4	1	1	3	0	2.0	.57	3.9
U29	1	1	4	1.0	1	0	0	.81	1.2	1	3	1	1.9	.13	1.4	1	2	2	0	2.3	.57	3.6
U30	1	1	3	3.1	1	2	1	.93	.96	2	2	1	1.6	.12	1.1	1	1	1	0	1.8	.53	3.1
U31	1	1	3	1.9	1	2	2	.78	1.0	1	3	1	1.5	.08	1.4	1	1	2	0	1.9	.55	4.4
U32	1	1	4	2.6	1	3	0	.65	.91	1	3	1	1.5	.09	1.2	1	2	3	0	3.2	.65	4.8
U33	1	1	4	1.0	1	0	1	.85	1.1	1	3	1	2.1	.16	1.1	1	1	3	0	1.9	.52	3.1
U34	1	1	3	0.7	1	0	0	.74	1.3	1	3	1	2.1	.15	1.4	1	1	3	0	2.1	.52	3.9
U35	1	1	3	1.1	1	1	0	.97	1.5	1	3	1	1.6	.15	1.6	1	1	3	0	2.0	.55	3.5
U36	1	1	4	3.3	1	1	3	.81	.97	1	3	1	1.7	.12	1.1	1	1	3	0	2.0	.57	4.0
U37	1	1	4	0.2	1	0	1	.97	1.1	1	3	1	1.7	.12	.95	1	1	2	0	2.6	.62	3.9
U38	1	1	3	3.0	1	1	1	.74	.93	1	3	1	1.9	.16	1.4	1	1	3	0	1.9	.53	3.5
U39	1	1	4	2.1	1	0	2	.80	.91	2	3	1	1.8	.16	1.4	1	2	3	0	2.6	.66	4.1
U40	1	1	3	1.4	1	0	0	1.1	.96	1	2	1	1.4	.09	1.2	1	1	3	0	2.4	.66	3.3
U41	1	1	3	0.9	1	1	1	.93	1.2	2	2	1	1.7	.13	1.2	1	1	2	0	2.2	.57	4.3
U42	1	1	3	2.1	1	2	1	.86	1.3	1	3	1	1.6	.10	1.1	1	1	3	0	2.6	.63	4.1
U43	1	1	4	0.6	1	0	0	.98	1.6	2	3	1	1.9	.16	1.2	1	2	3	0	2.4	.70	5.0

ID	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
042	4.1	1	1	0	1	1	11	2.2	.79	.45	3.8	.2	.4	.46	1.2	1.1	1.4	.76	1.2	1.1	3	1
043	3.1	1	1	0	1	1	13	2.2	.95	.42	4.0	.3	.5	.63	1.4	1.2	1.2	.68	1.0	1.1	3	1
044	4.2	5	1	0	1	1	14	2.6	.82	.42	4.1	.4	.5	.69	1.3	1.4	1.2	.79	1.4	1.1	3	1
045	3.8	1	1	0	1	0	12	2.2	.83	.58	4.7	.3	.4	.71	.86	0.9	1.1	.84	1.5	1.1	3	1
046	4.5	5	1	0	1	1	13	2.6	.86	.40	4.3	.2	.5	.30	1.4	1.4	1.3	.74	1.3	1.2	3	1
047	3.9	5	1	0	1	1	14	2.1	.73	.48	3.4	.2	.3	.68	.68	1.7	1.3	.78	1.6	1.0	3	1
048	3.8	5	1	0	1	1	16	2.2	.77	.37	3.9	.1	.5	.28	.97	0.8	1.1	.71	1.6	1.2	3	1
049	3.6	1	1	0	1	1	11	2.0	.80	.39	4.4	.3	.5	.53	1.7	1.3	1.2	.68	1.4	1.1	3	1
050	3.2	1	1	0	1	1	12	1.9	.98	.40	3.7	.3	.4	.63	1.4	1.0	1.1	.75	1.2	1.1	3	1
U01	3.2	3	3	0	1	1	25	1.5	.91	.60	3.9	.8	.7	1.2	2.3	3.2	1.1	.71	0.8	.88	3	0
U02	3.8	3	3	0	1	1	26	2.4	.97	.66	3.9	.8	.6	1.4	1.7	2.7	1.3	.80	1.2	.92	3	1
U03	3.5	1	3	0	1	1	29	1.9	.90	.56	3.8	.8	.8	1.0	1.1	2.2	1.8	.77	0.8	.68	3	1
U04	3.8	3	2	0	1	0	29	2.0	.90	.60	4.1	.7	.6	1.2	1.6	3.1	1.2	.71	0.8	.85	3	0
U05	4.4	3	3	0	1	0	26	2.7	.98	.77	4.6	.8	.6	1.4	1.7	2.7	1.5	.76	1.0	.75	3	1
U06	3.1	3	2	0	1	0	26	1.5	.88	.53	2.9	.6	.8	.73	1.8	1.6	1.6	.77	1.0	.72	3	1
U07	3.5	3	2	0	1	0	22	2.3	.97	.57	4.2	.6	.8	.77	1.8	2.0	1.2	.59	1.1	.91	3	1
U08	3.3	1	3	0	1	0	26	1.6	.91	.66	3.2	.6	.6	1.1	1.7	1.6	1.2	.75	0.5	.69	3	0
U09	4.5	3	1	0	1	0	32	2.8	.87	.70	5.6	.7	.7	.93	2.4	2.5	1.4	.75	1.0	.62	3	1
U10	3.4	3	3	0	1	0	24	1.8	.88	.65	3.2	.4	.7	.60	1.8	2.2	1.4	.55	1.2	1.0	3	1
U11	4.1	1	4	0	1	1	30	2.2	.85	.66	4.9	.7	.7	.98	2.2	3.9	1.2	.60	0.9	1.3	3	1
U12	3.6	1	3	0	1	0	32	1.6	.99	.61	3.2	.5	.7	.69	1.7	2.1	1.5	.74	0.8	.73	3	1
U13	4.2	3	3	0	1	1	29	2.3	.83	.64	4.3	.6	.6	1.0	2.0	3.1	1.2	.78	0.8	.94	3	1
U14	2.0	3	2	0	1	1	20	1.0	.90	.56	2.1	.5	.4	1.0	1.4	1.3	1.1	.73	0.6	.90	3	1
U15	4.0	3	3	0	1	1	26	2.5	.98	.60	4.5	.9	.7	1.3	2.5	2.3	1.4	.79	0.9	.64	3	1
U16	3.8	3	3	0	1	1	28	2.0	.92	.61	4.0	.8	.6	1.2	1.7	2.7	1.5	.74	0.5	.60	3	1
U17	2.8	1	3	0	1	1	24	1.4	.88	.63	3.0	.4	.7	.62	2.1	2.1	1.4	.46	0.7	.85	3	1
U18	3.7	2	4	0	1	0	16	1.7	.80	.68	3.9	.5	.7	.77	1.8	2.3	1.2	.60	0.6	.93	3	1
U19	3.5	3	2	0	1	1	25	2.1	.94	.60	4.1	.6	.8	.76	2.7	1.3	1.1	.70	0.7	.65	3	1
U20	4.4	3	2	0	1	1	33	2.4	.97	.57	2.7	1.0	.9	1.1	2.3	2.8	1.5	.64	1.7	.97	3	1
U21	4.2	3	2	0	1	0	24	2.2	.80	.60	3.7	.6	.6	1.0	1.4	2.9	1.0	.67	1.1	.84	3	1
U22	3.3	3	2	0	1	1	16	1.6	.70	.65	3.5	.5	.7	.76	2.2	1.8	1.3	.75	0.7	.80	3	1
U23	4.2	3	3	0	1	0	28	2.5	.95	.74	4.7	.6	.4	1.5	1.1	2.5	1.2	.67	0.8	.90	3	1
U24	3.9	3	2	0	1	0	22	2.0	.78	.69	3.0	.7	.7	1.1	2.0	3.0	1.2	.73	1.0	.70	3	1
U25	4.8	3	3	0	1	0	32	2.8	.90	.55	4.0	.9	.6	1.5	1.6	3.2	1.2	.57	1.0	.89	3	1
U26	3.5	3	2	0	1	0	32	1.6	.98	.53	3.0	.4	.8	.48	1.7	1.8	1.2	.89	0.8	.85	3	0
U27	3.5	1	3	0	1	1	16	1.8	.92	.59	3.1	.8	.8	1.1	2.1	2.9	1.2	.60	0.7	.73	3	1
U28	3.0	3	2	0	1	0	26	1.5	.90	.64	3.7	.5	.5	.97	1.7	1.5	1.4	.75	0.6	.80	3	1
U29	4.3	3	2	0	1	1	32	2.6	1.1	.57	3.5	.9	.8	1.1	1.9	3.0	1.2	.65	0.9	.81	3	1
U30	2.9	3	2	0	1	1	24	1.6	1.1	.50	3.4	.4	.8	.50	1.6	1.7	1.3	.71	0.8	.91	3	1
U31	2.9	3	4	0	1	1	20	1.6	.95	.49	3.2	.4	.7	.50	1.8	1.9	1.5	.82	0.7	.98	3	1
U32	4.7	3	3	0	1	0	29	2.6	.85	.59	4.3	.7	.6	1.1	2.1	2.2	1.3	.63	0.9	.97	3	1
U33	4.2	3	3	0	1	1	36	2.7	.90	.62	3.4	.8	.9	.96	2.0	2.9	1.2	.85	0.9	.72	3	1
U34	4.4	3	3	0	1	0	22	2.4	.99	.56	3.6	.7	.8	.96	1.8	2.8	1.1	.60	0.7	.71	3	1
U35	3.3	3	3	0	1	1	25	1.6	.91	.51	4.3	.5	.6	.89	1.6	2.6	1.3	.59	1.0	.83	3	1
U36	3.3	3	3	0	1	1	35	1.6	.87	.64	3.1	.8	.8	1.0	1.8	2.7	1.3	.80	0.5	.61	3	1
U37	4.4	3	2	0	1	1	32	2.2	.81	.53	4.0	.7	.8	.87	2.7	3.1	1.1	.63	0.8	.74	3	1
U38	3.6	3	3	0	1	1	27	1.6	.85	.64	3.1	.7	.6	1.2	1.8	2.4	1.3	.70	0.8	.87	3	1
U39	4.6	3	3	0	1	1	23	2.5	.83	.58	4.1	.6	.8	.85	2.0	1.8	1.3	.75	0.7	.75	3	1
U40	3.4	3	3	0	1	0	19	1.6	.80	.62	3.6	.5	.6	.89	1.7	1.6	1.2	.56	0.6	.81	3	1
U41	3.7	3	3	0	1	1	27	1.8	.85	.65	3.2	.5	.7	.69	1.7	2.7	1.5	.78	1.0	.75	3	1
U42	4.1	3	2	0	1	0	28	2.4	.90	.61	3.9	.8	.7	1.2	2.4	1.3	1.1	.75	0.7	.85	3	1
U43	4.5	3	3	0	1	1	32	2.7	.86	.63	4.5	.6	.6	1.1	1.7	2.2	1.3	.70	1.0	.82	3	1

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
U44	1	1	3	2.5	1	1	2	.83	1.0	1	3	1	1.7	.16	1.3	1	1	3	0	2.1	.52	4.5
U45	1	1	5	3.1	1	2	1	.82	.78	1	2	1	1.7	.10	1.2	1	1	2	0	2.5	.64	5.2
U46	1	1	4	1.3	1	0	2	.69	1.1	1	3	1	1.4	.08	1.2	1	1	3	0	2.2	.56	3.8
U47	1	1	3	3.4	1	0	2	.74	1.0	2	3	1	1.7	.11	1.1	1	2	3	0	2.4	.64	3.8
U48	1	1	3	0.8	1	1	1	.88	1.2	1	3	1	1.8	.12	1.3	1	1	3	0	2.2	.58	4.2
U49	1	1	3	1.9	1	1	1	1.0	1.3	1	3	1	1.7	.18	1.3	1	1	3	0	2.3	.58	4.0
U50	1	1	4	1.4	1	0	1	1.0	1.6	1	2	1	1.8	.13	1.3	1	1	2	0	2.1	.58	4.0
I01	4	3	3	0.8	1	0	0	1.4	1.3	3	2	1	1.0	.39	.96	0	1	2	1	2.7	.39	2.5
I02	4	3	3	1.7	1	0	0	1.1	1.4	3	2	1	1.1	.59	1.1	0	1	3	1	2.5	.59	2.4
I03	4	3	3	3.7	1	0	0	.98	1.4	3	2	1	1.1	.36	1.3	0	1	2	1	2.4	.36	2.4
I04	4	3	3	2.5	1	0	0	1.4	1.4	3	2	1	1.3	.41	2.0	0	1	2	0	2.3	.41	3.3
I05	4	3	3	1.2	1	0	0	1.3	1.4	3	2	1	1.4	.59	1.1	0	1	2	1	2.0	.59	2.3
I06	-	3	3	4.0	0	0	0	-	-	-	-	-	1.2	.50	1.3	0	1	2	1	2.3	.50	2.4
I07	4	3	3	2.1	1	0	0	1.3	1.3	3	2	1	1.2	.57	1.0	0	1	2	1	2.3	.57	2.5
I08	4	3	4	3.2	1	0	0	.78	1.7	3	2	1	1.8	.64	1.6	0	2	2	0	1.6	.64	2.7
I09	4	3	3	1.5	1	0	0	.97	1.7	3	2	1	1.5	.32	1.3	0	2	2	0	2.1	.32	2.8
I10	4	3	3	4.2	1	1	0	.92	1.3	3	2	1	1.5	.50	1.3	0	2	3	1	2.1	.50	2.1
I11	-	3	3	1.3	0	0	0	-	-	-	-	-	1.6	.61	1.5	0	1	3	1	1.8	.61	2.1
I12	4	3	3	3.0	1	0	0	.80	1.3	3	2	1	1.5	.46	1.2	0	2	2	0	2.1	.44	1.9
I13	4	3	3	2.8	1	0	0	1.1	1.2	3	2	1	1.3	.35	1.1	0	3	2	0	2.4	.35	2.3
I14	4	3	3	2.7	1	0	0	.71	1.2	3	2	1	1.5	.59	1.4	0	3	2	0	2.0	.59	2.1
I15	-	3	3	3.4	0	0	0	-	-	-	-	-	1.4	.67	1.4	0	1	2	1	1.9	.67	2.5
I16	4	3	3	1.9	1	0	0	1.1	1.5	3	2	1	1.2	.54	1.1	0	1	3	1	2.3	.54	2.1
I17	4	3	3	4.9	1	0	0	1.2	1.3	3	2	1	1.3	.63	1.1	0	1	2	1	2.1	.63	1.7
I18	4	3	3	1.2	1	0	0	.89	1.3	3	2	1	1.0	.43	1.0	0	1	3	1	2.5	.43	2.3
I19	4	3	3	1.1	1	0	0	.51	1.1	3	2	1	2.0	.51	1.5	0	1	2	0	1.5	.52	2.3
I20	4	3	3	2.9	1	0	0	.98	1.1	3	2	1	1.5	.75	1.1	0	1	2	0	2.4	.57	2.0
I21	4	3	3	1.7	1	0	0	.68	1.1	3	2	1	1.0	.68	1.0	0	1	2	1	2.5	.58	2.3
I22	4	3	3	3.2	1	0	0	1.0	2.2	3	2	1	1.6	.33	1.7	0	1	3	0	1.9	.49	2.4
I23	4	3	3	1.6	1	0	0	.84	1.8	3	2	1	2.0	.56	2.3	0	1	2	0	1.7	.48	2.5
I24	4	3	3	3.2	1	0	0	1.0	2.3	3	2	1	1.2	.55	1.5	0	1	2	0	2.5	.51	2.8
I25	4	3	3	2.6	1	0	0	.89	1.8	3	2	1	1.4	.74	1.4	0	1	2	0	2.0	.61	2.7
I26	4	3	3	2.7	1	0	0	1.6	1.8	3	2	1	0.8	.40	1.1	0	3	2	1	3.3	.54	2.6
I27	4	3	3	1.9	1	0	0	.76	1.4	3	2	1	1.6	.64	1.4	0	3	2	0	1.9	.53	2.4
I28	4	3	3	1.8	1	0	0	.96	2.0	3	2	1	1.7	.65	1.5	0	3	3	1	1.8	.65	2.2
I29	4	3	3	1.2	1	0	0	.54	1.5	3	2	1	2.0	.43	2.1	0	3	2	0	1.5	.55	2.5
I30	4	3	3	1.6	1	0	0	1.0	1.7	3	2	1	1.6	.57	1.3	0	3	2	1	2.0	.58	2.2
I31	4	3	3	3.0	1	0	0	.81	1.5	3	2	1	1.6	.57	2.0	0	3	2	0	1.7	.57	2.2
I32	4	3	3	1.3	1	0	0	.87	1.7	3	2	1	1.5	.46	1.3	0	3	2	0	2.3	.54	2.4
I33	4	3	3	1.6	1	0	0	.66	1.7	3	2	1	1.4	.42	1.7	0	3	2	0	2.3	.59	2.3
I34	4	3	3	2.0	1	0	0	.91	1.4	3	2	1	1.4	.49	1.1	0	3	2	0	2.6	.61	2.4
I35	4	3	3	0.9	1	0	0	.53	1.2	3	2	1	1.5	.43	1.6	0	3	2	0	2.0	.55	3.4
I36	4	3	3	1.4	1	0	0	.79	1.0	3	3	1	1.5	.52	1.2	0	3	3	0	1.8	.60	2.3
I37	4	3	3	1.9	1	0	0	.97	1.1	3	2	1	1.0	.45	1.0	0	3	2	0	3.0	.52	2.7
I38	4	3	3	2.1	1	0	0	.70	1.1	3	2	1	1.6	.37	1.8	0	3	2	0	1.9	.56	2.2
I39	4	3	3	3.0	1	0	0	.60	1.2	3	2	1	1.7	.56	1.3	0	3	2	1	2.1	.60	1.7
I40	4	3	3	4.2	1	0	0	.99	1.8	3	2	1	1.2	.44	1.4	0	1	2	0	2.6	.51	2.5
I41	4	3	3	3.3	1	0	0	.83	1.2	3	2	1	1.3	.54	1.2	0	3	2	0	2.6	.53	2.4
I42	4	3	3	1.9	1	0	0	.78	1.1	3	2	1	1.1	.52	1.2	0	3	2	0	2.5	.56	2.8
I43	4	3	3	1.2	1	0	0	.87	1.2	3	2	1	1.2	.45	1.3	0	3	2	0	2.3	.56	2.5
I44	4	3	3	1.0	1	0	0	.74	1.2	3	2	1	1.1	.43	1.3	0	3	2	0	2.7	.53	2.7
I45	4	3	3	1.6	1	0	0	.81	1.6	3	2	1	1.7	.49	1.7	0	1	2	0	1.8	.52	2.5

ID	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
U44	3.6	1	3	0	1	1	30	2.2	.95	.49	4.2	.6	.8	.83	1.8	2.7	1.3	.70	1.0	.82	3	1
U45	4.2	3	2	0	1	1	24	2.2	.82	.58	4.8	.8	.6	1.2	1.7	3.0	1.3	.63	0.9	.84	3	1
U46	3.1	2	3	0	1	0	20	1.5	.86	.65	3.3	.5	.5	.97	1.6	1.6	1.2	.65	0.7	.82	3	0
U47	4.2	3	3	0	1	1	30	2.4	.88	.62	4.1	.6	.6	1.0	1.8	1.4	1.1	.74	0.8	.66	3	1
U48	3.8	1	3	0	1	0	25	1.9	.86	.58	3.9	.7	.7	.91	1.9	2.7	1.5	.69	0.6	.67	3	1
U49	3.9	1	3	0	1	1	27	2.1	.96	.58	3.9	.5	.6	.74	1.6	1.5	1.4	.70	0.8	.70	3	1
U50	3.8	3	2	0	1	1	28	2.0	.91	.59	4.1	.7	.8	.94	2.0	1.7	1.4	.56	0.9	.82	3	1
I01	2.8	1	2	1	1	1	17	1.7	1.0	.38	2.4	.4	.6	.70	.93	0.8	1.1	.84	1.3	.75	3	1
I02	2.7	1	3	1	1	1	25	1.4	.88	.48	2.2	.4	.7	.66	1.1	0.8	1.1	.78	1.2	.84	3	1
I03	2.5	1	2	1	1	1	19	1.1	.83	.52	1.5	.4	.7	.56	1.2	0.9	1.3	.73	1.0	.79	3	1
I04	3.0	1	2	1	1	1	24	1.3	.80	.49	1.9	.4	.7	.58	1.5	1.3	1.1	.78	0.8	.82	3	1
I05	2.8	1	2	1	1	1	22	1.5	.86	.47	2.1	.3	.7	.43	1.1	0.9	1.1	.74	1.1	.82	3	1
I06	2.7	1	3	1	1	1	20	1.3	.85	.51	1.6	.5	.8	.69	1.4	1.1	1.1	.79	1.1	.85	3	1
I07	2.6	1	2	1	1	1	27	1.5	.95	.52	1.6	.4	.8	.48	1.5	1.0	1.1	.85	1.1	.86	3	1
I08	2.9	1	2	1	1	1	19	1.2	.76	.65	1.5	.7	.7	.91	1.1	0.9	1.1	.78	1.2	.93	3	1
I09	3.0	2	3	1	1	1	28	1.5	.96	.31	1.7	.6	.7	.86	1.2	1.0	1.0	.83	1.0	.87	4	1
I10	3.0	1	2	1	1	1	30	1.8	1.0	.34	2.0	.3	.8	.43	1.7	1.3	1.2	.81	1.1	.87	3	1
I11	2.9	1	2	1	1	1	20	1.5	.95	.54	2.0	.6	.7	.89	1.2	0.9	1.2	.79	0.9	.64	3	1
I12	3.3	1	3	1	1	1	24	1.8	.89	.42	1.9	.8	1.0	.83	1.8	1.6	1.3	.84	1.5	.82	4	1
I13	3.1	1	2	1	1	1	33	1.7	.95	.41	2.1	.7	.8	.81	1.5	2.1	1.1	.80	1.4	.94	3	1
I14	2.9	1	3	1	1	1	32	1.6	.95	.48	1.4	.9	.8	1.2	1.4	1.0	1.0	.86	1.3	.90	4	1
I15	2.7	1	3	1	1	1	24	2.0	1.3	.35	2.3	.7	.7	.96	1.2	1.1	1.0	.58	0.9	.62	3	1
I16	2.7	1	3	1	1	1	21	1.5	.87	.40	1.9	.6	.7	.83	1.6	1.2	1.1	.75	1.2	.73	3	1
I17	2.7	1	2	1	1	1	25	1.6	1.0	.48	1.9	.5	.6	.85	1.3	1.0	1.2	.73	1.3	.79	3	1
I18	2.6	1	2	1	1	1	20	1.4	.87	.47	1.8	.4	.6	.75	.92	0.9	1.1	.74	0.9	.90	3	1
I19	3.0	1	3	1	1	1	36	1.6	.99	.46	1.4	.6	.6	1.1	1.3	0.8	1.1	.85	1.4	.94	3	1
I20	3.6	1	2	1	1	1	33	2.2	1.1	.34	1.9	.6	.7	.78	1.4	1.3	1.0	.65	1.6	.75	3	1
I21	2.4	1	2	1	1	1	22	1.2	.84	.38	1.8	.4	.6	.60	1.7	1.1	1.1	.76	0.8	.54	3	1
I22	3.2	1	2	1	1	1	28	1.3	.86	.39	1.7	.6	.7	.80	1.4	0.7	1.3	.86	1.1	.93	3	1
I23	3.5	1	2	1	1	1	34	2.0	1.2	.36	1.7	.7	.8	.83	1.3	1.0	1.1	.77	1.0	.74	3	1
I24	3.0	1	2	1	1	1	30	1.5	.96	.44	1.6	.4	.7	.57	1.7	0.7	1.1	.75	1.0	.91	3	1
I25	2.8	1	2	1	1	1	24	1.7	.99	.40	1.7	.5	.8	.60	1.5	0.8	1.2	.61	1.2	1.0	3	1
I26	2.8	1	2	1	1	1	21	1.3	.87	.51	1.8	.4	.6	.71	1.2	0.8	1.0	.78	1.0	1.1	3	1
I27	2.9	1	2	1	1	1	28	1.7	1.1	.45	1.3	.6	.7	.85	1.2	1.2	1.0	.85	1.4	.67	3	1
I28	2.9	1	2	1	1	1	30	1.3	.71	.39	2.0	.7	.7	.93	1.6	1.0	1.0	.64	1.2	.84	3	1
I29	3.0	1	2	1	1	1	23	1.6	.99	.47	1.9	.5	.9	.63	1.5	0.7	1.0	.65	1.0	.68	3	1
I30	3.3	1	2	1	1	1	20	1.4	.76	.48	1.6	.9	.9	1.0	1.4	1.5	1.2	.78	1.0	.90	3	1
I31	2.7	1	2	1	1	1	21	1.8	1.1	.56	1.9	.6	.8	.63	1.3	1.4	1.3	.75	1.2	.90	3	1
I32	3.5	1	2	1	1	1	36	2.1	1.1	.48	2.1	.7	.8	.85	1.8	1.9	1.1	.70	1.4	.94	3	1
I33	3.1	1	2	1	1	1	28	1.8	.98	.52	1.9	.7	.7	.93	1.2	0.9	1.4	.63	1.0	.76	3	1
I34	3.6	1	2	1	1	1	28	1.8	.81	.48	2.1	.5	.6	.82	1.0	0.6	1.1	.61	1.4	.88	3	1
I35	2.9	1	3	1	1	1	46	1.7	1.1	.39	1.7	.5	.6	.94	1.3	0.8	1.2	.64	0.8	.55	3	1
I36	2.6	1	3	1	1	1	29	1.3	.87	.46	1.3	.4	.5	.64	1.3	1.1	1.1	.76	0.8	.76	3	1
I37	2.9	1	2	1	1	1	19	1.5	.95	.42	1.6	.5	.7	.79	1.3	1.4	1.3	.65	1.2	.89	3	1
I38	3.1	1	2	1	1	1	24	1.6	.94	.41	1.7	.5	.9	.58	1.7	1.2	1.1	.85	1.3	.76	3	1
I39	3.5	1	2	1	1	1	36	2.2	1.1	.43	1.9	.8	.7	1.2	1.1	1.6	1.3	.81	1.2	.64	3	1
I40	3.1	1	3	1	1	1	23	1.4	.89	.41	1.8	.5	.8	.62	1.6	1.1	1.0	.55	1.2	.97	3	1
I41	3.4	1	2	1	1	1	34	1.8	1.0	.38	1.6	.5	.9	.60	1.3	0.7	1.1	.82	1.4	.95	3	1
I42	2.8	1	2	1	1	1	26	1.3	.86	.43	1.7	.5	.7	.74	1.3	0.9	1.1	.74	1.1	.90	3	1
I43	2.9	1	2	1	1	1	24	1.4	.88	.46	1.6	.6	.8	.71	1.5	1.1	1.1	.73	1.4	.88	3	1
I44	3.0	1	2	1	1	1	20	1.4	.89	.43	1.4	.5	.7	.66	1.3	1.2	1.1	.74	1.0	.91	3	1
I45	3.1	1	2	1	1	1	32	1.3	.81	.62	1.2	.7	.7	.95	1.2	0.9	1.0	.84	1.2	.94	3	1

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
I46	4	3	3	2.1	1	0	0	.88	1.2	3	2	1	1.5	.40	1.3	0	3	3	0	2.0	.56	2.6
I47	4	3	3	2.3	1	0	0	.95	1.3	3	2	1	1.5	.38	1.4	0	3	2	0	2.0	.58	2.7
I48	4	3	3	3.0	1	0	0	1.3	1.4	3	2	1	1.3	.62	1.2	0	1	2	1	2.6	.57	2.6
I49	4	3	3	1.3	1	0	0	1.1	1.5	3	2	1	1.2	.49	1.1	0	3	2	0	2.4	.57	2.5
I50	4	3	3	1.9	1	0	0	.79	1.2	3	3	1	1.0	.44	1.1	0	3	2	0	2.5	.59	2.5
L01	4	3	3	5.3	1	0	0	.73	1.1	3	2	1	1.5	.49	1.7	0	2	2	1	1.8	.55	2.9
L02	4	3	3	3.4	1	0	0	.66	2.4	3	2	1	2.3	.26	2.6	0	3	2	0	1.2	.58	2.5
L03	4	4	3	3.1	1	0	0	.56	2.0	3	2	1	2.9	.30	3.1	0	2	2	1	1.1	.59	2.4
L04	4	3	3	4.1	1	0	0	.92	2.0	2	3	1	1.8	.53	2.0	0	3	2	0	1.7	.62	2.5
L05	4	3	3	2.8	1	0	0	.74	2.2	3	2	1	1.9	.23	2.4	0	3	2	0	1.5	.48	2.5
L06	4	3	3	1.8	1	0	0	.89	1.4	3	3	1	1.7	.23	3.0	0	3	2	0	1.9	.52	3.6
L07	4	3	3	2.6	1	0	0	.69	2.1	3	3	1	2.1	.38	1.8	0	3	2	0	1.5	.51	2.4
L08	4	3	3	1.2	1	0	0	.83	1.3	3	2	1	1.7	.49	1.3	0	3	2	0	2.3	.50	2.5
L09	4	3	3	5.3	1	0	0	.91	2.0	3	2	1	1.7	.34	1.8	0	3	2	1	1.9	.50	2.8
L10	4	3	3	1.5	1	0	0	.72	1.3	3	2	1	1.6	.39	1.1	0	3	2	0	2.0	.47	2.3
L11	4	3	3	0.8	1	0	0	.83	1.9	3	2	1	1.6	.39	1.8	0	3	3	0	1.9	.52	2.4
L12	4	3	3	3.0	1	0	0	.90	1.6	3	2	1	2.0	.17	2.1	0	3	2	0	1.5	.54	2.2
L13	4	3	3	2.8	1	0	0	.56	1.3	3	2	1	2.3	.39	1.6	0	3	2	0	1.7	.47	2.3
L14	4	3	3	3.3	1	0	0	.46	1.6	3	2	1	2.7	.50	2.1	0	3	2	0	1.3	.51	2.8
L15	4	3	3	1.4	1	0	0	.73	2.6	3	2	1	2.9	.17	4.0	0	3	2	0	1.1	.62	2.5
L16	4	3	3	2.1	1	0	0	.85	1.5	3	2	1	1.9	.26	2.5	0	3	2	0	1.3	.57	2.2
L17	4	3	3	3.2	1	0	0	.73	1.3	3	2	1	2.1	.31	2.0	0	3	2	0	1.4	.54	3.0
L18	4	3	3	2.6	1	0	0	.94	2.2	3	2	1	1.9	.18	2.7	0	3	2	0	1.5	.53	3.4
L19	4	3	3	3.3	1	0	0	.54	1.5	3	2	1	1.8	.58	2.3	0	3	2	0	1.8	.57	3.0
L20	4	3	4	2.2	1	0	0	.72	2.0	3	2	1	1.9	.29	2.4	0	3	2	0	1.8	.53	3.6
L21	4	3	3	1.3	1	0	0	.81	2.0	3	2	1	1.6	.47	1.4	0	3	2	0	1.7	.56	2.3
L22	4	3	3	0.9	1	0	0	.51	2.2	3	2	1	2.8	.31	2.9	0	3	2	0	1.0	.53	2.1
L23	4	3	3	0.5	1	0	0	1.0	1.8	3	2	1	2.0	.21	2.0	0	3	2	0	1.5	.58	1.9
L24	4	3	3	0.7	1	0	0	.75	2.1	3	2	1	2.5	.18	2.3	0	3	2	0	1.4	.62	2.2
L25	4	3	3	3.4	1	0	0	.54	1.5	3	2	1	1.7	.56	1.4	0	3	2	0	2.0	.61	2.7
L26	4	3	3	3.7	1	0	0	.54	1.9	3	2	1	2.8	.28	2.5	0	3	2	0	1.2	.57	2.7

ID	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
I46	3.0	1	3	1	1	1	29	1.7	1.0	.32	1.9	.5	.8	.60	1.4	1.1	1.1	.70	1.5	.91	3	1
I47	3.1	1	2	1	1	1	27	1.8	1.0	.41	2.0	.4	.7	.48	1.2	1.1	1.0	.82	1.4	.88	3	1
I48	3.4	1	2	1	1	1	32	1.9	1.0	.36	1.8	.6	.8	.81	1.5	1.4	1.0	.73	1.2	.96	3	1
I49	2.8	1	3	1	1	1	28	1.5	.91	.48	1.6	.9	.5	1.2	1.4	1.1	1.2	.71	1.0	.89	3	1
I50	2.5	1	2	1	1	1	27	1.2	.84	.42	1.3	.9	.5	1.1	1.1	1.1	1.1	.74	1.1	.87	3	1
L01	2.6	1	2	1	1	1	6	1.6	1.1	.71	3.0	.5	.4	1.3	1.0	0.6	1.1	.73	1.3	.96	3	1
L02	2.8	1	2	1	1	1	32	1.7	1.0	.39	1.8	.4	.8	.57	1.3	0.7	1.2	.88	1.2	.83	3	1
L03	3.1	1	3	1	1	1	24	1.7	.94	.48	1.7	.7	.9	.71	1.6	1.2	1.1	.63	1.3	.91	3	1
L04	3.0	1	2	1	1	1	27	1.9	1.0	.50	2.1	.6	.7	.85	1.1	1.4	1.1	.91	1.5	1.1	3	1
L05	2.8	1	2	1	1	1	28	1.6	1.2	.47	1.6	.6	.8	.73	1.2	0.8	1.3	.83	1.4	1.0	3	1
L06	3.2	1	2	1	1	1	20	1.8	1.1	.49	2.0	.7	.5	1.4	.91	1.6	1.1	.77	1.2	.99	3	1
L07	3.2	1	2	1	1	1	22	1.6	1.0	.40	1.7	.7	.8	.91	1.4	1.1	1.2	.77	1.1	.94	3	1
L08	3.8	1	2	1	1	1	26	1.9	.97	.37	1.7	.7	.7	1.0	1.5	0.6	1.1	.63	1.1	.89	3	1
L09	3.3	1	3	1	1	1	36	2.5	1.5	.34	1.5	.9	1.1	.89	1.6	1.0	1.1	.73	1.6	.92	3	1
L10	3.2	1	2	1	1	1	23	1.9	1.2	.27	1.6	.8	.7	1.1	1.1	1.2	1.1	.74	1.1	.85	3	1
L11	3.1	1	3	1	1	1	18	1.5	.91	.40	2.0	.5	.6	.78	1.1	1.7	1.1	.74	1.0	.84	3	1
L12	2.9	1	2	1	1	1	24	1.6	1.1	.33	1.4	.7	.8	.85	1.5	0.5	1.1	.84	1.0	.87	3	1
L13	3.8	1	2	1	1	1	28	1.8	1.0	.43	1.6	.8	.9	.87	1.5	1.4	1.0	.77	1.3	1.0	3	1
L14	3.5	1	2	1	1	1	31	2.0	1.1	.46	1.7	.6	.8	.70	1.2	1.0	1.1	.68	1.4	1.1	3	1
L15	3.2	1	2	1	1	1	25	1.9	.98	.45	2.0	.6	.7	.82	1.3	1.4	1.1	.78	1.5	.93	3	1
L16	2.4	1	2	1	1	1	21	1.2	.90	.36	1.4	.8	.6	1.2	1.3	0.7	1.0	.70	0.8	.74	3	1
L17	2.9	1	2	1	1	1	10	4.6	1.0	.41	2.0	.6	.5	1.2	1.3	0.7	1.1	.76	1.0	.75	3	1
L18	2.9	1	2	1	1	1	27	1.3	.89	.34	1.8	.5	.6	.94	1.1	0.8	1.2	.80	1.0	1.1	3	1
L19	3.2	1	3	1	1	1	24	1.5	.82	.47	1.9	.6	.5	.92	1.4	1.8	1.0	.57	1.3	.99	3	1
L20	3.5	1	3	1	1	1	31	1.9	1.0	.48	1.9	.5	.8	.65	1.5	0.9	1.2	.70	1.6	1.4	3	1
L21	2.7	1	2	1	1	1	25	1.7	1.1	.39	1.6	.7	.7	.89	1.4	1.3	1.1	.63	1.2	1.0	3	1
L22	2.8	1	2	1	1	1	26	1.6	1.1	.32	1.6	.8	.6	1.2	1.2	1.6	1.0	.81	1.2	1.2	3	1
L23	3.0	1	2	1	1	1	32	1.7	.95	.42	1.7	.7	.6	1.2	1.1	1.2	1.1	.71	1.4	1.1	3	1
L24	3.5	1	2	1	1	1	35	1.9	.89	.43	1.5	.8	.8	1.0	1.3	1.4	1.2	.67	1.4	.88	3	1
L25	3.4	1	2	1	1	1	28	2.1	1.0	.41	1.7	.7	.9	.75	1.3	0.8	1.1	.74	1.1	.73	3	1
L26	3.2	1	2	1	1	1	27	1.7	.93	.38	1.6	.6	.7	.91	1.3	1.4	1.1	.77	1.3	.95	3	1

Characters Used in the Morphological Analyses of *Cuscuta* Species

1. Bract Orientation*
2. Calyx Orientation*
3. Corolla Orientation*
4. Pedicel Length in mm
5. Number of Bracts at Base of Pedicel
6. Number of Bracts Along Pedicel
7. Number of Bracts at Pedicel Apex
8. Bract Length/Calyx Length
9. Bract Length/Bract Width
10. Shape of Bract Margin**
11. Shape of Bract Apex***
12. Presence of Bract Laticifers (0=absent, 1=present)
13. Calyx Length in mm
14. Length of Calyx Tube/Total Calyx Length
15. Calyx Length/Calyx Width
16. Overlap of Calyx Lobes (0=no overlap, 1=overlap)
17. Shape of Calyx Margin**
18. Shape of Calyx Apex***
19. Presence of Calyx Papillations (0=absent, 1=present)
20. Presence of Calyx Laticifers (0=absent, 1=present)
21. Corolla Length/Calyx Length
22. Corolla Tube Length/Total Corolla Length
23. Corolla Length/Corolla Width
24. Corolla Length in mm
25. Shape of Corolla Margin**
26. Shape of Corolla Apex***
27. Presence of Corolla Papillations (0=absent, 1=present)
28. Inflexing of Corolla Lobe Tips (0=tips not inflexed, 1=tips inflexed)
29. Number of Fringes Per Corolla Appendage
30. Length of Corolla Appendages in mm
31. Appendage Length/Length of Corolla Tube
32. Length of Appendage-Corolla Fusion/Appendage Length
33. Appendage Length/Appendage Width
34. Filament Length in mm
35. Anther Length in mm
36. Filament Length/Anther Length
37. Anther Length/Anther Width
38. Longer Style Length in mm
39. Longer Style Length/Shorter Style Length
40. Stigma Length/Stigma Width
41. Ovary Length in mm
42. Ovary Length/Ovary Width
43. Style Orientation*
44. Presence of Stylopodium (0=absent, 1=present)

*codes for orientations are as follows: 1=enclosing, 2=inflexed, 3=upright, 4=spreading, 5=reflexed.
**codes for margin shapes are as follows: 1=denticulate, 2=dentate, 3=entire, 4=ciliate, 5=erose.
***codes for apex shapes are as follows: 1=obtuse, 2=acute, 3=acuminate, 4=cuspidate, 5=attenuate.

APPENDIX C

RESULTS OF CLUSTERING TECHNIQUES

UPGMA Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Average Distance
181	I42	I44	2	32.03	.	0.182784
180	CL181	I43	3	23.75	1.71	0.225658
179	I02	I16	2	20.59	.	0.258710
178	L24	A08	2	19.31	.	0.260223
177	I05	I07	2	17.87	.	0.283614
176	I46	I47	2	16.42	.	0.309422
175	I37	CL180	4	14.73	2.72	0.311453
174	O04	O09	2	14.18	.	0.318602
173	O32	O33	2	13.50	.	0.342828
172	U48	U12	2	12.96	.	0.348642
171	L13	L14	2	12.57	.	0.348764
170	L07	L12	2	12.26	.	0.349313
169	I38	CL176	3	11.90	1.41	0.352338
168	CL179	CL177	4	11.28	2.41	0.352358
167	O38	O40	2	11.17	.	0.353354
166	I49	I50	2	11.08	.	0.353384
165	L23	CL178	3	10.88	2.16	0.356115
164	L02	L05	2	10.82	.	0.357351
163	I34	L08	2	10.76	.	0.364005
162	U39	U47	2	10.69	.	0.366325
161	CL169	I41	4	10.59	1.26	0.366942
160	L10	L21	2	10.55	.	0.367885
159	O10	O27	2	10.52	.	0.369904
158	I24	I25	2	10.48	.	0.372235
157	U44	U49	2	10.46	.	0.373099
156	CL165	A09	4	10.37	1.47	0.373580
155	O22	O42	2	10.35	.	0.379380
154	CL171	L26	3	10.30	1.27	0.381268
153	O01	O31	2	10.28	.	0.381617
152	U46	U08	2	10.27	.	0.382334
151	O28	O50	2	10.26	.	0.384853
150	I08	I45	2	10.25	.	0.390047
149	O20	O24	2	10.23	.	0.390065
148	I03	I18	2	10.23	.	0.390588
147	CL163	CL175	6	10.00	2.88	0.391011
146	I27	L25	2	10.01	.	0.391443
145	CL164	CL170	4	9.95	1.48	0.392678
144	A02	A07	2	9.96	.	0.400968
143	CL146	CL161	6	9.85	1.63	0.405830
142	CL158	I40	3	9.84	1.27	0.408288
141	O39	O43	2	9.84	.	0.412200
140	U15	U16	2	9.84	.	0.412449
139	I36	L11	2	9.84	.	0.414151
138	I28	I30	2	9.85	.	0.415791
137	I31	I33	2	9.85	.	0.417548
136	I22	L18	2	9.86	.	0.418257
135	I13	I32	2	9.87	.	0.423763
134	I17	I48	2	9.87	.	0.427258
133	CL147	CL166	8	9.67	2.74	0.434807
132	O29	O48	2	9.67	.	0.437275
131	U35	U38	2	9.67	.	0.438044
130	I12	I14	2	9.68	.	0.441610

UPGMA Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Average Distance
129	CL155	CL173	4	9.59	2.05	0.443363
128	CL156	A05	5	9.54	2.00	0.443489
127	U43	U02	2	9.56	.	0.444085
126	CL168	CL134	6	9.44	2.44	0.448881
125	CL131	CL157	4	9.41	1.47	0.451559
124	CL149	CL167	4	9.36	1.97	0.452139
123	O06	O47	2	9.38	.	0.454451
122	I23	CL160	3	9.37	1.70	0.454690
121	CL136	CL145	6	9.31	1.96	0.456918
120	U29	U33	2	9.33	.	0.459475
119	O08	CL159	3	9.32	1.81	0.463924
118	I29	CL137	3	9.33	1.32	0.465526
117	O15	O25	2	9.36	.	0.465843
116	CL125	U41	5	9.37	1.23	0.467061
115	CL135	CL143	8	9.28	2.32	0.472793
114	L22	CL128	6	9.26	1.80	0.474077
113	O12	CL151	3	9.27	1.72	0.474877
112	U21	U24	2	9.30	.	0.477443
111	CL127	U13	3	9.32	1.21	0.478409
110	U50	U19	2	9.35	.	0.478457
109	CL133	CL139	10	9.26	2.64	0.481357
108	CL122	CL118	6	9.23	1.69	0.483945
107	CL124	O36	5	9.24	1.48	0.488109
106	CL126	I10	7	9.23	1.86	0.494116
105	U37	CL110	3	9.26	1.09	0.495065
104	CL115	CL108	14	9.10	2.75	0.496190
103	U32	U42	2	9.14	.	0.499138
102	L15	CL114	7	9.14	1.70	0.499963
101	CL120	CL111	5	9.15	1.40	0.500598
100	CL106	CL148	9	9.09	2.37	0.501162
99	U34	CL172	3	9.11	2.44	0.501340
98	CL121	L04	7	9.13	1.68	0.502583
97	CL117	CL129	6	9.11	1.99	0.506840
96	CL150	I19	3	9.13	2.04	0.510749
95	CL98	CL154	10	9.01	3.08	0.511205
94	CL104	CL109	24	8.69	4.66	0.511217
93	U27	CL116	6	8.73	1.54	0.516100
92	U30	U31	2	8.78	.	0.517254
91	I20	CL142	4	8.82	2.08	0.518837
90	CL162	CL140	4	8.82	2.56	0.520317
89	I01	CL100	10	8.85	1.58	0.525008
88	CL119	O35	4	8.89	1.69	0.527956
87	U07	U10	2	8.95	.	0.530908
86	CL132	O46	3	9.00	1.65	0.532618
85	O19	O26	2	9.07	.	0.534771
84	CL93	CL90	10	9.02	2.36	0.536641
83	I09	CL130	3	9.08	1.65	0.537920
82	CL113	CL107	8	9.03	2.72	0.538821
81	CL94	CL91	28	8.92	3.00	0.541642
80	U45	CL112	3	8.99	1.40	0.543405
79	L06	L16	2	9.07	.	0.543671
78	CL144	A03	3	9.13	2.14	0.546135

UPGMA Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Average Distance
77	U40	U18	2	9.21	.	0.546848
76	U05	U09	2	9.29	.	0.556217
75	CL89	I21	11	9.34	1.72	0.557684
74	CL97	O16	7	9.39	1.70	0.560084
73	CL84	CL101	15	9.32	2.80	0.562801
72	CL95	CL102	17	9.09	5.11	0.563152
71	CL123	O14	3	9.17	1.73	0.564804
70	U23	U25	2	9.27	.	0.566408
69	CL152	U04	3	9.34	2.60	0.567217
68	O03	O13	2	9.44	.	0.568876
67	CL153	CL88	6	9.46	2.55	0.573259
66	O07	O34	2	9.56	.	0.573694
65	CL105	U22	4	9.65	1.57	0.573931
64	CL72	CL79	19	9.70	1.82	0.579401
63	CL96	CL81	31	9.65	3.08	0.581427
62	U28	CL99	4	9.74	1.99	0.582029
61	CL75	CL138	13	9.75	2.79	0.585499
60	O02	O05	2	9.87	.	0.586463
59	CL82	O45	9	9.97	1.67	0.591600
58	CL62	CL77	6	10.05	1.68	0.596360
57	CL103	CL70	4	10.16	1.51	0.597190
56	CL71	CL74	10	10.18	2.62	0.599520
55	CL73	U36	16	10.30	1.52	0.599650
54	O11	O37	2	10.45	.	0.600461
53	CL63	L19	32	10.57	1.68	0.601250
52	CL64	L20	20	10.69	1.58	0.608760
51	CL55	CL65	20	10.69	2.84	0.609847
50	CL92	U06	3	10.84	1.54	0.612658
49	CL58	CL87	8	10.96	1.69	0.615725
48	CL59	CL85	11	11.06	2.26	0.617690
47	CL174	CL86	5	11.14	3.27	0.620665
46	I04	I26	2	11.33	.	0.628367
45	CL56	O17	11	11.50	1.60	0.630590
44	CL61	CL46	15	11.63	2.24	0.632122
43	CL53	I35	33	11.80	1.92	0.633735
42	CL66	CL48	13	11.94	2.06	0.640365
41	CL141	O44	3	12.14	2.95	0.647072
40	CL57	CL76	6	12.32	1.80	0.648243
39	U26	CL69	4	12.55	1.91	0.649623
38	CL43	CL52	53	11.61	13.60	0.650482
37	CL67	CL45	17	11.59	4.27	0.653469
36	CL40	CL80	9	11.77	2.13	0.656778
35	CL50	U17	4	12.03	1.45	0.662437
34	CL68	CL42	15	12.24	2.17	0.666249
33	CL51	CL49	28	12.16	5.13	0.667510
32	CL60	CL34	17	12.41	1.92	0.672863
31	L03	A04	2	12.75	.	0.685082
30	CL32	CL47	22	12.84	3.50	0.687722
29	CL54	CL41	5	13.17	1.95	0.693725
28	O41	O49	2	13.58	.	0.693777
27	O18	O30	2	14.02	.	0.702074
26	CL33	CL36	37	14.00	4.96	0.702212

UPGMA Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Average Distance
25	CL37	CL30	39	13.83	6.25	0.704549
24	CL39	U01	5	14.32	1.74	0.704908
23	CL38	I39	54	14.82	1.90	0.717979
22	CL35	U14	5	15.40	1.59	0.728073
21	CL29	CL28	7	15.99	1.68	0.735609
20	CL26	U20	38	16.67	1.60	0.739775
19	CL31	CL78	5	17.36	2.61	0.744110
18	CL44	CL23	69	16.10	17.44	0.752055
17	CL20	CL22	43	16.51	4.36	0.768520
16	CL25	CL27	41	17.34	2.16	0.771686
15	CL19	A06	6	18.40	1.60	0.784148
14	CL17	U11	44	19.55	1.87	0.817598
13	CL16	O21	42	20.87	2.08	0.844445
12	CL18	L01	70	22.39	2.38	0.859813
11	CL12	CL15	76	22.83	8.46	0.865662
10	CL83	A01	4	24.98	3.94	0.872546
9	CL13	CL21	49	25.99	8.28	0.875737
8	CL14	U03	45	29.19	2.34	0.894610
7	CL11	L17	77	33.35	2.58	0.939004
6	CL7	L09	78	39.13	2.66	0.958132
5	CL24	CL8	50	44.61	9.66	0.958976
4	CL9	O23	50	58.13	2.50	0.984059
3	CL6	CL10	82	79.31	9.35	1.031846
2	CL5	CL3	132	65.99	68.03	1.080552
1	CL2	CL4	182	.	65.99	1.183175

WPGMA Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized McQuitty's Similarity
181	I42	I44	2	32.03	.	0.182784
180	CL181	I43	3	23.75	1.71	0.225658
179	I02	I16	2	20.59	.	0.258710
178	L24	A08	2	19.31	.	0.260223
177	I05	I07	2	17.87	.	0.283614
176	I46	I47	2	16.42	.	0.309422
175	I37	CL180	4	14.73	2.72	0.316178
174	O04	O09	2	14.18	.	0.318602
173	O32	O33	2	13.50	.	0.342828
172	U48	U12	2	12.96	.	0.348642
171	L13	L14	2	12.57	.	0.348764
170	L07	L12	2	12.26	.	0.349313
169	I38	CL176	3	11.90	1.41	0.352338
168	CL179	CL177	4	11.28	2.41	0.352358
167	O38	O40	2	11.17	.	0.353354
166	I49	I50	2	11.08	.	0.353384
165	L23	CL178	3	10.88	2.16	0.356115
164	L02	L05	2	10.82	.	0.357351
163	I34	L08	2	10.76	.	0.364005
162	U39	U47	2	10.69	.	0.366325
161	L10	L21	2	10.64	.	0.367885
160	CL165	A09	4	10.50	1.47	0.369344
159	O10	O27	2	10.47	.	0.369904
158	I24	I25	2	10.44	.	0.372235
157	U44	U49	2	10.41	.	0.373099
156	CL169	I41	4	10.37	1.26	0.373922
155	O22	O42	2	10.35	.	0.379380
154	CL171	L26	3	10.30	1.27	0.381268
153	O01	O31	2	10.28	.	0.381617
152	U46	U08	2	10.27	.	0.382334
151	O28	O50	2	10.26	.	0.384853
150	I08	I45	2	10.25	.	0.390047
149	O20	O24	2	10.23	.	0.390065
148	I03	I18	2	10.23	.	0.390588
147	I27	L25	2	10.22	.	0.391443
146	CL164	CL170	4	10.15	1.48	0.392678
145	CL163	CL175	6	9.95	2.88	0.397537
144	A02	A07	2	9.96	.	0.400968
143	CL147	CL156	6	9.85	1.63	0.401990
142	CL158	I40	3	9.84	1.27	0.408288
141	O39	O43	2	9.84	.	0.412200
140	U15	U16	2	9.84	.	0.412449
139	I36	L11	2	9.84	.	0.414151
138	I28	I30	2	9.85	.	0.415791
137	I31	I33	2	9.85	.	0.417548
136	I22	L18	2	9.86	.	0.418257
135	I13	I32	2	9.87	.	0.423763
134	I17	I48	2	9.87	.	0.427258
133	O29	O48	2	9.86	.	0.437275
132	U35	U38	2	9.86	.	0.438044
131	L22	CL160	5	9.75	2.22	0.438115
130	I12	I14	2	9.75	.	0.441610

WPGMA Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized McQuitty's Similarity
129	CL155	CL173	4	9.66	2.05	0.443363
128	U43	U02	2	9.67	.	0.444085
127	CL145	CL166	8	9.52	2.74	0.448292
126	CL168	CL134	6	9.41	2.44	0.448881
125	CL146	CL154	7	9.22	2.81	0.448931
124	CL132	CL157	4	9.20	1.47	0.451559
123	CL149	CL167	4	9.15	1.97	0.452139
122	O06	O47	2	9.18	.	0.454451
121	I23	CL161	3	9.18	1.70	0.454690
120	U29	U33	2	9.21	.	0.459475
119	O08	CL159	3	9.20	1.81	0.463924
118	I29	CL137	3	9.22	1.32	0.465526
117	O15	O25	2	9.24	.	0.465843
116	CL124	U41	5	9.26	1.23	0.467061
115	O12	CL151	3	9.26	1.72	0.474877
114	U21	U24	2	9.28	.	0.477443
113	CL128	U13	3	9.30	1.21	0.478409
112	U50	U19	2	9.33	.	0.478457
111	CL143	CL118	9	9.22	2.49	0.480432
110	CL123	O36	5	9.22	1.48	0.488109
109	CL126	I10	7	9.20	1.86	0.488656
108	CL121	CL111	12	9.11	2.10	0.489073
107	L15	CL131	6	9.11	1.83	0.489659
106	U37	CL112	3	9.14	1.09	0.495065
105	CL127	CL139	10	9.07	2.64	0.498497
104	U32	U42	2	9.11	.	0.499138
103	CL135	I20	3	9.13	1.54	0.499471
102	CL120	CL113	5	9.14	1.40	0.500999
101	U34	CL172	3	9.15	2.44	0.501340
100	CL148	I21	3	9.17	1.92	0.506741
99	CL116	CL140	7	9.11	2.21	0.506768
98	CL117	CL129	6	9.09	1.99	0.506840
97	CL150	I19	3	9.11	2.04	0.510749
96	CL136	CL125	9	9.04	2.55	0.516385
95	U30	U31	2	9.09	.	0.517254
94	CL96	L04	10	9.12	1.42	0.521049
93	CL119	O35	4	9.14	1.69	0.522753
92	CL107	A05	7	9.20	1.39	0.528731
91	I01	I26	2	9.25	.	0.528887
90	U07	U10	2	9.30	.	0.530908
89	CL133	O46	3	9.34	1.65	0.532618
88	CL99	CL162	9	9.30	2.14	0.533913
87	O19	O26	2	9.36	.	0.534771
86	I09	CL130	3	9.40	1.65	0.537920
85	CL103	CL108	15	9.37	2.25	0.539150
84	U45	CL114	3	9.42	1.40	0.543405
83	L06	L16	2	9.48	.	0.543671
82	CL144	A03	3	9.53	2.14	0.546135
81	U40	U18	2	9.60	.	0.546848
80	I04	CL142	4	9.63	2.36	0.548388
79	CL109	CL100	10	9.61	2.60	0.553066
78	U27	U17	2	9.68	.	0.556196

WPGMA Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized McQuitty's Similarity
77	U05	U09	2	9.76	.	0.556217
76	CL98	O16	7	9.80	1.70	0.556611
75	CL88	U36	10	9.85	1.52	0.557354
74	CL115	CL110	8	9.82	2.72	0.564283
73	CL122	O14	3	9.89	1.73	0.564804
72	U23	U25	2	9.98	.	0.566408
71	CL152	U04	3	10.04	2.60	0.567217
70	O03	O13	2	10.13	.	0.568876
69	CL102	CL106	8	10.09	2.70	0.570369
68	CL97	CL105	13	10.00	4.07	0.571558
67	O07	O34	2	10.10	.	0.573694
66	CL153	CL93	6	10.12	2.55	0.582093
65	CL68	L19	14	10.18	1.80	0.585592
64	O02	O05	2	10.29	.	0.586463
63	CL94	L20	11	10.37	1.87	0.594273
62	CL101	CL81	5	10.42	2.08	0.595357
61	CL104	CL72	4	10.51	1.51	0.597190
60	CL74	O45	9	10.60	1.67	0.597511
59	CL79	CL138	12	10.63	2.69	0.598950
58	U28	U14	2	10.76	.	0.599801
57	O11	O37	2	10.89	.	0.600461
56	CL62	CL90	7	10.97	1.69	0.604749
55	CL95	U06	3	11.10	1.54	0.612658
54	CL174	CL89	5	11.13	3.27	0.615166
53	CL65	CL83	16	11.15	2.78	0.616480
52	CL69	CL75	18	11.16	2.74	0.616699
51	CL92	CL82	10	11.12	4.25	0.619781
50	CL80	CL85	19	11.09	3.95	0.626243
49	CL73	CL76	10	11.15	2.62	0.631143
48	CL60	CL87	11	11.25	2.26	0.642649
47	CL52	U22	19	11.38	1.76	0.642676
46	CL78	CL56	9	11.49	1.83	0.646601
45	CL141	O44	3	11.66	2.95	0.647072
44	CL61	CL77	6	11.80	1.80	0.648243
43	CL67	CL48	13	11.93	2.06	0.652479
42	CL49	O17	11	12.13	1.60	0.653216
41	CL53	CL63	27	11.75	7.84	0.653985
40	U26	CL71	4	11.96	1.91	0.656228
39	CL44	CL84	9	12.10	2.13	0.660711
38	I35	I39	2	12.36	.	0.664094
37	CL50	CL41	46	12.43	3.16	0.677328
36	CL64	O21	3	12.69	1.50	0.682350
35	L03	A04	2	12.98	.	0.685082
34	CL91	CL59	14	13.23	2.52	0.691667
33	CL57	CL45	5	13.48	1.95	0.692578
32	O41	O49	2	13.83	.	0.693777
31	CL66	CL54	11	13.92	4.11	0.696839
30	CL46	CL47	28	13.89	4.87	0.699155
29	CL35	CL51	12	14.23	2.17	0.700640
28	O18	O30	2	14.67	.	0.702074
27	CL42	CL43	24	14.46	6.91	0.703441
26	CL30	CL55	31	14.70	3.06	0.710261

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                         WPGMA Clustering Results

  Number                                  Frequency                                Normalized
    of                                     of New      Pseudo       Pseudo       McQuitty's
 Clusters   Clusters Joined               Cluster        F          t**2        Similarity

      25    CL31        CL27                  35       14.88         3.46       0.725600
      24    CL26        CL58                  33       15.25         2.49       0.737150
      23    CL25        CL70                  37       15.68         2.21       0.746705
      22    CL33        CL32                   7       16.24         1.68       0.749762
      21    CL40        U01                    5       16.91         1.74       0.749778
      20    CL37        CL38                  48       17.58         2.44       0.750601
      19    CL23        CL28                  39       18.24         2.18       0.772043
      18    CL39        U20                   10       19.06         2.05       0.789485
      17    CL29        A06                   13       19.96         2.61       0.814329
      16    CL34        CL20                  62       19.04        15.71       0.824588
      15    CL19        CL36                  42       20.02         2.38       0.827303
      14    CL18        U11                   11       21.27         2.00       0.832247
      13    CL16        L01                   63       22.67         2.49       0.875347
      12    CL86        A01                    4       24.33         3.94       0.884212
      11    CL24        CL14                  44       25.68         4.94       0.913863
      10    CL15        CL22                  49       26.35         8.28       0.945375
       9    CL11        U03                   45       29.11         2.34       0.958067
       8    CL13        L17                   64       32.53         3.17       0.974943
       7    CL10        O23                   50       37.07         2.50       1.018062
       6    CL8         L09                   65       43.50         3.10       1.029172
       5    CL21        CL9                   50       49.57         9.66       1.083579
       4    CL6         CL17                  78       58.13        14.69       1.127833
       3    CL4         CL12                  82       79.31         9.35       1.174559
       2    CL5         CL7                  100       67.29        66.66       1.315223
       1    CL2         CL3                  182         .          67.29       1.447096
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UPGMC Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Centroid Distance
181	I42	I44	2	32.03	.	0.182784
180	CL181	I43	3	23.75	1.71	0.179962
179	I37	CL180	4	15.17	2.72	0.240997
178	I02	I16	2	15.48	.	0.258710
177	L24	A08	2	15.68	.	0.260223
176	I05	I07	2	15.37	.	0.283614
175	CL178	CL176	4	12.74	2.41	0.216777
174	I34	CL179	5	11.12	2.69	0.283976
173	CL174	L08	6	10.15	1.38	0.268955
172	CL173	I47	7	9.29	1.82	0.275356
171	CL172	I46	8	8.89	1.37	0.247358
170	CL171	I41	9	8.51	1.42	0.254653
169	CL170	I38	10	8.13	1.48	0.258534
168	I27	CL169	11	7.74	1.57	0.275090
167	CL168	L25	12	7.44	1.48	0.273201
166	CL167	L21	13	7.19	1.43	0.273714
165	CL166	I32	14	7.03	1.32	0.264811
164	CL165	I33	15	6.89	1.29	0.263050
163	CL164	I31	16	6.75	1.32	0.267508
162	I25	CL163	17	6.65	1.25	0.262659
161	CL162	L11	18	6.51	1.40	0.278433
160	CL161	L07	19	6.38	1.43	0.282469
159	CL160	L10	20	6.27	1.36	0.278571
158	I24	CL159	21	6.16	1.42	0.287354
157	L23	CL177	3	6.25	2.16	0.291059
156	CL157	A09	4	6.33	1.47	0.265530
155	CL158	CL156	25	4.89	8.43	0.278647
154	CL155	L13	26	4.89	1.05	0.274284
153	CL154	I29	27	4.89	1.08	0.278444
152	CL153	L12	28	4.88	1.13	0.283715
151	CL152	I45	29	4.87	1.15	0.289740
150	CL175	I18	5	4.92	1.98	0.292421
149	I23	CL151	30	4.91	1.19	0.292804
148	CL150	CL149	35	3.85	10.04	0.295838
147	CL148	I22	36	3.87	0.98	0.291389
146	CL147	I49	37	3.88	1.05	0.298814
145	CL146	I13	38	3.90	1.07	0.301612
144	CL145	I50	39	3.90	1.10	0.303357
143	CL144	I36	40	3.92	1.08	0.303043
142	O04	O09	2	4.01	.	0.318602
141	CL143	I19	41	4.01	1.22	0.322166
140	CL141	L05	42	3.99	1.34	0.333916
139	CL140	L18	43	3.98	1.32	0.336093
138	CL139	L16	44	3.97	1.29	0.333064
137	CL138	L04	45	3.96	1.31	0.338348
136	CL137	I08	46	3.95	1.30	0.340679
135	O32	O33	2	4.04	.	0.342828
134	CL135	O42	3	4.09	1.75	0.340414
133	O22	CL134	4	4.15	1.27	0.300744
132	CL133	O25	5	4.19	1.48	0.321607
131	O15	CL132	6	4.22	1.66	0.345804

UPGMC Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Centroid Distance
130	CL136	I20	47	4.20	1.38	0.346689
129	U48	U12	2	4.28	.	0.348642
128	CL130	I40	48	4.27	1.38	0.349971
127	CL128	L19	49	4.25	1.37	0.351701
126	O38	O40	2	4.33	.	0.353354
125	O24	CL126	3	4.39	1.54	0.329749
124	CL125	O28	4	4.45	1.26	0.293560
123	CL131	CL124	10	4.22	6.68	0.312347
122	CL142	CL123	12	4.12	2.86	0.328163
121	CL122	O50	13	4.14	1.06	0.333718
120	CL121	O08	14	4.16	1.01	0.329913
119	CL120	O27	15	4.18	0.98	0.320235
118	CL119	O10	16	4.21	1.00	0.319291
117	CL118	O12	17	4.23	1.00	0.317811
116	O01	CL117	18	4.26	0.99	0.318020
115	CL116	O31	19	4.28	1.08	0.328406
114	CL115	O14	20	4.29	1.13	0.339318
113	CL114	O19	21	4.30	1.17	0.341996
112	CL127	L26	50	4.30	1.46	0.355845
111	CL113	O36	22	4.31	1.26	0.356359
110	CL112	I30	51	4.31	1.38	0.358344
109	CL111	O20	23	4.32	1.29	0.360328
108	CL109	O02	24	4.33	1.24	0.360136
107	CL110	L02	52	4.33	1.49	0.363214
106	CL107	L14	53	4.33	1.45	0.359749
105	CL108	O45	25	4.34	1.28	0.365201
104	CL105	O34	26	4.35	1.27	0.365313
103	CL104	O26	27	4.36	1.25	0.365694
102	CL103	O16	28	4.37	1.25	0.365813
101	U39	U47	2	4.45	.	0.366325
100	CL129	U49	3	4.50	1.93	0.366880
99	U44	CL100	4	4.56	1.42	0.332115
98	U41	CL99	5	4.62	1.23	0.313824
97	CL101	CL98	7	4.61	3.15	0.298921
96	U38	CL97	8	4.67	0.91	0.284272
95	CL96	U16	9	4.73	0.88	0.273085
94	U35	CL95	10	4.78	1.13	0.299562
93	CL94	U50	11	4.83	1.21	0.313602
92	U27	CL93	12	4.88	1.20	0.312319
91	CL92	U15	13	4.93	1.18	0.309652
90	CL91	U02	14	4.97	1.26	0.320508
89	CL90	U43	15	5.02	1.21	0.314561
88	CL89	U13	16	5.07	1.15	0.308782
87	CL88	U33	17	5.12	1.18	0.312821
86	CL87	U29	18	5.17	1.19	0.313438
85	CL86	U34	19	5.21	1.33	0.334467
84	CL85	U37	20	5.25	1.39	0.343375
83	CL84	U42	21	5.29	1.43	0.353077
82	CL83	U19	22	5.33	1.42	0.352878
81	CL82	U07	23	5.36	1.38	0.351205
80	CL81	U36	24	5.40	1.46	0.361661

UPGMC Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Centroid Distance
79	CL106	L06	54	5.42	1.49	0.374226
78	CL80	U45	25	5.45	1.52	0.374991
77	CL102	O07	29	5.49	1.30	0.375364
76	CL78	U21	26	5.52	1.51	0.378316
75	CL79	I04	55	5.55	1.52	0.378918
74	CL77	O48	30	5.58	1.33	0.379566
73	CL74	O29	31	5.62	1.27	0.372468
72	CL73	O46	32	5.66	1.23	0.367950
71	CL75	I28	56	5.70	1.50	0.381268
70	CL71	I10	57	5.74	1.51	0.381425
69	U46	U08	2	5.85	.	0.382334
68	CL72	O05	33	5.89	1.34	0.385014
67	CL70	I48	58	5.92	1.56	0.385668
66	CL76	U40	27	5.97	1.57	0.387206
65	CL66	U22	28	6.02	1.54	0.389087
64	CL67	L20	59	6.06	1.55	0.390920
63	CL68	O13	34	6.11	1.38	0.392420
62	CL65	U10	29	6.16	1.58	0.397572
61	CL62	U28	30	6.21	1.55	0.396168
60	CL61	U05	31	6.27	1.51	0.395475
59	CL60	U09	32	6.33	1.50	0.395878
58	CL59	U32	33	6.39	1.48	0.395566
57	CL63	O35	35	6.45	1.41	0.398552
56	CL58	U25	34	6.51	1.49	0.398764
55	A02	A07	2	6.65	.	0.400968
54	CL64	CL55	61	6.54	4.35	0.397563
53	CL54	I35	62	6.61	1.57	0.403769
52	CL56	CL53	96	3.50	71.38	0.407867
51	CL52	CL57	131	1.70	56.78	0.400750
50	CL51	U30	132	1.72	0.62	0.390089
49	O39	O43	2	1.77	.	0.412200
48	I12	I14	2	1.81	.	0.441610
47	I09	CL48	3	1.85	1.65	0.427518
46	O06	O47	2	1.90	.	0.454451
45	CL69	U04	3	1.94	2.60	0.471634
44	CL50	U31	133	1.96	0.97	0.472411
43	CL44	U06	134	1.98	0.98	0.476344
42	CL43	U17	135	2.00	1.00	0.478151
41	L15	L22	2	2.06	.	0.480112
40	CL41	A05	3	2.11	1.36	0.420183
39	CL42	CL40	138	2.04	3.25	0.355006
38	U26	CL45	4	2.09	1.91	0.481093
37	CL38	CL39	142	1.89	6.62	0.472708
36	CL37	U14	143	1.91	0.99	0.487832
35	CL36	I39	144	1.93	1.08	0.489860
34	CL35	I17	145	1.95	1.15	0.502840
33	CL34	I03	146	1.98	1.14	0.500369
32	CL33	I21	147	2.00	1.20	0.517260
31	CL32	CL47	150	1.84	5.25	0.521331
30	CL31	A04	151	1.86	1.17	0.522698
29	I01	I26	2	1.92	.	0.528887

UPGMC Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Centroid Distance
28	CL30	CL29	153	1.88	2.47	0.437461
27	CL28	CL49	155	1.81	3.11	0.534113
26	CL27	O18	156	1.83	1.18	0.536371
25	CL26	O03	157	1.85	1.20	0.540614
24	CL25	U18	158	1.88	1.21	0.541455
23	CL24	U24	159	1.91	1.21	0.542749
22	CL46	O17	3	1.98	2.52	0.550328
21	CL23	CL22	162	1.76	5.34	0.509614
20	CL21	U20	163	1.79	1.23	0.552442
19	CL20	L03	164	1.81	1.33	0.565637
18	CL19	L01	165	1.83	1.35	0.580103
17	CL18	U23	166	1.86	1.36	0.581741
16	CL17	L17	167	1.89	1.35	0.589109
15	CL16	O30	168	1.92	1.40	0.596207
14	O11	O37	2	2.04	.	0.600461
13	CL14	O44	3	2.18	1.42	0.539020
12	CL15	CL13	171	1.92	4.58	0.468686
11	CL12	U03	172	1.95	1.54	0.634916
10	CL11	U11	173	1.97	1.69	0.664086
9	CL10	A06	174	1.98	1.83	0.691288
8	CL9	A03	175	1.99	1.84	0.693004
7	O41	O49	2	2.25	.	0.693777
6	CL8	CL7	177	1.98	3.49	0.554638
5	CL6	O23	178	2.01	1.81	0.703781
4	CL5	O21	179	2.03	1.90	0.713871
3	CL4	L09	180	2.08	1.91	0.716159
2	CL3	U01	181	2.31	1.85	0.716880
1	CL2	A01	182	.	2.31	0.813786

WPGMC Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Median Distance
181	I42	I44	2	32.03	.	0.182784
180	CL181	I43	3	23.75	1.71	0.179962
179	I37	CL180	4	15.17	2.72	0.248340
178	I02	I16	2	15.48	.	0.258710
177	L24	A08	2	15.68	.	0.260223
176	I05	I07	2	15.37	.	0.283614
175	CL178	CL176	4	12.74	2.41	0.216777
174	I34	CL179	5	11.12	2.69	0.289635
173	CL174	L08	6	10.15	1.88	0.266309
172	I33	CL173	7	9.28	1.83	0.281004
171	CL172	L21	8	8.48	1.86	0.285161
170	I32	CL171	9	7.88	1.72	0.278136
169	L23	CL177	3	7.91	2.16	0.291059
168	CL169	A09	4	7.89	1.47	0.264051
167	CL170	I46	10	7.74	1.20	0.291692
166	CL167	I47	11	7.62	1.16	0.242721
165	CL166	I38	12	7.40	1.40	0.247688
164	I27	CL165	13	7.22	1.36	0.257676
163	CL164	L25	14	7.06	1.32	0.275994
162	CL163	I41	15	7.03	1.05	0.263587
161	CL175	I18	5	6.98	1.98	0.292421
160	CL161	I03	6	6.81	2.08	0.305600
159	O04	O09	2	6.97	.	0.318602
158	L22	CL168	5	6.84	2.22	0.319456
157	CL162	I31	16	6.76	1.32	0.321494
156	CL157	L07	17	6.62	1.53	0.298576
155	CL156	L13	18	6.49	1.55	0.266765
154	CL155	L14	19	6.13	2.49	0.278276
153	CL154	L26	20	5.83	2.36	0.260243
152	CL153	CL158	25	4.58	8.45	0.250703
151	CL152	L05	26	4.56	1.13	0.307440
150	CL151	L02	27	4.50	1.47	0.257373
149	CL150	L12	28	4.53	0.81	0.267423
148	CL149	L18	29	4.51	1.20	0.295272
147	I22	CL148	30	4.51	1.10	0.312922
146	O32	O33	2	4.61	.	0.342828
145	CL146	O42	3	4.67	1.75	0.340414
144	O22	CL145	4	4.73	1.27	0.292035
143	CL144	O25	5	4.76	1.48	0.346119
142	CL147	I24	31	4.73	1.27	0.347424
141	CL142	I25	32	4.74	1.05	0.320987
140	CL141	I40	33	4.65	1.73	0.310259
139	CL160	CL140	39	3.69	11.06	0.341829
138	CL139	I04	40	3.66	1.46	0.336249
137	U48	U12	2	3.74	.	0.348642
136	O38	O40	2	3.82	.	0.353354
135	O24	CL136	3	3.88	1.54	0.329749
134	CL135	O28	4	3.94	1.26	0.289598
133	CL134	O50	5	3.97	1.71	0.320457
132	O12	CL133	6	3.99	1.73	0.337389
131	I49	I50	2	4.07	.	0.353384

WPGMC Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Median Distance
130	CL138	CL131	42	4.01	1.74	0.343170
129	CL130	L11	43	4.06	0.58	0.319439
128	CL129	I36	44	4.08	0.98	0.290708
127	O15	CL143	6	4.11	1.66	0.356874
126	CL128	I45	45	4.15	0.71	0.359316
125	CL126	I08	46	4.15	1.13	0.318822
124	O08	CL132	7	4.16	1.83	0.360213
123	CL124	O27	8	4.17	1.55	0.288974
122	CL123	O10	9	4.18	1.34	0.299744
121	CL122	CL127	15	3.98	5.26	0.325686
120	CL159	CL121	17	3.91	2.43	0.311450
119	U39	U47	2	3.98	.	0.366325
118	CL137	U49	3	4.03	1.93	0.366880
117	U44	CL118	4	4.08	1.42	0.311787
116	CL119	CL117	6	4.06	3.34	0.296437
115	U38	CL116	7	4.11	0.92	0.295413
114	CL115	U16	8	4.15	0.93	0.308286
113	CL114	U41	9	4.21	0.87	0.298490
112	U35	CL113	10	4.25	1.13	0.339980
111	CL112	U50	11	4.28	1.21	0.333542
110	CL111	U43	12	4.31	1.35	0.370129
109	CL110	U02	13	4.34	1.24	0.325644
108	CL109	U15	14	4.39	1.03	0.315758
107	U29	CL108	15	4.41	1.32	0.340969
106	CL107	U33	16	4.45	1.16	0.319312
105	CL106	U13	17	4.49	1.02	0.339185
104	CL105	U37	18	4.51	1.46	0.373545
103	O01	O31	2	4.59	.	0.381617
102	CL103	CL120	19	4.57	1.72	0.308730
101	U46	U08	2	4.65	.	0.382334
100	CL125	I19	47	4.68	1.06	0.386761
99	CL102	O35	20	4.68	1.48	0.393138
98	CL100	I29	48	4.72	0.87	0.395072
97	CL98	I23	49	4.76	0.95	0.352547
96	CL97	L10	50	4.81	0.88	0.329803
95	CL104	U19	19	4.83	1.52	0.396187
94	CL96	L16	51	4.86	1.08	0.399147
93	CL94	L06	52	4.87	1.42	0.388020
92	A02	A07	2	4.95	.	0.400968
91	U27	CL95	20	5.00	1.12	0.407489
90	CL91	U34	21	5.03	1.27	0.405948
89	CL90	U07	22	5.06	1.45	0.377991
88	CL89	U42	23	5.10	1.29	0.367591
87	CL88	U32	24	5.10	1.87	0.389560
86	CL87	U25	25	5.10	1.74	0.391164
85	CL86	U21	26	5.13	1.43	0.399949
84	CL85	U45	27	5.16	1.32	0.391570
83	CL84	U24	28	5.15	1.87	0.385041
82	O39	O43	2	5.24	.	0.412200
81	I28	I30	2	5.32	.	0.415791
80	I17	I48	2	5.41	.	0.427258

WPGMC Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Median Distance
79	I10	CL80	3	5.49	1.30	0.365464
78	CL79	CL81	5	5.51	2.95	0.354191
77	CL93	CL78	57	5.35	4.46	0.384230
76	CL77	L04	58	5.40	1.05	0.367195
75	CL76	I13	59	5.46	0.94	0.391459
74	CL75	I20	60	5.50	1.21	0.401574
73	CL99	O19	21	5.56	1.12	0.430056
72	CL73	O26	22	5.60	1.32	0.429248
71	CL72	O14	23	5.67	1.05	0.417383
70	CL71	O07	24	5.71	1.39	0.410935
69	CL70	O34	25	5.75	1.34	0.413602
68	CL69	O29	26	5.79	1.37	0.402196
67	CL68	O48	27	5.84	1.29	0.349881
66	CL67	O46	28	5.90	1.23	0.394466
65	I12	I14	2	6.01	.	0.441610
64	I09	CL65	3	6.10	1.65	0.427518
63	CL92	A03	3	6.19	2.14	0.445893
62	L15	CL63	4	6.28	1.34	0.382324
61	CL62	A05	5	6.35	1.69	0.427814
60	CL74	CL61	65	5.91	9.17	0.450440
59	CL60	L20	66	5.97	1.27	0.379805
58	CL59	L19	67	6.05	1.02	0.407764
57	CL66	O06	29	6.10	1.57	0.450534
56	CL57	O47	30	6.17	1.41	0.349461
55	CL56	O16	31	6.25	1.11	0.462660
54	CL55	O17	32	6.32	1.48	0.456083
53	CL101	U04	3	6.42	2.60	0.471634
52	CL83	U05	29	6.51	1.44	0.473314
51	CL52	U09	30	6.60	1.44	0.401747
50	O20	O36	2	6.74	.	0.479240
49	CL50	O45	3	6.87	1.68	0.468888
48	CL54	CL49	35	6.90	2.21	0.372347
47	CL48	O02	36	7.02	1.09	0.397592
46	CL47	O05	37	7.13	1.22	0.407891
45	CL58	L03	68	7.20	1.88	0.481760
44	CL45	A04	69	7.28	1.80	0.476371
43	CL51	U23	31	7.39	1.67	0.486586
42	U26	CL53	4	7.53	1.91	0.490528
41	CL46	O03	38	7.65	1.55	0.498042
40	CL41	O13	39	7.79	1.31	0.414849
39	CL43	U36	32	7.95	1.25	0.510158
38	CL39	U28	33	8.11	1.57	0.479737
37	CL38	U40	34	8.28	1.34	0.447643
36	CL37	U18	35	8.44	1.62	0.396971
35	CL36	U10	36	8.64	1.31	0.424502
34	CL35	U22	37	8.84	1.35	0.464353
33	CL34	U31	38	9.04	1.56	0.453740
32	CL33	U30	39	9.24	1.66	0.393203
31	CL32	U06	40	9.47	1.48	0.418672
30	CL31	U17	41	9.71	1.56	0.481019
29	CL40	CL82	41	9.77	3.47	0.511943

WPGMC Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Median Distance
28	CL29	O37	42	9.98	2.07	0.472888
27	CL28	O11	43	10.16	2.36	0.446794
26	CL27	O49	44	10.41	1.95	0.456009
25	CL26	O41	45	10.68	1.89	0.514791
24	CL30	U14	42	10.99	2.07	0.517127
23	I01	I26	2	11.49	.	0.528887
22	CL25	O44	46	11.83	2.07	0.529282
21	CL42	CL24	46	11.48	8.66	0.538291
20	CL21	U01	47	11.84	2.36	0.521614
19	CL44	A06	70	12.23	2.90	0.608339
18	CL23	I21	3	12.85	2.35	0.614493
17	CL18	I39	4	13.49	1.81	0.585746
16	CL17	I35	5	14.20	1.50	0.518909
15	CL16	CL19	75	14.81	3.35	0.503364
14	CL20	CL15	122	7.47	70.63	0.542296
13	CL14	CL64	125	7.39	5.36	0.579816
12	CL13	A01	126	7.70	2.73	0.653496
11	CL22	O18	47	8.39	1.27	0.659304
10	CL11	O30	48	9.20	1.50	0.526888
9	CL10	O21	49	10.17	1.82	0.684334
8	CL9	O23	50	11.30	2.50	0.721509
7	CL12	L17	127	12.84	1.61	0.788303
6	CL7	CL8	177	1.49	66.79	0.698294
5	CL6	U20	178	1.57	1.15	0.686973
4	CL5	U03	179	1.60	1.48	0.655883
3	CL4	U11	180	1.59	1.61	0.683764
2	CL3	L01	181	1.89	1.29	0.979540
1	CL2	L09	182	.	1.89	0.772276

Single Linkage Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Minimum Distance
181	I42	I44	2	32.03	.	0.182784
180	CL181	I43	3	23.75	1.71	0.208132
179	I02	I16	2	20.59	.	0.258710
178	L24	A08	2	19.31	.	0.260223
177	I05	I07	2	17.87	.	0.283614
176	I37	CL180	4	15.37	2.72	0.293145
175	CL179	CL177	4	12.74	2.41	0.308341
174	I46	I47	2	12.64	.	0.309422
173	O04	O09	2	12.49	.	0.318602
172	I38	CL174	3	11.94	1.41	0.318689
171	CL176	CL172	7	9.54	4.04	0.328049
170	CL171	I41	8	9.18	1.35	0.328965
169	CL170	I50	9	8.24	2.24	0.337266
168	CL178	A05	3	8.08	2.74	0.338317
167	O32	O33	2	8.21	.	0.342828
166	CL175	I18	5	7.99	1.98	0.343006
165	CL168	A09	4	7.78	1.76	0.343598
164	I27	CL169	10	7.58	1.44	0.345259
163	U48	U12	2	7.71	.	0.348642
162	L13	L14	2	7.83	.	0.348764
161	L07	L12	2	7.94	.	0.349313
160	O38	O40	2	8.05	.	0.353354
159	CL164	I49	11	7.68	1.92	0.353384
158	CL159	I34	12	7.57	1.22	0.353557
157	CL161	CL162	4	7.35	2.47	0.354813
156	L23	CL165	5	7.43	0.90	0.355426
155	L02	L05	2	7.53	.	0.357351
154	CL157	L26	5	7.60	0.81	0.357523
153	CL155	CL154	7	7.44	1.77	0.358618
152	CL158	L08	13	7.43	1.03	0.364005
151	U39	U47	2	7.53	.	0.366325
150	L10	L21	2	7.62	.	0.367885
149	O28	CL160	3	7.57	1.84	0.369209
148	O10	O27	2	7.65	.	0.369904
147	I24	I25	2	7.74	.	0.372235
146	CL152	CL150	15	7.47	2.18	0.372532
145	U44	U49	2	7.56	.	0.373099
144	CL167	O42	3	7.56	1.75	0.377479
143	CL146	I32	16	7.52	1.22	0.377673
142	L22	CL156	6	7.45	1.80	0.378537
141	CL143	CL153	23	5.92	10.12	0.379120
140	O22	CL144	4	5.97	1.27	0.379380
139	CL147	CL141	25	5.84	1.72	0.380171
138	CL139	L25	26	5.90	0.68	0.381015
137	O01	O31	2	5.99	.	0.381617
136	U46	U08	2	6.07	.	0.382334
135	CL149	O50	4	6.08	1.54	0.384853
134	CL138	I33	27	6.11	0.84	0.386271
133	O24	CL135	5	6.17	0.88	0.387628
132	I08	I45	2	6.25	.	0.390047
131	O20	CL133	6	6.26	1.41	0.390065
130	CL166	I03	6	6.26	2.08	0.390588

Single Linkage Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Minimum Distance
129	CL130	I48	7	6.26	1.88	0.391839
128	CL134	L11	28	6.28	0.92	0.392598
127	I22	CL128	29	6.27	1.16	0.394311
126	CL127	CL142	35	5.40	8.40	0.395645
125	CL126	I36	36	5.37	1.33	0.396805
124	O08	CL148	3	5.42	1.81	0.397167
123	CL125	I31	37	5.47	0.65	0.398024
122	CL123	I29	38	5.50	0.89	0.398690
121	A02	A07	2	5.58	.	0.400968
120	CL122	I40	39	5.52	1.65	0.400977
119	CL120	L18	40	5.53	1.12	0.408656
118	O39	O43	2	5.60	.	0.412200
117	U15	U16	2	5.67	.	0.412449
116	CL132	I19	3	5.70	2.04	0.413075
115	CL119	L15	41	5.55	2.49	0.413487
114	I28	I30	2	5.63	.	0.415791
113	I13	CL115	42	5.62	1.20	0.417995
112	U41	CL117	3	5.67	1.52	0.420224
111	CL113	L16	43	5.68	1.11	0.421249
110	O12	CL131	7	5.69	1.76	0.423681
109	CL111	I23	44	5.72	0.91	0.426427
108	CL129	I17	8	5.77	1.46	0.427258
107	U35	CL145	3	5.83	1.63	0.427842
106	CL116	CL109	47	5.76	1.91	0.428776
105	CL107	U38	4	5.83	1.13	0.432849
104	CL105	CL112	7	5.84	2.03	0.433990
103	CL124	CL110	10	5.70	3.94	0.434237
102	CL104	U02	8	5.75	1.32	0.435490
101	O29	O48	2	5.82	.	0.437275
100	I12	I14	2	5.90	.	0.441610
99	I01	CL108	9	5.94	1.54	0.442722
98	CL99	CL114	11	5.89	3.18	0.443773
97	CL140	O25	5	5.95	1.48	0.443776
96	CL102	U43	9	5.99	1.37	0.444085
95	CL106	L04	48	6.02	1.12	0.446502
94	I04	CL95	49	5.98	1.84	0.447060
93	CL98	I21	12	6.01	1.50	0.447471
92	CL94	I20	50	6.01	1.47	0.448221
91	CL96	CL163	11	6.00	2.31	0.452007
90	O15	CL97	6	6.05	1.66	0.453035
89	O06	O47	2	6.14	.	0.454451
88	CL103	O13	11	6.14	1.68	0.456505
87	CL91	CL151	13	6.14	2.06	0.458098
86	U29	U33	2	6.23	.	0.459475
85	CL88	O34	12	6.25	1.43	0.460893
84	U34	CL87	14	6.28	1.50	0.463314
83	CL86	CL84	16	6.30	1.71	0.463641
82	CL83	U36	17	6.33	1.53	0.464232
81	CL92	L06	51	6.36	1.35	0.466572
80	CL85	O36	13	6.41	1.13	0.467591
79	U27	CL82	18	6.47	1.10	0.469187
78	CL79	U50	19	6.55	0.97	0.469753

Single Linkage Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Minimum Distance
77	CL93	I10	13	6.62	1.25	0.469766
76	CL90	O17	7	6.65	2.23	0.474107
75	CL78	U13	20	6.73	1.01	0.474225
74	CL81	I35	52	6.74	1.69	0.475927
73	U21	U24	2	6.84	.	0.477443
72	CL75	U19	21	6.88	1.51	0.478457
71	CL72	U37	22	6.95	1.27	0.479596
70	CL173	CL80	15	6.94	2.16	0.482191
69	CL137	CL76	9	6.96	2.50	0.484451
68	CL70	O35	16	6.97	1.90	0.487776
67	U07	CL73	3	7.05	1.59	0.492397
66	CL77	CL74	65	6.11	15.64	0.492597
65	CL71	U31	23	6.15	1.84	0.492723
64	CL101	O46	3	6.24	1.65	0.494636
63	CL69	O16	10	6.32	1.45	0.496174
62	U32	U42	2	6.43	.	0.499138
61	CL65	U05	24	6.47	1.81	0.499406
60	CL66	A04	66	6.47	2.08	0.499449
59	O05	CL64	4	6.55	1.82	0.499829
58	CL68	O19	17	6.64	1.21	0.501334
57	CL60	L20	67	6.70	1.38	0.502442
56	CL63	O14	11	6.79	1.40	0.502556
55	CL57	I26	68	6.77	2.55	0.505021
54	CL56	CL58	28	6.61	5.15	0.509956
53	CL61	CL67	27	6.59	3.29	0.510407
52	CL55	A03	69	6.51	3.49	0.511351
51	CL53	U20	28	6.58	1.73	0.512798
50	CL54	CL59	32	6.58	2.72	0.515719
49	CL51	U30	29	6.65	1.76	0.517254
48	CL49	U28	30	6.74	1.54	0.517580
47	CL50	O07	33	6.85	1.19	0.517856
46	CL48	CL62	32	6.92	1.94	0.518997
45	CL46	U22	33	7.04	1.33	0.520481
44	CL45	U40	34	7.16	1.29	0.521241
43	CL52	L19	70	7.30	0.99	0.522283
42	CL44	U17	35	7.41	1.60	0.522299
41	CL42	U45	36	7.56	1.14	0.524306
40	CL43	L03	71	7.65	1.87	0.527709
39	CL41	U10	37	7.81	1.23	0.530908
38	CL40	I39	72	7.96	1.36	0.532303
37	I09	CL100	3	8.18	1.65	0.532336
36	CL47	O26	34	8.37	1.18	0.534771
35	CL39	U25	38	8.54	1.49	0.534855
34	CL38	CL121	74	8.54	3.42	0.535886
33	CL36	CL89	36	8.66	2.43	0.536240
32	CL35	U09	39	8.88	1.38	0.539208
31	CL33	O03	37	9.10	1.51	0.544323
30	CL31	O45	38	9.36	1.14	0.545336
29	CL32	U18	40	9.62	1.48	0.546848
28	CL30	O02	39	9.93	1.02	0.558247
27	CL136	U04	3	10.30	2.60	0.566133
26	CL29	U23	41	10.62	1.50	0.566408

Single Linkage Clustering Results

```
 Number                              Frequency                             Normalized
   of                                 of New      Pseudo      Pseudo        Minimum
Clusters   Clusters Joined            Cluster        F         t**2         Distance

    25     CL26        U06                 42      10.97        1.43      0.576388
    24     CL28        O18                 40      11.35        1.47      0.587064
    23     CL24        O21                 41      11.69        2.11      0.590669
    22     CL25        U14                 43      12.07        2.07      0.599801
    21     O11         O37                  2      12.65         .        0.600461
    20     U26         CL27                 4      13.26        1.91      0.605554
    19     CL23        CL118               43      13.62        3.32      0.610038
    18     CL34        L01                 75      14.18        2.23      0.617575
    17     CL19        O49                 44      14.82        2.15      0.619790
    16     CL17        O44                 45      15.51        2.29      0.633696
    15     CL22        U11                 44      16.41        1.87      0.639889
    14     CL20        U01                  5      17.55        1.74      0.643406
    13     CL16        CL21                47      18.46        3.26      0.644190
    12     CL13        O30                 48      19.91        1.51      0.663493
    11     CL15        CL12                92      10.61       67.62      0.670203
    10     CL11        O41                 93      11.48        1.62      0.691125
     9     CL10        O23                 94      12.59        1.60      0.703320
     8     CL18        A06                 76      14.04        2.78      0.725729
     7     CL9         U03                 95      15.87        1.83      0.732012
     6     CL7         CL8                171       3.66       68.56      0.732539
     5     CL6         L09                172       4.04        1.99      0.747305
     4     CL14        CL5                177       2.86        7.23      0.775659
     3     CL4         L17                178       3.63        1.30      0.777332
     2     CL37        A01                  4       6.28        3.94      0.823232
     1     CL3         CL2                182        .          6.28      0.835291
```

Complete Linkage Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Maximum Distance
181	I42	I44	2	32.03	.	0.182784
180	CL181	I43	3	23.75	1.71	0.243183
179	I02	I16	2	20.59	.	0.258710
178	L24	A08	2	19.31	.	0.260223
177	I05	I07	2	17.87	.	0.283614
176	I46	I47	2	16.42	.	0.309422
175	O04	O09	2	15.37	.	0.318602
174	I37	CL180	4	14.18	2.72	0.330354
173	O32	O33	2	13.50	.	0.342828
172	U48	U12	2	12.96	.	0.348642
171	L13	L14	2	12.57	.	0.348764
170	L07	L12	2	12.26	.	0.349313
169	O38	O40	2	12.00	.	0.353354
168	I49	I50	2	11.80	.	0.353384
167	L23	A09	2	11.62	.	0.356636
166	L02	L05	2	11.48	.	0.357351
165	I34	L08	2	11.33	.	0.364005
164	U39	U47	2	11.20	.	0.366325
163	L10	L21	2	11.09	.	0.367885
162	O10	O27	2	10.99	.	0.369904
161	I27	I38	2	10.90	.	0.372208
160	I24	I25	2	10.83	.	0.372235
159	U44	U49	2	10.77	.	0.373099
158	I41	CL176	3	10.74	1.41	0.376998
157	O22	O42	2	10.68	.	0.379380
156	O01	O31	2	10.63	.	0.381617
155	U46	U08	2	10.58	.	0.382334
154	O28	O50	2	10.54	.	0.384853
153	I08	I45	2	10.49	.	0.390047
152	O20	O24	2	10.46	.	0.390065
151	CL179	CL177	4	10.36	2.41	0.390385
150	I03	I18	2	10.33	.	0.390588
149	CL161	L25	3	10.32	1.10	0.391443
148	A02	A07	2	10.29	.	0.400968
147	CL171	L26	3	10.28	1.27	0.405013
146	O39	O43	2	10.24	.	0.412200
145	U15	U16	2	10.21	.	0.412449
144	I36	L11	2	10.18	.	0.414151
143	CL160	I40	3	10.15	1.27	0.415599
142	I28	I30	2	10.13	.	0.415791
141	CL149	I31	4	10.10	1.23	0.416048
140	I22	L18	2	10.08	.	0.418257
139	CL167	CL178	4	10.07	1.81	0.420506
138	CL166	CL170	4	10.05	1.48	0.421368
137	I13	I32	2	10.04	.	0.423763
136	I33	CL165	3	10.04	1.33	0.426622
135	I17	I48	2	10.04	.	0.427258
134	O29	O48	2	10.02	.	0.437275
133	U35	U38	2	10.01	.	0.438044
132	I12	I14	2	10.00	.	0.441610
131	CL136	CL174	7	9.86	2.78	0.441805
130	U43	U02	2	9.85	.	0.444085

Complete Linkage Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Maximum Distance
129	O06	O47	2	9.84	.	0.454451
128	CL137	CL158	5	9.76	1.93	0.458420
127	U29	U33	2	9.75	.	0.459475
126	O15	O25	2	9.74	.	0.465843
125	I23	CL163	3	9.72	1.70	0.465977
124	I10	CL135	3	9.69	1.30	0.473083
123	CL133	CL159	4	9.66	1.47	0.476948
122	U21	U24	2	9.66	.	0.477443
121	U50	U19	2	9.65	.	0.478457
120	CL152	O36	3	9.63	1.65	0.479240
119	O17	CL157	3	9.61	1.77	0.479762
118	L15	L22	2	9.61	.	0.480112
117	CL123	U41	5	9.61	1.23	0.481869
116	CL130	U13	3	9.62	1.21	0.482165
115	O08	O12	2	9.63	.	0.482516
114	I01	CL151	5	9.60	2.55	0.486547
113	CL141	I29	5	9.64	1.40	0.486976
112	U32	U42	2	9.64	.	0.499138
111	U37	CL121	3	9.65	1.09	0.500439
110	CL131	CL168	9	9.60	2.45	0.501028
109	U34	U07	2	9.60	.	0.510407
108	CL140	CL138	6	9.58	1.96	0.512443
107	U30	U31	2	9.59	.	0.517254
106	U28	CL172	3	9.57	2.61	0.519147
105	CL139	A05	5	9.60	2.00	0.527602
104	CL120	CL169	5	9.59	1.67	0.531798
103	CL108	L04	7	9.59	1.68	0.534243
102	O19	O26	2	9.60	.	0.534771
101	CL127	CL116	5	9.60	1.40	0.537636
100	CL164	CL145	4	9.55	2.56	0.538790
99	CL115	CL162	4	9.58	1.49	0.540606
98	CL126	CL173	4	9.58	1.87	0.541557
97	I19	CL125	4	9.58	1.84	0.542066
96	CL150	I21	3	9.60	1.92	0.542578
95	I09	CL132	3	9.62	1.65	0.543504
94	L06	L16	2	9.65	.	0.543671
93	U40	U18	2	9.68	.	0.546848
92	CL148	A03	3	9.68	2.14	0.547211
91	CL147	L19	4	9.68	2.66	0.549666
90	CL128	I20	6	9.73	1.63	0.550075
89	U27	U17	2	9.77	.	0.556196
88	U05	U09	2	9.81	.	0.556217
87	U45	CL122	3	9.85	1.40	0.562505
86	U23	U25	2	9.89	.	0.566408
85	O07	O14	2	9.93	.	0.567017
84	CL155	U04	3	9.94	2.60	0.568301
83	CL110	CL144	11	9.94	2.53	0.568563
82	O03	O13	2	9.99	.	0.568876
81	CL134	O46	3	10.05	1.65	0.570599
80	O16	O45	2	10.10	.	0.579089
79	CL97	CL113	9	10.13	1.89	0.580001
78	O02	O05	2	10.19	.	0.586463

Complete Linkage Clustering Results

Number of Clusters	Clusters Joined		Frequency of New Cluster	Pseudo F	Pseudo t**2	Normalized Maximum Distance
77	CL156	CL99	6	10.15	2.70	0.589048
76	CL118	CL105	7	10.20	2.09	0.596898
75	O11	O37	2	10.26	.	0.600461
74	CL80	O34	3	10.32	1.06	0.605034
73	CL91	L20	5	10.37	1.78	0.611464
72	CL114	I26	6	10.41	2.69	0.612544
71	CL89	CL117	7	10.45	1.90	0.613810
70	CL104	CL154	7	10.50	2.12	0.614803
69	CL93	U10	3	10.56	1.35	0.619069
68	CL90	CL143	9	10.56	3.01	0.619309
67	CL111	U22	4	10.64	1.57	0.626431
66	CL124	CL142	5	10.63	2.95	0.627893
65	CL72	I04	7	10.68	2.28	0.628367
64	CL112	CL109	4	10.76	1.64	0.636172
63	U36	CL100	5	10.86	1.58	0.637814
62	CL107	U06	3	10.95	1.54	0.648929
61	CL106	CL69	6	10.99	1.85	0.653571
60	CL129	CL98	6	10.98	3.07	0.659888
59	CL146	O44	3	11.04	2.95	0.660449
58	CL153	A04	3	11.12	3.19	0.662893
57	I35	I39	2	11.22	.	0.664094
56	CL77	O35	7	11.35	1.47	0.666102
55	CL101	U20	6	11.45	2.00	0.674597
54	U26	CL84	4	11.54	1.91	0.676042
53	CL175	CL81	5	11.58	3.27	0.679134
52	CL96	CL66	8	11.64	2.28	0.686356
51	CL68	CL83	20	11.61	4.29	0.687788
50	CL85	CL102	4	11.72	1.70	0.690521
49	O41	O49	2	11.86	.	0.693777
48	CL87	CL88	5	11.94	2.26	0.698054
47	CL103	CL94	9	12.08	2.45	0.701499
46	O18	O30	2	12.24	.	0.702074
45	CL64	CL86	6	12.40	1.68	0.707990
44	CL79	CL47	18	12.41	3.87	0.708666
43	CL63	CL67	9	12.52	2.54	0.708811
42	L03	CL73	6	12.72	1.94	0.709649
41	CL50	CL74	7	12.87	1.76	0.716653
40	CL78	CL82	4	13.03	1.97	0.728896
39	CL60	CL119	9	13.24	2.03	0.733557
38	CL75	CL59	5	13.42	1.95	0.751810
37	CL76	CL92	10	13.52	4.25	0.758001
36	CL40	CL70	11	13.72	2.37	0.761687
35	CL71	U14	8	13.94	2.61	0.763041
34	CL45	CL48	11	14.16	2.07	0.778704
33	CL36	CL53	16	14.25	3.30	0.791648
32	CL58	CL42	9	14.46	2.71	0.791774
31	CL61	CL43	15	14.43	4.60	0.809243
30	CL56	CL39	16	14.48	4.70	0.810620
29	CL52	CL51	28	14.32	7.67	0.812828
28	CL54	U01	5	14.72	1.74	0.833942
27	CL35	CL62	11	15.09	2.31	0.848585
26	CL55	U11	7	15.52	2.45	0.856110

```
                 Complete Linkage Clustering Results


 Number                              Frequency                          Normalized
   of                                 of New      Pseudo     Pseudo       Maximum
Clusters   Clusters Joined            Cluster       F         t**2        Distance

     25    CL33        CL41               23      15.79        3.04      0.856269
     24    CL44        CL57               20      16.26        2.74      0.862376
     23    CL38        CL49                7      16.80        1.68      0.890732
     22    CL30        CL46               18      17.22        2.98      0.899209
     21    CL65        CL29               35      17.48        5.37      0.904999
     20    CL37        A06                11      18.12        3.09      0.908422
     19    CL95        A01                 4      18.78        3.94      0.919211
     18    CL26        CL34               18      19.35        3.70      0.921232
     17    L01         L17                 2      20.27         .        0.935631
     16    CL27        CL31               26      21.26        2.52      0.947862
     15    CL22        CL25               41      21.87        4.77      0.956928
     14    CL32        CL20               20      22.91        4.14      0.990288
     13    CL16        U03                27      24.36        2.59      1.018370
     12    CL24        CL17               22      25.96        3.85      1.019386
     11    O21         O23                 2      28.06         .        1.028245
     10    CL12        L09                23      30.55        3.07      1.074893
      9    CL13        CL18               45      32.64        5.95      1.082445
      8    CL15        CL23               48      34.46        8.44      1.123604
      7    CL8         CL11               50      39.32        2.37      1.160198
      6    CL21        CL10               58      43.66       10.41      1.234476
      5    CL28        CL9                50      49.75        9.66      1.238503
      4    CL14        CL19               24      60.36       11.09      1.294162
      3    CL5         CL6               108      43.89       67.26      1.526606
      2    CL3         CL4               132      65.99       15.03      1.597149
      1    CL2         CL7               182        .         65.99      1.714660
```

APPENDIX D

RESULTS OF DISCRIMINANT ANALYSIS

Discriminant Analysis Results
(original data)

ID	From taxa	Into taxa		Posterior Probability of Membership in TAXA:		
				A	I	L
I01	I	I		0.0000	1.0000	0.0000
I02	I	I		0.0000	1.0000	0.0000
I03	I	I		0.0000	1.0000	0.0000
I04	I	I		0.0000	1.0000	0.0000
I05	I	I		0.0000	1.0000	0.0000
I07	I	I		0.0000	1.0000	0.0000
I08	I	I		0.0000	0.9999	0.0001
I09	I	I		0.0000	1.0000	0.0000
I10	I	I		0.0000	1.0000	0.0000
I12	I	I		0.0000	1.0000	0.0000
I13	I	I		0.0000	1.0000	0.0000
I14	I	I		0.0000	1.0000	0.0000
I16	I	I		0.0000	1.0000	0.0000
I17	I	I		0.0000	1.0000	0.0000
I18	I	I		0.0000	0.9999	0.0001
I19	I	I		0.0000	0.9998	0.0002
I20	I	I		0.0000	1.0000	0.0000
I21	I	I		0.0000	1.0000	0.0000
I22	I	I		0.0000	0.9726	0.0274
I23	I	I		0.0000	0.9960	0.0040
I24	I	I		0.0000	1.0000	0.0000
I25	I	I		0.0000	1.0000	0.0000
I26	I	I		0.0000	0.9999	0.0001
I27	I	I		0.0000	1.0000	0.0000
I28	I	I		0.0000	0.9989	0.0011
I29	I	L	*	0.0000	0.4816	0.5184
I30	I	I		0.0000	0.9924	0.0076
I31	I	I		0.0000	1.0000	0.0000
I32	I	I		0.0000	0.9999	0.0001
I33	I	I		0.0000	1.0000	0.0000
I34	I	I		0.0000	0.9996	0.0004
I35	I	I		0.0000	0.9999	0.0001
I36	I	I		0.0000	0.9995	0.0005
I37	I	I		0.0000	1.0000	0.0000
I38	I	I		0.0000	0.9994	0.0006
I39	I	I		0.0000	0.9996	0.0004
I40	I	I		0.0000	0.9916	0.0084
I41	I	I		0.0000	1.0000	0.0000
I42	I	I		0.0000	1.0000	0.0000
I43	I	I		0.0000	1.0000	0.0000
I44	I	I		0.0000	0.9996	0.0004
I45	I	I		0.0000	1.0000	0.0000
I46	I	I		0.0000	0.9927	0.0073
I47	I	I		0.0000	0.9048	0.0952
I48	I	I		0.0000	1.0000	0.0000

A=*Cuscuta attenuata*
I=*Cuscuta indecora* var. *indecora*
L=*Cuscuta indecora* var. *longisepala*

Discriminant Analysis Results (original data)

ID	From taxa	Into taxa		Posterior Probability of Membership in TAXA:		
				A	I	L
I49	I	I		0.0000	1.0000	0.0000
I50	I	I		0.0000	1.0000	0.0000
L01	L	L		0.0000	0.0000	1.0000
L02	L	L		0.0000	0.0026	0.9974
L03	L	L		0.1863	0.0000	0.8137
L04	L	L		0.0000	0.0000	1.0000
L05	L	L		0.0000	0.0009	0.9991
L06	L	L		0.0000	0.0000	1.0000
L07	L	L		0.0000	0.0000	1.0000
L08	L	L		0.0000	0.0963	0.9037
L09	L	L		0.0000	0.0000	1.0000
L10	L	L		0.0000	0.0001	0.9999
L11	L	L		0.0000	0.0095	0.9905
L12	L	L		0.0000	0.0000	1.0000
L13	L	L		0.0001	0.0012	0.9988
L14	L	L		0.0000	0.0000	0.9999
L15	L	L		0.0153	0.0000	0.9847
L16	L	L		0.0000	0.0003	0.9997
L17	L	L		0.0000	0.0000	1.0000
L18	L	L		0.0000	0.0000	1.0000
L19	L	L		0.0000	0.0040	0.9960
L20	L	L		0.0000	0.0000	1.0000
L21	L	L		0.0001	0.0041	0.9958
L22	L	L		0.0002	0.0000	0.9998
L23	L	L		0.0190	0.0021	0.9789
L24	L	A	*	0.5218	0.0019	0.4763
L25	L	I	*	0.0000	0.9746	0.0254
L26	L	L		0.0000	0.0000	1.0000
A01	A	A		0.9998	0.0000	0.0002
A02	A	A		1.0000	0.0000	0.0000
A03	A	A		1.0000	0.0000	0.0000
A04	A	A		0.9939	0.0000	0.0061
A05	A	A		0.9934	0.0000	0.0066
A06	A	A		1.0000	0.0000	0.0000
A07	A	A		1.0000	0.0000	0.0000
A08	A	A		0.7967	0.0000	0.2033
A09	A	L	*	0.0437	0.0002	0.9561

* misidentified

A=*Cuscuta attenuata*
I=*Cuscuta indecora* var. *indecora*
L=*Cuscuta indecora* var. *longisepala*

Discriminant Analysis Results
(modified data)

ID	From taxa	Into taxa	Posterior Probability of Membership in TAXA:		
			A	I	L
I01	I	I	0.0000	1.0000	0.0000
I02	I	I	0.0000	1.0000	0.0000
I03	I	I	0.0000	1.0000	0.0000
I04	I	I	0.0000	1.0000	0.0000
I05	I	I	0.0000	1.0000	0.0000
I07	I	I	0.0000	1.0000	0.0000
I08	I	I	0.0000	1.0000	0.0000
I09	I	I	0.0000	1.0000	0.0000
I10	I	I	0.0000	1.0000	0.0000
I12	I	I	0.0000	1.0000	0.0000
I13	I	I	0.0000	1.0000	0.0000
I14	I	I	0.0000	1.0000	0.0000
I16	I	I	0.0000	1.0000	0.0000
I17	I	I	0.0000	1.0000	0.0000
I18	I	I	0.0000	1.0000	0.0000
I19	I	I	0.0000	0.9996	0.0004
I20	I	I	0.0000	1.0000	0.0000
I21	I	I	0.0000	1.0000	0.0000
I22	I	I	0.0000	0.9954	0.0046
I23	I	I	0.0000	0.9997	0.0003
I24	I	I	0.0000	1.0000	0.0000
I25	I	I	0.0000	1.0000	0.0000
I26	I	I	0.0000	1.0000	0.0000
I27	I	I	0.0000	1.0000	0.0000
I28	I	I	0.0000	0.9998	0.0002
I29	I	I	0.0000	0.9308	0.0692
I30	I	I	0.0000	0.9999	0.0001
I31	I	I	0.0000	1.0000	0.0000
I32	I	I	0.0000	1.0000	0.0000
I33	I	I	0.0000	1.0000	0.0000
I34	I	I	0.0000	1.0000	0.0000
I35	I	I	0.0000	1.0000	0.0000
I36	I	I	0.0000	0.9993	0.0007
I37	I	I	0.0000	1.0000	0.0000
I38	I	I	0.0000	0.9999	0.0001
I39	I	I	0.0000	1.0000	0.0000
I40	I	I	0.0000	0.9997	0.0003
I41	I	I	0.0000	1.0000	0.0000
I42	I	I	0.0000	1.0000	0.0000
I43	I	I	0.0000	1.0000	0.0000
I44	I	I	0.0000	1.0000	0.0000
I45	I	I	0.0000	1.0000	0.0000
I46	I	I	0.0000	0.9983	0.0017
I47	I	I	0.0000	0.9903	0.0097
I48	I	I	0.0000	1.0000	0.0000

A=*Cuscuta attenuata*
I=*Cuscuta indecora* var. *indecora*
L=*Cuscuta indecora* var. *longisepala*

Discriminant Analysis Results
(modified data)

ID	From taxa	Into taxa	Posterior Probability of Membership in TAXA:		
			A	I	L
I49	I	I	0.0000	1.0000	0.0000
I50	I	I	0.0000	1.0000	0.0000
L01	L	L	0.0000	0.0000	1.0000
L02	L	L	0.0000	0.0064	0.9936
L03	L	L	0.0188	0.0000	0.9812
L04	L	L	0.0000	0.0000	1.0000
L05	L	L	0.0000	0.0001	0.9999
L06	L	L	0.0000	0.0000	1.0000
L07	L	L	0.0000	0.0000	1.0000
L08	L	L	0.0000	0.0149	0.9851
L09	L	L	0.0000	0.0000	1.0000
L10	L	L	0.0000	0.0001	0.9999
L11	L	L	0.0000	0.0096	0.9904
L12	L	L	0.0000	0.0000	1.0000
L13	L	L	0.0000	0.0028	0.9972
L14	L	L	0.0000	0.0000	1.0000
L15	L	L	0.0064	0.0000	0.9936
L16	L	L	0.0000	0.0001	0.9999
L17	L	L	0.0000	0.0000	1.0000
L18	L	L	0.0000	0.0000	1.0000
L19	L	L	0.0000	0.0003	0.9997
L20	L	L	0.0000	0.0000	1.0000
L21	L	L	0.0000	0.0013	0.9987
L22	L	L	0.0000	0.0000	1.0000
L23	L	L	0.0166	0.0001	0.9833
A24	A	A	1.0000	0.0000	0.0000
I75	I	I	0.0000	1.0000	0.0000
L26	L	L	0.0010	0.0000	0.9990
A01	A	A	1.0000	0.0000	0.0000
A02	A	A	1.0000	0.0000	0.0000
A03	A	A	1.0000	0.0000	0.0000
A04	A	A	0.9989	0.0000	0.0011
A05	A	A	1.0000	0.0000	0.0000
A06	A	A	1.0000	0.0000	0.0000
A07	A	A	1.0000	0.0000	0.0000
A08	A	A	0.9918	0.0000	0.0082
A10	A	A	1.0000	0.0000	0.0000

A=<u>Cuscuta</u> <u>attenuata</u>
I=<u>Cuscuta</u> <u>indecora</u> var. <u>indecora</u>
L=<u>Cuscuta</u> <u>indecora</u> var. <u>longisepala</u>

VITA

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Master of Science

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