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TAXONOMIC STUDIES IN THE VERBENA STRICTA COMPLEX

The University of Oklahoma PH.D. 1980

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

TAXONOMIC STUDIES IN THE *VERBENA STRICTA* COMPLEX

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

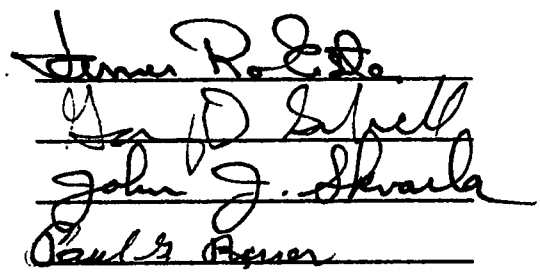
SUSAN CARROL BARBER

Norman, Oklahoma

1980

TAXONOMIC STUDIES IN THE VERBENA STRICTA COMPLEX

APPROVED BY



DISSERTATION COMMITTEE

PREFACE

This study employs various techniques in an effort to elucidate relationships within the Verbena stricta complex. The taxonomic decisions which were made are, as always, a matter of opinion; however, I feel that the data provided a basis on which to make objective decisions concerning the relationships of the taxa. The manuscript will be submitted for publication and is written in the format required for the American Journal of Botany. Citations to Barber (1980) refer to this dissertation.

First, special thanks is given to my major professor, Dr. James R. Estes, for his guidance and support throughout the course of this study. His opinions have often been invaluable.

I would like to express my appreciation to members of my committee, Dr. Gary D. Schnell, Dr. Paul G. Risser, Dr. John J. Skvarla, and Dr. Johnnie L. Gentry, Jr. for their advice and assistance during the course of study. My thanks goes especially to Dr. Gentry for his help in decisions which required intuitive taxonomic judgements, his encouragement, and his friendship during my PhD program at the University of Oklahoma.

My appreciation is also expressed to Dr. George J. Goodman for help with nomenclatural problems, to Dr. W. Ethen Perkins and Rahmona

Thompson for drawing the illustrations, to Joe Bruner, Jim Vaughn, and Bonnie Amos for extensive help with the collection of living materials to be used in the greenhouse experiments, to Varsha Patel and Bill Chissoe for their help with the SEM work, to Scott Collins for his theoretical opinions, and to Arthur Howard for his aid in cataloging the plants. Special thanks goes to Tom Antonio, my office mate, for his constant encouragement, friendship,and assistance during the course of study.

There are many others to thank, but the list becomes tedious so to all of my friends which have given me their encouragement, support, and ideas my most humble gratitude is expressed, especially to Dr. Jack W. Stanford who originally instilled in me a love for plants.

Finally, my deepest thanks is given to my parents, Raymond and Loreta Barber, for their continual support and sacrifices throughout my stay at the University of Oklahoma. Without their encouragement, understanding, and love this study would not have been possible.

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TAXONOMIC STUDIES IN THE *VERBENA STRICTA* COMPLEX

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ABSTRACT

Ten species of the genus *Verbena* and their putative interspecific hybrids form the *V. stricta* complex. Breeding studies, light and scanning electron microscopy of pollen and nutlets, and numerical methods based on morphological features were used to analyze natural hybridization and taxonomic boundaries within the complex. All species are self-compatible (4.9%-87.9% seed-set) and cross-compatible with *V. stricta*, but the greatest fertility from interspecific crosses was 55%. In most cases the natural seed-set was greater than that resulting from insect exclusion experiments. Morphologically, the species are discreet with the exceptions of the species pairs *V. halei-officinalis* and *V. lasiostachys-robusta*. The species are allogamous, cross-compatible, and often sympatric; therefore the potential for hybridization is great. Limited numbers of individuals are morphologically intermediate indicating a hybrid origin. However, introgression appears to be rare.

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(INTRODUCTION)

Verbena L. (Verbenaceae) is a complex New World genus of approximately 380 named taxa, including hybrids (Moldenke, 1961). The genus includes two sections Verbena and Glandularia with the latter section recognized as a segregate genus by Solbrig (1968) based in part on differing chromosome size and number. The section Verbena is further divided into two series Pachystachyae and Leptostachyae (Perry, 1933). The series Leptostachyae includes 24 species in North American including Verbena stricta. Based on herbarium specimens collected by Geyer, Engelmann (1844) proposed that interspecific hybrids occur within the series. Moldenke (1958) proposed names for 16 putative interspecific hybrids (Fig.1), many on the basis of single records. Ten species which are the putative parents of these hybrids and form the Verbena stricta complex, are widely distributed in North America north of Mexico and frequently coexist (Moldenke, 1958;and Perkins et al., 1975). Taxa within the complex also exhibit morphological overlap and are difficult to circumscribe (Perry, 1933). With extensive sympatry, confusing morphological types (including intermediate forms), and profusion of nomenclatural synonyms, the Verbena stricta complex was in need of a biosystematic and taxonomic investigation. Thus, the major goals of my study were to estimate the incidence of hybridization based on systematic and numerical analyses of the data and to provide a revision of the taxa of the complex.

METHODS AND MATERIALS--Living materials for reproductive studies were collected from 1976 to 1978 and grown in the University of Oklahoma greenhouse (see Appendix A of Barber, 1980). Voucher specimens are deposited in the Bebb Herbarium, University of Oklahoma (OKL) and the Oklahoma State

University Herbarium (OKLA).

Scanning electron microscopy and light microscopy--Pollen samples were taken from one herbarium sheet of each species and acetolyzed (Erdtman, 1960). One-half of each sample was mounted on a plug, sputter-coated with gold, and examined on a Super II-ISI scanning electron microscope(SEM). Aperture number and sculpturing of the exine was noted. The remaining portion of each sample was mounted on a glass slide with glycerine jelly and examined using a Zeiss light microscope. Polar and equatorial diameters of 10 pollen grains of each specimen were measured, P/E (polar axis/equatorial axis) indices were calculated, and size class determinations were made for each species.

Nutlets (when present) from every sampled herbarium specimen were measured and examined under a Wild Heerburg stereoscope and morphological differences were noted. A representative sample was then mounted on a plug, coated with gold, and examined on the SEM to determine differences in the morphological features of the outer and commissural faces of the nutlets.

Numerical techniques--Specimens were examined from the following institutions: Gray Herbarium (GH), Oregon State University Herbarium (OSC), Southern Illinois University Herbarium (SIU), University of California at Santa Barbara Herbarium (UCSB), University of Michigan Herbarium (MICH), Greene (NDG) and Nieuwland (ND) Herbaria, Louisiana State University Herbarium (LSU), Herbarium of Royal Botanic Gardens, Kew (K), Herbarium

of the University of California at Berkeley (UC), Jepson (J), Iowa State University (ISC), U.S. National Herbarium (US), John G. Searle Herbarium, Field Museum of Natural History (F), Missouri Botanical Garden (MO), University of Colorado Herbarium (COLO), University of Washington Herbarium (WTU), New Mexico State University Herbarium (NMC), California State University at Chico (CHSC), University of Minnesota Herbarium (MIN), University of Tennessee Herbarium (TENN), University of Arizona Herbarium (ARIZ), University of Georgia Herbarium (GA), Rocky Mountain Herbarium (RM), Intermountain Herbarium (UTC), California State Polytechnic University at Pomona Herbarium (CSPU), Rancho Santa Ana Botanic Garden Herbarium (RSA), University of North Carolina Herbarium (NCU), Herbarium of Philadelphia Academy of Science (PH), Oklahoma State University (OKLA), and Robert Bebb Herbarium (OKL).

Fourty-four morphological characters (Table 1) were measured on 2,006 specimens (see Appendix B of Barber, 1980). These sheets were selected by sorting the specimens into groups from 300 km/side quadrats superposed on the range of the complex to represent the variation across the geographic ranges of the complex and each species. I attempted to select 30 samples/quadrat; however, most often 30 or more were unavailable. If more than 30 were available (7 out of 87 quadrats), I selected 30 specimens to measure. Specimens were measured from the United States only. Simple statistics of the quantitative characters of the quadrats used in numerical analyses were calculated and are listed in Appendices C and D of Barber (1980). Four data matrices were generated: (1) 44 character by 87 operational taxonomic unit (OTU) matrix where the OTU's are represented by the means

of the quadrats of the sampled specimens of the 10 taxa; (2) 44 character by 150 OTU matrix with putative hybrids (Appendix E, Barber, 1980) included in addition to the above data set: (3) 44 character by 100 OTU matrix where individual sheets of V. halei, V. officinalis, V. robusta, and V. lasiostachys represent the OTU's' and (4) 44 character by 10 matrix of the grand means of characters for each species in the complex.

Various multivariate analyses of the data were conducted on an IBM/370-158 computer using the NT-SYS package of Rohlf, Kishpaugh, and Kirk (1974) at the University of Oklahoma. Pearson product-moment correlation and average taxonomic distance coefficients were used for comparison of the OTU's (Sneath and Sokal, 1973). Two resemblance matrices were constructed -- one for standardized data and another for raw data. Phenograms were then generated by the unweighted pair group method using arithmetic averages (UPGMA) (Sneath and Sokal, 1973). Cophenetic correlation coefficients were calculated to measure the agreement between the values of each phenogram and its original similarity matrix. A product-moment correlation matrix of characters was also computed and subjected to principal components analysis (PCA)(Sneath and Sokal, 1973) and the OTU's projected in a three-dimensional model. In addition, discriminant functions were calculated for two data sets (one with quantitative data only and one with both the quantitative and qualitative characters) using the SAS computer package of Barr, Goodnight, Sall, and Helwig (1976) at the University of Oklahoma. Using discriminant function analysis the probability that each OTU belonged to its assigned species was computed. Sneath and Sokal (1973) have indicated several

problems with discriminant analysis, the two most important are that (1) the analysis assumes that all of the clusters have the same size, shape, and orientation in phenetic space; and (2) the clusters have multivariate normal distributions. Data analyzed in numerical taxonomic studies often do not fit these criteria.

Reproductive systems--Most of the experiments were conducted in the greenhouse and a natural population at the corner of 48th Avenue Southeast and Cedar Lane in Norman, Cleveland County, Oklahoma. In addition, I studied a population of V. stricta and V. halei at Fobb Bottom (Texoma Public Hunting Area) about 1.5 km west of Willis, Marshall County, Oklahoma in the summer of 1977. Limited observations were also made at other areas (see Appendix A of Barber, 1980).

To test the capacity for autogamy and agamospermy spikes with unopened flowers were enclosed in parchment bags in the field or plants were left to set seed in the greenhouse. Spikes of additional plants were exposed to pollinators and treated as controls.

I performed 388 interspecific hybridizations utilizing 150 flowers of V. stricta as the pistillate parent and 150 flowers of other members of the complex as the staminate parent. The reciprocal crosses were not performed because of the limited availibility of flowers from species other than V. stricta and the difficulty in crossing. The stamens are epipetalous so the pollen receptive parent was emasculated by removing the corolla. Verbena stricta has the largest flowers among the species in the complex

and the calyx does not close during the period necessary to make the cross, while in other species it does close, making it virtually impossible to transfer pollen.

RESULTS AND DISCUSSION--Light and Scanning Electron Microscopy--

The mean polar diameters and the mean equatorial diameters are 31-49 μm and 34-49 μm respectively for the ten species (Table 2). Erdtman (1969) describes five shape classes for pollen grains based on the P/E index. All of the shapes calculated for the examined Verbena pollen are subdivisions of Erdtman's major shape class, subspheroidal. Only slight variability in the shape of the pollen grains exists within the complex (Table 2). The exine sculpturing is also uniform throughout the complex; smooth exine and tricolporate (Fig. 2-1). Although the pollen analysis is not useful in delimiting species of the complex, this is the first report of their size and surface morphology for these ten species.

Whiffen and Tomb (1972), Crow (1979) and others (reviewed by Crow) have demonstrated the importance of seed morphology as an aid in determining relationships within various taxonomic groups. The seed surface features have proven especially useful as indicators of taxonomic boundaries. Further, the technique of examination of seeds using a scanning electron microscope is now often utilized to describe diagnostic seed characters within closely related groups. I examined the outer surfaces and commissural faces of the nutlets of the complex. The outer surfaces were glabrous and ridged in all species and lacked discriminant

patterns (Fig. 2-2). However, the commissural faces of the nutlets exhibited discontinuous intertaxon variability with almost no intrataxon variation (Fig. 2-3 to 6 and Fig. 3). The surface morphology of the faces is glabrous in V. urticifolia (Fig. 3-1) and V. hastata (Fig. 3-2); papillate in V. bracteata (Fig. 3-6), V. robusta (Fig. 2-6), and V. officinalis (Fig. 2-4); tortuous in V. neomexicana (Fig. 3-3); bullate in V. lasiostachys (Fig. 2-5) and V. stricta (Fig. 3-4); verrucate in V. simplex (Fig. 3-5); and saginoid in V. halei (Fig. 2-3). These surface types appear constant for each species, with the exception that occasionally one of the specimens has a glabrous surface instead of its more characteristic surface type. This occured most often in V. stricta.

Numerical analysis--Distance and correlation phenograms for the 10 species of the Verbena stricta complex were constructed based on character means for each taxon from each quadrat. The phenograms produced were almost identical, and only the phenogram from the correlation matrix (Fig. 4) will be discussed. The cophenetic correlation coefficient was 0.947 which indicates that most of the variation was explained. There are three major clusters: BRACT01-LASI003 (Group I), STRIC01-STRIC15 (Group II), and HASTA01-SIMPX08 (Group III). Within Group I there are six distinct subclusters, each representing a separate taxon: (1) BRACT01-BRACT10 represents OTU's of V. bracteata, (2) ROBUS01-ROBUS03, V. robusta OTU's, (3) NEOMX01-NEOMX05, V. neomexicana OTU's, (4) HALEI01-HALEI07, V. halei OTU's, (5) OFFIN01-OFFIN05, V. officinalis OTU's, and (6) LASI001-LASI003, V. lasiostachys OTU's. The subclusters within Group I exhibit very little intragroup variability and, in general, form discreet groups at a high

CORRELATION LEVEL (0.8 or greater). The exceptions are OFFINO4, and V. neomexicana and V. lasiostachys which exhibit intrataxon variability in that they cluster at the 0.6 level or greater. Group II consists entirely of V. stricta OTU's. Group III is defined by three subclusters each representing a species: (1) HASTAO1-HASTA12 represents V. hastata OTU's, (2) URTICO1-URTIC10, V. urticifolia OTU's and (3) SIMPXO1-SIMPXO8, V. simplex OTU's. Again little intraspecific variability is noted as most of the OTU's are correlated at approximately the 0.8 level, except V. urticifolia OTU's which indicates some variability in that the OTU's cluster at the 0.6 level. All 10 taxa form discreet subclusters again with the exception of V. halei and V. officinalis.

Principal components analysis of characters yielded 10 components with eigenvalues greater than one (92.4% of trace) indicating that the characters are not highly correlated. The first three components had eigenvalues greater than 5 and accounted for 56.5% of the variance (Table 3). Component I is essentially a pubescence and general size component with correlations greater than 0.5 for plant height, petiole length, leaf length, corolla limb pubescence, glabrous nutlet, leaves with scattered hairs, and calyx with scattered hairs. It separates the smaller V. halei , V. officinalis, V. bracteata, V. neomexicana, V. lasiostachys, and V. robusta group from V. hastata, V. urticifolia, V. simplex, and V. stricta. Component II has loadings greater than 0.5 for petiole length, number of leaf clefts, leaf cleft length, glabrous corolla, and papillate nutlet. This component further separates the OTU's with long petioles (V. hastata, V. urticifolia, and V. simplex) from

the other taxa. Component III has its highest correlations with spike length, leaf width, pilose stems, and pilose leaves. This component separates the long-spicate, pilose V. lasiostachys from the other taxa.

The matrix correlation comparing the euclidean distance matrix of the model with the standardized distance matrix was 0.912 indicating that the resulting 3-D model (Fig. 5) is an accurate representation of the original data matrix. There are three groups formed when the data are subjected to PCA. Group 1 consists of V. bracteata, V. lasiostachys, V. halei, V. neomexicana, V. officinalis, and V. robusta. Group 2 consists of V. simplex, V. hastata and V. urticifolia. Group 3 is represented by V. stricta OTU's. Within 2 and 3 separation of the species can be most easily noted along Component III.

In summarizing the analysis of the 10 species, the cluster and principal component analysis show that there are three major groups of OTU's. The first group consists of six taxa: (1) V. bracteata, a subgroup which appears to be the most isolated of the six in Group 1, (2) V. halei, (3) V. officinalis, (4) V. robusta, (5) V. lasiostachys, and (6) V. neomexicana. The second cluster group includes three species: (1) V. simplex, a subgroup of the other two taxa, (2) V. hastata, and (3) V. urticifolia. Finally, V. stricta is separated from the remainder of the taxa in the complex. The numerical analysis of the complex yields groups which can be recognized.

Upon casual observation during pre-sorting of the specimens it

became apparent that the species were not morphologically discreet, but rather (1) two pairs of taxa (Verbena halei-officinalis and V. lasiostachys-robusta) within the complex exhibit internal morphological continuity and (2) occasional intermediates unite Verbena stricta and the remainder of the taxa. For one of the pairs, Perry (1933) stated that Verbena halei is closely related to V. officinalis, but is easily distinguished by the somewhat more slender nutlets. In addition she indicated for the second pair that V. lasiostachys closely resembles V. robusta, but is delimited on the basis of its decumbent habit, soft villous pubescence and elongated spikes whereas V. robusta is coarser and greener. These features did not appear to be consistent. Therefore, I hypothesized that V. halei-officinalis and V. lasiostachys-robusta comprised two species instead of four. To test this hypothesis, I subjected these four inclusive taxa to various numerical analyses.

Phenograms were generated from the correlation and distance matrices between OTU's. Since results were virtually identical, only the correlation phenogram (Fig. 6) will be discussed. The cophenetic correlation coefficient was 0.836. There are two major clusters, HALEI01-OFFIN23 including the V. halei and V. officinalis OTU's and ROBUS01-LASI011 including the V. robusta and V. lasiostachys OTU's. Within the upper cluster there are nine major subclusters above the 0.3 correlation level (HALEI01-OFFIN11, HALEI02-OFFIN20, HALEI03-HALEI24, HALEI12-HALEI20, OFFIN05-OFFIN17, OFFIN09-OFFIN10, HALEI18-OFFIN18, OFFIN22-OFFIN24, and OFFIN01-OFFIN23). Many of the V. halei OTU's comprise the third subcluster and the majority of the V. officinalis

OTU's occur in the ninth subcluster. However, the two taxa do not clearly separate within the remaining subclusters. The slight segregation apparent in Fig. 4 tends to disappear when individual specimens rather than quadrat means are used as OTU's. Within the lower cluster are 2 subclusters of OTU's with correlation greater than 0.2 (ROBUS01-ROBUS09 and ROBUS13-LASI011). Verbena lasiostachys and V. robusta form two discreet subclusters with the exception of ROBUS12 which is not closely correlated with either subcluster and ROBUS13 which occurs with the V. lasiostachys OTU's.

Principal components analysis of characters yielded 13 components with eigenvalues greater than one (83.7%of trace) indicating that the characters are not highly correlated (Table 4). The first 3 factors had eigenvalues greater than 3 accounting for 38.6% of the variation. For Component I the characters with loadings greater than 0.5 (Table 4) reflect both quantitative vegetative variation such as leaf length (0.508) and qualitative variation such as pilose leaves (0.794). However, qualitiative reproductive characters also have high loadings: bract length (0.515) and pilose calyx (0.826). This component separates the pilose V. lasiostachys-robusta group from the hirsute V. halei-officinalis group. Components II and III have no loadings greater than 0.5 except for bullate nutlets in Component II which somewhat separates V. lasiostachys and V. robusta.

The factor matrix was used to generate a projection matrix which generated a euclidean distance matrix to produce three-dimensional

models (Fig. 7). The matrix correlation comparing the euclidean distance matrix with the standardized distance matrix was 0.933 indicating that the 3-D model (Fig. 7) is an accurate representation of the original distance matrix. There are two major groups produced when the data are subjected to PCA (Fig. 7). Group I consists of V. halei and V. officinalis OTU's. The distributions of the two taxa are very similar along all three axes indicated by the close clustering of the OTU's. Group II is represented by V. robusta and V. lasiostachys OTU's. They also exhibit similar distributions with respect to Components I and III; however, along the axis of component II a continuum of OTU's is revealed. The separation, however, does not form 2 discreet groups, but rather a continuum of OTU's from V. lasiostachys to V. robusta.

Discriminant function analysis was performed in an effort to determine if a taxon assigned to a specific group actually belongs in that group. The OTU's of V. halei and V. officinalis with less than 90% probability of belonging to a different class are given in Table 5 and assigned to a different class if warranted. In most cases with the V. halei and V. officinalis OTU's there was some affinity with the other species, but the probability of belonging to the other species was generally less than 10%. On the other hand HALEI21 has a 0.2872 probability of belonging to V. officinalis. I still consider it to be a member of the V. halei group, but with some affinities with V. officinalis. Other observations indicate misidentifications of OTU's, i.e. they were probably assigned to the wrong species. For example OFFIN36 has a 0.5292 probability

of belonging to the taxon V. halei and a 0.4708 probability of being a member of V. officinalis; therefore, based on the analysis I regrouped OFFIN36 to V. halei. There was only one misidentification among the V. lasiostachys-robusta OTU's with the 100% probability that ROBUS35 belongs to V. lasiostachys.

The analysis was recalculated on a data set containing quantitative data only since it is more likely that these data correspond more closely to normality. Results were different from those based on both quantitative and qualitative data. The OTU's with less than 90% probability of membership in the preassigned species are listed in Table 6. Note that OFFIN36 discussed above has a 100% probability of belonging to V. officinalis using this data set. However, there are now more members of the V. lasiostachys-robusta group that do not have the strict 100% probability of belonging to its preassigned taxon.

In summarizing the findings for V. halei, V. officinalis, V. lasiostachys, and V. robusta the numerical analysis indicates the congruence of V. halei and V. officinalis: (1) they cluster closely; (2) in PCA it is virtually impossible to separate the OTU's, and (3) discriminant function analysis shows their close relationship. In the case of V. lasiostachys and V. robusta the taxa separate in cluster analysis and can be distinguished in the 3-D model, but only as the extremes along a continuum of the OTU's. In the phenogram for the 10 species (Fig. 4), V. bracteata and V. robusta cluster more closely than V. robusta and V. lasiostachys. However, intrataxon variability for V. robusta and V. lasiostachys is low as all of the OTU's within each

taxon are joined above the 0.7 phenon level and neither group is closely correlated to other groups. Subspecies need not cluster if intrataxon variability is low and the other members of the clusters form a continuum. It is important to note that clusters are formed in the process and continuous variation may be obscured and PCA may give a clearer analysis of continuous variation. In PCA of the 10 species (Fig. 5), however, V. robusta (c) falls between V. bracteata and V. lasiostachys. Verbena robusta diverges from V. bracteata along Components II and II and from V. lasiostachys along Components I and III. All seem to be components of a closely related subset.

Jensen and Eshbaugh (1976a,b) analyzed hybridization in oaks utilizing numerical methods. The intent of their analyses using both cluster and principal components analysis was to gain insight into the probable parentage of hybrids. These techniques were also used in this study to test the hypothesis that interspecific hybridization occurs in the complex.

Phenograms were generated for the ten species plus the twenty-four hybrids from the correlation and distance matrices of OTU's. The portions of the correlation phenogram which includes most of the hybrids (Figs. 8 and 9) will be discussed. The cophenetic correlation coefficient was 0.837 explaining 70.1% of the variance. Jensen and Eshbaugh (1976a) indicated that hybrids have a strong tendency to cluster with one of their putative parents. This phenomenon appears to be generally true of hybrids in the Verbena stricta complex. For all hybrids represented

in Fig. 8 except HYBRD20, V. stricta has been postulated to be one of the putative parents (Moldenke, 1958) all cluster with that species. The postulated parents for HYBRD20 are V. Hastata and V. simplex. In Fig. 9 HYBRD06, HYBRD07, and HYBRD05 cluster with V. urticifolia one of the putative parents. HYBRD19 and HYBRD04 cluster with V. hastata a putative parent of the two hybrids. Putative parents for HYBRD01 are V. hastata and V. stricta and for HYBRD08 are V. hastata and V. urticifolia.

Probable parentage may also be predicted examining a similarity matrix (Table 7). HYBRD01 has as its putative parents V. hastata and V. stricta. In the cluster analysis it joined with V. hastata and V. urticifolia and the mean similarity is higher for V. urticifolia than either putative parent; therefore I propose that HYBRD01 is more likely a hybrid between V. hastata and V. urticifolia. Also, it could be of trihybrid origin. HYBRD03 clusters with V. stricta (Fig. 8) and has a high similarity coefficient with V. stricta (0.418), however, the similarity coefficients for V. urticifolia and V. hastata are very close so three parents are possible: V. stricta, V. hastata, and V. urticifolia. The same situation exists for HYBRD16 with three possible parents: V. stricta, V. bracteata, and V. lasiostachys. However, V. lasiostachys does not occur in Illinois, the collection site for HYBRD16, therefore its origin is problematic. HYBRD06 and HYBRD08 cluster with V. urticifolia and have high similarity coefficients with V. hastata and V. urticifolia. These are the two putative parents for the hybrids and they are probably crosses between the two species. HYBRD14 is a purported hybrid between V. stricta and V. simplex. However, since HYBRD14 has a negative correlation with

V. stricta, this species is probably not in its pedigree. HYBRD18, HYBRD20, and HYBRD21 fit the situation discussed for HYBRD01 where a similarity coefficient is higher with a species that is not a putative parent than with both that are putative parents and are probably misidentified.

The first 10 components in PCA of all characters gave eigenvalues of greater than one (79.8% of variation) again showing that the characters are not highly correlated (Table 8). The first three components had eigenvalues greater than 0.4 yielding 47.2% of the trace.

The first component has its highest correlation with plant height (0.565), corolla with pubescent limb (0.546), and hirsute stem (0.513) (Table 8). On the second component most of the characters with high loadings are quantitative and qualitative leaf characters and the third component summarizes the variation of plant height (0.624), spike length (0.586), and leaf width (0.507). The matrix correlation comparing the euclidean distance matrix with the standardized distance matrix in this analysis was 0.831.

When subjected to PCA (Fig. 10), the three major groups of OTU's discussed previously can be distinguished. The hybrids (represented by the OTU's within the broken line) close the gaps between the groups. Special note is made that most of the hybrid OTU's are intermediate between Group 2 (*V. simplex*, *V. urticifolia*, *V. hastata*) and Group 3 (*V. stricta*), the species most often involved in hybridization.

Goodman (1967) and Sneath and Sokal (1974) have shown that discriminant analysis is useful in categorizing hybrids. The analysis will place the hybrid with some group; however, the probability of misclassification of the hybrid can be determined using a posteriori probabilities. The more distant a taxon is from the centroid of the group, the less the probability that it actually belongs to that group and that it is a member of another group. If a taxon has any probability of belonging to two groups, then possible hybrid origin may be assumed. When discriminant function analysis was performed on the hybrids, only HYBRD02 had the probability of belong to V. hastata (47% change) or V. stricta (53% chance). All other hybrid OTU's were situated near (90% chance or greater) the centroid values of one group or another indicating that perhaps they are not of hybrid origin.

There are two plausible explanations for these results. Goodman (1967) stressed the importance of normally distributed characters as did Sneath and Sokal (1973). Taxonomic data often are not normally distributed. Perhaps this fact would function in part to produce results that appear non-supportive of the principal components and cluster data. However, another possible explanation is related to the degree of closeness of the groups formed in the discriminant analysis. The Verbena stricta complex is a closely related group of taxa with the centroids of each taxon near each other. Since one would not necessarily expect exact morphological intermediates, the probability would be high that an unknown OTU would fall near the centroid of one group indicating non-hybrid origin when in fact the OTU is a hybrid, but not a morphological intermediate.

Breeding systems-- The numerical analyses suggest that hybrids can and do exist in the Verbena stricta complex, but studies of the breeding systems were conducted in an effort to correlate morphological information with breeding system data.

Perkins et al. (1975) studied in the pollination ecology of four sympatric species of the complex in southern Oklahoma (V. stricta, V. bracteata, V. halei, and V. urticifolia). They found that V. stricta is primarily allogamous. The other three form a series of increasing autogamy: V. bracteata, V. halei, and V. urticifolia. Verbena stricta was also visited by the greatest number and diversity of floral visitors and shared the greatest number and diversity of floral visitors with the other species. These authors also determined that V. stricta is genetically compatible with the remaining species, but seed set in interspecific crosses is greatly reduced. On the basis that V. stricta is allogamous and shares pollinators and that the others are autogamous, Perkins et al. (1975) concluded that V. stricta is more likely to enter interspecific hybridizations.

The floral morphology of the members of the complex (Fig. 11) suggest that self-fertilization is less likely to occur in V. stricta (Fig. 11-3) because the anthers are 2 mm above the stigma and the pollen remains at that level. The distal one-third of the tube is nearly horizontal which prevents pollen from falling on the stigma. The dense hairs at the throat of the corolla apparently also function to prevent self-pollination. V. stricta also has male sterile plants which completely prohibits autogamy in those individuals. Spatial separation of anthers

and stigmas is less in other species as illustrated by V. urticifolia (Fig. 11-1) and V. halei (Fig. 11-2). Also the distal portion is not horizontal, therefore indicating that autogamy is more likely to occur (cf. Perkins et al., 1975).

Table 9 summarizes percent seed-set of my insect exclusion experiments. The low numbers in V. stricta, V. neomexicana, and V. simplex are predictable. All have larger flowers and a stricta-type floral morphology to prevent selfing. The low seed-sets in V. urticifolia, V. lasiostachys, and V. robusta were not expected as their floral morphology is apparently conducive to selfing. They have very small flowers and anthers near the stigma. Whether these results are reflective of the breeding system or an artifact is unclear. Perkins et al. (1975) did find that V. urticifolia had a high seed-set in their autogamy experiments (47.3%). Verbena halei and V. bracteata were autogamous which was a predictable result on the basis of their floral morphology and follows the results of the experiment by Perkins et al. (1975).

Seed-set via allogamy is greater than that through autogamy for all of the species on which both sets of experiments were conducted. The fact that the species produce more seeds when left to open pollination than when insects are excluded leads to the conclusion that the species set at least some seed via allogamy. Therefore the possibility for hybridization definitely exists in areas of sympatry most especially in areas where V. stricta occurs as it shares the greatest number of pollinating taxa with other members of the complex.

Interspecific crosses were conducted in an effort to determine if F_1's can be produced. The results are summarized in Table 10. Although potential for hybridization is present, genetic incompatibility mechanisms must exist because the interspecific fertilizations do not approach that of the open controls with the greatest seed-set being 55% for V. stricta x V. neomexicana.

TAXONOMY OF THE VERBENA STRICTA COMPLEX

According to Moldenke (1958) the Verbena stricta complex is compromised of 10 closely related taxa. On the basis of the data presented in this study, I conclude that six of these taxa are discreet species: Verbena bracteata, V. neomexicana, V. simplex, V. urticifolia, V. hastata, and V. stricta. The remaining four species named constitute two species pairs, V. halei-officinalis and V. lasiostachys-robusta. Small recognized V. halei in 1898, prior to that time both phenodemes were included in the Linnaean V. officinalis. He distinguished the two on the basis of nutlet length. He considered Verbena halei and V. officinalis to be sympatric in Florida, Georgia, and South Carolina, however, V. officinalis is of European origin and is naturalized in the United States along the Atlantic seaboard states, whereas V. halei is native to the southeastern United States. On the basis of numerical analysis, V. halei and V. officinalis cannot be separated. Moldenke (1958) named putative interspecific hybrids between the two taxa. As hybrids have been named and the two are very closely related morphologically, I feel that the two taxa are one species with each taxon representing a subspecies; plants with papillate commissural faces represent subspecies officinalis and plants with saginoid

commissural faces represent subspecies halei. The resultant species exhibits an interesting distributional pattern with subspecies halei of New World origin ad subspecies officinalis from the Old World. Raven and Axelrod (1974) indicated that subfamily Verbenoideae, which includes the genus Verbena, has an appreciable Laurasian element. With the evidence of Raven and Axelrod (1974) there is a plausible explanation for the distributions of the two subspecies. Verbena officinalis probably evolved prior to the split of Laurasia in the Northern Hemisphere and subsequently subspecies officinalis evolved in Europe and subspecies halei evolved in North America. Radiation however was slight. The weedy taxon subspecies officinalis was then introduced into the United States.

The other species pair in question is the Verbena lasiostachys-robusta group. When the numerical data are assessed the arguments for merging these two taxa are weaker than for the previous pair. The two taxa separate in cluster analysis and can be distinguished in the 3-D model; although there is a continuum of OTU's in the latter. Typical V. robusta has hirsute and scabrous leaves and short spikes whereas V. lasiostachys has pilose leaves with relatively longer spikes. However, there is an array of intermediates uniting the two, including plants with both pilose and scabrous leaves. The argument for merging these two into one species including two subspecies does not diminish when distribution is considered. Verbena lasiostachys occurs from southern Oregon (Fig. 12) throughout California while V. robusta has a narrow distribution of southern California and Baja California (Fig. 12). V. robusta is poorly collected and most sheets are from Santa Catalina Island, Los Angeles County. Verbena lasiostachys subspecies robusta may have evolved on the island

after the islands separated from the mainland with subsequent reinvasion of the mainland. Because variation is continuous as shown by the OTU's in the PCA and V. robusta is a narrow endemic which occurs within the range of the more widespread V. lasiostachys, I recommend that V. robusta should be considered a subspecies of V. lasiostachys.

Following are the keys and descriptions which are based on the recommendations outlined above.

KEYS AND DESCRIPTIONS TO THE VERBENA STRICTA COMPLEX

Perennial herbs; erect (except V. bracteata); 9-150 cm tall; leaves opposite, often pinnatifid, 7-115 mm long, 2-60 mm wide; inflorescence spicate, terminal, mostly densely flowered; 4-90 cm long; 2-10 mm wide; flowers subtended by bracts 1-11 mm long; calyx tubular, 5-angled, 1-6 mm long, corolla slightly zygomorphic with 5 lobes, salverform or funnel form, tube straight or curved, 2-8 mm long; stamens 4, didynamous, inserted on the upper half of the corolla tube; ovary 2-carpellate, 4-celled; fruit of four nutlets. Chromosome number n=7 with one report of n=14 in V. bracteata (Solbrig, 1959).

1. Bracts longer than the calyx tube, reflexed at maturity; plants prostrate. . . . . 1. V. bracteata
1. Bracts equal to or shorter than the calyx tube, not reflexed at maturity; plants erect (sometimes spreading).
    2. Lower leaves pinnatifid or cleft
        3. Stems glabrous or occasionally with scattered hairs . . . . . .2. V. officinalis

3. Stems densely pubescent

    4. Corolla tubes 4-7 mm long; spikes loosely flowered; nutlets 2-3 mm long . . . . . 3. V. neomexicana

    4. Corolla tubes 2-5 mm long; spikes densely flowered; nutlets 1.5-2 mm long . . . . . 4. V. lasiostachys

2. Lower leaves dentate or serrate, but not cleft (occasionally one lobe present)

    5. Leaves sessile, densely pubescent; corolla tubes 4-9 mm long, corolla limb width greater than 7 mm....5. V. stricta

    5. Leaves petiolate, with scattered hairs; corolla tubes 1-6 mm long, corolla limb width less than 7 mm

        6. Nutlets 2-3 mm long, pubescent; leaves linear to lanceolate, much longer than broad; plants less than 75 cm tall . . . . . .6. V. simplex

        6. Nutlets 1-2 mm long, glabrous; leaves broadly lanceolate to ovate; plants generally over 75 cm tall

            7. Corolla tubes 1-2(3) mm long, spikes 1-2 mm wide . . . . . 7. V. urticifolia

            7. Corolla tubes 2-5 mm long; spikes 2-5 mm wide . . . . . 8. V. hastata

1. Verbena bracteata Lag. & Rodr. Anal. Ciene. Nat. 4: 260. 1801.

Synonyms:

V. bracteosa Michx.

V. squarrosa Roth

V. canescens Chapman

V. bracteosa var. brevibracteata Gray

V. rudis Greene

V. confinis Greene

V. bracteosa var. albiflora Cockerell

V. imbricata Wooton & Standley

Zapania bracteosa Poir.

Prostrate perennial, 9-55 cm tall; stems hirsute; leaves 8-55 mm long, 4-28 mm wide, usually 3-lobed with clefts to 18 mm, narrowed into a petiole 2-20 mm long, hirsute; spike 5-15 cm long, 2-10 mm wide; bracts longer than the calyx 4-11 mm long, reflexed at maturity, hirsute; calyx 2-4 mm long, hirsute; corolla tube 2-8 mm long, limb 3 mm wide, glabrous or with a pubescent limb; nutlet 2 mm long, papillate commissural surface.

Distribution: Disturbed areas throughout North America.

Flowering Time: April-October

2. Verbena officinalis L. Sp. Pl. 20. 1753.

Synonyms:

V. spuria L.

V. domingensis Urb.

V. leucanthemifolia Greene

V. halei Small

Erect annual, or weakly perennial, 22-90 cm tall; stems glabrous or essentially so; leaves 15-70 mm long, 2-40 mm wide, pinnatifid, clefts to 25 mm long, narrowed into a petiole 3-40 mm long, hirsute; spike 4-38 cm long, 2-8 mm wide; bracts 1-3 mm long, hirsute; calyx 1-4 mm long, hirsute or glandular; corolla tube 2-7 mm long, 5-7 mm wide, glabrous to sparsely pubescent; nutlet 2 mm long, papillate or saginoid commissural surface.

2 subspecies are included:

Calyx glandular; commissural seed surface papillate . subsp. officinalis

Calyx hirsute; com missural seed surface saginoid . . subsp. halei

(Small) Barber, n. comb. (V. halei Small, Bull. Torr. Bot. Club 25: 617. 1898)

Distribution: Subsp. officinalis: Disturbed areas, Old World, Atlantic States, Washington and Oregon (Fig. 12)

subsp. halei Southeastern United States (Fig. 12)

Flowering Time: March-July

3. Verbena neomexicana (Gray) Small Fl. Southeast. U. S. ed. 1: 1010. 1903 and ed. 2 1913.

Synonyms:

V. canescens var. neomexicana Gray

V. officinalis var. hirsuta Torr.

Weakly perennial; 10-71 cm tall; stems hirsute; leaves 7-60 mm long, 2-30 mm wide, usually with clefts to 2 mm long, hirsute; spike 4-29 cm. long, 2-7 mm wide; bracts 2-5 mm long, hirsute;

calyx 2-5 mm long, hirsute; corolla tube 3-7 mm long, limb 2-7 mm wide, glabrous to sparsely pubescent; nutlet 2 mm long, tortous commissural surface.

Distribution: Texas, New Mexico, and Arizona (Fig. 13).

Flowering Time: April-August

4. Verbena lasiostachys Link Enum. Hort. Berol. 2: 122. 1822.

Synonyms:

V. prostrata R. Br.

V. robusta Greene

Erect to spreading perennial, 17-115 cm tall; stems hirsute or pilose; leaves 15-110 mm long, 8-60 mm wide, usually with 2-10 clefts, up to 20 mm long, narrowed into a petiole 2-35 mm long, hirsute, scabrous and/or pilose; spikes 4-34 cm long, 3-10 mm wide; bracts 1-4 mm long, hirsute or pilose; calyx 2-4 mm long, hirsute or pilose; corolla tube length 2-5 mm long, limb 3-5 mm wide, variously pubescent; nutlet 1-1.5(2) mm long, papillate or bullate commissural surface.

2 subspecies are included:

Pubescence pilose, commissural seed surface bullate . . . . . .subsp. lasiostachys

Pubescence hirsute and/or scabrous, commissural seed surface papillate. . . . . subsp. robusta (Greene) Barber, n. comb.

(V. robusta Greene, Pittonia 3: 309. 1898)

Distribution: subsp. lasiostachys: Southern Oregon and California

(Fig.12)

subsp. robusta: Southern California and Baja California (Fig. 12)

Flowering Time: May-August

5. Verbena stricta Vent. Hort. Cels. 53, pl. 53. 1800.

Synonyms:

V. alopecurus Cav.

V. rigens Michx.

V. cuneifolia Raf.

V. stricta var. mollis Torr.

V. mollis Raf.

V. stricta f. roseiflora Benke

V. stricta f. albiflora Wadmond

Perennial, 29-90 cm tall; stems tomentose; leaves 30-100 mm long, 14-50 mm wide, usually sessile, occasionally with petiole to 10 mm long, densely hirsute-tomentose; spike 4-43 cm long, 3-9 mm wide; bracts 3-6 mm long, hirsute; calyx 3-6 mm long, hirsute; corolla tube 4-8 mm long, limb 7-9 mm wide, hirsute; nutlet 2-3 mm long, bullate commissural surface.

Distribution: Eastern and Central United States to Rocky Mountains. Reported from E. Washington and W. Idaho, where it is probably introduced. (Fig. 14)

Flowering Time: June-September

6. Verbena simplex Lehm. Sem. Hort. Hamb. 17. 1825; in Nova Acta K.

Acad. Leop. (Pubill. Pl. 1: 37) 14: 824. 1828; Linnaea 3: Litt.-Ber. 10. 1828.

Weakly perennial, 21-72 cm. tall; stems sparsely pubescent; leaves 20-80 mm long, 3-15 mm wide, narrowed into a petiole to 20 mm long, sparsely pubescent; spike 5-25 cm long, 2-5 mm wide; bracts 2-6 mm long, sparsely pubescent; calyx 3-6 mm long, sparsely pubescent; corolla tube 3-6 mm long, limb 4-6 mm wide, glabrous or with a pubescent limb; nutlet 2-3 mm long, verrucate commissural surface.

Distribution: Eastern United States west to Nebraska (Fig. 14).

Flowering Time: May-September

7. Verbena urticifolia L. Sp. Pl. 20. 1753.

Synonyms:

V. diffusa Pir.

V. diffusa Desf. ex Spreng.

V. urticifolia var. simplex Farwell

Perennial, 33-140 cm tall; stems sparsely pubescent; leaves 40-110 mm long, 15-60 mm wide, petiole to 30 mm long, sparsely pubescent; spike 8-90 cm long, 1-3 mm wide; bracts 1 mm long, sparsely pubescent; calyx 1-3 mm long, sparsely pubescent; corolla tube 1-3 mm long, limb 1-2 mm wide, glabrous or with a pubescent limb; nutlet 1-2 mm long, glabrous commissural surface.

Distribution: Eastern United States west to Nebraska (Fig. 13).

Flowering Time: June-September

8. Verbena hastata L. Sp. Pl. 20. 1753.

Synonyms:

V. pinnatifida Lam.

V. paniculata Lam.

V. paniculata var. pinnatifida Schauer

V. hastata var. pinnatifida Gray

V. hastata var. panniculata Farwell

V. hastata f. rosea Cheney

V. hastata var. paniculata f. rosea Farwell

Perennial, 17-150 cm tall; stems sparsely pubescent; leaves 30-115 mm long, 7-38 mm wide, petiole 3-25 mm long, occasionally with one hastate lobe; spike 2-70 cm long, 2-5 mm wide; bracts 1-3 mm long, sparsely pubescent; calyx 1-3 mm long, sparsely pubescent; corolla tube 2-5 mm long, limb 3-4 mm wide, pubescent limb; nutlet 1-2 mm long, glabrous commissural surface.

Distribution: Throughout North America

Flowering Time: June-October

CONCLUSIONS

In summary, there are two basic difficulties in species circumscription in the Verbena stricta complex. The first involves the distinctness of the species. The evidence indicates that V. halei and V. officinalis are conspecific. The specific status of V. lasiostachys and V. robusta is also questionable and I believe that the two taxa represent geographic morphodemes at the subspecific rank. The other six taxa are distinct,

but closely related, species.

The second problem concerns that of hybridization within the group. Some of the hybrids named would be highly improbable in nature because the species are allopatric. However, the morphological and breeding evidence indicate that hybridization of sympatric species within the group is possible. The potential is reduced between most species because the pollinators are species constant and because genetic incompatibility mechanisms are indicated by the lower seed sets of interspecific crosses. Also, only 24 of 2,006 specimens are morphologically intermediate, indicating that hybrids are either not very common or have been overlooked by collectors. Importantly there is no evidence for introgression. Therefore the hybrids are sporadically occuring and are interesting anomalies and do not significantly influence intertaxon boundaries.

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Table 1. List of morphological characters chosen for analysis.

Character Number		Character Number	
1	Plant Height	23	Stem Pilose
2.	Spike Length	24	Stem Tomentose
3	Spike Width	25	Stem Hirsute
4	Petiole Length	26	Stem Scabrous
5	# of Leaf Clefts	27	Leaf with Scattered Hairs
6	Length of Leaf Cleft	28	Leaf Hirsute
7	Leaf Length	29	Leaf Pilose
8	Leaf Width	30	Leaf Tomentose
9	Corolla Tube Length	31	Leaf Scabrous
10	Bract Length	32	Calyx Glandular
11	Calyx Length	33	Calyx Hirsute
12	Nutlet Length	34	Calyx Pilose
13	Corolla Limb $<$ 5 mm	35	Calyx with Scattered Hairs
14	Corolla Limb = 5 mm	36	Nutlet Papillate
15	Corolla Limb $>$ 5 mm	37	Nutlet Tortuous
16	Corolla Glabrous	38	Nutlet Saginoid
17	Corolla Limb Pubescent	39	Nutlet Bullate
18	Corolla with Scattered Hairs	40	Nutlet Verrucate
19	Corolla Hirsute	41	Spike Width/Spike Length
20	Nutlet Glabrous	42	Leaf Width/Leaf Length
21	Nutlet Pubescent	43	Spike Length/Plant Height
22	Stem Glabrous	44	Calyx Length/Corolla Length

Table 2. Pollen Size Comparisons in Verbena stricta complex.

Verbena taxa	P/E Index & Shape [1]	Diameters			
		Polar Axis µm	s.d.	Equatorial µm	s.d.
hastata	1.15 Prolate spheroidal	39	0.044	34	0.032
halei	1.05 Prolate spheroidal	41	0.048	39	0.047
simplex	1.02 Prolate spheroidal	49	0.047	48	0.046
neomexicana	0.95 Oblate spheroidal	42	0.032	44	0.041
bracteata	0.92 Oblate spheroidal	34	0.037	39	0.042
stricta	0.88 Oblate spheroidal	43	0.000	49	0.048
urticifolia	0.79 Suboblate	31	0.045	39	0.000
officinalis	0.79 Suboblate	34	0.043	43	0.044
lasiostachys	0.79 Suboblate	34	0.048	43	0.033
robusta	0.79 Suboblate	34	0.045	43	0.000

[1] Index and shapes from Erdtman (1969)

Table 3. Loadings for the first three principal components of the 10 species of the Verbena stricta complex based on all characters.

Character	Components		
	I	II	III
Plant Height	0.554	-0.487	0.445
Spike Length	-0.126	-0.154	0.658
Spike Width	-0.694	-0.012	-0.378
Petiole Length	0.755	0.509	0.239
Number of Clefts	-0.299	0.652	0.597
Length of Cleft	-0.444	0.769	0.266
Leaf Length	0.760	-0.512	0.152
Leaf Width	0.199	-0.441	0.507
Corolla Tube Length	-0.722	-0.526	0.014
Bract Length	-0.739	-0.005	-0.499
Calyx Length	-0.614	-0.486	-0.107
Nutlet Length	-0.427	-0.676	-0.162
Corolla Limb<5 mm	0.457	0.694	-0.077
Corolla Limb = 5 mm	-0.466	-0.719	0.087
Corolla Limb>5 mm	-0.009	0.027	-0.028
Corolla Glabrous	-0.162	0.525	-0.098
Corolla Limb Pubescent	0.589	-0.177	-0.420
Corolla with Scattered Hairs	0.003	0.309	0.454
Corolla Hirsute	-0.460	-0.771	0.146
Nutlet Glabrous	0.569	-0.542	0.096
Nutlet Pubescent	-0.569	0.542	-0.096

Table 3. Continued

Character	Components		
	I	II	III
Stem Glabrous	-0.095	0.433	0.356
Stem Pilose	-0.067	0.219	0.659
Stem Tomentose	-0.341	-0.588	0.123
Stem Hirsute	0.339	-0.046	-0.725
Leaf with Scattered Hairs	0.908	-0.151	-.0296
Leaf Hirsute	-0.488	0.707	-0.178
Leaf Pilose	-0.067	0.219	0.659
Leaf Tomentose	-0.475	-0.846	0.128
Leaf Scabrous	-0.096	0.209	-0.067
Calyx Glandular	-0.055	0.246	0.096
Calyx Hirsute	-.0788	-0.164	-0.185
Calyx Pilose	-0.067	0.219	0.659
Calyx with Scattered Hairs	0.869	-0.066	-0.230
Nutlet Papillate	-0.417	0.539	-0.348
Nutlet Tortuous	-0.186	0.124	-0.111
Nutlet Saginoid	-0.062	0.314	0.319
Nutlet Bullate	-0.468	-0.634	0.462
Nutlet Verrucate	0.218	-0.007	-0.426
Spike Width/Spike Length	-0.496	0.183	-0.550
Leaf Width/Leaf Length	-0.630	0.146	0.372
Spike Length/Plant Height	-0.573	0.402	-0.166
Calyx Length/Corolla Length	0.380	0.070	0.060
Eigen value	10.088	8.627	5.581
Percent Trace	23.460	20.060	12.980

Table 4. Loadings for the First Three Principal Components of *Verbena halei*, *V. officinalis*, *V. robusta* and *V. lasiostachys* based on all characters

Character	Components		
	I	II	III
Plant Height	0.248	-0.106	0.247
Spike Length	-0.236	0.350	-0.305
Spike Width	0.814	-0.269	0.079
Petiole Length	0.057	0.074	0.004
Number of Clefts	0.348	0.028	-0.239
Cleft Length	-0.135	0.163	0.053
Leaf Length	0.508	-0.255	0.155
Leaf Width	0.474	-0.211	0.030
Corolla Tube Length	0.088	0.053	0.164
Bract Length	0.515	-0.273	-0.056
Calyx Length	0.204	0:111	0.233
Nutlet Length	-0.561	0.044	-0.059
Corolla Limb <5 mm	0.012	-0.270	-0.031
Corolla Limb = 5 mm	-0.012	0.270	0.031
Corolla Glabrous	0.356	-0.517	-0.036
Corolla Limb Pubescent	-0.012	0.123	0.009
Corolla With Scattered Hairs	-0.244	0.373	0.040
Corolla Hirsute	-0.172	0.141	-0.013
Nutlet Glabrous	0.392	0.385	0.080
Nutlet Pubescent	-0.359	-0.401	-0.082

Table 4. Continued.

Character	Components		
	I	II	III
Stem Glabrous	-0.898	0.180	-0.054
Stem Pilose	0.853	0.284	-0.047
Stem Tomentose	0.165	-0.140	-0.948
Stem Hirsute	0.162	-0.693	-0.129
Stem Scabrous	0.165	-0.140	-0.948
Leaf With Scattered Hairs	0.165	-0.140	-0.948
Leaf Hirsute	-0.775	-0.417	0.137
Leaf Pilose	0.794	0.438	-0.123
Leaf Scabrous	0.227	-0.674	0.214
Calyx Glandular	-0.243	-0.159	-0.029
Calyx Hirsute	-0.572	-0.245	0.059
Calyx Pilose	0.826	0.293	-0.043
Calyx with Scattered Hairs	-0.177	0.123	-0.003
Nutlet Papillate	-0.119	-0.809	-0.035
Nutlet Saginoid	-0.629	0.381	-0.045
Nutlet Bullate	0.747	0.558	0.088
Spike width/Spike Length	0.562	-0.385	0.247
Leaf Width/Leaf Length	0.229	-0.094	-0.105
Spike Length/Plant Height	-0.431	0.318	-0.397
Calyx Length/Corolla Length	0.094	0.008	0.091
Eigenvalue	8.086	4.363	3.401
Percent Trace	20.220	10.910	8.500

Table 5. Posterior Probability of Membership in a Preassigned Species of *Verbena halei* and *V. officinalis* using the quantitative-qualitative data set.

OTU	Reclassification	*V. halei*	*V. officinalis*
HALEI05		0.8948	0.1052
HALEI07		0.8611	0.1389
HALEI21		0.7128	0.2872
HALEI23		0.7765	0.2235
HALEI24		0.8181	0.1819
OFFIN35	*V. halei*	0.6049	0.3951
OFFIN36	*V. halei*	0.5292	0.4708
OFFIN38	*V. halei*	0.9962	0.0038
OFFIN41	*V. halei*	0.6806	0.3194
OFFIN42	*V. halei*	0.5252	0.4748
OFFIN43	*V. halei*	0.9616	0.0384
OFFIN45	*V. halei*	0.8271	0.1729

Table 6. Posterior Probability of Membership in a Preassigned Species of *Verbena halei*, *V. officinalis*, *V. robusta*, *V. lasiostachys* using the quantitative data set.

OTU	Reclassification	*V. halei*	*V. officinalis*	*V. robusta*	*V. lasiostachys*
HALEI08	*V. officinalis*	0.3156	0.6842	0.0000	0.0003
OFFIN35	*V. halei*	0.9197	0.0803	0.0000	0.0000
OFFIN38		0.4301	0.5699	0.0000	0.0000
ROBUS51		0.0000	0.0000	0.8248	0.1752
ROBUS56		0.0000	0.0000	0.8896	0.1104
LASI085		0.0000	0.0000	0.3527	0.6473

Table 7. Mean Similarity matrix of nine hybrids with the members of the Verbena stricta complex.

	STRICTA	SIMPLEX	BRACTEATA	URTICIFOLIA	HASTATA	NEOMEXICANA	HALEI	OFFICINALIS	ROBUSTA	LASIOSTACHYS
HYBRD01	.177*	-0.73	-.287	.381	.214*	-.599	-.332	-.244	-.218	-.096
HYBRD03	.418*	-.304	-.396	.083	.064*	-.198	-.167	-.162	-.098	-.103
HYBRD06	-.328	.117	-.365	.383*	.377*	-.233	-.078	-.090	-.107	-.111
HYBRD08	-.212	-.055	-.343	.550*	.382*	-.433	-.217	-.193	-.090	-.091
HYBRD14	-.119*	.585*	-.128	.053	.225	-.174	-.256	-.213	-.193	-.100
HYBRD16	.263*	-.168	.163*	-.061	-.240	-.162	-.178	-.121	.027	.165
HYBRD18	.001*	-.100	-.050	-.162	-.238	.304	.358*	.211	.163	.050
HYBRD20	.381	.181*	-.336	-.044	.224*	-.191	-.436	-.374	-.351	-.342
HYBRD21	.366*	-.316	-.295	.121*	.111	-.162	-.215	.106	-.202	-.162

[1] Taxa with astrisks represent putative parents.

Table 8. Loadings for the first three principal components of the members of the Verbena stricta complex and hybrids based on all characters.

Character	Components		
	I	II	III
Plant Height	0.565	-0.168	0.624
Spike length	-0.084	0.055	0.586
Spike Width	-0.587	-0.149	-0.428
Petiole Length	0.376	0.672	0.141
Number of Clefts	-0.568	0.583	0.426
Cleft Length	-0.585	0.515	0.155
Leaf Length	0.787	-0.191	0.303
Leaf Width	0.257	-0.162	0.507
Corolla Tube Length	-0.470	-0.597	0.114
Bract Length	-0.616	-0.270	-0.572
Calyx Length	-0.427	-0.545	-0.034
Nutlet Length	-0.287	-0.736	-0.150
Corolla Limb<5mm	0.022	0.665	-0.107
Corolla Limb=5mm	0.020	-0.573	0.063
Corolla Limb>5mm	-0.140	-0.340	0.148
Corolla Limb Pubescent	0.546	-0.136	-0.226
Corolla with Scattered Hairs	-0.136	0.351	0.412
Corolla Hirsute	-0.265	-0.669	0.256
Nutlet Glabrous	0.771	-0.238	0.208
Nutlet Pubescent	-0.771	0.238	-0.208

Table 8. Continued.

Character	Components		
	I	II	III
Stem Glabrous	-0.232	0.313	0.285
Stem Pilose	-0.321	0.327	0.432
Stem Tomentose	-0.220	-0.819	0.282
Stem Hirsute	0.335	0.567	-0.557
Leaf Pilose	-0.262	0.355	0.536
Leaf Tomentose	-0.206	-0.853	0.280
Leaf Scabrous	-0.141	0.211	0.015
Calyx Glandular	-0.069	0.059	0.070
Calyx Hirsute	0.012	0.242	0.225
Calyx Pilose	-0.451	0.417	0.014
Calyx with Scattered Hairs	0.293	-0.544	-0.221
Nutlet Tortuous	-0.590	-0.271	-0.101
Nutlet Saginoid	-0.267	0.375	0.531
Nutlet Bullate	0.775	0.051	-0.191
Nutlet Verrucate	0.256	0.015	0.069
Spike Width/Spike Length	-0.349	-0.061	-0.613
Leaf Width/Leaf Length	-0.521	0.058	0.211
Spike Length/Plant Height	-0.541	0.191	-0.155
Calyx Length/Corolla Length	0.164	0.144	-0.252
Eigenvalue	7.471	7.084	4.813
Percent Trace	18.220	17.280	11.740

Table 9. Number and Percent Seed-set in Autogamy and Allogamy Experiments.

Species	Autogamy		Allogamy	
	Potential Seeds	% Set	Potential Seeds	% Set
V. urticifolia	3340	15.5	3000	87.3
V. simplex	5840	16.1	3000	97.2
V. lasiostachys-robusta	9140	5.0	-	-
V. neomexicana	5360	4.0	-	-
V. stricta	4608	18.3	5480	89.2
V. bracteata	2220	87.9	1000	93.9
V. halei	996	58.3	4492	78.6
V. hastata	-	-	1000	98.5

Table 10. Number and Percent Seed-set of the Interspecific Hybridizations in the *Verbena stricta* complex.

Hybrids	Potential Seeds	Percent Set
V. stricta x *V. lasiostachys*	120	44
V. stricta x *V. neomexicana*	40	55
V. stricta x *V. halei*	88	8
V. stricta x *V. simplex*	32	53
V. stricta x *V. bracteata*	48	44
V. stricta x *V. urticifolia*	36	11
V. stricta x *V. stricta* x *V. simplex*	24	0

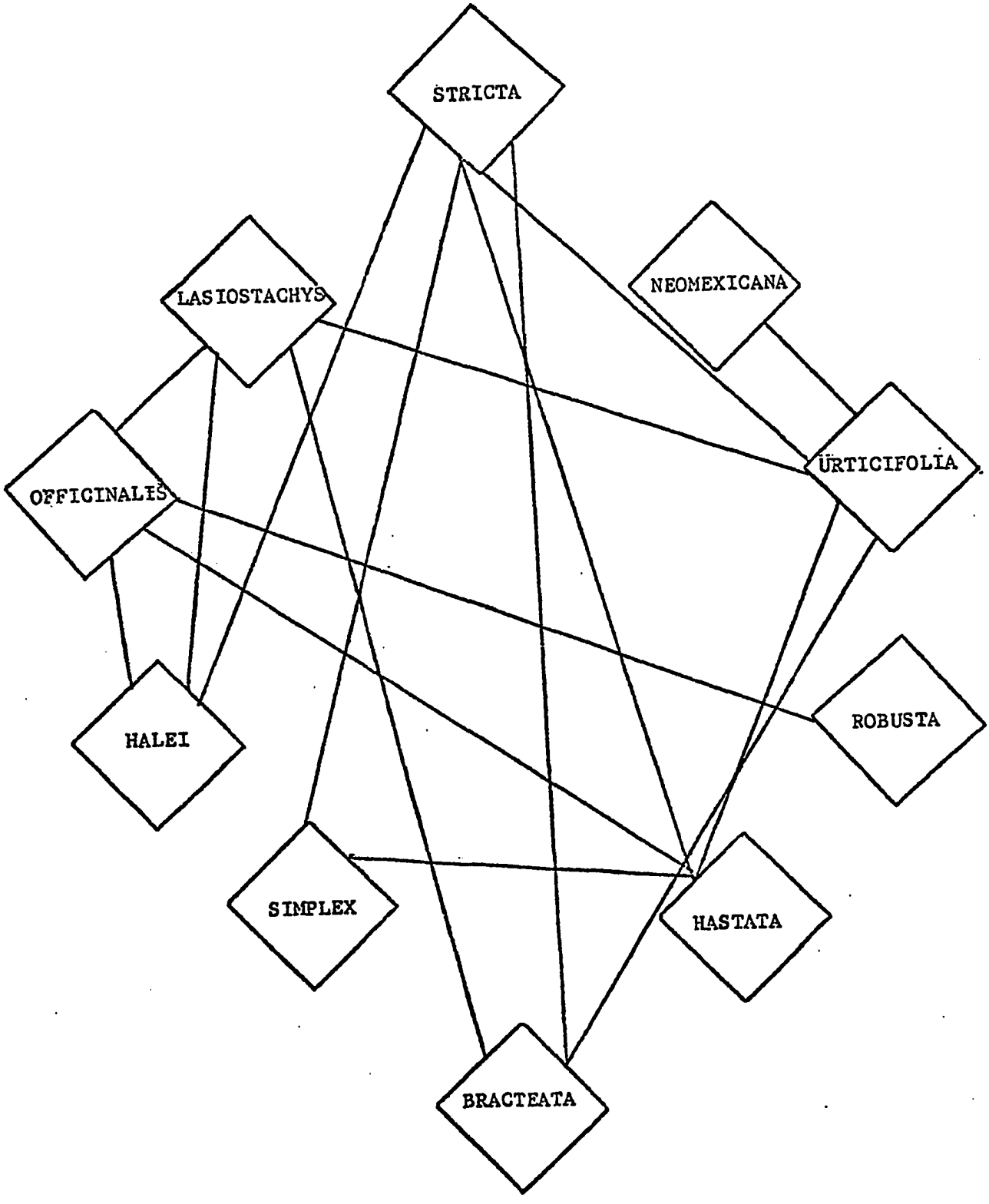


Figure 1. Taxa comprising the Verbena stricta complex. Lines between taxa indicate named interspecific hybrids of Moldenke (1958).

Figure 2-1. *Verbena stricta* pollen x 2000

2-2. Outer seed surface of *Verbena robusta* x 50.

2-3,4,5,6. Commissural surfaces of *Verbena halei*, *officinalis*, *lasiostachys*, ad *robusta*, respectively x 400.

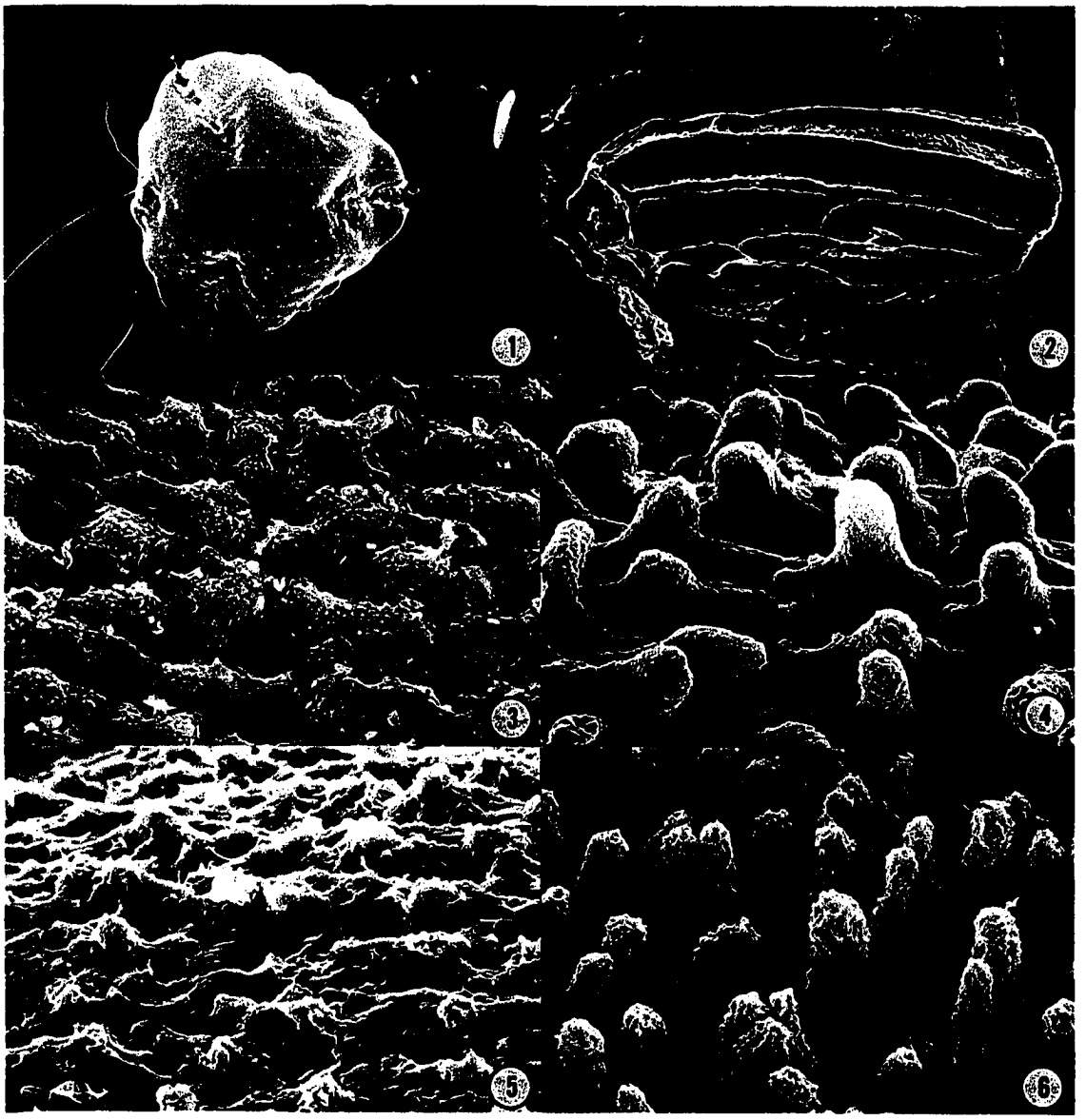

1
2
3
4
5
6

Figure 3. Commissural face surfaces of *Verbena urticifolia*, *hastata neomexicana*, *stricta*, *simplex*, and *bracteata*, respectively, x 400.

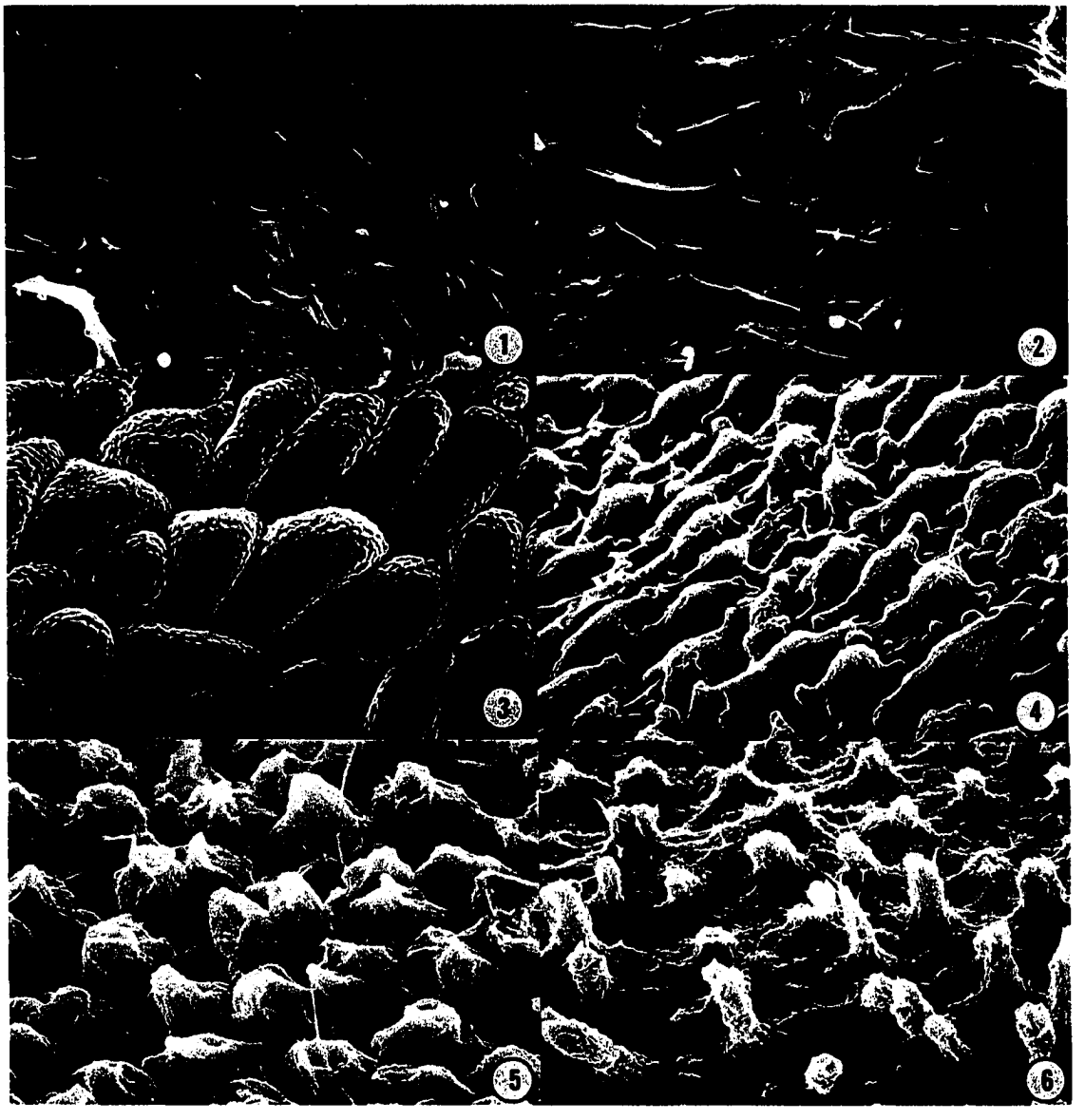

1
2
3
4
5
6

Figure 4. Correlation phenogram of 87 OTU's representing sample means of quadrats for the 10 taxa in the Verbena stricta complex. Based on unweighted pair group method using arithmetic averages (UPGMA) for 44 character measurements. Cophenetic correlation coefficient is 0.947.

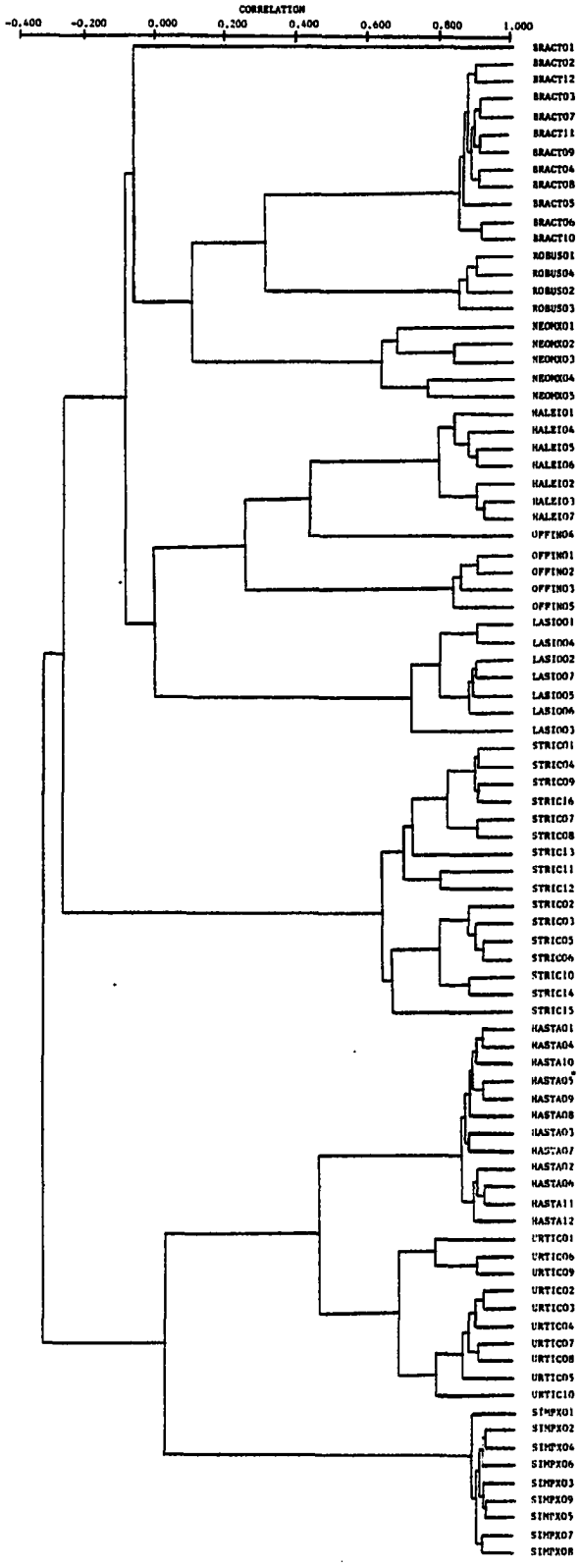

CORRELATION
-0.400
-0.200
0.000
0.200
0.400
0.600
0.800
1.000
BRACT01
BRACT02
BRACT12
BRACT03
BRACT07
BRACT11
BRACT09
BRACT04
BRACT08
BRACT05
BRACT06
BRACT10
ROBUS01
ROBUS04
ROBUS02
ROBUS03
NEOMX01
NEOMX02
NEOMX03
NEOMX04
NEOMX05
HALEI01
HALEI04
HALEI05
HALEI06
HALEI02
HALEI03
HALEI07
OFFIN04
OFFIN01
OFFIN02
OFFIN03
OFFIN05
LASI001
LASI004
LASI002
LASI007
LASI005
LASI006
LASI003
STRIC01
STRIC04
STRIC09
STRIC16
STRIC07
STRIC08
STRIC13
STRIC11
STRIC12
STRIC02
STRIC03
STRIC05
STRIC06
STRIC10
STRIC14
STRIC15
HASTA01
HASTA04
HASTA10
HASTA05
HASTA09
HASTA08
HASTA03
HASTA07
HASTA02
HASTA06
HASTA11
HASTA12
URTIC01
URTIC06
URTIC09
URTIC02
URTIC03
URTIC04
URTIC07
URTIC08
URTIC05
URTIC10
SIMPX01
SIMPX02
SIMPX04
SIMPX06
SIMPX03
SIMPX09
SIMPX05
SIMPX07
SIMPX08

Figure 5. Projections of the 87 OTU's of the ten taxa in the *Verbena stricta* complex onto the first three axes based on a matrix of correlation of all characters (View B).

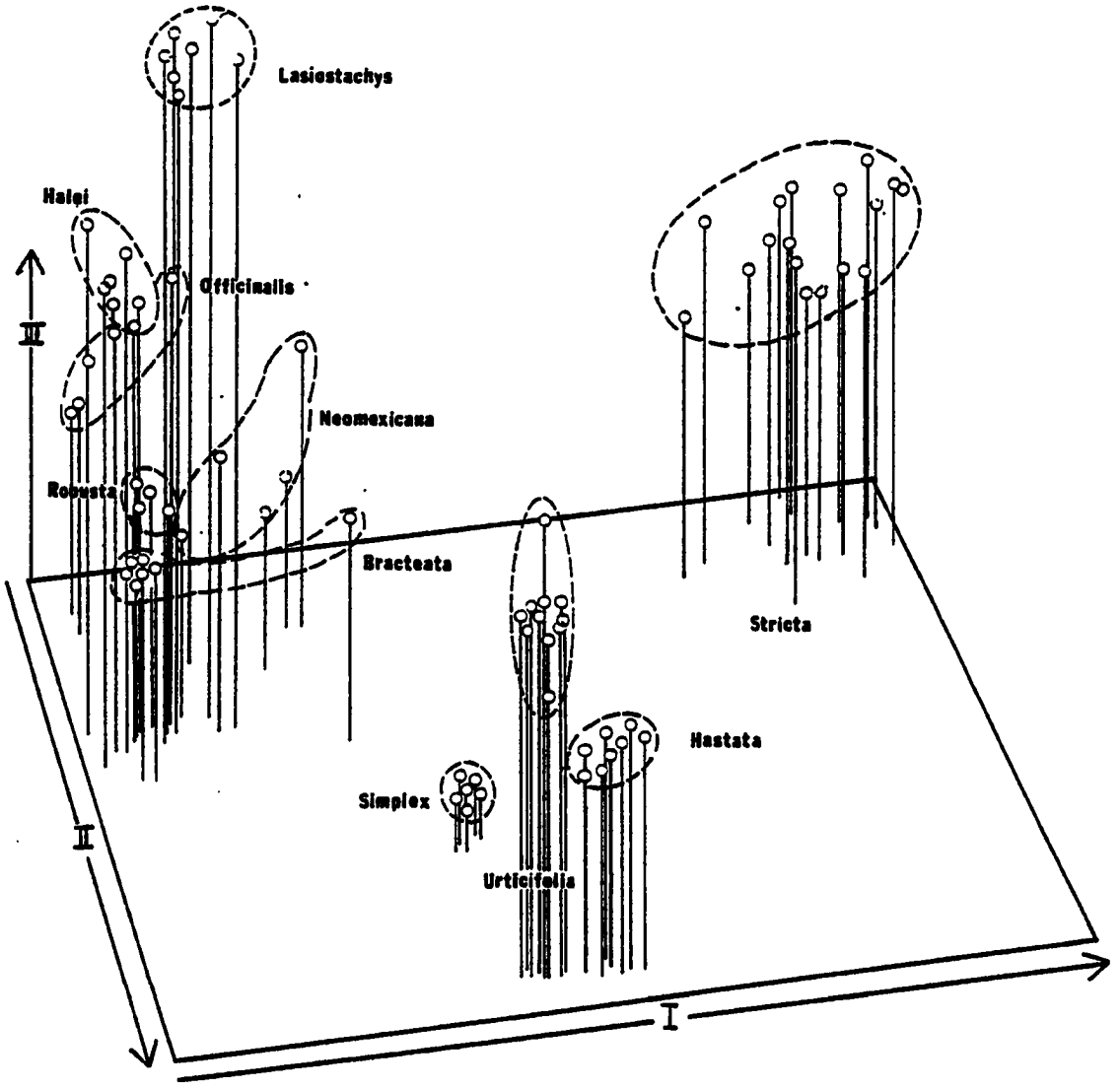

Lasiostachys
Halei
Officinalis
Neomexicana
Robusta
Bracteata
Stricta
Hastata
Simplex
Urticifolia
III
II
I

Figure 6. Correlation phenogram of 100 OTU's of *Verbena halei* *V. officinalis*, *V. robusta*, and *V. lasiostachys* based on unweighted pair group method using arithmetic averages (UPGMA) for 44 character measurements. Cophenetic correlation coefficient is 0.836.

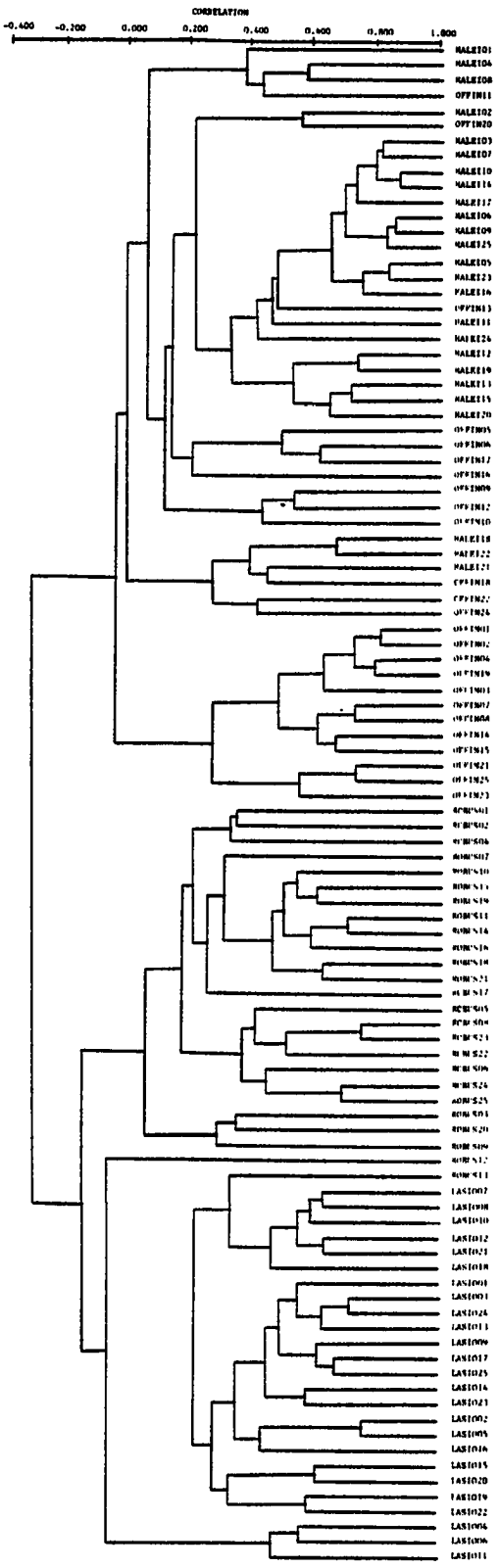

CORRELATION
-0.400
-0.200
0.000
0.200
0.400
0.600
0.800
1.000

Figure 7. Projections of the 100 OTU's of *Verbena halei*, *V. officinalis*, *V. robusta*, and *V. lasiostachys* onto the first three axes based on a matrix of correlation of all characters.

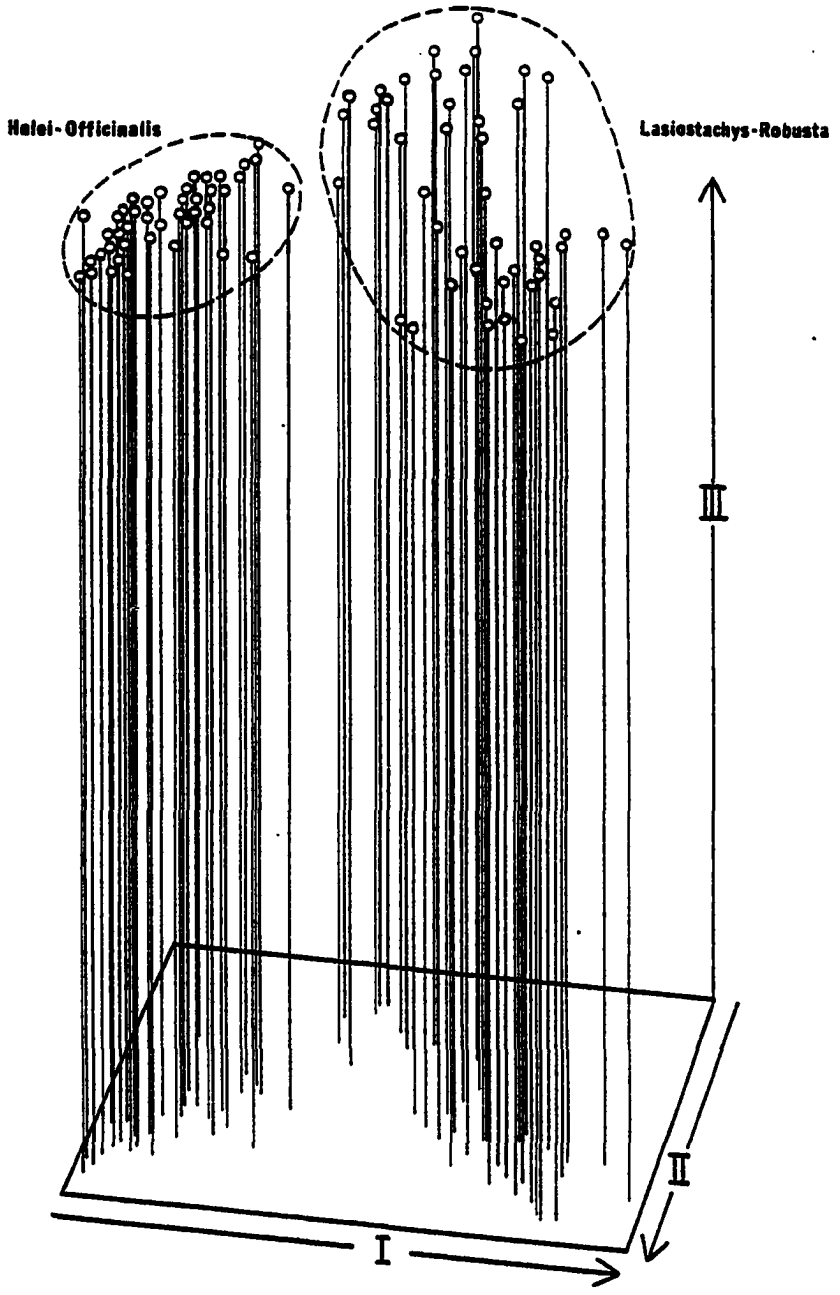

Helei-Officinalis
Lasiostachys-Robusta
III
II
I

Figure 8. Portion of correlation phenogram of 150 OTU's of members of the Verbena stricta complex and hybrids. Based on unweighted pair group method using arithmetic averages (UPGMA) for 44 character measurements. Cophenetic correlation coefficient is 0.837.

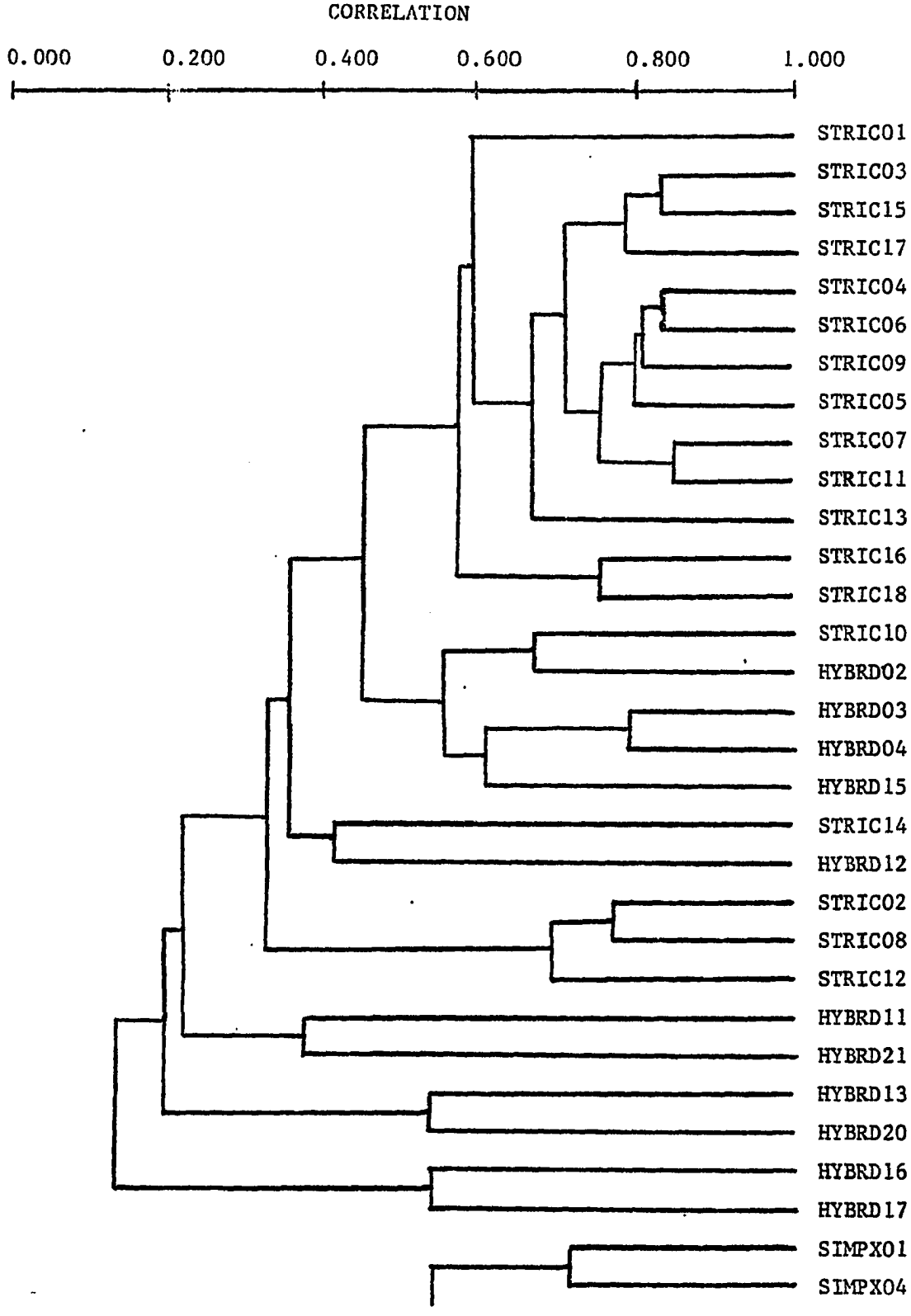

CORRELATION
0.000
0.200
0.400
0.600
0.800
1.000
STRIC01
STRIC03
STRIC15
STRIC17
STRIC04
STRIC06
STRIC09
STRIC05
STRIC07
STRIC11
STRIC13
STRIC16
STRIC18
STRIC10
HYBRD02
HYBRD03
HYBRD04
HYBRD15
STRIC14
HYBRD12
STRIC02
STRIC08
STRIC12
HYBRD11
HYBRD21
HYBRD13
HYBRD20
HYBRD16
HYBRD17
SIMPX01
SIMPX04

Figure 9. Portion of correlation phenogram of 150 OTU's which includes members of the Verbena stricta complex and hybrids. Based on unweighted pair group method using arithmetic averages (UPGMA) for 44 character measurements. Cophenetic correlation is 0.837.

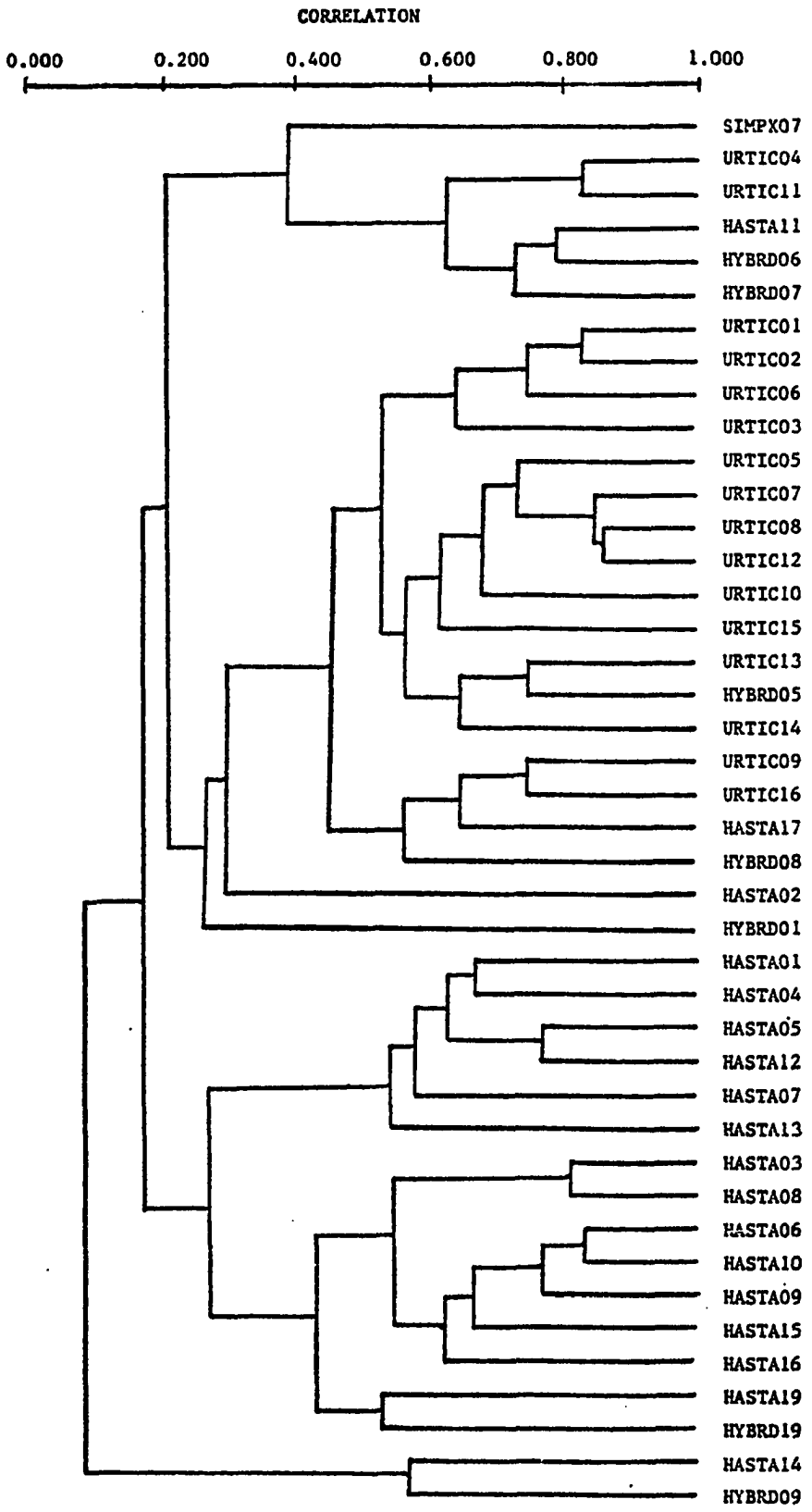
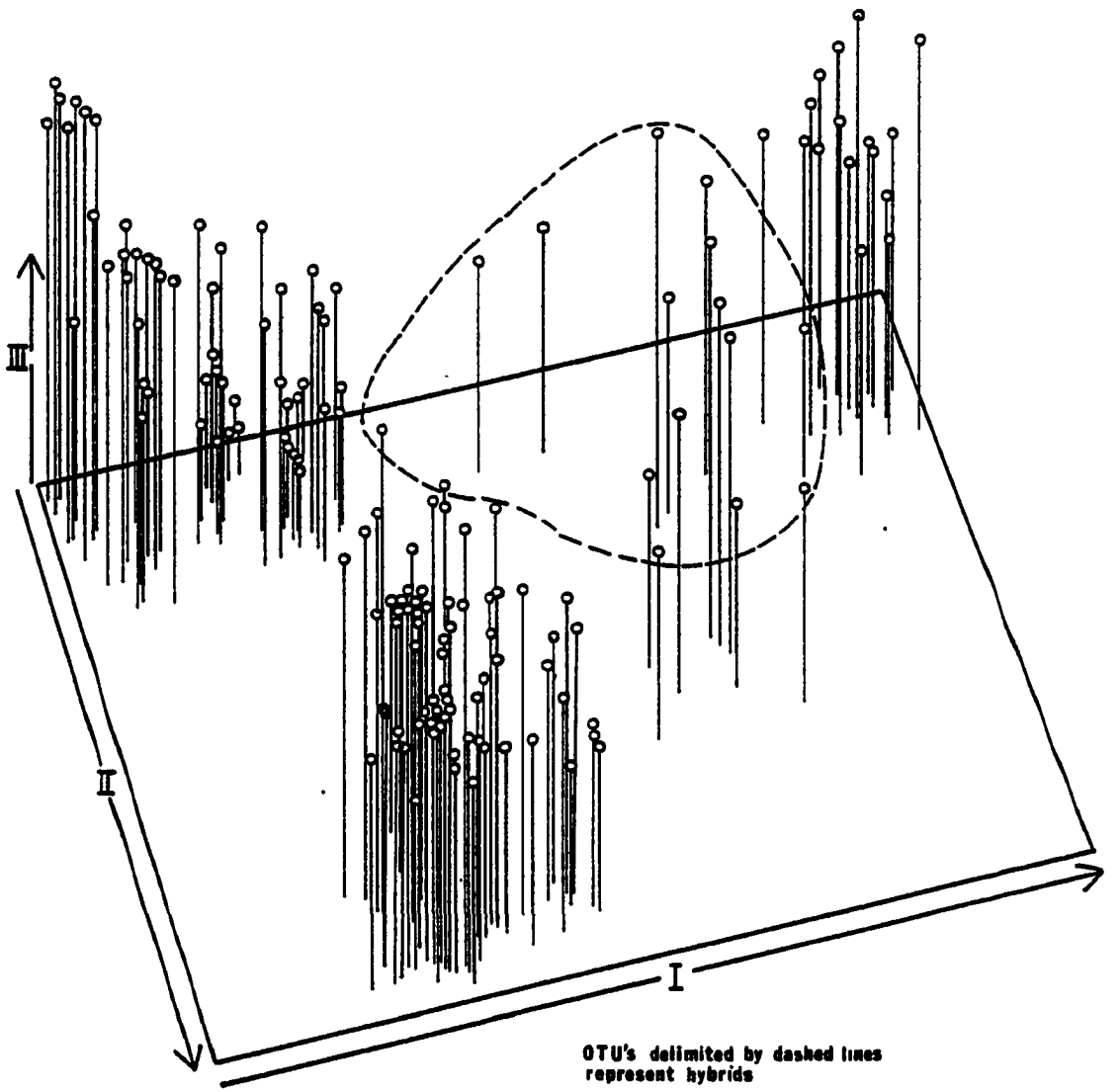

CORRELATION
0.000
0.200
0.400
0.600
0.800
1.000
SIMPX07
URTIC04
URTIC11
HASTA11
HYBRD06
HYBRD07
URTIC01
URTIC02
URTIC06
URTIC03
URTIC05
URTIC07
URTIC08
URTIC12
URTIC10
URTIC15
URTIC13
HYBRD05
URTIC14
URTIC09
URTIC16
HASTA17
HYBRD08
HASTA02
HYBRD01
HASTA01
HASTA04
HASTA05
HASTA12
HASTA07
HASTA13
HASTA03
HASTA08
HASTA06
HASTA10
HASTA09
HASTA15
HASTA16
HASTA19
HYBRD19
HASTA14
HYBRD09

Figure 10. Projections onto the first three principal components axes of the 150 OTU's that are members of the Verbena stricta complex and hybrids. Based on a matrix of correlation of all characters.



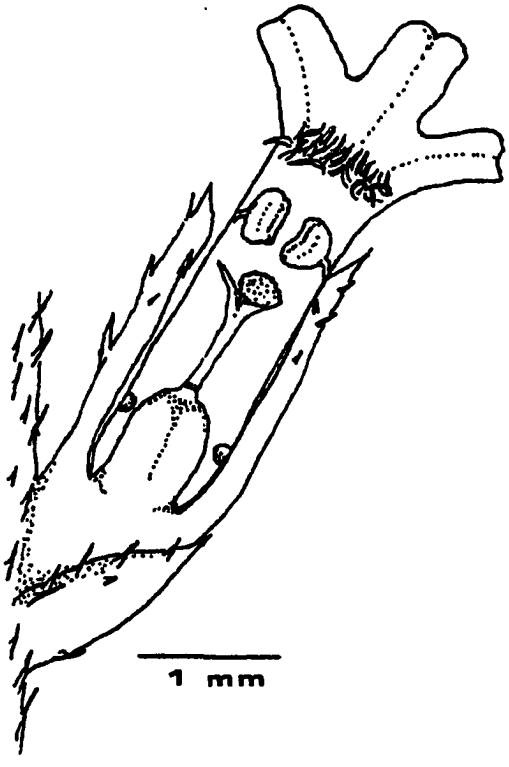
OTU's delimited by dashed lines represent hybrids

Figure 11. Representative floral types in the Verbena stricta complex.

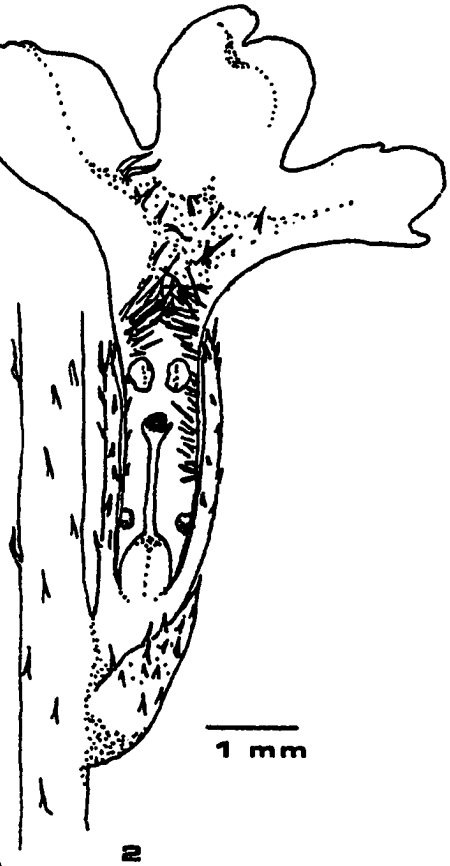
11-1. V. urticifolia.

11-2. V. halei.

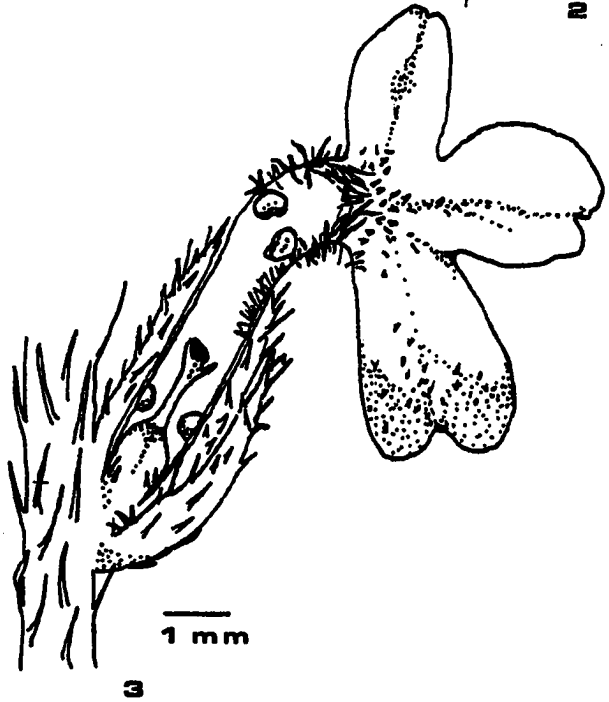
11-3. V. stricta.



1



2



3

Figure 12. *Verbena officinalis* (Eastern and N.W.) Distribution of *Verbena halei* (S.E.), *Verbena lasiostachys* (Western) and *Verbena robusta* (Baja).

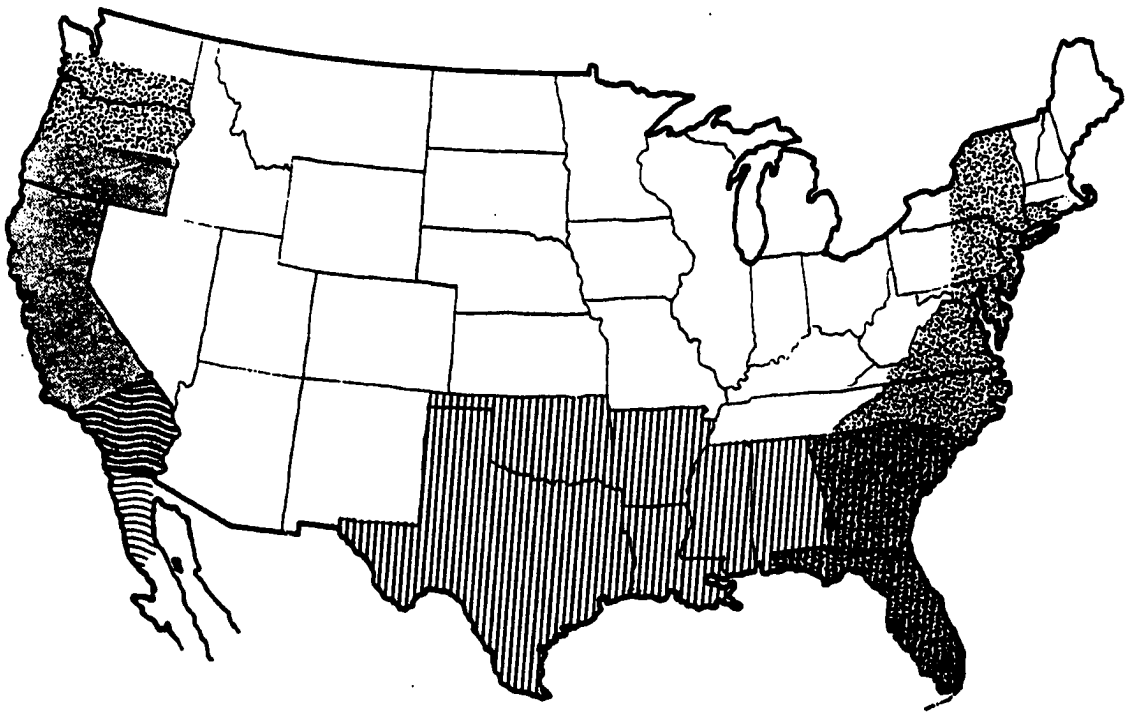


Figure 13. Distribution of *Verbena urticifolia* (Eastern), *Verbena neomexicana* (S.W.).

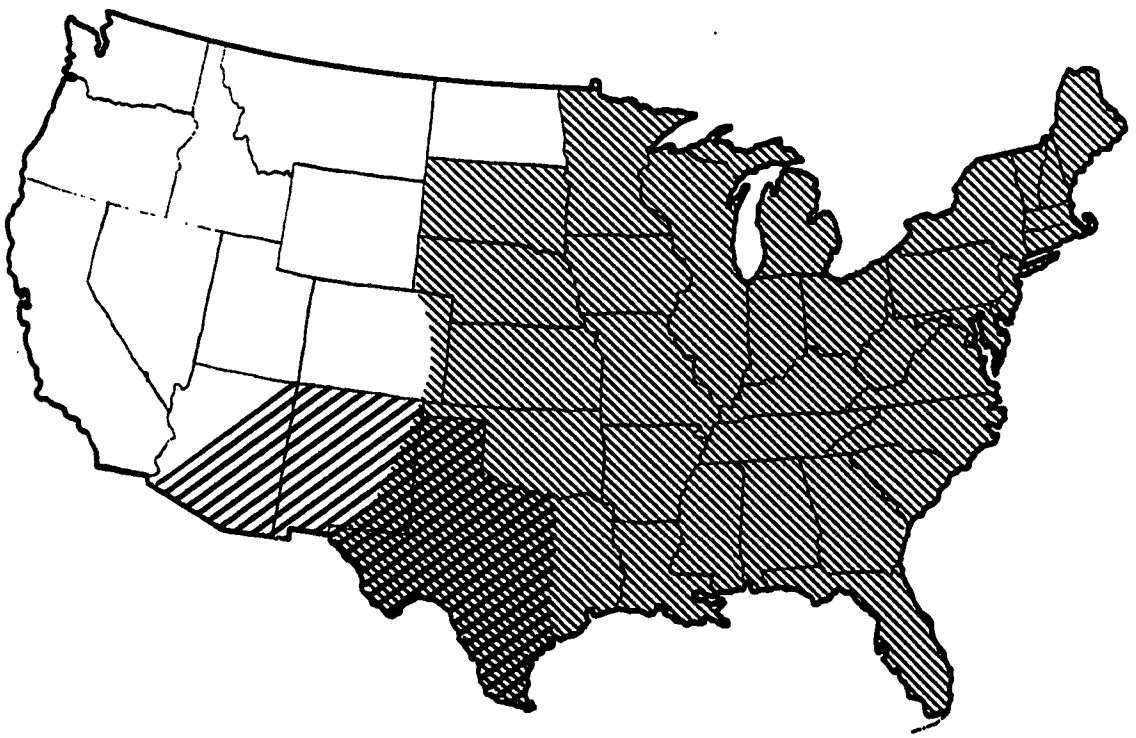
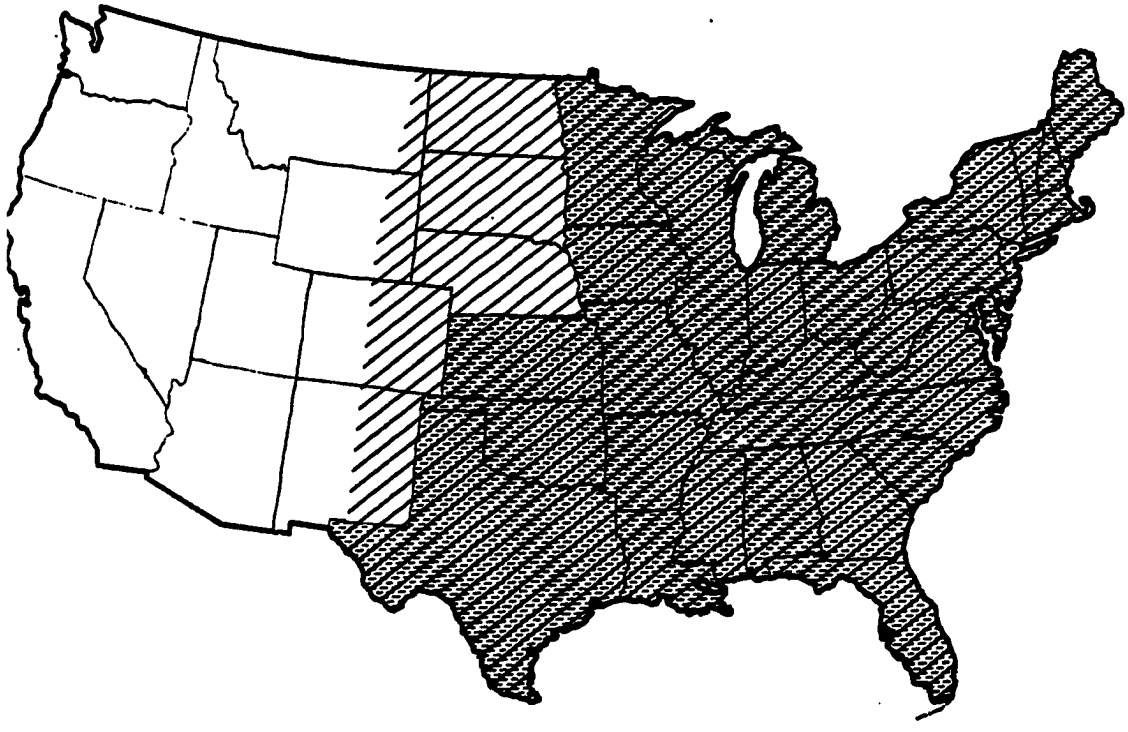


Figure 14. Distribution of Verbena stricta (Eastern) and Verbena simplex (Eastern- broken lines)



Appendix A. Collection and Observation Sites.

ARIZONA: Santa Cruz Co.: Near Elgin at jct Ariz 82 and road to Elgin.

ARKANSAS: Boone Co.: 1 mi W jct U.S. 62 and U.S. 65. Carroll Co.: 0.1 mi E jct Ark 187 and U.S. 62 on U.S. 62. Izard Co.: 0.6 mi SW ARK 58 and 7 mi E jct U.S. 69 and ARK 58. Lawrence Co.: 10.6 mi S jct U.S. 62 and U.S. 63 and ARK 115. Marion Co.: 0.5 mi from jct ARK 178 and Broadway in front of Bull Shoals Community Hospital. Sharp Co.: 0.7 mi E jct Pershing Way Rd and U.S. 62 at entrance of Arkansas Folk Theater.

CALIFORNIA: Kern Co.: Upper Emigdio Canyon, 1.9 mi E Mill Portrero Rd on Mill Portrero. Monterey Co.: 6 mi N Lucia on CA 1, foothills of Santa Lucia Mts. San Luis Obispo Co.: 9.8 mi E Santa Margarita Lake Headquarters on CA 229; 2 mi ESE jct CA 229 and CA 58, Santa Margarita Lake Fork; 10 mi SW Shandon on CA 41. San Mateo Co.: 0.1 mi W jct Farm Rd and Hidden Valley Rd in Portola Valley. Santa Barbara Co.: Lopez Lake; N Goleta near San Marcos Pass, River Valley of Ynez River; 1 mi below summit of Refugio Peak. Santa Cruz Co.: S entrance on CA 9 to Cowell State Park. Tulare Co.: ca 7 mi NE Springville on CA 190.

MISSOURI: Greene Co.: Fm Rd 150 out of Springfield, 0.2 mi to Fm Rd 185. Laclede Co.: AA State Rd off U.S. 64 to Prosperine Baptist Church, then 3.6 mi W on gravel road; 1.5 mi N of oasis canoe camp.

Appendix A continued.

NEW MEXICO: Torrance Co.: 4.2 mi N Punta on NM 14.

OKLAHOMA: Cleveland Co.: 2 mi E jct OK 9 and U.S. 62; OK 9 toward Lake Thunderbird; OU lawn. Garvin Co.: 5 mi S Purcell on OK 77. Grady Co.: 0.9 mi N jct OK 17 and U.S. 81. Johnston Co.: at jct OK 7 and OK 99 N. Marshall Co.: Buncombe Creek crossing, 1.5 mi E jct OK 99 and OK 32; OU Biological Station grounds; Buncombe Creek Recreation Area, 1.2 mi E Willis; Willis roadside; 1.7 mi N Enos Church of Christ; 1.9 mi E jct OK 99 and OK 32, then 2.1 mi S on paved road; 9 mi W jct U.S. 70 and OK 199, then 1 mi S on sec. road, then E on road N of McMillan cemetery. Murray Co.: Buckhorn Springs ca 6 mi S Sulphur. Ottawa Co.: 2.3 mi W jct U.S. 66 and OK 10, then 2.1 Mi S on sec. road, then 0.3 m W on sec. road. Stephens Co.: 3 mi E jct U.S. 81 ad Plata Rd. in Duncan.

OREGON: Jackson Co.: 1.6 mi W jct Fielder Creek Rd ad West Evans Creek Road. Josephine Co.: 8.7 mi W Merlin on Merlin-Galice Rd, then 0.3 mi S on Onion Mt Rd.

Appendix B. Herbarium specimens measured in the Verbena stricta complex.

Verbena bracteata

ARIZONA: Apache Co: R.H. Peebles 13568 (ARIZ); R.R. Halse 154 (ARIZ); Anderson & Young 60 (ARIZ); T.L. Burgess 748 (ARIZ); C.F. Deaver 41010 (ARIZ); Barr, Brewer, Mason 61-197 (ARIZ); Gould & Phillips 4796 (ARIZ); R.R. Halse 286 (ARIZ); R.R. Halse 231 (ARIZ);

Cochise Co: Darron, Phillips, Gould & Pultz 1486 (ARIZ);

Coconino Co: G.A. Pearson 4 (US); W.N. Clute 93 (US); W.B. McCougall s.n. (ARIZ); H.J. Fulton s.n. (ARIZ); D.T. MacDougal 286 (ARIZ); L.N. Gooding 45-48 (ARIZ); L.N. Gooding s.n. (ARIZ); J.T. Howell 24600 (ARIZ); J.T. Howell 24405 (ARIZ); Thornbar (ARIZ); H.E. Lee 7138 (ARIZ); L.H. Gooding 163-49 (ARIZ); A. Purchase ARP-485 (ARIZ); C.F. Deaver 6234 (ARIZ); C.F. Deaver 2509 (ARIZ)

Navajo Co: Mrs. W. Haugh s.n. (US); L.F. Ward s.n. (US)

CALIFORNIA: Los Angeles Co: E. Braunton 379 (US)

Tulare Co: E. Palmer 2699 (US)

COLORADO: Boulder Co: J. Ewan 1090 (US,WTU)

Comejos Co: P. Standly 6496 (US)

Denver Co: A. Eastwood 25 (US); W.G. Smith s.n. (US)

El Paso Co: F.S. Clements s.n. (US); Vanderbilt 1082C (US) Curtiss s.n. (US)

Appendix B. continued.

La Plata Co: E.O. Wooten 2836 (US); F. Tweedy 433 (US).

Larimer Co: J.H. Cowen 2019 (US); J.H. Cowen 404 (US).

Otero Co: R. Fitch 17503 (US); C.S. Crandall s.n. (US).

GEORGIA: Dekalb Co: J.K. Small s.n. (US).

Gwinnett Co: H.A. Allard 207 (US).

IDAHO: Ada Co: S.A. Clark 279 (US).

Bingham Co: J.M. Coulter s.n. (US); Palmer 255 (US).

Custer Co: L.F. Henderson 4070 (MICH).

Canyon Co: MacBride 200 (US).

INDIANA: Howard Co: C.M. EK 16 (US).

LaPorte Co: C.C. Deam 1272 (US).

Marshall Co: H.W. Clark 1745 (US).

IOWA: Franklin Co: P.H. Monson 2020 (ISC).

Fremont Co: W.S. Craig s.n. (ISC).

Guthrie Co: L.H. Pammel 562 (ISC).

Hamilton Co: L.H. Pammell & B.B. Zimmerman 300 (ISC).

Hardon Co: B. Shimek s.n. (ISC).

Johnson Co: M.P. Somes 3596 (US).

Webster Co: M.P. Somes 3062 (ISC); F.W. Paige s.n. (ISC).

Winneshiek Co: E.W. Holway s.n. (ISC); R.D. Albertson 315-101 (ISC).

Appendix B. continued.

KANSAS: Douglas Co: W.H. Horr E570 (US); W.C. Stevens s.n. (US).

Finney Co: F.D. Coville 24 (US).

Grant Co: C.H. Thompson 42 (US).

Greeley Co: J.P. Anderson s.n. (ISC).

Jewell Co: W.H. Hoor 4394 (US).

Morton Co: R. Fitch 17106 (US).

Osborne Co: C.L. Shear 62 (US).

Riley Co: J.B. Norton 392 (US).

Marion Co: W.H. Horr 3472 (US)

Sedqewick Co: T.L. Andrews s.n. (ISC).

Woodson Co: E.W. Lathrop 1276 (US).

Wyandotte Co: Smith s.n. (US).

MINNESOTA: Anoka Co: R.I. Cratty s.n. (ISC).

Hennepin Co: J.H. Sandberg 267 (ISC).

Jackson Co: R.I. Cratty s.n. (ISC).

Stearns Co: Dr. R. Gruelin s.n. (ISC).

Stearns Co: E.B. Watson s.n. (ISC).

MISSOURI: Bates Co: N.C. Henderson 65-373 (ISC).

Buchanan Co: N.C. Henderson 65-578 (ISC); N.C. Henderson 65-456 (ISC).

Livingston Co: S. Sparling 522 (ISC); S. Sparling 188 (ISC).

MONTANA: Flathead Co: W.E. Booth 6380 (WTU).

Appendix B. continued.

Sweetgrass Co: C.L. Hitchcock & C.V. Muhlick 13305 (WTU).

Dawson Co: L.H. Pammel s.n. (ISC).

Granite Co: R. Riggins 856 (ISC).

NEBRASKA: Buffalo Co: L.H. Pammel & J.C. Brinlee s.n. (ISC).

Lancaster Co: E. Robinson s.n. (WTU).

NEVADA: Clark Co: I.W. Clokey 8096 (WTU, ISC & GA).

NEW MEXICO: Bernalillo Co: D. Tuttle 166 (ARIZ)

Dona Ana Co: Wotten s.n. (ARIZ); Wooten & Standley 3330 (ARIZ).

Grant Co: Mason & Niles 607 (ARIZ); Anderson, Rhinehart, & Nelson 1245 (ARIZ); W. Hess 1353 (ARIZ); O.B. Metcalfe 137 (ARIZ).

Otero Co: Mason 2514 & Niles 595 (ARIZ).

Sandoval Co: V.L. Bohrer 1311 (ARIZ).

San Juan Co: G. Tierney 151 (ARIZ).

Sierra Co: O.B. Metcalfe 897 (ISC & WTU).

Taos Co: P.S. Martin s.n. (ARIZ).

NEW YORK: Brooklyn Co: J. Monachino 122 (ISC).

OHIO: Butler Co: D. Demaree 27351 (ISC).

OKLAHOMA: Caddo Co: D. Demaree 12533 (MIN).

Appendix B. continued.

Cleveland Co: D. Demaree 12471 (MIN); N.E. Bruner s.n. (ISC).

Cimarron Co: D. Demaree 13307 (MIN).

Harmon Co: G.N. Stevens 1051 (MIN).

Kiona Co: G.W. Stevens 1192 (MIN).

LeFlore Co: O.W. Blakley 1462 (MIN).

McClain Co: M. Hopkins 13358 (MIN).

Payne Co: G.B. Fink 4 (ARIZ); M. Crowder s.n. (ARIZ); D.G. Clark 67 (ISC); C.O. Chambers s.n. (ISC).

OREGON: Baker Co: W.A. Weber 3148 (WTU).

Harney Co: A.N. & D. Steward 6838 (ISC); A. Cronquist 8570 (WTU).

Multnomah Co: J.W. Thompson 3789 (WTU).

Union Co: Bartlett & Grayson 862 (MIN).

PENNSYLVANIA: Lehigh Co: J.R. Churchill s.n. (MIN).

Philadelphia Co: J.M. Fott 9870 (PH & MIN).

SOUTH DAKOTA: Bon Homme Co: J.J. Thornbar s.n. (ARIZ)

Brookings Co: J.S. Mooore 1575 (MIN); E.C. Pammel s.n. (ISC).

Brown Co: J.W. Moore 1577 (MIN).

Fall River Co: J.W. Moore 1578 (MIN); J.W. Whitham s.n. (ISC).

Hand Co: J.W. Moore 2082 (MIN).

Harding Co: J.W. Moore 153 (MIN).

Lawrence Co: E.P. Thatcher 13 (MIN); P.A. Rydberg 179 (MIN).

Meade Co: L.R. Moyer s.n. (MIN).

Appendix B. continued.

Spink Co: A.E. Ricksecker 66 (MIN).

Todd Co: W.L. Tolstead 4-527 (ISC).

Turner Co: V.P. Fressenden s.n. (ISC).

TENNESSEE: Montgomery Co: T.L. Andrews s.n. (ISC).

TEXAS: Brewster Co: V.L. Cory 9147 (ARIZ)

Denton Co: V.L. Cory 57306 (MIN).

El Paso Co: T.R. Van Devender s.n. (ARIZ).

Hale Co: U.T. Waterfall 3703 (ARIZ).

Jeff Davis Co: T. Head 20 (ISC).

Moore Co: B & H. Jespersen 2708 (MIN, WTU, MICH).

Presidio Co: L.C. Hinckley s.n. (ARIZ).

Roberts Co: C. Wallis 4978 (ARIZ).

Tarrant Co: A. Ruth 109 (ISC); W.L. McCart 39 (MIN); A. Ruth 109 (MIN).

Taylor Co: S.M. Tracy 8001 (MIN).

UTAH: Beaver Co: Parker, McLintock, and Robbins 6347 (ARIZ).

Garfield Co: N. Holmgren, J. Reveal & LaFrance 2101 (MIN); H. Buchanan 464 (ARIZ).

Millard Co: J.A. Harris 25142 (MIN).

Plute Co: P.A. Rydberg & Carlton 7043 (MIN)

Salt Lake Co: W.S. Cooper 4000 (MIN).

Tooele Co: J. Harris 20564 (MIN).

Appendix B. continued.

Utah Co: J.A. Harris 28113 (MIN).

Washington Co: J.L. Gentry & E. Jensen 2255 (MIN); F.W. Gould 2027 (ARIZ); R.W. Christian 1050 (ARIZ).

VIRGINIA: Southhampton Co: A.A. Helter 1012 (MIN).

WASHINGTON: Benton Co: L.S. Rose 48153 (ARIZ).

Chelan Co: C. Abair s.n. (MIN).

Grant Co: Sandberg & LEibexq s.n. (MIN).

Spokane Co: L.R. Moyer s.n. (MIN); F.O. Kreager 474 (MIN).

Whitman Co: Lake & Hull s.n. (MIN); A.D.E. Elmer 324 (MIN).

Yakima Co: C.S. Parker 653 (MIN).

WISCONSIN: Racine & Kenosha Co: S.C. Wadmond 3062 (MIN).

Rock Co: S.C. Wadmond 3765 (MIN).

Walworth Co: S.C. Wadmond 13034 (MIN)

Waukesha Co: R.N. Pohl P1 203 (MIN).

WYOMING: Albany Co: A. Nelson s.n. (MIN); A. Nelson 7671 (MIN).

ALABAMA: Lee Co: F.S. Earle C.F.Baker s.n. (MICH).

ARIZONA: Apache Co: G.J. Goodman C.L. Hitchcock 1317 (MICH).

Craighead Co: D. Demaree 27044 (OKL).

Desha Co: D. Demaree 45863 (TENN).

Appendix B. continued.

Independence Co: R.D. THomas 19903 (TENN).

Marion Co: D. Demaree 47929 (TENN).

CALIFORNIA: Freno Co: F. Beylik 59 (RSA).

Kern Co: E.C. Twisselmann 10239 (RSA); E.C. Twisselmann 8479 (RSA).

Lassen Co: I.L. Wiggins & D.B. Wiggins 16338 (RSA).

Los Angeles Co: F.W. Peirson 1038 (RSA); R.S. Thorne C.W. Tilforth 40646 (RSA); L. Abrams 2574 (MO); R.F. THorne 36679 (RSA); R.F. Thorne 36516 (RSA).

Monterey Co: C.B. Hardham 10390 (RSA).

Orange Co: E.L. Paddock 12733 (RSA); E.R. Johnson 11285 (RSA).

Riverside Co: J. Ewan 5220 (MO); F.W. Peirson 11477 (RSA).

San Bernardino Co: J. & L. Roos 4413 (RSA).

San Luis Obispo Co: E.C. Twisselmann 15646 (RSA); R.S. Ferris 9770 (WTU); R.S. Ferris 9770 (MICH).

Stanislaws Co: R. Baeigalupi L. Constance (WTU).

Ventura Co: H.M. Pollard s.n. (RSA).

COLORADO: Boulder Co: J. Ewan 11419 (WTU).

Larimer Co: C.S. Crandall 172 (MICH).

Sedgewick Co: W.A. Weber 6407 (WTU).

GEORGIA: Clarke Co: W.H. Duncan 12696 (TENN).

IDAHO: Boise Co: C.L. Hitchcock & C.V. Muhlick 9960 (WTU).

Appendix B. continued.

Elmore Co: C.L. Hitchock & C.V. Muhlick 22627 (WTU).

Idaho Co: J.H. Christ 12668 (WTU); Q. Jones 366 (WTU)

Nez Perce Co: F.W. Gail s.n. (WTU); M. Ownbey & W.A. Weber 2746A (WTU).

ILLINOIS: Cook Co: H.R. Bennett s.n. (WTU).

St. Clair Co: A.S. Hitchcock s.n. (MO)

INDIANA: Clark Co: J.F. Baird s.n. (MICH).

LaPorte Co: W.S. Moffatt 1685 (WTU); H.H. Bartlett s.n. (MICH)

Putnam Co: R.C. Friesner 17832 (MICH)

St. Joseph Co: M.W. Lyon, Jr. s.n. (MICH).

KANSAS: Ellis Co: R.J. Baalman 209 (OKL).

Kearney Co: A.S. Hitchcock 1129 (MICH).

Wallace Co: D. Demaree 40393 (OKL).

MASSACHUSETTS: Bristol Co: W.R. Taylor 29463 (MICH).

MICHIGAN: Alger Co: R.H. Read 3116 (MICH).

Antrim Co: E.J. Cole 5687 (MICH).

Cheboygan Co: J.H. Ehlers 627 (MICH); E.G. Voss 12736 (MICH); J.H. Ehlers 1771 (MICH); J.H. Ehlers 472 (MICH).

Dickinson Co: C.A. Davis 243 (MICH); M.L. Fernald A.S. Pease 3495 (MICH); J.S. Pringle 836 (MICH).

Appendix B. continued.

Emmet Co: E.G. Voss 2420 (MICH).

Houghton Co: C.A. Davis s.n. (MICH); C.D. Richards 2710 (MICH).

Keweenee Co: F.J. Hermann 509 (MICH).

Leelanau Co: C.R. Hanes s.n. (MICH)

Menominee Co: C.O. Grassl 2620 (MICH).

Hennepin Co: C.E. Burglehaus 8455 (WTU).

Saginaw Co: Mr. & Mrs. H.A. Davis 8953 (WTU).

MISSOURI: Butler Co: J.H. Kellogg 15276 (MO).

Marion Co: J. Davis 9039 (MO).

St. Louis Co: H. Eggert s.n. (MO); V.M. Glatfelter s.n. (MICH)

Wayne Co: E.J. Palmer 6106 (MO).

MONTANA: Broadwater Co: C.L. Hitchcock & C.V. MUhlick 11825 (WTU).

Carter Co: W.E. Booth 2669 (WTU).

Flathead Co: D.B. Dunn 10850 (RSA).

Gallatin Co: C.L. Hitchcock & C.V. Muhlick 12478 (WTU); J.W. Blankenship s.n. (MICH).

Missoula Co: J.H. Sandberg s.n. (UC).

Park Co: C.L. Hitchcock & C.V. Muhlick 13567 (WTU).

Pondera Co: H.H. Bartlett & J.F. Grayson 400 (WTU).

Powell Co: C.L. Hitchcock & C.V. Muhlick 11520 (WTU).

Rosebud Co: J.W. Blankenship s.n. (WTU); J.W. BLankenship s.n. (WTU).

Appendix B. continued.

NEBRASKA: Otoe Co: E.H. Jones 8 (WTU)

NEVADA: Clark Co: I.W. Clokey 5571 (WTU); I.W. Clokey 8473 (WTU); A.M. Alexander L. Kellogg 1739 (WTU).
Humboldt Co: N.A. Archer 1966 (MICH).
Storey Co: C.A. Purpus 5946 (UC).
White Pine Co: N.H. Holmgren J.L. Reveal 1023 (WTU)

NEW JERSEY: Cambden Co: Dr. Hornbaugh s.n. (PH); I.C. Martindale s.n. (PH); C.F. Parker s.n. (PH).

NEW MEXICO: Eddy Co: C.O. Grassl (MICH).

NEW YORK: Saratoga Co: H.D. House 29411 (OKL)

OHIO: Hamilton Co: C.G. Lloyd s.n. (MICH).

OKLAHOMA: Cimarron Co: C.M. Rogers 4668 (MICH).

PENNSYLVANIA: Berks Co: N.C. Brumbach 3931 (PH).
Lehigh Co: H.W. Pretz 12280 (PH).
Philadelphia Co: E.T. Wherry s.n. (PH); E.L. Linbrook s.n. (PH)

SOUTH DAKOTA: Custer Co: W.H. Over 2020 (WTU).
Fall River Co: G.N. Jones 35991 (WTU).

Appendix B. continued.

TENNESSEE: Benton Co: E.B. Harger 7138 (TENN).

Decatur Co: G.L. Ames s.n. (MICH).

Chester Co: K.E. Rogers 8140 (TENN).

Montgomery Co: E.W. Chester 2710 (TENN).

Obion Co: H.H. Iltis 1747 (TENN).

Shelby Co: F.D. Bowers & K.E. Rogers 45217 (TENN); K. Rogers 33496 (TENN).

Tipton Co: S. Fairchild, E. Clebsh, A.J. Sharp 8261 (TENN).

TEXAS: Bexar Co: J.B. Darz 11 (UC).

Floyd Co: J. Roberts 140 (OKL).

Hale Co: E. Whitehouse 9926 (MICH).

Parmer Co: C.M. Rowell 8631 (OKL)

Tom Green CO: R. Eckhardt 1753 (MICH).

UTAH: Salt Lake Co: R.K. Vickery, Jr. 2374 (UC).

WASHINGTON: Adams Co: R.G. Jeffrey s.n. (WTU).

Benton Co: C. Nelson s.n. (WTU)

WYOMING: Big Horn Co: C.L. POrter 323 (WTU)

Verbena halei

ALABAMA: Mobile Co: B. Harrington 340 (CSPU); R. Deramus D83 (NCU).

Russell Co: R. Kral s.n. (PH).

Appendix B. continued.

ARKANSAS: Miller Co: D. Demaree 39156 (GA); D. Demaree 39156 (OKL).
Stone Co: D. Demaree 31874 (OKL).

FLORIDA: Alachera Co: F.H. Sargent 6207 (GA); E.S. Ford s.n. (GA).

GEORGIA: Ben Hill Co: W.R. Faircloth 5082 (MO).
Turner Co: B.B. Higgins s.n. (GA).

LOUISIANA: Calcasieu Par.: Small 1008 (LSU).
Cameron Par.: C.A. Brown 9271 (LSU).
East Baton Rouge Par.: S. Brown s.n. (LSU). M.F. Peterson s.n. (LSU); C.A. Brown 1156 (LSU), C.A. Brown 2118 (MICH).
Lafayette Par.: G.C. Claycomb 51135 (LSU)
Madison Par: R. Jones 210 (NCU).
Natchitoches Par.: L. Urbatsch 2392 (LSU).
Orleans Par: G. Montz 2577 (LSU).
Pointee Coupee Par; M. Chaney 399 (LSU).
St. Charles Par: G. Montz 3089 (LSU).
St. Helena Par: C.M. Allen 990 (LSU); C.M. Allen 675 (LSU).
St. Mary Par: R.D. THomas, R. Reid, C.A. Smith, R. Dooley 27020 (NCU); Bynum, Ingram, Jaunes s.n. (LSU); G. Montz 4033 (LSU).
St. Tammany Par: L. Bougere 1087 (LSU); G. Arsene 12242 (LSU).
Tangipahua Par: D.S. & H.S. Correll 9254 (ND LSH).
Terrebonne Par: Small 1009 (LSU).

Appendix B. continued.

Vermillion Par: J.L. Killmer 35 (LSU); C.A. Brown 18279 (LSU); C.A. Brown 21409 (LSU).

Vernon Par: J. Turba s.n. (LSU).

West Feliciano: Curry, Martin, Allen 437 (LSU)

Ninn Par: K. Vincent 925 (GA); K. Vincent 956 (GA).

MISSISSIPPI: Adams Co: F.A. Barkley 86 (OKL).

Harrison Co: D. Demaree 30585 (MICH).

Issaquena Co: L.C. Temple 8247 (GA).

Jackson Co: A.D. Lowe 85 (GA); J. Skehan 1599 (MICH).

Lawrence Co: S.B. Jones 11740 (GA).

Neshoba Co: S.B. Jones 18695 (GA).

OKLAHOMA: Atoka Co: M. Hopkins & A. & R. Nelson 1092 (WTU); M. Hopkins & A.R. Nelson 1092 (OKL); C. Perino & J. Williams 706 (OKL).

Bryan Co: Taylor, Silver, Fox 1221 (OKL); R.A. Nelson H. Holland 6010 (OKL).

Carter Co: K. & M. Crook 1022 (OKL); J. & H. Massey 2403 (OKL); G.J. Goodman 7853 (OKL); J. & H. Massey 2403 (NCU); C.H. Perino J. Massey 813 (OKL); A.G. Payne 38 (OKL).

Choctaw Co: H. Eggert s.n. (MO); UT Waterfall 2102 (OKL); R.A. Nelson & H. Holland 6017 (OKL)

Jefferson Co: K. & M. Crook 943 (OKL); UT Waterfall 7829 (OKL)

Love Co: J.E. Williams 353 (NCU).

McCurtain Co: UT Waterfall 10470 (CSPU); UT Waterfall 11829 (CSPU); U.T. Waterfall 11829 (US)

Appendix B. continued.

Pushmataha Co: V. Board 215 (NCU)

SOUTH CAROLINA: Aiken Co: W.L. Ellison & E.L. Ellison 1010 (MO, OSC).

TEXAS: Anderson Co: J.W. Hardin 531 (MICH).

Archer Co: E. Whitehouse 9721 (MICH).

Austin Co: Prof Hugo s.n. (LSU).

Bastrop Co: C.L. & A.A. Lundell 10344 (MICH).

Bee Co: F.A. Barkley 16T421 (OSC).

Bexar Co: Mr. & Mrs. J. Adams 502 (CSPU); Mr. & Mrs. J. Adams 970 (CSPU); B.H.A. Groth 75 (US); R. Bebb 2282 (OKL); C.R. Ball 927a (US); E.D. Schulz s.n. (MICH); E.D. Shulz s.n. (MICH); E.D. Schulz 518 (US); E.D. Schulz 766 (US); V. Havard s.n. (US); V. Havard s.n. (US); E.D. Shultz 103 (US).

Bowie Co: D.S. & H.B. Correll 12421 (MICH).

Brazoria Co: D. Demaree 61546 (GA).

Brazos Co; H.S. Jennings s.n. (MICH); D. Unger 37 (LSU); L. Tallerine 30 (LSU); V.L. Cory 50627 (MICH); J.N. Weaver 490 (MICH); N.L. Byrd 401 (OSC); C.E. Gray 23 (MICH).

Brooks Co: J.R. & H. Massey 2913 (NCU).

Brewster Co: V.L. Cory 2294 (GH).

Brown Co: J. Miller 2 (GA); J. Bingham 8 (OKL).

Calhoun Co: D. Demaree 61559 (GA).

Cameron Co: Mrs. M. Cannon (MICH); E.U. Clover 736 (MICH); C.L. & A.A. Lundell 8623 (MICH); L.I. Davis s.n. (MO); W.C. & M.W. Muenscher 14448 (GH); H.P. Chandler 7082 (US); C.L. Lundell 10689 (MICH).

Appendix B. continued.

Cass Co: H. Gentry 3482 (NCU)

Chambers Co: B.C. Tharp s.n. (MICH)

Cherokee Co: F.A. Barkley 13585 (ND).

Coke Co: W. King 320 (MICH).

Coleman Co: B.H. Warnock 46341 (MO)

Culberson Co: U.T. Waterfall 4496 (GH); V.L. Cory 53037 (MICH).

Dallas Co: M.E. Jones s.n. (CSPU); C.L. & A.A. Lundell 12107 (MICH); C.L. & A.A. Lundell 8346 (MICH); C.L. & A.A. Lundell 8579 (MICH); C.L. & A.A. Lundell 10398 (MICH).

Denton Co: B.L. Lipscomb 1309 (NCU); A.W. Roach F.W. Wyatt s.n. (OSC); W.L. McCart 2006 (MICH).

Dimmit Co: N.D. Atwood 2030 (NCU).

Duval Co: Á. Flores, A. Chavez, G. Hein, Jr. 43 (GH).

Ellis Co: D. Sanders 19 (MICH).

Erath Co; P. Hoisington 241 (OKL); P. Hoisington 84 (OKL).

Fayette Co: B.H. Warnock 46436 (CSPU).

Frio Co: W.L. McCart 8020 (WTU); C.L. & A.A. Lundell 10139 (MICH).

Galveston Co.: V.L. Cory 51017 (MICH).

Goliad Co: C.L. & A.A. Lundell 10060 (MICH).

Grayson Co: J.H. Oyster s.n. (MICH).

Hardeman Co: R.A. Norris 2485 (CSPU).

Harris Co: K. Luke s.n. (LSU); L.C. Higgins 3925 (MICH); E. Hall 632 (CSPU).

Hidalgo Co: J.T. Pointer F.A. Barkley 14428 (MO); E.U. Clover 672 (MICH); E.U. Clover 600 (MICH); C.L. & A.A. Lundell 10035 (MICH).

Appendix B. continued.

Hidalgo Co: C.L. & A.A. Lundell 10035 (MICH).

Howard Co: J.M. Milligan s.n. (US).

Jasper Co: J.F. Jooc s.n. (MICH); C.L. & A.A. Lundell 10513 (MICH).

Jim Wells Co: C.L. & A.A. Lundell 10076 (MICH).

Kaufman Co: F.J. Tyler s.n. (US); C.L. & A.A. Lundell 8506 (MICH).

Kenedy Co: B.D. Tharp 49098 (PH); R.P. Wagner & F.A. Barkley 16T392 (GH); S.F. Glassman 220i (OKL); C.L. & A.A. Lundell 10847 (MICH); J. & C. Taylor 3587 (OKL).

Kerr Co: E.J. Palmer 10037 (US, MO).

Kleberg Co: V.L. Cory 51322 (MICH).

LaSalle Co: C.L. & A.A. Lundell 10143 (MICH); K.M. & M.C. Wiegand 2002 (CSPU).

Leon Co: C.L. & A.A. Lundell 10391 (MICH); R.A. Norris 715 (CSPU).

Llano Co: C.L. & A.A. LUndell 9040 (MICH); S.E. Wolff 3067 (US).

Love Co: Nelson, Goodman, Waterfall 5706 (WTU).

Matagorda Co: V.L. Cory 51091 (MICH).

McIntosh Co: W.H. Duncan 20214 (US).

McLennon Co: R. Gordon s.n. (NCU)

Medina Co: D. Seigler K. Beckes DS-3069 (OKL).

Milam Co: C.L. & A.A. Lundell 10374 (MICH)

Montgomery Co: L.C. Higgins 5471 (NCU) .

Nueces Co: B.C. Tharp 5603 (US); A.A. Heller 1419 (US).

Palo Pinto Co: G.C. Nealley s.n. (US)

LOUISIANA: Plaquemine Par: V. Keller s.n.(LSU).

Appendix B. continued.

TEXAS: Polk Co: B.K. Windler 2605 (NCU).

Reeves Co: U.T. Waterfall 4388 (OKL).

Robertson Co: C.M. Rowell, Jr. 8029 (MICH).

San Patricio Co: E.R. Gutierrez 70 (ISC); S. Sanderson 11 (ISC); V.L. Cory 51259 (WTU); E.G. Holden s.n. (MICH); C.L. & A.A. Lundell 10082 (MICH); G.G. Wiliges 4-W (NCU); G.G. Goodman 7470 (NCU).

Starr Co: C.L. & A.A. Lundell 9924 (MICH); Miss M.B. Croft s.n. (GA).

Tarrant Co: W.H. Aiken s.n. (CSPU); A. Ruth 108 (PH); C.L. & A.A. Lundell 8522 (MICH).

Terrell Co: E.M. Farr s.n. (PH).

Tom Green Co: C. Smith 151 (OKL).

Travis Co: Westly s.n. (MICH); L.E. Urbatsh 1559 (LSU); C.L. York 49001 (ND); D.L. & A.A. Lundell 10308 (MICH).

Uvalde Co: E.J. Palmer 13564 (US).

Val Verde Co: B.H. Warnock 254 (MICH).

Van Zandt Co: A. Ezell 5699 (US).

Victoria Co: R. McVaugh 12422 (MICH).

Webb Co: A. Perkins, J.M. Hall 2627 (CSPU).

Wichita Co: E. Whitehouse 10474 (MICH); R.S. Ferris & C.D. Duncan 3337 (MO).

Willacy Co: J. & C. Taylor 3494 (OKL); C.L. & A.A. Lundell 8786-(MICH); V.L. Cory 51489 (MICH).

Wilson Co: S.S. White 1359 (MICH).

Zapata Co: F. Guajardo 39 (ISC).

Appendix B. continued.

Verbena hastata

CALIFORNIA: Contra Costa Co: M.A. Nobs & S.G. Smith 942 (RSA).

Mendocino Co: V.K. Chestnut 5840 (US).

San Joaquin Co: H.L. Mason 5425 (UC); A.L. & H.N. Moldenke 30290 (MIN); J.W. Congdon s.n. (MIN); J.W. Congdon s.n. (MIN); J.W. Congdon s.n. (MIN); E.E. Stanford 721 (RSA).

Shasta Co: M.A. Nobs S.G. Smith 1040 (RM,US).

COLORADO: Adams Co: L. Kelso 1441 (RM).

Boulder Co: F. Tweedy 5124 (RM); F. Ramaley 748 (RM); W.W. Robbins 2554 (RM).

Clear Creek Co: ME. Jones s.n. (RSA).

Denver Co: A. Eastwood 41 (US,NCU).

Fremont Co: T.S. Brandegee 464 (UC).

Jefferson Co: M.E. Jones 523 (RSA); D. Fambrough 536 (NCU).

Larimer Co: W.F. Marshall 2016 (RM); W.F. Marshall 2015 (RM); C.S. Crandall 2014 (MIN); W.T. Marshall 2016 (US); J.H. Cowan 405 (US).

Weld Co: G.E. Osterhout 8210 (RM); G.E. Osterhout s.n. (MIN).

Yuma Co: W.W. Eggleston 1555 (RM).

CONNETICUT: Fairfield Co: C.L. polard 186 (US).

Litchfield Co: N.M. Whitfield s.n. (MIN).

IDAHO: Ada Co: J.A. Clark 253 (MIN,UC,US)

Appendix B. continued.

Canyon Co: J.F. MacBride 304 (WTU,MIN,US).

Kootenai Co: H.J. Rust 209 (OKL)

Latah Co: L.G. Henderson s.n. (US).

Owyhee Co: J.M. Johnson 254 (NSU,US).

INDIANA: Clay Co: R.C. Friesner 21768 (US).

Greene Co: R.C. Friesner 22294 (US).

Lake Co: L.M. Umbach 8243 (MIN).

Pulaski Co: R.C. Friesner 9768 (ISC).

Wayne Co: F.W. Pennell 9813 (MIN).

Monroe Co: J.D. Lipps s.n. (US).

ILLINOIS: Adams Co: A.A. Evers 802 (MIN).

Cook Co: R. Bebb 1686 (MIN); H.R. Bennett s.n. (MIN); R. Bell 2109 (MIN).

Jackson Co: J. McCree & G. Wilson 1021 (MIN).

Jefferson Co: R.A. Evers 65196 (NCU).

Johnson Co: C. Schwab 309 (NCU).

Lawrence Co: W.M. Bailey, J.R. Swayne 1745 (NCU).

Perry Co: W.M. Bailey & J.R. Swayne 137 (NCU).

Peoria Co: J.R. Stwart s.n. (F).

Pilot Co: G.S. Winterrimyer 626 (F).

Pope Co: J. & W. Rapp 62 (F).

Randolph Co: W.M. Bailey 1614 (NCU).

Richland Co: R. Ridgeway 427 (F).

Appendix B. continued.

St. Clair Co: J.O. Neill 11161 (NCU); J.O. Neill 15458 (NCU).

Stark Co: V.H. Chase 981 (F).

Vermillion Co: D. Siegler 5080 (MIN).

IOWA: Cook Co: H.S. Fawcett s.n. (ISC).

Fayette Co: B. Fink s.n. (ISC); B. Fink s.n. (ISC).

Howard Co: D. Isely 10795 (ISC).

Jeff Co: C.L. Gilly & M. McDonald 834 (ISC).

Johnson Co: R. Riggins 278 (ISC).

Linn Co: B. Shimek s.n. (ISC).

Louisa Co: B. Shimek & P.C. Myers s.n. (ISC).

Mitchell Co: R.J. Cratty s.n. (ISC).

Muscatine Co: Pammel, Kelso, Harlan s.n. (ISC); M.E. & R.G. Brown s.n. (ISC).

Palo Alto Co: R.J. Cratty s.n. (ISC).

Pocahontas Co: J.D. Brotherson 1485 (ISC).

Scott Co: D.H. Hull s.n. (ISC).

Sioux Co: N. Newell 20785 (ISC).

Story Co: Pearl Clayton 137 (ISC); L.H. Pammel s.n. (ISC); L.H. Pammell 78 (ISC).

Union Co: B. Shimek s.n. (ISC).

Van Buren Co: J. Fults s.n. (ISC).

Webster Co: C.H. Churchill 3059 (ISC); O.M. Oleson 3059 (ISC); M.P. Somes 12078 (ISC); D.W. Augstine 668 (ISC); D.A. Niemann 447 (ISC).

Appendix B. continued.

Winneshiek Co: W. Holway s.n. (ISC); R.D. Albertson 181-61 (ISC); P.H. Monson 174 (ISC).

KANSAS: Douglas Co: R.L. McGregor 14570 (NCU).
Franklin Co: R.L. McGregor 12699 (MIN).
Osage Co: G. Tucker 6174 (NCU).
Reno Co: J. Poindexter 195-23 (NCU).

MAINE: Aroostook Co: G.D. Chamberlain s.n. (UC).
Kennebec Co: N.C. Fassett s.n. (MIN).
Lincoln Co. J.A. Steyermark s.n. (F);
Piscataquis Co: M.L. Fernald 296 (MIN).
Waldo Co: G.B. Rossback 6509 (NCU).

MARYLAND: Prince Georges Co: J. Tidestrom 6611 (F); B.F. Hyacinth 1786 (F).

MASSACHUSETTS: Barnstable Co: R. Murdoch 1433 (F).
Franklin Co: S. Garanin 7219 (ISC); S. Garanin 7219 (MIN).
Hampshire Co: M.E. Harris s.n. (MIN).

MICHIGAN: Berrien Co: O.E. Lansing 3276 (F).
Cheboygan Co: C.A. Kofoid s.n. (ISC).
Berrien Co: O.E. Lansin 3241 (F).
Door Co: C.F. Millspagh 3647 (F).

Appendix B. continued.

Emmett Co: H.A. Gleason Jr. & Sr. 162 (ISC); F.C. & M.T. Gates 10708 (MO).

Houghton Co: C.D. Richards 3849 (MIN).

Jackson Co: S.H. & D.R. Camp s.n. (F).

Kalamazoo Co: A.G. Burgess 493 (F).

Kent Co: C.W. Bagnin 3287 (F).

Mason Co: Miller E 1049 (GA); R.W. Chaney 81 (F); R.W. Chaney 31 (MO).

MINNESOTA: Anoka Co: R.G. Cottrell s.n. (MIN); J.W. Moore 25129 (MIN); R.J. Benson 6 (MIN); E.E. Jukkola 120 (MIN); J.W. Moore 25287 (MIN).

Becker Co: M.F. Buell 2019 (MIN); M.L. Grant 3073 (ISC).

Beltran Co: J.S.A. 271 (MIN); E.L. Nielsen (MIN).

Benton Co: J.W. Moore N.L. Huff 18846 (MIN).

Brainerd Co: E.B. Watson s.n. (ISC).

Brown Co: E.P. SHeldon 5366 (MIN).

Isanti Co: J.N. Moore 25647 (MIN); D. Isaak 17 (MIN).

Kelly Lake Co: L. Clapper s.n. (ISC).

Kittson Co: C.A. Ballard 2647 (MIN); J.W. & M.F. Moore 11641 (MIN)

Koochiching Co: O. Lakela 191988 (MIN).

Lake Co: O. Lakela 5814 (MIN).

Lake of the Woods Co: J.W. & M.F. Moore 10977 (MIN); G. Swanson s.n. (MIN); J.W. & M.F. Moore 12028 (MIN); J.W. & M.F. Moore 12217 (MIN).

Appendix B. continued.

Ottertail Co: P. Johnson 545 (ISC).

Polk Co: J.E. Campbell s.n. (F)

MARYLAND: Benton Co: J.A. Steyermark 68670 (F); J.A. Steyermark 7268 (F).

MONTANA: Bates Co: N.C. Henderson 65-584 (ISC).

Johnson Co: J.A. steyermark 24528 (F).

LaClede Co: J.A. Steyermark 72389 (F).

LaFayette Co: J.A. Steyermark 24745 (F).

Livingston Co: S. Sparling 1363 (ISC); S. Sparling 240 (ISC).

Miss Co: J.A. Steyermark 72229 (F).

Pettis Co: J.A. steyermark 21340 (F).

St. Louis Co: H. Eggert s.n. (MIN); H. Eggert s.n. (ISC).

Gallatin Co: D.B. Swingle s.n. (RM); D.B. Swingle s.n. (WTU).

Jefferson Co: M.E. Jones s.n. (RSA).

Lewis & Clark Co: F.D. Kelsey s.n. (RSA).

Ravalli Co: C.L. Hitchcock C.V. Muhick 21937 (WTU).

NEBRASKA: Buffalo Co: W.E. B. s.n. (US).

Brown Co: S. Stephens 24438 (NCU).

Cass Co: T.A. Williams s.n. (US).

Hooker Co: P.A. Rydberg 1515 (US).

Holt Co: O.E. White s.n. (US); E. Hodges E.L. Nielson 3495 (MIN).

Sheridan Co: J.B. Hatcher s.n. (UC).

Appendix B. continued.

NEW HAMPSHIRE: Coos Co: W. Deane s.n. (MIN).

Hillsboro Co: C.F. Batchelder s.n. (MIN).

NEW JERSEY: Cape May Co: M.A. Johnson s.n. (ISC).

Mercer C6: A. Schott s.n. (F).

NEW MEXICO: Socoro Co: E.O. Wooten s.n. (US).

NEW YORK: Albany Co: N.H. Russell 817534 (MIN).

Columbia Co: W.A. Weber 1414 (ISC).

Delaware Co: B. Envir & B.M. Ottlery 2685 (ISC).

Jefferson Co: W.C. Muencher B. MaGuire 2501 (MIN).

Madison Co: H.D. House 23127 (US); W.R. Maxon s.n. (US).

Monroe Co: O.E. Pearce s.n. (US); W.A. Matthews 3154 (NCU).

Rensselar Co: J. Hall s.n. (F).

Sereca Co; J.W. Chickering s.n. (US).

Shuyter Co: McCarthy s.n. (US).

Sullivan Co: W.A. Weber 208 (ISC).

Tompkins Co: W.C. Muchscher 340 (ISC); H.E. summers s.n. (ISC); O.E. Pearce s.n. (US).

NEVADA: Lincoln Co: M.E. Jones s.n. (RM).

NORTH CAROLINA: Allegany Co: S.W. Leonard, A.E. Radford, D. Culwell, F. Greenlee 2073 (NCU).

Wake Co: S. Leonard & J. Moore 5525 (NCU).

Appendix B. continued.

NORTH DAKOTA: Bensen Co: J. Lunell 547 (MIN); J. Lunell 870 (MIN); J. Lunell s.n. (MIN); J. Lunell s.n. (US).

Bottineau Co: E.L. Nielssen 1214 (MIN).

Burleigh Co: J. Koch 276 (NCU).

Grand Forks Co: S.L. Rider 128 (F).

Grant Co: W.B. Bell 1348 (UC).

McClean Co: F.P. Metcalf 427 (US).

Pembina Co: H.F. Bergman 2256 (GA).

Richland Co: O.A. Stowes s.n. (US).

Stutsman Co: E.L. Nielsen 2186 (MIN).

Ward Co: O. Lakela 291 (MIN); L.F. Lautenschlager 823 (MIN).

OHIO: Champaign Co: D. Demaree 11689 (MIN).

Cuyahoga Co: J.R. Watson s.n. (MIN).

Erie Co: C.S. Mead 3059 (F); D. Albright 187 (MIN).

Hamilton Co: E.L. Braun s.n. (US).

Lorain Co: A.E. Rickseeker s.n. (US).

Richland Co: E. wilkinson 8461 (MIN).

Tama Co: J.W. Peuduff s.n. (ISC).

Wayne Co: E. wilkinson s.n. (MIN).

OKLAHOMA: Alfalja Co: R. J. Baalman 490 (MIN).

Bryan Co: J. & C. Taylor 2479 (OKL).

Ellis Co: G.W. Stevens 2901 (MIN).

Grant Co: G.W. Stevens 1791 (MIN).

Appendix B. continued.

Muskogee Co: C.S. Wallis 7728 (GA); E.L. Little, Jr. 2435 (GA).

Oklahoma Co: M. Hopkins 121 (OKL); UT Waterfall 3074 (OKL).

Okmulgee Co: T.R. Stemen 547 (OKL).

Ottawa Co: G.W. Stevens 2308 (US).

Sequoyah Co: C.W. Wallis 5557 (OKL).

OREGON: Marion Co: E. Hall s.n. (F).

Umatilla Co: M.E. Peck 10461 (F); J.B. Leiberg 2630 (US).

PENNSYLVANIA: Cameron Co: H.A. Wahl 831 (ISC).

KENTUCKY: Powell Co: D.D. Higgins 1681 (NCU).

Tioga Co: A.L. & H.N. Moldenke 31139 (US).

Trigg Co: E. Wofford 02268 (ISC).

PENNSYLVANIA: Union Co: A.L. & H.N. Moldenke 31150 (US).

Westmoreland Co: L.K. Henry 551 (ISC).

RHODE ISLAND: Newport Co: P. Spalding s.n. (US).

SOUTH DAKOTA: Fall River Co: P.A. Rydberg 933 (US).

Roberts Co: W.H. Over 14384 (US).

Sheridan Co: R.E. Buchanan s.n. (ISC).

Todd Co: W.L. Tolstead s.n. (ISC).

Appendix B. continued.

TENNESSEE: Carroll Co: E. & A. Clebsch A.J. Sharp 6008 (TENN).
Cojje Co: R.E. Shank, A.J. Sharp, E. Clebsch 5234 (TENN).
Chester Co: A.J. Sharp, E. & A. Clebsch 9434 (TENN).
Henry Co: E. & A. Clebsch A.J. Sharp G110 (TENN); E. Clebsch & A. Clebsch 7737 (TENN).
Morgan Co: A.S. Percival s.n. (F).

TEXAS: Hemphill Co: V.L. Cory 50298 (US); C.M. Rowell 10596 (MIN); E.L. Reed 4034 (RM).

UTAH: Salt Lake Co: I.H. Pammel & R.E. Blackwood 3638 (ISC).
Utah Co: S.L. Welsh & G. Moore 3249 (ISC); B.F. Harrison 11865 (US); B.F. Harrison 9217 (US UC); I. Tidestrom 1718 (US); C. King 822 (US); J.H. Harris C27628 (MIN); M.E. Jones 487 (RSA); C.V. Morton 9217 (UC); M.E. Jones 1487 (F); R.E. COombs 1510 (ISC).

VERMONT: Bennington Co: M.A. Day 149 (US).

VIRGINIA: Campbell Co: G.W. Ramsey, R.S. Freer, W. Thacker, N.F. Ruska 4568 (NCU).
Fonquier Co: H.A. Allard 5349 (GH); H.A. Allard 3281 (US).
Lee Co: J.K. Small s.n. (F).
Montgomery Co: W.A. Murrill s.n. (ISC); L.J. Uttal 10837 (NCU); L.J. Uttal 8163 (NCU).

Appendix B. continued.

Randolph Co: H.H. Smith 1546 (F)

Roanoke Co: C.E. Wood, Jr. 6239 (GH).

Sussex Co: M.L. Fernald & Bayard Long 9624 (GH).

Smyth Co: J.K. Small s.n. (GH,F).

WASHINGTON: Benton Co: Mrs. A. Gotfredson 90 (RSA).

Clark Co: C. English, Jr. 477 (US).

Multnomah Co: E.P. Sheldon S11167 (CSPU,MIN,WTU,F); H.M. Gilkey s.n. (CSPU, WTU).

Okanogan Co: A.D.E. Elmer 537 (MIN)

Spokane or Stevens Co: F.O. Kreager 469 (MIN,US); R.K. Beattie R. Chapman 2188 (US).

Walla Walla Co: R.M. Homer 17 (US)

Yakima Co: A.R. Kruckeberg 2545 (RSA); R.F. Hoover 5930 (RSA); C. Abair s.n. (MIN); J.S. Cotton 1396 (US); J.S. Cotton 787 (US).

WEST VIRGINIA: Cabell Co: F.A. Gilbert 1000 (GH).

Grant Co: M. Brown s.n. (NCU).

Greenbriar Co: F.W. Hunnewell 2795 (GH).

Tucker Co: H.A. Allard 9233 (US)

Wood Co: W.M. Pollock s.n. (F)

WISCONSIN: Brown Co: J.H. Schaette 90 (F).

Calumet Co: H.C. Benke 386 (F).

Dane Co: N.C. Fassett 8686 (ISC)

Appendix B. continued.

WYOMING: Sheridan Co: A. Nelson 2258 (RM,US); A. Nelson 8489 (RM,US); Vie Willits 468 (RM).

Verbena lasiostachys

CALIFORNIA: Alameda Co: Michener & Bioletti s.n. (MICH); I.L. Wiggins 8957 (WTU).

Alpine Co: R.F. Hoover 4161 (CSPU,UC).

Amador Co: G. Hansen 1823 (NDG).

Butte Co: Mrs. R.M. Austin s.n. (NDG).

Colusa Co: R. Stinchfield 375 (CSPU).

Contra Costa Co: J.A. Ewan 9719 (WTU).

Fresno Co: H.P. Kelley s.n. (UC); C.H. Quibell 522 (CSPU); S. Simonian 01203A (CSPU); F. Beylik 53 (CSPU); Mrs. J. Clemens s.n. (CSPU); J. McDonald s.n. (US); E.C. Twisselman 17522 (RSA).

Glenn Co: R.E. Nelson 159 (WTU).

Humboldt Co: J.P. Tracy 18090 (WTU,UC); L. Constance 660 (UC); J.F. Tracy 2775 (NCU); H.E. Parks 5072 (UC); A.L. & H.N. Moldenke 30232 (US); J.P. Tracy 18090 (CSPU).

Kern Co: L.R. SHort & I.H. Johnson (UC); E.C. Twisselmann 8767 (RSA); F.V. Coville, F. Funston 1110 (US).

Lake Co: W.L. Jepson 18935 (UC); W.L. Jepson 21227 (UC); A.A. Heller 5919 (WTU); H.N. Bolander 2683 (US).

Los Angeles Co: H.H. Smith 5063 (UC); F.W. Peirson 175 (UC); E.D. Palmer s.n. (UC); F.R. Fosberg 706 (UC); F.A. MacFadden 92E (UC); I. Johnston 1320 (US); H.E. Hasse s.n. (US)L. Abrams 2481 (RSA);W.H. Brewer 31 (US); C. Crum s.n. (UCSB)J.R. Haller 151 (UCSB);

Appendix B continued.

J.F. James s.n. (US).

Marin Co: H.A. Davis s.n. (WTU).

Mendocino Co: L.S. Rose 39140 (US); J. McMurphy 320 (US); J.B. Davy W.C. Blasdah 5892 (US); Miss H.A. Wallar 211 (UC); W.L. Jepson 7643 (UC); W.L. Jepson 17668 (UC); W.L. Jepson 20869 (UC); W.L. Jepson 9279 (UC); W.C. Matthews 174 (UC); D.E. Breedlove 2931 (UCSB); J.P. Tracy 5059 (WTU).

Monterey Co: F. Chisaki, H. Sharsmith, O.T. Solbrig 2823 (US); C.B. Hardham 10466 (RSA); J.R. Howell 11562 (RSA); C. Dudley s.n. (WTU); A.A. Heller 6778 (WTU); L.W. Reinecke s.n. (WTU); M. Bench s.n. (WTU); F. Youngberg s.n. (WTU); A.A. Heller 6778 (ISC); W.L. Jepson 9738 (UC); L.C. Wheeler 4294 (ND); G. Keaton s.n. (UCSB).

Nevada Co: M.E. Jones 2598 (CSPU).

Orange Co: W.H. Brewer 717 (US); D.L. Crawford s.n. (CSPU); L.M. Booth 1171 (CSPU); J.T. Howell 448 (CSPU); L.M. Booth 1171 (UC)N. Murbarger 218 (UC); P.A. Munz 6734 (UC).

Riverside Co: J.T. Howell 1040 (CSPU); L.B. Ziegler s.n. (CSPU).

San Benito Co: V.F. Hesse 26060 (UC); W. Hickey s.n. (UC); A.J. Pietero s.n. (MICH).

San Bernardino Co: H.L. Wedberg 1121 (UC); G.W. Dunn s.n. (NDG) P.A. Munz 12313 (WTU); S.B. Parish 8464 (WTU).

San Diego Co: R.D. Alderson s.n. (UC); I.L. Wiggins 2967 (UC); I.L. Wiggins 2614 (UC); R.D. Alderson s.n. (UC); L. Abrams 3787 (RSA); M.F. Spencer 994 (CSPU); E.R. Johnson 1308 (CSPU); C.B.

Wolf 2252 (CSPU); R.D. Alderson s.n. (MICH); C.R. Orcutt s.n. (MICH); I.L. Wiggins 2614 (WTU); E. Hewlett 51 (UC); C.V. Meyer 240 (UC).

San Joaquin Co: E.L. Greene s.n. (NDG).

San Mateo Co: L.S. Rose 32321 (UC); M.L. Linvill 16 (OSC) L.S. Rose 32321 (WTU,ND).

Santa Barbara Co: D. Demaree 18103 (ISC); W.L. Jepson 12,144 (UC); I.W. Clokey 5041 (ND); D.E. Breedlove 2856 (UCSB); J. Zellhoefer 26 (UCSB); J. DeWitt 21 (UCSB); H.J. Rocke 160 (UCSB); J. Nowell 46 (UCSB); Y.A. Rocke 160 (UCSB); D.E. Breedlove 122 (UCSB); A. Whistler 2A (UCSB); F. Smith 1348 (UCSB); A.D.E. Elmer 3846 (RSA).

Santa Clara Co: D. Demaree 9205 (ND); T96 (CSPU); L. Abrams s.n. (CSPU).

Santa Cruz Co: J.T. Howell 11615 (Rancho Snata Ana); J.H. Thomas 3219 (RSA); J.H. Thomas 3188 (RSA); Mallory 245 (RSA); E.E. Stanford 488 (OSC); M. Epling 8310 (OSC).

Shasta Co: W.L. Jepson 21226 (UC); F.P. Nutting s.n. (CSPU).

Siskiyon Co: G.D. Butler 83 (UC); G.D. BUtler 943 (UC); L.C. Wheeler 3315 (ND); E.L. Greene 860 (NDG); W.B. Cooke 15149(OSC); L.C. Wheeler 3315 (CSPU); D. Barbe 017 (CSPU); C.B. Wolf 1047 (CSPU).

Sonoma Co: L.M. Newlon 271 (UC); W.L. Jepson 9486 (UC); M.E. & E. Van Ferguson 238 (UC); A.A. Heller 5785 (RSA).

Tehama Co: P.A. Munz 16963 (CSPU).

Appendix B. continued.

Trinity Co: W.J. Ferlath B.D. Rogers 2031 (UC); P.A. Munz 16588 (CSPU); E.K. Balls 13802 (CSPU); E.R. Johnson 1163 (CSPU).
Tulare Co: Miss Vastwood 4210 (CSPU); W. Fry 333 (UC); G.T. Robbins L.R. Heckard 3542 (UC).
Tuolumne Co: R.L. Konrod 10412 (CSPU); A.L. Grant s.n. (UC); W.L. Jepson 6419 (UC); A.L. Grant s.n. (UC).
Ventura Co: O. Thacher 40 (UC); J.T. Howell 1028 (RSA); A. Simontacch 74 (UC); H.M. Pollard s.n. (MO).

OREGON: Curry Co: D.L. Friebe s.n. (OSC); M.E. Peck 8702 (OSC); W.H. Baker 4207 (UC,OSC); W.H. Baker 4368 (OSC).
Douglas Co: M.E. Peck 23722 (OSC); V.L. Crosby 00132 (OSC); M.E. PEck 7450 (OSC); M.E. Peck 20215 (OSC); I.W. Thompson 4412 (MO).
Jackson Co: J.W. THompson 12409 (ND,MO); A.N. Steward 7188 (OSC); L.J. & Z.B. Dennis 2255 (OSC); Mrs J.D. Holst s.n. (OSC); L.J. Dennis 2536 (OSC); H.M. Gilkey s.n. (OSC); M.E. Peck 14961 (OSC); D.P. Rogers s.n. (OSC); M.E. PEck 7451 (OSC); M.E. Peck 16357 (OSC); E.W. Hammond 322 (US,MO).
Josephine Co: T. Howell s.n. (OSC).

Verbena neomexicana

ARIZONA: Cochise Co: F.W. Gould, L.M. Pultz 3164 (UC); L.N. Gooding 2246 (UC); A.L. Hinckley s.n. (ARIZ); Maguire, Richards, Meoller 11065 (ARIZ); Kearney, Peebles 13847 (ARIZ); Lemmon s.n. (F,ARIZ); L. Grines 7138 (ARIZ); Harrison & Kearney 5796 (US,ARIZ);

Appendix B. continued.

J.C. Blumer 2170 (US); J.I. Carlson s.n. (US); J.C. Blumer 1804 (MIN,NMC); D. Anderson & E. Rhinehart 1292 (NMC).

Gila Co: Mrs. R.E. Collum 355 (US); Parker, McClintock, Robbins 6121 (ARIZ); A. & R. Nelson 2018 (RM).

Maricopa Co: L.R. Albee s.n. (NMC); E. Lehto 4643 (NCU); E. Lehto 5126 (NCU); E. Lehto 416 (NCU).

Pima Co: Peebles, Harrison, Kearney 3790 (US,ARIZ); G.J. Harrison 4778 (US,ARIZ), C.B. Carter s.n. (NMC); H.H. Nichol s.n. (ARIZ); Peebles 7928 (ARIZ); J. Arnold s.n. (ARIZ); L. Benson s.n. (ARIZ); T.H. Kearney & C.H. Peebles 10355 (ARIZ).

Pinal Co: Peebles, Harrison, Kearney 1753 (ARIZ); Lehto, Hensel, Pinkova 11033 (US); R.H. Peebles G.J. Harrison 1649 (ARIZ); Harrison & Kearney 1488 (ARIZ).

Santa Cruz Co: Kearney & Peebles 13863 (ARIZ); C.G. Pringle s.n. (F); I. Tidestrom 872 (US); A. Hesselberg s.n. (ARIZ); L.N. & C. Gooding s.n. (ARIZ); Darrow s.n. (ARIZ).

Yavapai Co: M.E. Jones s.n. (US); F.W. Gould, R.A. Darrow 4180 (US,ARIZ), F.S. Crosswhite 718 (NCU).

NEW MEXICO: Bernallilo Co: E.O. Wooten 3852 (NMC).

Eddy Co: B.E. McKechnie 360 (MO).

Grant Co: N.W. Eggleston 16505 (F); D.A. & A.D. Zimmermann DAZ-ADZ 2239 (ARIZ); E.L. Greene s.n. (F,MO); W.W. Eggleston 16399 (F); E.L. Greene s.n. (US); J.M. Holzinger s.n. (US).

Lincoln Co: Wharton, Huber s.n. (MO); F.S. & E.S. Earle 387 (RM); Turner s.n. (NMC); Turner s.n. (NMC).

Appendix B. continued.

Otero Co: W. Huber s.n. (F); E.O. Wooten s.n. (NMC).

Santa Cruz Co: W.E. Niles 759 (MINARIZ).

Sierra Co: E.L. Greene 955 (NMC).

Socorro Co: C.L. Merrick (NMC); O.B. Metcalfe 612 (MO,NMC); R.J. Fleetwood 670 (US); E.L. Greene 610 (RM).

TEXAS: Bell Co: S.E. Wolff 539 (F); C.L. & Gertrude York 54448 (M,N).

Bexar Co: Metz 2156 (F); H.C. Cutler 901 (MO); B.H.A. Groth 16 (F).

Brewster Co: R.R. Innes B.H. Narnock 537 (GH); A.R. Kruckeberg 4796 (UC); R.R. Innes & Brunelle Moon 1200 (GH); D. Sutherland 2802 (NMC); O.E. Sperry 477 (US); Missouri Botanical Garden 357 (US,MO); E.G. Marsh 219 (F)E.D. SChulz 2026 (F); C.H. Mueller 8139 (F); E.G. Marsh 249 (F,MO); J.A. Moore & J.A. Steyermark 3277 (GH,MIN) ; B.H. Narnock s.n. (ARIZ); A. & R. Nelson 5129 (RM); B.C. Tharp s.n. (RSA).

Brown Co: J. Reverchon 737 (F).

Comal Co: Lindheimer 1074 (GH); Lindheimer 1074 (GH,NMC).

Dimmit Co: M.E. Jones 28293 (RSA).

Edwards Co: L.C. Higgins 5608 (NCU).

Hudspeth Co: B.D. Tharp 43-804 (MO).

Jeff Davis Co: L.C. Hinckley 170 (F); Tharp, Janszen 49-1144 (MIN); L.C. Hinckley s.n. (ARIZ); E.J. Palmer 30791 (MO); M.E. Jones 26224 (RSA).

Kerr Co: A.A. Heller 1732 (GH).

Appendix B. continued.

Presidio Co: L.C. Hinkley 1971 (US); S.D. McKelvey 2046 (US); C.L. & A.A. Lundell 14340 (US); L.C. Hinckley 1254 (GH); L.C. Hinckley 3246 (GH); L.C. Hinckley 2709 (GH); H.C. Hanson 645 (GH,US); B.H. Warnock 46615 (F,US); L.C. Hinckley 1089 (F,ARIZ); T.R. Van Devender s.n. (ARIZ): L.C. Higgins 5070 (NCU); L.C. Hinckley s.n. (GH).

San Patricio Co; S.D. McKelvey 1710 (GH).

San Saba Co: E. Howell 12 (NCU).

Travis Co: B.D. Tharp s.n. (F,MO); E. Hall 630 (F), C.L. York 49003 (MIN); B.C. Tharp s.n. (GH); C.L. & A.A. Lundell 8876 (GH).

Tom Green Co: E.J. Palmer 12382 (RM).

Val Verde Co: G.B. Rossbach 4826 (UC).

Webb Co: Thpar & York 52-153 (RM); H.S. Gentry & A.S. Barclay 18439 (US); A. & R. Nelson 5138 (RM); B.C. Tharp 3687 (US).

Wharton Co: J.K. Small s.n. (GH).

Verbena officinalis

ALABAMA : Barbour Co: R.M. Harper 4333 (GA).

DeKalb Co: H. Eggert s.n. (MO); H. Eggert s.n. (US).

Mobile Co: C. Mohr s.n. (US); C. Mohr s.n. (US); C. Mohr s.n. (MICH); S. Jewett s.n. (MICH).

DELAWARE: New Castle Co: C. Spuria s.n. (GH).

FLORIDA: Alachura Co: F.H. Sargent 6207 (CSPU).

Appendix B. contined.

Jackson Co: R.K. Godfrey 53168 (GA).

Pasco Co: P. Genelle, G. Fleming 198 (CSPU).

Volusia Co: O. Lakela 31863 (CSPU).

GEORGIA: Decatur Co: R.A. Norris 377 (GA).

Dougherty Co: R.F. Thorne 3629 (GA).

Miller Co: R.F. THorne 5437 (GA).

Wilkes Co: J.A. Lowell s.n. (GH).

LOUISIANA: Acadia Par: F.W. Pennell 10201 (GA).

East Carroll Par: BIlly Thompson 151a (WTU).

Lincoln Par: R.D. Thomas, K. Gremillion 2487 (UCSB).

MARYLAND: Worcester Co: R.R. Tatnall 2377 (GH); R.H. True 13 (PH).

MASSACHUSETTS: Essex Co: W. Oakes s.n. (GH).

MISSISSIPPI: Newton Co: L.C. Temple 8610 (GA).

Warren Co: T.M. Pullen 64609 (GA).

NEW JERSEY: Cambden Co: C.F. Parker s.n. (GH); C.F. Parker s.n. (GH).

Cape May Co: L. Griscom 10518 (GH).

NEW YORK: Dutchess Co: J. Hall s.n. (F).

Bronx Co: H.N. Moldenke 20562 (CSPU).

Appendix B. continued.

Brooklyn Co: J. Schrenk s.n. (MO).

Suffolk Co: E.S. Miller s.n. (F).

Yates Co: S.H. Wright s.n. (MICH).

OREGON: Marion Co: J.C. Nelson 1693 (GH).

Multnomah Co: W.N. Suksdoy 1894 (GH); J.C. Nelson 4841 (OSC); J.C. Nelson 835 (GH).

PENNSYLVANIA: Dauphin Co: T.C. Porter s.n. (GH); J.K. Small s.n. (F).

Delaware Co: B. Long 38759 (PH); J.M. Fogg, Jr. 5695 (GH).

Lancaster Co: W. Stone 2166 (PH); T.C. Porter s.n. (PH,6H).

Philadelphia Co: A.H. Smith s.n. (PH); C.F. Parker s.n. (PH); C.F. Parker s.n. (PH); H.B. Meredith s.n. (PH); B. Long 24578 (PH); H.B. Meredith s.n. (GH); C.F. Parker s.n. (F); E.C. Martindale 1960 (SIU).

York Co: A. MacElwee s.n. (PH); A. MacElwee 873 (GH).

SOUTH CAROLINA: Anderson Co: J. Davis 8493 (US).

TENNESSEE: Carroll Co: H. Eggert 445 (F).

Carter Co: J.K. Small, A.A. Heller 4848 (F).

Knox Co: A. Ruth s.n. (MO,WTU).

TEXAS: Wilson Co: D. Nindler 403 (SIU).

Appendix B. continued.

VIRGINIA: Accomee Co: H. Wilkens 5372 (PH).

Dinwiddie Co: M.L. Fernald B. Long 10798 (GH).

Henriw Co: M.L. Fernald, B. Long 12451 (GH).

NORTH CAROLINA: Madison Co: J.D. Smith s.n. (US).

Catawba Co: J.K. Small, A.A. Heller s.n. (F).

Guiford Co: J.K. Small, A.A. Heller s.n. (F).

Rowan Co: J.K. Small, A.A. Heller 484 (F).

Currituck Co: L.F. & F.R. Randolph 587 (GH).

Washington Co: L.F. & F.R. Randolph 645 (GH).

Polk Co: E.C. Townsend s.n. (US).

Macon Co: L.N. Johnson 1960 (F).

Bladen Co: Biltmore 4762 (GTT).

VIRGINIA: Norfolk Co: H.B. Meredith s.n. (MICH).

Princess Anne Co: M.L. Fernald, B. Long 4152 (GH); M.L. Fernald B. Long 12452 (GH); K.K. MacKenzie 1679 (CSPU,MO).

Smyth Co: J.K. Small s.n. (US).

Southhampton Co: M.L. Fernald, B. Long 14395 (GH); A.A. Heller 964 (US).

WEST VIRGINIA: Jefferson Co: E.L. Greene s.n. (F).

Ohio Co: H.N.M. & G. Guthenberg 1960 (F).

Verbena robusta

CALIFORNIA: Alameda Co: W.L. Jepson 12935 (UC); Michener & Bioletti 123 (GH);

Appendix B. continued.

R.P. Brandt s.n. (UC); M.S. Baker 10504 (UC); Michener & Bioletti s.n. (UC).

Contra Costa Co: R. Brandt s.n. (UC); P.H. Raven 2489 (UCSB); J.A. Ewan 9726 (UCSB); M.L. Bowerman 393 (UC); M.L. Bowerman 371 (UC); M.L. Bowerman 464 (UC); K. Brandeger s.n. (UC).

Los Angeles Co: C.F. Millspaugh 4588 (F); E.C. Knopf 160 (F); L.W. Nuttall 125 (F); E.C. Knopf 246 (F); W.X. Knopf 138 (F); J.F. MacBride 850 (GH,MO); K. Brandeger s.n. (UC); R.F. Thorne, P. Everett 35007 (CSPU); C.B. Wolf 3612 (UC); R.F. THorne 36670 (CSPU); R.F. Thorne 36508 (CSPU); F.R. Fosberg 54843 (UC); F.R. Fosberg 54606 (UC); F.R. Fosberg 54741 (CSPU,ND); M.B. Dunkle 1955 (CSPU); J.F. Carlson s.n. (GH,MO); L.W. Nuttall 348 (F).

Marion Co: W.L. Jepson 21230 (UC); G. Keaton s.n. (UCSB); A. Eastwood s.n. (GH).

Monterey Co: A. Eastwood, J.T. Howell 5808 (WTU,GH); C.M. Belshaw 2731 (GH).

Santa Barbara Co: O. Thacher s.n. (UC); D.E. Breedlove 833 (UCSB); R.E. Broder & M.R. Benedict B64-32 (UCSB); C.B. Wolf 4160 (UC,WTU); F.H.E. 38-291 (MICH); I.W. Clokey 5041 (MICH); M.E. Jones SM-11-26 (CSPU); M.W. Williams 42 (CSPU); E.K. Balls, E.R. Blakely 23677 (CSPU,UC).

Santa Clara Co: J.B. Davy 289 (UC); L.S. Rose 65098 (WTU); J.H. Thomas 4309 (MICH); C.P. SMith 1155 (MICH).

San Diego Co: C.R. Orcutt 539 (F); C. Epling, M. Darsie,

C. Knox, W. Robinson s.n. (UC); E. Palmer 310 (F,GH).

San Luis Obispo Co: M. Cooper 49 (UCSB); I.L. Wiggins 3618 (WTU); C.B. Wolf 3614 (CSPU); E. Palmer 341½ (GH).

San Mateo Co: A.D.E. Elmer 4950 (UC,OSC); J.T. Howell 14745 (CSPU).

Solano Co: W.L. Jepson 20250 (UC); Willis, L. Jepson s.n. (UC); J.W. Congdon s.n. (GH).

Tuolumne Co: Mrs. N.J. Williamson 189 (CSPU).

Verbena simplex

ALABAMA: Blount Co: C.F. Baker s.n. (US).

Choctaw Co: C. Schuchert s.n. (US).

Franklin Co: J. Massey 4638 (NCU).

Jackson Co: J. Massey, R.D. Whetstone 4610 (NCU).

Mobile Co: C. Wohr s.n. (US).

Montgomery Co: E.M. Farr s.n. (PH).

ARKANSAS: Baxter Co: D. Demaree 28939 (ISC).

Boone Co: D'Arcy, Porter, Demaree 4394 (ISC).

Independence Co: C.C. Smith s.n. (OKL); D. Demaree 26752 (MIN).

Izard Co: D. Demaree 23378 (OKL).

Lawrence Co: P.H. Rolfs s.n. (ISC).

Marion Co: D. Demaree 29249 (ISC).

Searcy Co: R. Bebb 4027 (OKL).

Sebastian Co: H. Ayers s.n. (MICH).

Sharp Co: D.B. Dunn 12814 (GA).

Appendix B. continued.

CONNETICUT:NewHaven Co: W.E. Safford 216 (US).

DELAWARE: New Castle Co: B. Long s.n. (PH).

GEORGIA: Bartow Co: W.H. Duncan 8427 (GA).
Catoosa Co: J.K. Small s.n. (ISC,F).
Cherokee Co: W.H. Duncan 8349 (GA).
Dade Co: W.H. Duncan 2600 (GA).
Floyd Co: H.C. Jones 155 (GA).
Meriwether Co: H.E. Wetherill s.n. (PH).
Walker Co: A. Cronquist 5280 (GA,MICH).
Whitfield Co: H.G. DiGioia 15 (GA).

ILLINOIS: Cook Co: L.M. Umbach s.n. (PH,MIN); E. summers s.n. (MIN); H.F. Munroe s.n. (MICH); N.V. Haynie 2626 (F); N.V. Haynie 1846 (F); H.H. Smith 5670 (GH); A. Chase 1620 (GH); G.H. Shull s.n. (OKL); R. Bebb 1683 (OKL).
Gallatin Co: Voight & Weber 1846 (MIN).
Iron Co: S. Stull 85 (F)
Lake Co: F.C. Gates 1127 (MICH).
Monroe Co: P.P. Wunderlin 2817 (NCU).
Perry Co: W.M. Bailey, J.R. Swayne 111 (NCU).
St. Clair Co. J.O. Neill 10691 (NCU).
Stephenson Co. C.F. Johnson s.n. (MIN)
L.M. Umbach s.n. (US); T.E. Boyce s.n. (ISC).
Winnebago Co: S.C. Wadmond 3763 (MIN); L.H. Pammel, V.C. Fish

Appendix B. continued.

291 (ISC).

INDIANA: Cass Co: C.C. Deam 25916 (PH).

DeKalb Co: C.C. Deam 3234 (MIN).

Harrison Co: R.M. Tryon 2733 (MIN); C.C. Deam 16429 (MIN).

Lake Co: E.D. McDonald s.m. (US); J.W. Thieret 620 (F).

Monroe Co: J. Wynn 63 (GA,MIN).

Porter Co: H.R. Bennett s.n. (F,MIN); H.R. Bennett 7127 (F).

Posey Co: F.J. Hermann 6640 (MICH).

Warren Co: R.C. Friesner 22854 (MICH).

IOWA: Black Hawk Co: B. Shimek s.n. (MIN); L.H. Pammel s.n. (ISC).

Clinton Co: T.S. & M.K. Cooperrider 1290 (NCU,MIN).

Jones Co: T.S. Cooperrider 291 (MIN).

Lyon Co: L.H. Pammel s.n. (ISC).

Muscatine Co: B. Shimek s.n. (MIN); M.E. & R.G. Brown s.n. (ISC).

Story Co: R.W. Pohl 7195 (ISC).

KANSAS: Anderson Co: A.S. Hitchcock 791 (GH-US).

Coffey Co: W.H. Horr 3476 (GH).

Crawford Co: T.M. Sperry 4003 (NCU).

Douglas Co: W.H. Horr E76 (US,PH); W.C. Sterns s.n. (US).

Labette Co: S. Stephens 11037 (NCU).

Miami Co: L. Hauser, R. Brooks 2887 (GH).

Appendix B. continued.

Osage Co: G. Tucker 132 (NCU).

Woodson Co: E.N. Lathrop 204 (GH); E.W. Lathrop 282 (US,GH).

KENTUCKY: Boyle Co: M.E. Wharton 1002 (MICH).

Bullitt Co: C.R. Gunn 40 (NCU).

Edmonson Co: C. Schwab 138 (ISC); H.W. Lix 217 (US).

Fayette Co: C.W. SHort s.n. (MICH).

Grayson Co: C. Schwab 48 (ISC).

Jessamine Co: E.L. Braun s.n. (US); E.L. Braun 921 (US).

Madison Co: R.E. Fothergill s.n. (MICH).

Nelson Co: M.E. Wharton 4058 (MICH).

Rockcastle Co: L.B. Smith, A.R. Hodgdon 3705 (US); M.E. Wharton 2595 (MICH).

Scott Co: J.W. Singer 178 (US).

Wayne Co: E.L. Braun 3083 (US).

MARYLAND: Cecil Co: J.J. Carter s.n. (PH).

Montgomery Co: A.J. Pierters s.n. (MICH); F.J. Hermann 9533 (MICH).

Prince Georges Co: E.H. Walker, F.R. Fosberg 2855 (GA).

MASSACHUSETTS: Hempshire Co: H.G. Jesup s.n. (F).

MICHIGAN: Chippewa Co: E.G. Voss 12389 (MICH); C. & B. Horne 153 (MICH).

Lenawee Co: J. Wright s.n. (MICH).

Appendix B. continued.

St. Clair Co: C.K. Dodge s.n. (MICH); C.K. Dodge s.n. (MICH); W.S. Cooper s.n. (MIN).

MINNESOTA: Fillmore Co: H. Huoslef s.n. (MIN).

Rock Co: Moore, Tryon 17580 (MIN).

Scott Co: C.A. Ballard B212 (MIN).

MISSISSIPPI: Lee Co: T.M. Pullen 64388 (GA).

Oktibbeha Co: C.L. Pollard 1312 (F).

Tishomingo Co: T.M. Pullen 64445 (GA).

MONTANA: Barry Co: B.F. Bush 206 (US).

Boone Co: D. & D. Wade 2192 (PH).

Burton Co: J.A. Steyermark 7430 (F).

Callaway Co: J.A. Steyermark 26145 (F).

Cole Co: J.A. Steyermark 24905 (F).

Cooper Co: J.A. Steyermark 21810 (F).

Franklin Co: E.E. Sherff 1010 (F).

Greene Co: P.L. Redfearn, Jr. 3599 (GA); P.C. Standley 8311 (US); P.C. Standley 9336 (US).

Iron Co: J.R. Churchill s.n. (MIN).

Jackson Co: B.F. Bush 914 (US).

Jefferson Co: G.B. Ownbey 737 (MIN).

Lincoln Co: J. Davis s.n. (MICH).

Montgomery Co: C.O. Elamson 1707 A (MICH).

Appendix B. continued.

Polk Co: J.A. Steyermark 24049 (ISC).

Ozark Co: E.J. Palmer 34766 (GH); P. Maycock s.n. (NCU).

Phelps Co: M. Ganz, D. Keil s.n. (NCU).

St. Louis Co: G. Engelmann s.n. (GH,US); V.M. Flatfeller s.n. (MICH).

Stone Co: P.L. Redfearn, Jr. 18876 (NCU).

NEW JERSEY: Burlington Co: B. Long s.n. (PH).

Cambden Co: B. Long 4320 (PH); J.B. Brinton s.n. (PH).

Gloucester Co: E.B. Bartram s.n. (PH); I. Burk s.n. (PH); C.S. Wilhamson s.n. (PH).

Hunterdon Co: H.L. Fisher s.n. (PH).

Mercer Co: A.R. Slack s.n. (PH); E. volk s.n. (PH); E.B. Bartram s.n. (PH).

Warren Co: T. Seal s.n. (PH).

NEW YORK: Columbia Co: R. McVaugh 2239 (PH).

NORTH CAROLINA: Chatham Co: P.A. Kessler 573 (GA).

Durham Co: W.B. Fox, R.K. Godfrey, L.E. Anderson 3624 (GA); A.E. Radford 44754 (US).

Granville Co: R.K. Godfrey 5117 (GH); W.T. Batson, Jr. 1206 (PH); A.E. Radford, O'Briant 45472 (MIN); A.E. Radford 43888 (MIN).

Polk Co: E.C. Townsend s.n. (US).

Rowan Co: W.W. Davis 249-5 (PH)

Appendix B. continued.

OHIO: Adams Co: E.L. Braun s.n. (US).

Butler Co: L.H. Wehmeyer, C.N. Waters 42 (MICH).

Champaign Co: E.C. Leonard 19069 (US).

Erie Co: D. Albright 182 (MIN); E.L. Mosely s.n. (US); H.H. York s.n. (PH).

Hamilton Co: E.L. Braun s.n. (US).

Highland Co: E.L. Braun s.n. (US).

Ottawa Co: C.S. Mead 3060 (F); H.H. York s.n. (PH).

Trumbull Co: A.N. Road 1057 (MIN).

Washington Co: T. Schoepfle s.n. (MICH).

OKLAHOMA: Bryan Co: J. & C. Taylor 795 (OKL); Bryan Co: J. & C. Taylor 4071 (OKL).

Cherokee Co: R. Bebb 4377 (OKL).

Choctaw Co: UT Waterfall 8901 (GH); C. Smith, W. Radel 69 (GH).

Craig Co: U.T. Waterfall 6852 (OKL).

Harmon Co: D. Demaree 12216 (OKL).

LeFlore Co: C. & J. Taylor 16333 (OKL).

McCurtain Co: E.L. Little, Jr., C.E. Olmstead 104 (GH); H.W. Houghton 3622 (GH); H.W. Houghton 3646 (OKL); P.B. Sears 1432 (OKL).

Marshall Co: G.H. Ware s.n. (OKL).

Mayes Co: J. First 42 (OKL).

Muskogee Co: E.L. Little Jr. 1584 (OKL); E.L. Little, Jr.2346(OKL); E.L. Little Jr. 1785 (OKL); S.E. Reins s.n. (OKL).

Ottawa Co: G.W. Stevens 2299 (OKL); G.W. Stevens 2299 (GH,MIN).

Osage Co: U.T. Waterfall 8179 (OKL); A.H. Valkenburgh 434 (OKL);

Appendix B. continued.

G.W. Stevens 1980 (MIN).

Payne Co: A.H. Valkenburgh 399 (OKL).

Rogers Co: U.T. Waterfall 1453 (OKL).

Tulsa Co: J.B. McFarlin s.n. (OKL); M.B. Clark 342 (OKL); C.H. Perino 283 (OKL).

Wagoner Co: R. Bebb 4324 (OKL).

Washington Co: G.W. Stevens 2080 (MIN).

PENNSYLVANIA: Berks Co: H. Wilkens 5191 (PH); D. Berkheimer 2540 (PH).

Centre Co: H.A. Wahl 17474 (NCU); H.A. Wahl 1316 (ISC).

Franklin Co.: W.F. Westerfield 13802 (NCU).

Lancaster Co: J.K. Small s.n. (US).

Lehigh Co: R.L. Schaeffer 35931 (US).

TENNESSEE: Anderson Co: L.M. Rohrbaugh 206 (OKL); W.H. Ellis 28806 (GA).

Carroll Co: D. Demaree 30781 (ISC).

Carter Co: J.D. Smith s.n. (US).

Davidson Co: W.N. Egglestone 4430 (US); G.G. Ainslie s.n. (MICH).

Knox Co: A. Ruth s.n. (MIN); F. Lamson-Scribner s.n. (US).

Lewis Co: W. Hess 1135 (OKL).

Roane Co: F.R. Neose 517 (US).

Rutherford Co: D. Demaree 45755 (GA).

Stewart Co: R. Riggins 735 (ISC).

Wayne Co: W.B. McDougall 1059 (US).

Appendix B. continued.

VIRGINIA: Bedford Co: A.H. Curtiss s.n. (MICH); A.H. Curtiss s.n. (MICH).
Lee Co: J.K. Small s.n. (PH,MIN).
London Co: H.O. House 875 (US).
Mecklenburg Co: F.R. Fosberg 15466 (PH).
Middlesex Co: Leonard Killip 534 (US).
Roanoke Co: C.E. Wood, Jr. 3692 (PH); C.E. Wood, JR. 1223 (PH).
Rockbridge Co: O.W. Gupton 3256 (NCU)

WASHINGTON D.C.: D.L. Topping s.n. (MIN), G.B. Sudworth 538 (MICH), G.B. Sudworth 750 (MICH); A.J. Pieters s.n. (MICH); E.S. Steele s.n. (MIN); C.S. Sheldon s.n. (MIN).

Verbena stricta

ARKANSAS: Baxter Co: D. demaree 23606 (GH); D. Demaree 29314 (MIN).
Clay Co: D. Demaree 27030 (MIN).
Craighead Co: D. Demaree 27113 (MIN); D. Demaree 30772 (MIN); D. Demaree 5085 (OKL).
Green Co: D. Demaree 26698 (MIN).
Independence Co: D. Demaree 23800 (OKL).
Izard Co: D. Demaree 23376 (OKL).
Lawrence Co: D. Demaree 26152 (MIN).
Logan Co: D. Demaree 17723 (MIN); D. Demaree 25194 (OKL).
Phillips Co: D. Demaree 15224 (MIN).
Poinsette Co: D . Demaree 17568 (MIN).
Pope Co: D. Demaree 19871 (GH).
Randolph Co: D. Demaree 30963 (OKL).
Sharp Co: D. Demaree 26270 (MIN)

Appendix B. continued.

Stone Co: D. Demaree 27888 (MIN).

Washington Co: F.L. Harvey s.n. (MIN)

COLORADO: Denver Co: A. Eastwood 90 (US)

Kit Carson Co: M. Ownbey 1363 (RM)

Las Animas Co: C.M. Rogers 4967 (MICH); C.M. Rogers 6076(MICH): C.M. Rogers 6956 (MICH); C.M. Rogers 6111 (MICH).

Washington Co: R.L. Piemeisel 1576 (US).

Weld Co: G.E. Osterhout 6473 (RM).

Yuma Co: G.E. Osterhout 4039 (RM); R.L. Piemeisel 1533 (US); W.W. Egglestone 15528 (US).

ILLINOIS: Adams Co: E.W. Erlanson 18 (MICH).

Cass Co: H.F. Galos 551 (MICH).

Champaign Co: H.E. Ahles & R.H. Gilpin 8148 (NCU).

Cook Co: E.R. Shipman s.n. (MICH); M.H. Clark s.n. (MICH); A.P. Anderson 2066 (MIN); G.H. Shull s.n. (NCU,MIN).

DuPage Co: L.M. Umbach s.n. (MIN).

Gallatin Co: Bailey, Swayne 473 (MIN).

Henderson Co: H.N. Patterson s.n. (US).

Peoria Co: F.E. McDonald s.n. (MIN).

Pike Co: J. Davis 6370 (MIN).

McDonough Co: C.H. Kauffman s.n. (MICH).

Stephenson Co: C.F. Johnson s.n. (MIN).

Will Co: L.M. Umbach s.m. (MICH).

Winnebago Co: S.C. Wadmond 3769 (MIN).

Appendix B. continued.

INDIANA: Carroll Co: K. Miller, W. Milstead 130 (NCU).

Jennings Co: C. Hendricks s.n. (NCU).

Marion Co: H.H. Bartlett s.n. (MICH).

Newton Co: W.H. Welch 1729 (MIN).

Porter Co: R.M. Tryon 1513 (MIN).

Posey Co: C.C. Dean 16841 (MIN); C.C. Deam 16862 (MIN).

Pulsaki Co: R.C. Friesnex 22373 (MICH).

Putnam Co: T.G. Yuneker 3677 (MIN).

IOWA: Allamakee Co: B. Shimek s.n. (MIN).

Boone Co: Pammel, Henning s.n. (MIN)

Cedar Co: M.J. Fay 688 (NCU).

Clay Co: A. Hayden 3005 (MIN).

Dickinson Co: E.R. Mathews 90 (NCU)

Fayette Co: B. Fink s.n. (MIN).

Fremont Co: B. Shimek s.n. (MIN).

Hamilton Co: G. Blanch 141 (NCU).

Hardin Co: B. Shimek s.n. (MIN).

Harrison Co: L. Kellogg 174 (MICH).

Ida Co: J.L. Carter 1122 (MIN).

Lee Co: B. Shimek s.n. (MIN).

Lynon Co: B. Shimek s.n. (MIN).

Mills Co: M.J. Fay 3593 (NCU).

Porter Co: M.W. Lyon s.n. (MICH).

Pottawattamie Co: D. Demaree 23662 (NCU).

Appendix B. continued.

Poweshiek Co: N.H. Russell NR6285-215 (MIN).

Sioux Co: J.L. Carter 1271 (NCU).

Story Co: C. Schwab 204 (NCU); M.A. Anderson 29 (NCU); B. Martin 86 (MIN); F.C. Stewart s.n. (MIN).

KANSAS: Barber Co: J. Barrell 38-72 (US); J. Poindexter 201-11 (NCU); J. Poindexter 201-56 (NCU).

Crawford Co: D.J. Housholder 966 (NCU); H.F. Becker s.n. (MICH).

Douglas Co: W.C. Stevens s.n. (US).

Ellis Co: R.J. Bealman 131 (OKL); E. Runyon 175 (MIN).

Greenwood Co: J. Engleman 1079 (OKL).

OHIO: Hamilton Co: E.L. Braun s.n. (US); C.H. Thompson 154 (US).

KENTUCKY: Marshall Co: W.W. Eggleston 4837 (MIN).

KANSAS: Mead Co: J. Poindexter 166-12 (NCU).

Osage Co: W.H. Horr E33 (MIN).

Riley Co: A. Abel s.n. (OKL); M. Varnay s.n. (MICH); P. Maus s.n. (MICH).

KENTUCKY: Union Co: H.T. Shackletter 506 (MICH).

KANSAS: Wabaunsee Co: D. Seigler, D. Dusek DS-4077 (OKL).

OHIO: Wood Co: E.L. Mosely s.n. (MICH).

Appendix B. continued.

KANSAS: Woodson Co: E.W. Lathrop 1268 (MIN); E.W. Lathrop 842 (MIN); E.W. Lathrop 1275 (MIN).

MICHIGAN: Berrien Co: F.A. Swink 16 (MICH).

Charlevoix Co: J.H. Ehlers 642 (MICH).

Cheboygan Co: J.H. Ehlers 5165 (MICH); J.H. Ehlers 5613 (MICH); E.G. Voss 1038 (MICH); E.G. Voss 1315 (MICH).

Dickinson Co: M.L. Fernald, A.S. Pease 3496 (MICH).

Emmet Co: J.H. Ehlers 3489 (MICH); J.H. Ehlers 2453 (MICH).

Grant Traverse Co: J.V.A Dieterle 1850 (MICH).

Gratiot Co: C. Davis s.n. (MICH).

Kalkaska Co: J. LaRue 95 (MICH).

Kent Co: W.E. Mulliken s.n. (MICH); G.W. Parmelee 826 (MICH); W.E. Mulliken s.n. (MICH); C. Bozin 2232 (MICH); W.E. Mulliken s.n. (MICH).

Menominee Co: C.O. Grassl 2750 (MICH).

Missaukee Co: E.G. Voss 3065 (MICH).

Oakland Co: O.A. Farwell 6359 (MICH).

St. Joseph Co: E.G. Voss 7494 (MICH).

Van Buren Co: R. Weaver s.n. (MICH).

Wayne Co: F.G. Schmid s.n. (MICH).

Wexford Co: E.G. Voss 7606 (MICH).

MINNESOTA: Anoka Co: R.G. Cottrell s.n. (MIN); R.G. Cottrell s.n. (MIN).

Blue Earth Co: J.W. Moore, Y. Hsi 23375 (MIN); J.W. Moore 26793 (MIN).

Appendix B. continued.

Brown Co: E.J. Cahoon 84 (MIN); E.P. Sheldon S1113 (MIN).

Chippewa Co: L.R. Moyer s.n. (MIN).

Clay Co: O.A. Stevens 1271 (MIN).

Goodhue Co: J.H. Sandberg s.n. (MIN).

Hennepin Co: J.H. Sandberg s.n. (MIN); E. Morean s.n. (MIN); O.W. Oestheud s.n. (MIN); C.O. Rosendahl 2304 (MIN); J.S. McCartney 80 (MIN); T.S. Roberts s.n. (MIN); D. Houghton 29 (MICH).

Houston Co: W.A. Wheeler 402 (MIN).

Jackson Co: N. Hotchkiss, P. Jones 303 (MIN).

Kandiyohi Co: W.D. Frost 293 (MIN).

Le Seuer Co: G.G. Ainslie 3061 (MIN).

Murray Co: J.A. Scharf s.n. (MIN).

Pipestone Co: O.A. Stevens s.n. (MIN).

Ramsey Co: H. Eneboe 9 (MIN).

Redwood Co: G.W. Moore, C.O. Rosendahl 13354 (MIN).

Renville Co: C. MacMillan s.n. (MIN).

Scott Co: G.B. Ownbey 4591 (MIN).

St. Louis Co: O. Lakela 2669 (MIN); O. Lakela 5176 (MIN.

Stearns Co: R. Westkaempor s.n. (MIN).

Traverse Co: J.W. & M.F. Moore 10478 (MIN).

Wabasha Co: S.M. Manning s.n. (MIN).

Washington Co: J.W. Moore 16667 (MIN).

Yellow Medicine Co: E.L. Nielson 2882 (MIN).

Appendix B. continued.

MONTANA: Jefferson Co: J.A. Steyermark 1110 (MO).

Johnson Co: D. Castaner 4183 (MO).

Marion Co: J. Davis 6246 (MO); J. Davis s.n. (MICH).

Reynolds Co: W.G. D'Arcy 4644 (MO).

St. Louis Co: N.M. Flatferh s.n. (MICH); W.T. Kennell s.n. (MO).

Wayne Co: E.J. Palmer 6107 (US).

NEBRASKA: Antelope Co: J.B.E. Wennecke 11965 (MICH).

Cedar Co: F. Clements 2663 (MIN).

Bauaer Co: C.L. & M.W. Porter 8752 (MIN).

Cherry Co: B.T. Ostenson 1 (MICH).

Douglas Co: Miss A.C. Lawton 1 (F).

Kearney Co: H. Hapemen s.n. (MIN); H. Hapemen s.n. (MIN); H. Hapeman s.n. (MIN).

Keith Co: C.O. Elanson 2260 (MICH).

Saline Co: W. Seigerist s.n. (MIN).

Sherman Co: W.T. Barber 2861 (MIN).

Webster Co: J.M. Bates s.n. (MIN).

NEW JERSEY: Hudson Co: W.M. Van Sickle s.n. (US).

Ocean Co: F.F. Hunnewell 6996 (GH).

NEW YORK: Platte Co: A. Nelson 8354 (RM); A. Nelson 3646 (RM).

Warren Co: H.D. House 28901 (GH).

Appendix B. continued.

NORTH DAKOTA: Cass Co: O.A. Stevens s.n. (F); O.A. Stevens 2030 (MIN).
Richland Co: O.A. Stevens 318 (MIN,F).

OKLAHOMA: Alfalfa Co: R.J. Baalman 344 (OKL).
Beaver Co: F. Hindman 254 (OKL); A. Laverty 7363 (OKL).
Beckham Co: B. Osborn 1368R (OKL).
Bryan Co: J. & C. Taylor 4175 (OKL); Taylor, Silver, Fox 1223 (OKL).
Caddo Co: A.H. Valkenburgh 34 (OKL).
Carter Co: S. Kinnan 91 (OKL).
Cherokee Co: R. Bebb 4376 (OKL).
Cleveland Co: M.B. George 29 (OKL); W.S. Myers 55 (OKL); C.T. Eskew 1019 (OKL); D. Demaree 13077 (OKL); M. Fielder 100 (OKL); R.L. Gowan 46 (OLK); M. Babb 108 (OKL); M. Flowers 67 (OKL); R.E. Jeffs s.n. (OKL).
Comanche Co: C.T. Eskew 1089 (OKL); G.W. Stevens 1354½ (OLK); C.T. Eskew 1089 (OKL); M. Koeiser 33 (OKL); D. Demaree 12996 (OKL).
Craig Co: U.T. Waterfall 8193 (OKL).
Custer Co: R.E. Jeffs s.n. (OKL); L. Mericle 1825 (OKL); L. Mericle 1629 (OKL); D. Seigler 1569 (OKL).
Delaware Co: S. & R. Olney 65 (OKL).
Dewey Co: G.W. Stevens 875½ (OKL).
Ellis Co: G.W. Stevens 2930 (OKL).
Garfield Co: H.B. Gephardt 769 (OKL).
Garvin Co: C. Kennedy 317 (OKL).

Appendix B. continued.

Grady Co: L. Wall 3 (OKL); R.L. Albers 46 (OKL); R. Pearce 657 (OKL); M.W. Shackleford s.n. (OKL).

Greer Co: G.W. Stevens 1034 (OKL).

Kay Co: C. Barker 40 (F).

McCurtain Co: W.A. Nation 19 (RM).

Murray Co: G.M. Merrill, W.A. Hagen 1215 (F).

Oklahoma Co: U.T. Waterfall 2849 (OKL); U.T. Waterfall 1483 (OKL).

Osage Co: F. Johnson s.n. (OKL).

Pittsburg Co: J.E. McClary 58 (OKL); M.P. Mauldin s.n. (F).

Tulsa Co: E.R. Force s.n. (OKL); B. Frantz s.n. (OKL); M.B. Clark 366 (OKL).

Woods Co: P.J. White 26852 (RM); P. Nighswonger, S. Bellah 1037 (OKL).

PENNSYLVANIA: Lancaster Co: J.K. Small s.n. (F); J.K. Small s.n. (F) A.A. Heller s.n. (F); J.K. Small s.n. (F); A.A. Heller 638 (US).

Montgomery Co: W.M. Findley s.n. (F).

SOUTH DAKOTA: Custer Co: H.E. Hayward 2561 (F,RM).

Deuel Co: J.F. Brenckle 4602 (F).

Fall River Co: P.A. Rydberg 932 (US); G.E. Osterhout 7777 (RM).

Lawrence Co: C.L. & M.W. Porter 8359 (RM); P. Johnson s.n. (MICH); H.E. Hayward 202 (F); H.E. Hayward 2591 (RM); P.A. Rydberg 118 (F).

Meade Co: W.H. Forwood 299 (US,RM); C.P. Pase 645 (US).

Appendix B. continued.

Pennington Co: A.C. McIntosh 521 (RM); R.G. Stolze 306 (F); Visher, Greenman 1129 (F); S.S. Visher s.n. (F).

Sanborn Co: S.S. Visher 4450 (F).

Shannon Co: H.E. Hayward 2518 (F,RM).

Washabaugh Co: S.S. Visher 2034 (F).

TENNESSEE: Henry Co: A.J. Sharp, E. & A. Clebsch 7724 (GH).

Obion Co: D.E. & M.S. Eyles 61 (GH).

TEXAS: Dallas Co: J. Reverchon s.n. (F).

Hemphill Co: V.L. Cory 50269 (US); J. Blassingame s.n. (NCU).

Lipscomb Co: A.H. Howell 64 (US).

Wheeler Co: L.C. Higgins 4537 (MICH).

WISCONSIN: Dane Co: J.R. Heddle 691 (F); J.R. Heddle 2540 (F); W.N. Terry s.n. (MICH).

WYOMING: Albany Co: C.L. Porter 7151 (RM); E.B. Payson 3819 (RM); B. Hammel 521 (RM).

Crook Co: V.J. Wetherell 301 (RM); H.E. Heywood 212 (RM); A. Nelson 2188 (RM); S.L. Welsh, G. Moore, E. Matthews 9269 (NCU).

Goshen Co: C.L. Porter 20 (RM).

Natrona Co: F.X. Jozwik 186 (RM).

Platte Co: A. Nelson 505 (RM).

Weston Co: C.L. Porter 3413 (RM).

Appendix B. continued.

Verbena urticifolia

ALABAMA: Baldwin Co: C.H. Fitzgerald 455 (GA); S.M. Tracy 8037 (US).

ARKANSAS: Bradley Co: D. Demaree 23865 (OKL).
Craighead Co: D. Demaree 25777 (ISC).
Hot Springs Co: D. Demaree 16520 (OKL); D. Demaree 15609 (OKL);
Hot Springs Co: R. Runyon 1487 (US); D. Demaree 17887 (ISC).
Johnson Co: D. Demaree 20282 (GA).
Lawrence Co: P.H. Rolfs s.n. (ISC).
Nevada Co: M.P. Hollister 110 (US).
Polk Co: M.O. Hill 512 (OKL).
Pulaski Co: D. Demaree 8632 (US).
Searcy Co: R.D. THomas 9480 (GA).
Sharp Co: D. Demaree 26273 (ISC).

CONNETICUT: Litchfield Co: F.C. Seymour 19889 (MO).

FLORIDA: Manatee Co: S.M. Tracy 6652 (US).

GEORGIA: Bartow Co: W.H. Duncan 8535 (GA).
Clarke Co: Mrs. K.M. Drury E6650 (GA); M.T. Holder E8338 (GA).
Dawson Co: W.P. Adams, Witt Duncan 19032 (GA).
Decatur Co: R.F. Thorne 4637 (GA); W.R. Faircloth 2755 (GA).
Hall Co: W.H. Duncan 19433 (GA); W.H. Duncan 19017 (GA)
Harris Co: S.B. & C. Jones 22219 (GA).
Rabun Co: J.R. Massey, H. Massey 3647 (OKL).

Appendix B. continued.

Taliaferro Co: Witt Duncan 11359 (GA).

Whitfield Co: H.G. DiGioia 46 (GA).

ILLINOIS: Cook Co: R. Bebb 2107 (OKL); R. Bebb 1681 (OKL).

Fayette Co: D. Seigler 7861 (OKL).

Madison Co: A.F. Bucholtz s.n. (MO).

Vermillion Co: D. Seigler 5070 (OKL).

INDIANA: Fulton Co: R.C. Friesner 23098 (MICH).

Jennings Co: C.C. Deam 58280 (OKL).

Lake Co: O.E. Lansing, Jr. 2806 (US).

Lawrence Co. J. Wynn 90 (GA).

Marion Co: H.H. Bartlett s.n. (MICH).

Marshall Co: B.W. Evermann G86 (US).

Monroe Co: W.H. Duncan 228 (GA); J.D. Lipps s.n. (OKL).

Porter Co: M.W. Lyon s.n. (MICH).

IOWA: Adams Co: D. Isely 5714 (GA).

Mahaska Co: D.W. Augustine 412 (OKL).

Story Co: R.E. Jeffs s.n. (OKL).

KANSAS: Atchison Co: W.H. Horr, R.L. McGregor #531 (OKL).

Geary Co: F.C. Gates 21405 (GA).

KENTUCKY: Bath Co: M.E. Wharton 3174 (MICH).

Boyle Co: M.E. Wharton 2919 (MICH).

Edmonson Co: H.W. Lix 433 (US).

Appendix B. continued.

Estill Co: M.E. Wharton 30106 (MICH).

Lexington Co: E.A. McGreger 258 (US).

Madison Co: M.E. Wharton 835 (MICH).

Montgomery Co: M.E. Wharton 3076 (MICH).

LOUISIANA: E. Baton Rouge Par: E.L. Hunt 6 (LSU); C.A. Brown 1071 (LSU).

Lafayette Par: G.B. Claycomb s.n. (LSU).

Pointe Coupe Par: C.A. Brown 3893 (LSU); M. Chancy 42 (LSU).

St. Charles Par: G.N. Montz 2950 (LSU); G.N. Montz 3433 (LSU).

St. Helna Par: C.M. Allen 349 (LSU); R.G. Kirkpatrick 16 (LSU); C.M. Allen 1161 (LSU).

St. Tammany Par: G. Arsene 11391 (US); G. Arsene 12069 (US).

MARYLAND: Charles Co: E.P. Killip 770 (GA).

Garrett Co: J.D. Smith s.n. (US).

Worcester Co: T.H. Milby 88 (OKL).

MASSACHUSETTS: Berkshire Co: G.L. Ames s.n. (MICH).

Franklin Co: R.G. Poland s.n. (MO).

Middlesex Co: F.S. Beattie s.n. (OKL).

MICHIGAN: Alger Co: E.G. Voss 968213 (MICH).

Allega Co: C.H. Kauffman s.n. (MICH).

Berrier Co: C. Billington s.n. (MICH).

Branch Co: E.G. Voss 7484 (MICH).

Appendix B. continued.

Cass Co: H.R. Bennett 2708 (US); E.G. Voss 7528 (MICH).

Clinton Co: C.A. Brown 2650 (MICH).

Gratiot Co: C.A. Davis s.n. (MICH).

Jackson Co: H.H. Bartlett s.n. (MICH).

Kent Co: E.J. Cole s.n. (MICH); W.E. Mulliken 42632 (MICH); H.M. Bailey s.n. (MICH); E.J. Cole 5687 (MICH).

Livingston Co: F.N. Hamerstrom 197 (MICH).

St. Clair Co: C.K. Dodge s.n. (MICH); C.K. Dodge s.n. (MICH).

Washtenaw Co: N.A. Harvey s.n. (MICH); C. LaRue s.n. (MICH); E.C. Almendinger s.n. (MICH); M.W. Harrington (MICH).

Wayne Co: L. Foote s.n. (MICH); H.H. Rush s.n. (MICH).

MINNESOTA: Brown Co: E.P. Sheldon 1091 (MIN).

Carver Co: C.A. Ballars B667 (MIN).

Clay Co: C.A. Ballard 3170 (MIN); J.N. Moore 23050 (MIN).

Clearwater Co: Ownbey & Bloom 3462 (MIN); Buell 1689 (MIN).

Cottonwood Co: Hotchkiss, Jones 316 (MIN).

Crow Wing Co: Moore & Moore 475 (MIN).

Goathue Co: N.L. T. Nelson s.n. (MIN).

Grant Co: J.W. Moore 21255 (MIN).

Hennepin Co: O.W. Eastland s.n. (MIN); J.C. Kessube s.n. (MIN; E.P. Sheldon 4223 (MIN); T.S. Roberts s.n. (MIN); J.H. Sandberg s.n. (MIN).

Houston Co: W.A. Wheeler 548 (MIN).

Hubbard Co: M. Graftstrom 155 (MIN).

Appendix B. continued.

Kittson Co: Moore, McAndrews 24836 (MIN).

Lincoln Co: E.P. Sheldon 1575 (MIN); Moore & Ownby 22330 (MIN).

Newman Co: G.B. Ownby 4663 (MIN).

Nobles Co: S.A. Skinner 269 (MIN).

Pipe Stone Co: O.A. Stevens s.n. (MIN).

Pope Co: B.C. Taylor 809 (MIN).

Rice Co: T. Merrell s.n. (MIN).

Scott Co: C.A. Ballard 530 (MIN).

Stearns Co: J.E. Campbell 97 (MIN); R. Westkaemper s.n. (MIN).

Wabasha Co: J.W. Moore, A.O. Dahl 18290 (MIN); S.M. Manning s.n. (MIN).

Washington Co: R. Gunderson 587 (MIN).

MISSISSIPPI: Bolivar Co: L.C. Temple 5577 (GA).

Holmes Co: L.C. Temple 10263 (GA).

Lafayette Co: T.M. Puller 64779 (GA).

Smith Co: S.M. Tracy s.n. (MIN).

Tate Co: L.C. Temple 5738 (GA).

Warren Co: D. Demaree 25493 (OKL).

Wilkinson Co: S.B. Jones, C. Hudson, B. Noble 13476 (GA); S.B. & C. Jones, C. Clark 19809 (GA).

MONTANA: Greene Co: P.L. Redfearn, Jr. 3701 (GA); P.C. Standley 9435 (US); F.W. Dewart 18 (MO).

Johnson Co: D. Castaner 4309 (MO).

Appendix B. continued.

McDonald Co: E.J. Palmer 4229 (US,MO).

Miller Co: W. Trelease 719 (MO).

Ralls Co: B. Hinterthuer 667 (MO).

Reynolds Co: W.G. D'Arcy 4639 (MO).

St. Louis Co: A. Chandler 4832 (MO); G.H.M. Goehring 427 (LSU); H. Eggert s.n. (US); V. Muehlenbach 3129 (MO); V. Muehlenbach 3836 (MO).

NEBRASKA: Jefferson Co: L.M. Rohrbaugh 167 (OKL).

Knox Co: F. Clements 2743 (US).

Saline Co: W. Grigrrist (MIN).

NEW HAMPSHIRE: Grafton Co: H.E. Sargent s.n. (OKL).

Hillsboro Co: C.F. Batchelder s.n. (MIN).

NEW JERSEY: Somerset Co: H.N. Moldenke 1330 (MICH).

NEW YORK: Albany Co: C.A. Brown 742 (MICH); H.N. Russell 8245424 (MIN).

Columbia Co: R. McVaugh 14767 (MICH).

Dutchess Co: P.C. Standley, H.C. Bollman 11996 (US).

Madison Co: H.D. House 13648 (GA); W.R. Maxon s.n. (US).

Orange Co: H.M. Raup 7603 (MICH).

Queens Co: J.A. Harris C15997 (MIN).

Tompkins Co: P. Hoisington 74 (OKL).

Appendix B. continued.

NORTH CAROLINA: Granville Co: M.F. Buell 1438 (US).

Lee Co: D.F. Houck 476 (MIN).

Yadkin Co: A.E. Radford 44917 (US).

NORTH DAKOTA: Cass Co: H.F. Bergman 869 (MIN).

Stutsman Co: J. Lunell 549 (MIN).

OHIO: Butler Co: Wehmeyer, Waters 111 (MICH).

Champaign Co: A. Jewett s.n. (MICH); D. Demaree 11704 (MIN); E.C. Leonard 1608 (US).

Cuyahaga Co: J.M. Greenman 1380 (MO).

HamiHon Co: C.G. Lloyd s.n. (MICH).

Lorain Co: A.E. Ricksecker s.n. (US); W.M. Dick s.n. (MICH).

Ottawa Co: R.H. Moore s.n. (OKL).

Richland Co: E. Wilkinson 8467 (MIN).

OKLAHOMA: Bryan Co: J. & C. Taylor 827 (OKL); J. & C. Talor 3400 (OKL).

Canadian Co: C.S. Taylor 260 (OKL).

Carter Co: M. Hopkins 6366 (OKL).

Choctaw Co: H.W. Houghton 4015 (OKL).

Cleveland Co: C.T. Eskew 2001 (OKL); M. Hopkins 1094 (OKL).

Drew Co: D. Demaree 17897 (OKL); D. Demaree 17909 (OKL); D. Demaree 17620 (OKL).

Garfield Co: H.B. Gephardt 655 (US).

Grady Co: R. Pearce 970 (OKL).

Johnston Co: G.T. Robbins 3163 (OKL); G.J. Goodman 6325 (OKL).

Appendix B. continued.

Kay Co: G.W. Stevens 1821 (MIN).

McCurtain Co: L.E. Hornuff s.n. (OKL).

Major Co: G.W. Stevens 1742 (MIN).

Marshall Co: E. Perkins 366 (OKL).

Muskogee Co: C.S. Wallis 7719 (OKL).

Oklahoma Co: U.T. Waterfall 1415 (OKL); U.T. Waterfall 2895 (OKL).

Payne Co: S.E. Myers s.n. (MIN).

Seqouyah Co: C.S Wallis 7704 (OKL).

Woods Co: G.W. Stevens 1673 (US,MIN).

Woodward Co: G.J. Goodman, C. Lawson, J. Massey 8114 (OKL).

PENNSYLVANIA: Northampton Co: R.L. Schaeffer 3327 (OKL).

Butler Co: L.K. Henry 552 (US).

Fulton Co: W.F. Westerfield 15246 (OKL).

Lancaster Co: A.A. Heller s.n. (US).

Lebanon Co: C.H. Kauffman s.n. (MICH).

SOUTH CAROLINA: Williamsburg Co: R.K. Godfrey, R.M. Tryon, Jr. 466 (US).

SOUTH DAKOTA: Clay Co: W.H. Over 4037 (US).

Roberts Co: J.N. Moore 849 (MIN).

TENNESSEE: Anderson Co: L.M. Rohrbaugh 214 (OKL).

Roane Co: F.R. Nease 515 (US).

Appendix B. continued.

TEXAS: Bell Co: S.E. Wolff 1329 (US).

Dallas Co: M.R. Stephenson s.n. (US).

Ellis Co: O. Sanders 5 (MICH).

Lamar Co: S.T. Turner s.n. (MICH).

Newton Co: B.C. Tharp s.n. (MICH).

Tarrant Co: O.K. Killian 6933 (US).

VERMONT: Bennington Co: M.A. Day 147 (US); F.C. Seymour 26620 (MO).

Chittenden Co: L.A. Charette, P.T. Sawyer 2506 (MIN).

VIRGINIA: Fauqeier Co: F.R. Fosberg 33538 (US).

Franklin Co: J. Tidestrom 7334 (US).

Greensville Co: M.L. Fernald, B. Long 10801 (OKL).

London Co: E.C. Leonard 891 (US).

Nansemond Co: T.H. Kearney, Jr. 1739 (US).

Page Co: F.R. Fosberg 48000 (US); E.H. Walker 2668 (US).

Sussex Co: M.L. Fernald, B. Long 7588 (US).

UpShur Co: W.M. Pollock s.n. (US).

Wythe Co: J.K. Small s.n. (MIN).

WEST VIRGINIA: Lewis Co: G.B. Rossbach 8745 (GA).

WISCONSIN: Dane Co: N.C. Fassett 8677 (MIN).

LaCrosse Co: T.G. Hartley 1962 (US).

Milwaukee Co: R.M. Strong s.n. (MICH).

St. Croix Co: F.R. & J.S. Banner 105 (MIN); N. Russell s.n. (MIN).

Appendix B. continued.

Walworth Co: S.C. Wadmond 3770 (MIN).

WASHINGTON D.C.: F.L.J. Boettcher 221 (ISC); F.L.J. Boettcher 176 (ISC); G.B. Sudworth 603 (MICH); E.S. Steele s.n. (MIN).

Appendix C. Grid Sample Means of Members of the Verbena stricta complex.

Verbena bracteata # 1	N	MEAN	VAR.	S. D.	RANGE
Plant Height	19	26.000	38.81	6.23	18–40 cm
Spike Length	21	8.381	8.64	2.96	5–15 cm
Spike Width	20	7.400	3.42	1.85	5–10 mm
Petiole Length	20	6.150	10.89	3.30	2–11 mm
# of Leaf Clefts	19	1.421	0.26	0.51	1–2
Length of Cleft	19	7.632	18.92	4.35	2–20 mm
Leaf Length	20	28.100	106.09	10.30	11–55 mm
Leaf Width	20	15.700	15.13	3.89	8–25 mm
Corolla Tube Length	15	3.333	0.67	0.82	2–4 mm
Bract Length	21	2.905	1.37	1.17	4–9 mm
Calyx Length	21	2.028	0.19	0.44	2–4 mm
Nutlet Length	18	2.028	0.01	0.12	2–3 mm
Verbena bracteata # 2					
Plant Height	17	26.294	96.04	9.80	9–50 cm
Spike Length	19	7.737	13.54	3.68	1–15 cm
Spike Width	19	7.684	3.13	1.77	2–9 mm
Petiole Length	19	6.211	17.31	4.16	2–20 mm
# of Leaf Clefts	19	1.000	0.00	0.00	1
Length of Cleft	19	7.000	11.90	3.45	2–10 mm
Leaf Length	19	30.579	113.00	10.63	15–50 mm
Leaf Width	19	14.842	42.77	6.54	6–28 mm
Corolla Tube Length	13	4.077	0.08	0.28	4–5 mm
Bract Length	18	7.722	0.92	0.96	6–9 mm
Calyx Length	19	2.947	0.05	0.23	2–3 mm
Nutlet Length	14	2.000	0.00	0.00	2 mm

Appendix C. Continued.

Verbena bracteata # 3	N	MEAN	VAR.	S. D.	RANGE
Plant Height	12	19.417	67.74	8.47	11-34 cm
Spike Length	14	7.929	6.71	2.59	4-12 cm
Spike Width	14	7.500	1.96	1.40	5-9 mm
Petiole Length	12	6.167	13.39	3.66	2-16 mm
# of Leaf Clefts	12	1.167	0.15	0.39	1-2
Length of Cleft	12	6.250	6.92	2.63	3-12 mm
Leaf Length	12	27.667	71.23	8.44	19-50 mm
Leaf Width	12	16.583	48.44	6.96	7-35 mm
Corolla Tube Length	8	3.625	2.86	1.69	2-7 mm
Bract Length	14	7.857	1.51	1.23	6-9 mm
Calyx Length	14	2.929	0.69	0.83	2-4 mm
Nutlet Length	14	2.000	0.04	0.20	1-3 mm
Verbena bracteata # 4					
Plant Height	16	20.563	63.68	7.98	10-30 cm
Spike Length	16	7.063	7.24	2.69	2-11 cm
Spike Width	16	8.438	1.06	1.03	6-9 mm
Petiole Length	16	4.813	3.76	1.94	2-9 mm
# of Leaf Clefts	16	1.000	0.00	0.00	1
Length of Cleft	16	5.813	10.43	3.23	2-11 mm
Leaf Length	16	23.688	53.58	7.32	15-35 mm
Leaf Width	16	12.813	42.25	6.50	7-31 mm
Corolla Tube Length	14	4.071	0.07	0.27	4-5 mm
Bract Length	16	7.188	1.37	1.17	6-9 mm
Calyx Length	16	3.000	0.14	0.37	2-4 mm
Nutlet Length	14	2.000	0.00	0.00	2 mm

Appendix C. Continued.

Verbena bracteata # 5	N	MEAN	VAR.	S. D.	RANGE
Plant Height	21	18.333	52.71	7.26	8-30 cm
Spike Length	23	7.304	10.76	3.28	3-19 cm
Spike Width	23	6.957	1.69	1.30	5-9 mm
Petiole Length	23	4.870	5.02	2.24	2-10 mm
# of Leaf Clefts	23	1.000	0.00	0.00	1
Length of Cleft	23	4.217	5.71	2.39	1-10 mm
Leaf Length	23	18.783	41.60	6.45	11-35 mm
Leaf Width	23	11.304	19.54	4.42	5-20 mm
Corolla Tube Length	18	3.944	0.18	0.42	3-5 mm
Bract Length	23	6.478	1.08	1.04	4-9 mm
Calyx Length	23	3.000	0.00	0.00	3 mm
Nutlet Length	20	2.000	0.00	0.00	2 mm
Verbena bracteata # 6					
Plant Height	58	26.017	126.56	11.25	9-57 cm
Spike Length	59	9.017	11.63	3.41	3-24 cm
Spike Width	59	7.458	2.31	1.52	5-11 mm
Petiole Length	59	5.627	7.45	2.73	1-11 mm
# of Leaf Clefts	59	1.153	0.20	0.45	0-3
Length of Cleft	59	5.339	13.54	3.68	0-18 mm
Leaf Length	59	22.729	61.78	7.86	7-42 mm
Leaf Width	59	13.237	35.40	5.95	5-30 mm
Corolla Tube Length	44	3.182	0.38	0.62	2-5 mm
Bract Length	59	6.560	1.85	1.36	5-9 mm
Calyx Length	59	2.729	0.20	0.45	2-3 mm
Nutlet Length	53	2.000	0.00	0.00	2 mm

Appendix C . Continued.

Verbena bracteata # 7	N	MEAN	VAR.	S. D.	RANGE
Plant Height	36	23.472	51.55	7.18	13-37 cm
Spike Length	40	8.100	10.96	3.31	3-15 cm
Spike Width	40	7.800	1.74	1.32	5-11 mm
Petiole Length	39	5.026	7.24	2.69	2-15 mm
# of Leaf Clefts	37	1.081	0.18	0.43	0-3
Length of Cleft	37	5.595	12.11	3.48	0-15 mm
Leaf Length	38	24.632	103.43	10.17	12-50 mm
Leaf Width	38	12.553	34.57	5.88	4-25 mm
Corolla Tube Length	21	3.762	0.59	0.77	3-5 mm
Bract Length	40	7.800	1.39	1.18	6-11 mm
Calyx Length	40	3.000	0.20	0.45	2-4 mm
Nutlet Length	36	2.000	0.00	0.00	2 mm
Verbena bracteata # 8					
Plant Height	30	23.233	67.90	8.24	9-50 cm
Spike Length	32	7.438	7.67	2.77	4-14 cm
Spike Width	32	8.719	5.24	2.29	5-15 mm
Petiole Length	33	4.697	4.33	2.08	2-11 mm
# of Leaf Clefts	33	1.061	0.06	0.24	1-2
Length of Cleft	33	5.636	5.62	2.37	2-11 mm
Leaf Length	33	25.182	36.97	6.08	12-35 mm
Leaf Width	33	14.758	35.50	5.92	5-30 mm
Corolla Tube Length	23	3.609	0.52	0.72	2-5 mm
Bract Length	33	7.212	1.37	1.17	5-9 mm
Calyx Length	33	2.939	0.25	0.50	2-3 mm
Nutlet Length	28	2.000	0.00	0.00	2 mm

Appendix C. Continued.

Verbena bracteata # 9	N	MEAN	VAR.	S. D.	RANGE
Plant Height	10	20.700	38.44	6.20	15-28 cm
Spike Length	11	8.636	14.82	3.85	6-15 cm
Spike Width	11	8.091	1.49	1.22	6-9 mm
Petiole Length	11	4.545	5.29	2.30	2-9 mm
# of Leaf Clefts	11	1.091	0.09	0.30	1-2
Length of Cleft	11	4.727	18.23	4.27	1-15 mm
Leaf Length	11	23.727	78.15	8.84	10-41 mm
Leaf Width	11	12.000	40.98	7.14	4-29 mm
Corolla Tube Length	7	3.857	0.14	0.38	3-4 mm
Bract Length	11	7.273	1.21	1.10	6-9 mm
Calyx Length	11	2.910	0.09	0.30	2-3 mm
Nutlet Length	11	2.000	0.00	0.00	2 mm
Verbena bracteata # 10					
Plant Height	16	26.000	74.48	8.63	11-42 cm
Spike Length	18	8.500	15.21	3.90	3-17 cm
Spike Width	18	7.000	1.54	1.24	5-9 mm
Petiole Length	18	5.889	11.42	3.38	2-10 cm
# of Leaf Clefts	18	1.167	0.14	0.38	1-2
Length of Cleft	18	5.389	5.52	2.35	2-10 mm
Leaf Length	18	22.056	99.00	9.95	8-42 mm
Leaf Width	18	13.722	31.15	5.58	4-25 mm
Corolla Tube Length	12	3.333	0.24	0.49	3-4 mm
Bract Length	18	6.444	1.79	1.34	4-9 mm
Calyx Length	18	2.778	0.30	0.55	2-4 mm
Nutlet Length	15	2.000	0.00	0.00	2 mm

Appendix C. Continued.

Verbena bracteata # 11	N	MEAN	VAR.	S. D.	RANGE
Plant Height	20	25.903	52.73	7.26	15-40 cm
Spike Length	24	8.637	14.42	3.80	4-20 cm
Spike Width	24	7.502	1.04	1.02	6-9 mm
Petiole Length	24	5.500	4.96	2.23	0-10 mm
# of Leaf Clefts	24	1.138	0.11	0.34	1-2
Length of Cleft	24	6.382	11.29	3.36	2-14 mm
Leaf Length	24	24.673	53.88	7.34	12-40 mm
Leaf Width	24	15.000	34.43	5.87	7-30 mm
Corolla Tube Length	18	3.671	0.47	0.69	3-5 mm
Bract Length	24	7.208	1.48	1.22	5-9 mm
Calyx Length	24	2.750	0.28	0.53	2-4 mm
Nutlet Length	19	2.000	0.00	0.00	2 mm
Verbena bracteata # 12					
Plant Height	10	31.300	100.90	10.04	19-50 cm
Spike Length	11	8.455	9.67	3.11	5-16 cm
Spike Width	11	8.545	1.27	1.13	6-10 mm
Petiole Length	11	5.727	10.02	3.17	2-12 mm
# of Leaf Clefts	11	1.364	0.45	0.67	1-3
Length of Cleft	11	8.000	20.20	4.49	2-25 mm
Leaf Length	11	30.000	123.60	11.12	10-43 mm
Leaf Width	11	18.091	64.29	8.02	5-32 mm
Corolla Tube Length	8	3.750	0.50	0.71	3-4 mm
Bract Length	11	7.727	0.82	0.90	7-9 mm
Calyx Length	11	2.727	0.22	0.47	2-3 mm
Nutlet Length	9	2.000	0.00	0.00	2 mm

Appendix C. Continued.

Verbena halei # 1	N	MEAN	VAR.	S. D.	RANGE
Plant Height	8	44.000	309.43	17.59	28-74 cm
Spike Length	9	15.667	11.00	3.32	12-22 cm
Spike Width	9	2.111	0.11	0.33	2-3 mm
Petiole Length	7	10.571	36.29	6.02	0-19 mm
# of Leaf Clefts	7	1.889	1.61	1.27	0-4
Length of Cleft	7	4.000	9.00	3.00	0-8 mm
Leaf Length	7	30.571	67.29	8.20	20-40 mm
Leaf Width	7	14.286	25.24	5.02	7-21 mm
Corolla Tube Length	9	3.333	0.25	0.50	3-4 mm
Bract Length	9	1.889	0.11	0.33	1-2 mm
Calyx Length	9	3.000	0.00	0.00	3 mm
Nutlet Length	6	2.000	0.00	0.00	2 mm
Verbena halei # 2					
Plant Height	34	50.500	86.44	9.30	33-68 cm
Spike Length	41	14.805	22.51	4.74	5-27 cm
Spike Width	41	2.098	0.09	0.30	2-3 mm
Petiole Length	36	14.611	30.42	5.52	5-30 mm
# of Leaf Clefts	38	2.829	1.02	1.01	1-4
Length of Cleft	35	6.114	10.75	3.28	2-18 mm
Leaf Length	36	31.722	72.55	8.52	20-45 mm
Leaf Width	35	14.771	22.42	4.73	9-50 mm
Corolla Tube Length	40	3.763	0.23	0.48	3-4 mm
Bract Length	39	2.000	0.00	0.00	2 mm
Calyx Length	41	3.000	0.15	0.39	2-4 mm
Nutlet Length	28	2.000	0.00	0.00	2 mm

Appendix C. Continued.

Verbena halei # 3	N	MEAN	VAR.	S. D.	RANGE
Plant Height	26	48.538	165.30	12.86	30-72 cm
Spike Length	29	16.931	47.50	6.89	9-38 cm
Spike Width	29	2.138	0.12	0.35	2-3 mm
Petiole Length	26	13.769	63.37	7.96	3-35 mm
# of Leaf Clefts	24	2.750	1.07	1.03	0-4
Length of Cleft	24	9.625	39.03	6.25	0-25 mm
Leaf Length	26	37.038	187.08	13.68	15-70 mm
Leaf Width	26	17.308	105.10	10.45	5-40 mm
Corolla Tube Length	27	3.704	0.37	0.61	3-5 mm
Bract Length	28	2.000	0.14	0.38	1-3 mm
Calyx Length	29	2.845	0.27	0.52	2-4 mm
Nutlet Length	23	2.000	0.00	0.00	2 mm
Verbena halei # 4					
Plant Height	39	53.615	181.09	13.45	32-79 cm
Spike Length	43	17.023	20.02	4.48	11-26 cm
Spike Width	43	2.209	0.22	0.47	2-4 mm
Petiole Length	35	13.600	44.19	6.65	0-25 mm
# of Leaf Clefts	34	3.500	1.53	1.24	0-7
Length of Cleft	34	5.059	35.81	5.98	0-25 mm
Leaf Length	35	35.086	115.43	10.74	20-55 mm
Leaf Width	35	14.771	47.24	6.87	2-25 mm
Corolla Tube Length	39	3.795	0.38	0.61	3-5 mm
Bract Length	43	2.081	0.09	0.31	2-3 mm
Calyx Length	43	3.081	0.21	0.45	2-4 mm
Nutlet Length	34	2.044	0.07	0.26	2-3 mm

Appendix C. Continued.

Verbena halei # 5	N	MEAN	VAR.	S. D.	RANGE
Plant Height	26	48.692	255.58	15.99	30-87 cm
Spike Length	32	18.288	30.70	5.54	11-30 cm
Spike Width	31	2.258	0.26	0.51	2-4 mm
Petiole Length	26	13.962	53.08	7.29	5-30 mm
# of Leaf Clefts	26	3.385	0.64	0.80	1-5
Length of Cleft	26	10.077	22.39	4.73	4-25 mm
Leaf Length	27	34.259	289.81	17.02	15-105 mm
Leaf Width	27	17.148	68.51	8.28	6-45 mm
Corolla Tube Length	26	3.942	0.61	0.78	3-7 mm
Bract Length	31	1.984	0.22	0.47	1-3 mm
Calyx Length	31	2.919	0.18	0.43	2-4 mm
Nutlet Length	20	2.000	0.00	0.00	2 mm
Verbena halei # 6					
Plant Height	6	44.667	159.47	12.63	30-60 cm
Spike Length	7	16.429	71.95	8.48	9-29 cm
Spike Width	7	2.000	0.00	0.00	2 mm
Petiole Length	7	12.143	40.48	6.36	5-20 mm
# of Leaf Clefts	7	3.286	0.24	0.49	3-4
Length of Cleft	7	6.571	11.95	3.46	2-10 mm
Leaf Length	7	32.143	140.48	11.85	20-45 mm
Leaf Width	7	11.000	28.67	5.35	5-20 mm
Corolla Tube Length	6	3.833	0.17	0.41	3-4 mm
Bract Length	7	1.857	0.14	0.38	1-2 mm
Calyx Length	7	2.714	0.24	0.49	2-3 mm
Nutlet Length	5	2.000	0.00	0.00	2 mm

Appendix C. Continued.

Verbena halei # 7	N	MEAN	VAR.	S. D.	RANGE
Plant Height	18	43.000	200.00	14.14	30-74 cm
Spike Length	23	15.783	36.18	6.01	8-30 cm
Spike Width	23	2.087	0.08	0.29	2-3 mm
Petiole Length	20	13.850	34.13	5.84	7-30 mm
# of Leaf Clefts	21	2.905	1.09	1.04	1-5
Length of Cleft	21	8.333	30.73	5.54	2-20 mm
Leaf Length	21	38.667	157.83	12.56	20-60 mm
Leaf Width	21	18.476	65.76	8.11	8-30 mm
Corolla Tube Length	22	3.773	0.26	0.51	3-5 mm
Bract Length	23	2.022	0.10	0.32	1-3 mm
Calyx Length	23	2.957	0.13	0.37	2-4 mm
Nutlet Length	15	2.000	0.00	0.00	2 mm
V. hastata #1					
Plant Height	11	77.833	890.47	29.84	45-140 cm
Spike Length	19	9.632	15.25	3.90	4-19 cm
Spike Width	19	3.000	0.44	0.67	2-4 mm
Petiole Length	19	11.316	28.89	5.38	5-25 mm
# of Leaf Clefts	19	0.105	0.10	0.32	0-1
Length of Cleft	2	9.000	2.00	1.41	8-10 mm
Leaf Length	18	73.278	447.62	21.16	60-95 mm
Leaf Width	18	21.33	65.76	8.11	11-40 mm
Corolla Tube Length	15	3.267	0.64	0.80	2-5 mm
Bract Length	19	1.632	0.47	0.68	1-3 mm
Calyx Length	19	2.263	0.20	0.45	2-3 mm
Nutlet Length	12	2.000	0.00	0.00	2 mm

Appendix C continued.

V. hastata #2	N	MEAN	VAR.	S. D.	RANGE
Plant Height	5	89.000	505.00	22.47	65-120 cm
Spike Length	8	8.375	3.98	1.99	7-12 cm
Spike Width	8	2.375	0.27	0.52	2-3 mm
Petiole Length	8	14.125	11.27	3.36	10-20 mm
# of Leaf Clefts	8	0.000	0.00	0.00	0
Length of Cleft	8	0.000	0.00	0.00	0 mm
Leaf Length	8	89.875	149.27	12.22	70-98 mm
Leaf Width	8	28.250	41.36	6.43	15-35 mm
Corolla Tube Length	6	2.667	0.27	0.52	2-3 mm
Bract Length	8	1.125	0.13	0.35	1-2 mm
Calyx Length	8	2.125	0.13	0.35	2-3 mm
Nutlet Length	7	2.000	0.00	0.00	2 mm
V. hastata #3					
Plant Height	24	62.292	315.78	17.77	24-90 cm
Spike Length	32	9.031	75.45	8.69	3-13 cm
Spike Width	32	2.625	0.37	0.61	2-3 mm
Petiole Length	34	9.647	15.20	3.90	3-21 mm
# of Leaf Clefts	34	0.000	0.00	0.00	0
Length of Cleft	34	0.000	0.00	0.00	0 mm
Leaf Length	33	69.848	296.82	17.23	35-99 mm
Leaf Width	33	19.272	54.20	7.36	7-38 mm
Corolla Tube Length	27	3.000	0.54	0.73	2-5 mm
Bract Length	34	1.309	0.21	0.46	1-2 mm
Calyx Length	34	2.235	0.25	0.50	1-3 mm
Nutlet Length	26	2.000	0.00	0.00	2 mm

Appendix C continued.

V. hastata #4	N	MEAN	VAR.	S. D.	RANGE
Plant Height	10	74.500	314.94	17.75	40-90 cm
Spike Length	22	9.591	7.02	2.65	6-15 cm
Spike Width	22	2.637	0.34	0.58	2-4 mm
Petiole Length	22	12.909	37.61	6.13	7-25 mm
# of Leaf Clefts	22	0.000	0.00	0.00	0
Length of Cleft	22	0.000	0.00	0.00	0 mm
Leaf Length	22	8.455	212.74	14.59	55-110 mm
Leaf Width	22	22.864	24.32	4.93	15-30 mm
Corolla Tube Length	21	3.190	0.66	0.81	2-5 mm
Bract Length	22	1.500	0.26	0.51	1-2 mm
Calyx Length	22	2.273	0.49	0.70	2-3 mm
Nutlet Length	16	2.000	0.00	0.00	2 mm
V. hastata #5					
Plant Height	11	71.364	526.25	22.94	33-110 cm
Spike Length	19	7.105	6.54	2.56	4-12 cm
Spike Width	19	2.684	0.67	0.82	2-4 mm
Petiole Length	19	10.632	19.13	4.37	3-20 mm
# of Leaf Clefts	19	0.000	0.00	0.00	0
Length of Cleft	19	0.000	0.00	0.00	0 mm
Leaf Length	19	75.211	150.94	12.29	50-99 mm
Leaf Width	19	19.474	15.82	3.98	14-29 mm
Corolla Tube Length	18	3.278	0.57	0.75	2-5 mm
Bract Length	19	1.395	0.24	0.49	1-2 mm
Calyx Length	19	2.158	0.14	0.37	2-3 mm
Nutlet Length	13	2.000	0.00	0.00	2 mm

Appendix C continued.

V. hastata #6	N	MEAN	VAR.	S. D.	RANGE
Plant Height	5	96.000	692.50	26.32	70-140 cm
Spike Length	11	9.000	12.40	3.54	5-15 cm
Spike Width	11	2.636	0.45	0.67	2-4 mm
Petiole Length	11	16.000	17.20	4.15	10-21 mm
# of Leaf Clefts	11	0.000	0.00	0.00	0
Length of Cleft	11	0.000	0.00	0.00	0
Leaf Length	11	81.273	316.42	17.79	60-99 mm
Leaf Width	11	23.546	67.47	8.21	10-36 mm
Corolla Tube Length	9	2.889	0.86	0.93	2-4 mm
Bract Length	11	1.455	0.27	0.52	1-2 mm
Calyx Length	11	2.091	0.29	0.54	1-3 mm
Nutlet Length	8	2.000	0.00	0.00	2 mm
V. hastata #7					
Plant Height	5	55.400	34.80	5.90	48-60 cm
Spike Length	27	7.611	7.81	2.80	2-15 cm
Spike Width	27	2.852	0.75	0.86	2-5 mm
Petiole Length	26	13.192	25.68	5.07	3-20 mm
# of Leaf Clefts	26	0.000	0.00	0.00	0
Length of Cleft	26	0.000	0.00	0.00	0
Leaf Length	26	84.154	172.30	13.13	45-100 mm
Leaf Width	26	19.692	24.78	4.98	10-27 mm
Corolla Tube Length	23	3.043	0.59	0.77	2-5 mm
Bract Length	27	1.519	0.57	0.75	1-3 mm
Calyx Length	27	2.167	0.21	0.46	1-3 mm
Nutlet Length	17	2.000	0.00	0.00	2 mm

Appendix C continued.

V. hastata #8	N	MEAN	VAR.	S. D.	RANGE
Plant Height	13	70.846	227.47	15.08	50-100 cm
Spike Length	36	7.361	14.35	3.79	2-20 cm
Spike Width	36	3.028	0.49	0.70	2-5 mm
Petiole Length	37	14.108	44.49	6.67	0-35 mm
# of Leaf Clefts	36	0.000	0.00	0.00	0
Length of Cleft	36	0.000	0.00	0.00	0
Leaf Length	33	83.303	356.97	18.89	50-132 mm
Leaf Width	36	21.722	36.00	6.00	12-38 mm
Corolla Tube Length	33	3.303	0.33	0.57	2-4 mm
Bract Length	37	1.730	0.23	0.48	1-3 mm
Calyx Length	37	2.243	0.16	0.40	2-3 mm
Nutlet Length	25	2.000	0.00	0.00	2 mm
V. hastata #9					
Plant Height	14	76.429	535-.80	23.15	43-132 cm
Spike Length	34	7.382	8.67	2.94	3-15 cm
Spike Width	34	2.691	0.45	0.67	2-4 mm
Petiole Length	34	11.353	19.20	4.38	3-21 mm
# of Leaf Clefts	34	0.000	0.00	0.00	0
Length of Cleft	34	0.000	0.00	0.00	0 mm
Leaf Length	35	76.457	258.08	16.06	42-115 mm
Leaf Width	35	19.057	39.47	6.28	10-30 mm
Corolla Tube Length	31	2.823	0.44	0.67	2-4 mm
Bract Length	35	1.400	0.22	0.47	1-2 mm
Calyx Length	35	2.014	0.11	0.33	2-3 mm
Nutlet Length	32	1.984	0.06	0.24	1-3 mm

Appendix C continued.

V. hastata #10	N	MEAN	VAR.	S. D.	RANGE
Plant Height	15	79.400	410.11	20.25	45-120 cm
Spike Length	40	8.975	11.87	3.45	4-19 cm
Spike Width	40	2.550	0.51	0.71	2-5 mm
Petiole Length	42	13.380	21.36	4.62	7-25 mm
# of Leaf Clefts	42	0.000	0.00	0.00	0
Length of Cleft	42	0.000	0.00	0.00	0 mm
Leaf Length	41	82.756	230.19	15.17	40-110 mm
Leaf Width	41	20.171	44.55	6.67	11-35 mm
Corolla Tube Length	35	3.058	0.23	0.48	2-4 mm
Bract Length	42	1.381	0.20	0.45	1-2 mm
Calyx Length	42	2.119	0.14	0.38	2-3 mm
Nutlet Length	27	2.000	0.00	0.00	2 mm
V. hastata #11					
Plant Height	6	84.500	425.50	20.63	60-120 cm
Spike Length	12	9.250	12.93	3.60	4-15 cm
Spike Width	12	2.667	0.61	0.78	2-4 mm
Petiole Length	12	15.333	25.15	5.02	9-25 mm
# of Leaf Clefts	12	0.000	0.00	0.00	0
Length of Cleft	12	0.000	0.00	0.00	0 mm
Leaf Length	12	81.167	210.88	14.52	50-99 mm
Leaf Width	12	22.500	17.72	4.21	13-28 mm
Corolla Tube Length	9	3.111	0.61	0.78	2-5 mm
Bract Length	12	1.333	0.24	0.49	1-2 mm
Calyx Length	12	2.333	0.42	0.65	2-4 mm
Nutlet Length	10	1.900	0.44	0.22	1.5-2 mm

Appendix C continued.

V. hastata #12	N	MEAN	VAR.	S. D.	RANGE
Plant Height	5	77.600	511.30	22.61	40-98 cm
Spike Length	29	8.966	15.75	3.97	4-22 cm
Spike Width	29	2.379	0.39	0.62	2-4 mm
Petiole Length	29	13.414	12.54	3.54	10-20 mm
# of Leaf Clefts	29	0.000	0.00	0.00	0
Length of Cleft	29	0.000	0.00	0.00	0
Leaf Length	29	81.276	133.85	11.57	50-99 mm
Leaf Width	29	19.759	25.26	5.03	10-30 mm
Corolla Tube Length	27	2.667	0.38	0.62	2-4 mm
Bract Length	29	1.293	0.21	0.45	1-2 mm
Calyx Length	29	2.103	0.17	0.41	2-3 mm
Nutlet Length	19	2.000	0.00	0.00	2 mm
V. lasiostachys #1					
Plant Height	12	63.417	210.82	14.52	38-84 cm
Spike Length	22	15.773	21.61	4.65	10-27 cm
Spike Width	22	4.591	1.30	1.14	3-8 mm
Petiole Length	20	8.100	18.73	4.33	0-18 mm
# of Leaf Clefts	20	3.800	0.59	0.77	3-5
Length of Cleft	20	5.350	13.08	3.62	2-15 mm
Leaf Length	20	41.100	257.88	16.06	20-70 mm
Leaf Width	20	21.500	60.79	7.80	10-30 mm
Corolla Tube Length	19	3.816	0.20	0.45	3-4.5 mm
Bract Length	22	2.364	0.24	0.49	2-3 mm
Calyx Length	22	3.136	0.24	0.49	2-4 mm
Nutlet Length	17	1.412	0.10	0.32	1-2 mm

Appendix C continued.

V. lasiostachys #2	N	MEAN	VAR.	S. D.	RANGE
Plant Height	16	59.938	258.86	16.09	29-83 cm
Spike Length	23	15.630	61.19	7.82	4-34 cm
Spike Width	23	4.348	0.60	0.78	3-6 mm
Petiole Length	22	13.909	31.61	5.62	5-30 mm
# of Leaf Clefts	22	3.591	2.25	1.50	1-7
Length of Cleft	22	5.682	10.80	3.29	2-15 mm
Leaf Length	22	45.045	176.24	13.28	21-85 mm
Leaf Width	22	25.545	52.16	7.22	9-36 mm
Corolla Tube Length	20	3.800	0.38	0.62	3-5 mm
Bract Length	23	2.413	0.38	0.62	1-3 mm
Calyx Length	23	3.000	0.45	0.67	2-4 mm
Nutlet Length	19	1.605	0.10	0.32	1-2 mm
V. lasiostachys #3					
Plant Height	14	62.571	171.81	13.11	37-82 cm
Spike Length	21	16.286	36.81	6.07	7-28 cm
Spike Width	21	4.619	0.35	0.59	3-5 mm
Petiole Length	21	11.238	44.69	6.69	0-30 mm
# of Leaf Clefts	15	4.733	1.21	1.10	3-7
Length of Cleft	15	7.267	21.21	4.61	3-20 mm
Leaf Length	19	51.316	280.12	16.74	30-80 mm
Leaf Width	19	26.158	104.81	10.24	12-45 mm
Corolla Tube Length	19	3.579	0.26	0.51	3-4 mm
Bract Length	21	2.405	0.32	0.56	2-4 mm
Calyx Length	21	3.000	0.28	0.52	2-4 mm
Nutlet Length	18	1.583	0.15	0.39	1-2 mm

Appendix C continued.

V. lasiostachys #4	N	MEAN	VAR.	S. D.	RANGE
Plant Height	14	50.714	307.76	17.54	17-80 cm
Spike Length	21	13.429	18.26	4.26	8-19 cm
Spike Width	21	4.810	0.96	0.98	3-7 mm
Petiole Length	21	10.619	48.35	6.95	3-35 mm
# of Leaf Clefts	20	4.800	10.59	3.25	0-15
Length of Cleft	19	6.211	17.51	4.18	2-20 mm
Leaf Length	21	46.143	230.03	15.17	30-70 mm
Leaf Width	21	24.524	92.96	9.64	14-45 mm
Corolla Tube Length	19	3.712	0.43	0.65	3-5 mm
Bract Length	21	2.548	0.22	0.47	2-3 mm
Calyx Length	21	3.190	0.16	0.40	3-4 mm
Nutlet Length	13	1.462	0.34	0.19	1-2 mm
V. lasiostachys #5					
Plant Height	8	47.750	225.00	15.00	26-63 cm
Spike Length	20	15.350	26.24	5.12	6-22 cm
Spike Width	20	4.900	0.73	0.85	4-7 mm
Petiole Length	20	11.550	35.63	5.97	5-25 mm
# of Leaf Clefts	20	4.850	3.92	1.98	3-9
Length of Cleft	20	5.800	12.17	3.49	1-12 mm
Leaf Length	20	52.350	232.03	15.23	25-80 mm
Leaf Width	20	28.050	93.94	9.69	11-40 mm
Corolla Tube Length	19	3.579	0.37	0.61	2-4 mm
Bract Length	20	2.600	0.36	0.60	2-4 mm
Calyx Length	20	3.025	0.22	0.47	2-4 mm
Nutlet Length	8	1.500	0.07	0.27	1-2 mm

Appendix C continued.

V. lasiostachys #6	N	MEAN	VAR.	S. D.	RANGE
Plant Height	6	45.000	323.20	17.98	30-70 cm
Spike Length	12	13.000	20.91	4.57	4-17 cm
Spike Width	12	4.167	0.52	0.72	3-5 mm
Petiole Length	12	11.417	26.99	5.20	1-20 mm
# of Leaf Clefts	12	2.833	0.70	0.83	1-4
Length of Cleft	12	5.833	16.70	4.09	2-15 mm
Leaf Length	12	42.500	188.64	13.73	30-70 mm
Leaf Width	12	23.917	224.08	14.97	10-60 mm
Corolla Tube Length	12	3.917	0.27	0.51	3-5 mm
Bract Length	12	2.292	0.48	0.69	2-4 mm
Calyx Length	12	2.917	0.45	0.67	2-4 mm
Nutlet Length	6	1.333	0.07	0.26	1-1.5 mm
V. lasiostachys #7					
Plant Height	7	56.857	512.14	22.63	40-100 cm
Spike Length	16	15.375	43.98	6.63	5-25 cm
Spike Width	16	4.375	0.92	0.96	3-6 mm
Petiole Length	16	13.813	44.56	6.68	4-30 mm
# of Leaf Clefts	14	4.071	1.46	1.21	3-7
Length of Cleft	14	8.357	28.09	5.30	3-20 mm
Leaf Length	15	51.333	405.24	20.13	20-90 mm
Leaf Width	15	23.267	142.35	11.93	10-40 mm
Corolla Tube Length	15	3.567	0.25	0.50	3-4 mm
Bract Length	16	2.500	0.30	0.55	2-4 mm
Calyx Length	16	2.969	0.15	0.39	2-4 mm
Nutlet Length	12	1.500	0.18	0.43	1-2 mm

Appendix C continued.

V. neomexicana #1	N	MEAN	VAR.	S. D.	RANGE
Plant Height	23	44.391	174.16	13.20	25-71 cm
Spike Length	30	15.700	28.22	5.31	10-25 cm
Spike Width	30	3.867	1.36	1.17	2-6 mm
Petiole Length	30	7.933	23.10	4.81	0-20 mm
# of Leaf Clefts	29	2.034	0.96	0.98	0-4
Length of Cleft	28	6.143	16.72	4.09	1-20 mm
Leaf Length	30	25.867	103.43	10.17	7-45 mm
Leaf Width	30	13.367	43.55	6.60	3-25 mm
Corolla Tube Length	26	4.500	0.74	0.86	3-6 mm
Bract Length	30	3.000	0.34	0.59	2-4 mm
Calyx Length	30	3.233	0.25	0.50	2-4 mm
Nutlet Length	14	2.000	0.00	0.00	2 mm
V. neomexicana #2					
Plant Height	13	37.846	214.81	14.66	19-68 cm
Spike Length	14	15.000	39.85	6.31	6-31 cm
Spike Width	14	3.571	1.49	1.22	2-5 mm
Petiole Length	14	5.142	20.75	4.55	0-16 mm
# of Leaf Clefts	14	1.286	1.14	1.07	0-3
Length of Cleft	10	4.700	8.01	2.83	2-11 mm
Leaf Length	14	21.357	38.40	6.20	10-31 mm
Leaf Width	14	7.857	24.59	4.95	2-19 mm
Corolla Tube Length	10	4.800	1.07	1.03	3-7 mm
Bract Length	14	3.143	0.44	0.66	2-5 mm
Calyx Length	14	3.286	0.53	0.73	2-5 mm
Nutlet Length	11	2.000	0.00	0.00	2 mm

Appendix C continued.

V. neomexicana #3	N	MEAN	VAR.	S. D.	RANGE
Plant Height	21	30.476	158.06	12.57	10-65 cm
Spike Length	22	11.500	15.60	3.95	5-20 cm
Spike Width	22	3.500	1.98	1.41	2-7 mm
Petiole Length	22	2.545	19.50	4.42	0-10 mm
# of Leaf Clefts	22	1.045	1.75	1.33	0-5
Length of Cleft	11	1.273	0.22	0.47	1-2 mm
Leaf Length	22	23.273	82.30	9.07	10-35 mm
Leaf Width	22	6.273	9.83	3.13	2-15 mm
Corolla Tube Length	21	4.619	0.35	0.59	4-6 mm
Bract Length	22	2.909	0.37	0.61	2-4 mm
Calyx Length	22	3.682	0.42	0.65	3-5 mm
Nutlet Length	16	2.000	0.00	0.00	2 mm
V. neomexicana #4					
Plant Height	11	21.727	69.42	8.33	15-37 cm
Spike Length	11	9.636	24.25	4.92	4-15 cm
Spike Width	11	3.182	1.56	1.25	2-6 mm
Petiole Length	11	6.455	30.27	5.50	0-15 mm
# of Leaf Clefts	11	1.818	0.96	0.98	0-3
Length of Cleft	10	2.500	0.50	0.71	1-3 mm
Leaf Length	11	25.182	72.36	8.62	12-40 mm
Leaf Width	11	10.455	7.87	2.81	4-15 mm
Corolla Tube Length	7	4.143	1.14	1.07	3-6 mm
Bract Length	11	3.364	0.45	0.67	2-4 mm
Calyx Length	11	3.000	0.60	0.77	2-4 mm
Nutlet Length	9	2.111	0.11	0.33	2-3 mm

Appendix C continued.

V. neomexicana #5	N	MEAN	VAR.	S. D.	RANGE
Plant Height	10	24.600	31.82	5.64	14-32 cm
Spike Length	10	11.900	6.32	2.51	8-15 cm
Spike Width	10	3.600	1.38	1.17	2-5 mm
Petiole Length	10	5.500	41.39	6.43	0-15 mm
# of Leaf Clefts	10	1.800	0.84	0.92	1-4
Length of Cleft	10	2.300	2.01	1.42	1-5 mm
Leaf Length	10	27.000	51.11	7.15	10-35 mm
Leaf Width	10	9.000	10.44	3.23	5-15 mm
Corolla Tube Length	7	3.857	0.48	0.69	3-5 mm
Bract Length	10	3.200	0.40	0.63	2-4 mm
Calyx Length	10	2.700	0.46	0.67	2-4 mm
Nutlet Length	7	2.000	0.00	0.00	2 mm
Plant Height					
Spike Length					
Spike Width					
Petiole Length					
# of Leaf Clefts					
Length of Cleft					
Leaf Length					
Leaf Width					
Corolla Tube Length					
Bract Length					
Calyx Length					
Nutlet Length					

Appendix C continued.

V. officinalis #1	N	MEAN	VAR.	S. D.	RANGE
Plant Height	16	41.750	289.80	17.02	22-78 cm
Spike Length	24	12.417	12.08	3.48	6-21 cm
Spike Width	24	2.000	0.00	0.00	2 mm
Petiole Length	24	7.500	6.17	2.48	3-10 mm
# of Leaf Clefts	24	2.167	1.80	1.34	0-5
Length of Cleft	22	6.000	4.29	2.07	3-10 mm
Leaf Length	24	34.625	138.59	11.77	20-60 mm
Leaf Width	24	18.333	67.97	8.24	5-40 mm
Corolla Tube Length	19	2.895	0.43	0.66	2-4 mm
Bract Length	22	2.000	0.00	0.00	2 mm
Calyx Length	24	2.083	0.17	0.41	1-3 mm
Nutlet Length	19	2.000	0.00	0.00	2 mm
V. officinalis #2					
Plant Height	9	48.333	160.25	12.66	32-65 cm
Spike Length	9	16.333	30.25	5.50	10-27 cm
Spike Width	9	2.000	0.00	0.00	2 mm
Petiole Length	9	7.333	7.00	2.65	3-10 mm
# of Leaf Clefts	9	2.333	0.50	0.71	2-4
Length of Cleft	9	5.000	5.25	2.29	2-9 mm
Leaf Length	9	31.889	44.61	6.68	22-40 mm
Leaf Width	9	18.556	43.03	6.56	10-27 mm
Corolla Tube Length	8	3.375	0.27	0.52	3-4 mm
Bract Length	9	1.889	0.11	0.33	1-2 mm
Calyx Length	9	2.222	0.19	0.44	2-3 mm
Nutlet Length	9	2.000	0.00	0.00	2 mm

Appendix C continued.

V. officinalis #3	N	MEAN	VAR.	S. D.	RANGE
Plant Height	13	51.154	255.31	15.98	33-90 cm
Spike Length	14	13.643	9.48	3.08	10-21 cm
Spike Width	14	2.071	0.23	0.47	1-3 mm
Petiole Length	14	7.643	6.25	2.50	3-10 mm
# of Leaf Clefts	13	1.923	1.74	1.32	0-4
Length of Cleft	11	6.455	9.48	3.08	2-12 mm
Leaf Length	14	28.429	126.88	11.26	15-60 mm
Leaf Width	14	13.786	44.95	6.70	4-30 mm
Corolla Tube Length	12	2.375	0.32	0.57	2-3 mm
Bract Length	14	1.143	0.13	0.36	1-2 mm
Calyx Length	14	2.000	0.00	0.00	2 mm
Nutlet Length	12	2.000	0.00	0.00	2 mm
V. officinalis #4					
Plant Height	7	60.428	205.62	14.34	44-84 cm
Spike Length	8	21.125	44.13	6.64	14-30 cm
Spike Width	8	2.375	0.27	0.52	2-3 mm
Petiole Length	7	14.714	153.57	12.39	4-32 mm
# of Leaf Clefts	7	4.286	4.90	2.21	2-9
Length of Cleft	7	6.714	7.24	2.69	3-10 mm
Leaf Length	7	39.286	161.90	12.72	25-60 mm
Leaf Width	7	18.000	23.00	4.80	15-25 mm
Corolla Tube Length	8	3.438	0.67	0.82	2-4 mm
Bract Length	8	1.688	0.49	0.70	1-3 mm
Calyx Length	8	2.375	0.27	0.52	2-3 mm
Nutlet Length	8	2.000	0.00	0.00	2 mm

Appendix C continued.

V. officinalis #5	N	MEAN	VAR.	S. D.	RANGE
Plant Height	2	75.500	180.5	13.44	66-85 cm
Spike Length	4	14.500	17.67	4.20	13-20 cm
Spike Width	4	2.500	0.33	0.58	2-3 mm
Petiole Length	4	7.000	6.00	2.45	5-10 mm
# of Leaf Clefts	4	2.250	0.92	0.96	1-3
Length of Cleft	4	7.500	9.00	3.00	5-11 mm
Leaf Length	4	38.750	39.58	6.29	30-45 mm
Leaf Width	4	24.750	36.92	6.08	19-30 mm
Corolla Tube Length	3	3.000	0.00	0.00	3 mm
Bract Length	4	1.750	0.25	0.50	1-2 mm
Calyx Length	3	2.000	0.00	0.00	2 mm
Nutlet Length	3	2.000	0.00	0.00	2 mm
V. robusta #1					
Plant Height	5	54.000	491.50	22.17	27-79 cm
Spike Length	14	10.000	9.69	3.11	6-15 cm
Spike Width	14	5.571	0.58	0.76	5-7 mm
Petiole Length	14	12.214	29.72	5.45	5-20 mm
# of Leaf Clefts	13	3.462	2.44	1.56	2-8
Length of Cleft	13	5.154	8.81	2.97	3-12 mm
Leaf Length	14	41.071	158.38	12.58	15-60 mm
Leaf Width	14	23.214	62.18	7.89	8-40 mm
Corolla Tube Length	12	3.833	0.33	0.58	3-5 mm
Bract Length	13	3.000	0.00	0.00	3 mm
Calyx Length	14	2.929	0.23	0.47	2-4 mm
Nutlet Length	12	1.500	0.45	0.21	1-2 mm

Appendix C. continued

V. robusta #2	N	MEAN	VAR.	S. D.	RANGE
Plant Height	7	63.857	563.81	23.74	29-97 cm
Spike Length	13	12.462	30.93	5.56	5-26 cm
Spike Width	14	5.571	1.96	1.40	4-9 mm
Petiole Length	14	13.214	61.41	7.84	2-35 mm
# of Leaf Clefts	14	3.000	0.62	0.78	2-4
Length of Cleft	14	7.214	18.95	4.35	4-20 mm
Leaf Length	14	55.071	353.92	18.81	25-90 mm
Leaf Width	14	28.500	91.65	9.57	20-52 mm
Corolla Tube Length	11	3.364	0.65	0.81	2-4 mm
Bract Length	14	2.607	0.39	0.63	2-4 mm
Calyx Length	14	2.857	0.13	0.36	2-3 mm
Nutlet Length	12	1.588	0.05	0.22	1-2 mm
V. robusta #3					
Plant Height	5	48.400	341.30	18.47	28-78 cm
Spike Length	13	13.923	31.58	5.62	4-17 cm
Spike Width	13	5.077	1.24	1.12	3-7 mm
Petiole Length	12	8.667	17.88	4.23	5-20 mm
# of Leaf Clefts	10	3.000	0.22	0.47	2-4
Length of Cleft	10	4.700	4.67	2.16	2-10 mm
Leaf Length	12	42.667	129.88	11.40	25-65 mm
Leaf Width	11	20.909	19.89	4.46	10-25 mm
Corolla Tube Length	13	3.692	0.56	0.75	3-5 mm
Bract Length	13	2.615	0.42	0.65	2-4 mm
Calyx Length	13	2.846	0.47	0.69	2-4 mm
Nutlet Length	10	1.350	0.58	0.24	1-1.5 mm

Appendix C. continued.

V. robusta #4	N	MEAN	VAR.	S. D.	RANGE
Plant Height	7	57.429	676.95	26.02	30-92 cm
Spike Length	17	10.176	8.40	2.90	4-15 cm
Spike Width	17	5.235	0.69	0.83	4-7 mm
Petiole Length	16	11.375	15.72	3.96	7-20 mm
# of Leaf Clefts	16	3.125	0.92	0.96	1-5
Length of Cleft	16	5.563	20.13	4.49	2-20 mm
Leaf Length	17	56.882	326.49	18.07	30-110 mm
Leaf Width	17	26.118	54.86	7.41	20-44 mm
Corolla Tube Length	16	3.938	0.46	0.68	2-5 mm
Bract Length	17	2.706	0.35	0.59	2-4 mm
Calyx Length	17	2.882	0.11	0.33	2-3 mm
Nutlet Length	7	1.643	0.60	0.24	1.5-2 mm
V. simplex #1					
Plant Height	9	33.222	39.69	6.30	24-40 cm
Spike Length	10	12.500	14.06	3.75	6-17 cm
Spike Width	10	3.800	0.40	0.63	3-5 mm
Petiole Length	10	8.100	40.32	6.35	0-20 mm
# of Leaf Clefts	10	0.000	0.00	0.00	0
Length of Cleft	10	0.000	0.00	0.00	0 mm
Leaf Length	10	43.500	172.50	13.13	30-70 mm
Leaf Width	10	4.500	1.17	1.08	3-6 mm
Corolla Tube Length	7	4.429	0.29	0.53	4-5 mm
Bract Length	10	4.050	0.36	0.60	3-5 mm
Calyx Length	10	4.200	0.18	0.42	4-5 mm
Nutlet Length	9	2.278	0.13	0.36	2-3 mm

Appendix C. continued

V. simplex #2	N	MEAN	VAR.	S. D.	RANGE
Plant Height	18	36.722	71.98	8.48	26-60 cm
Spike Length	22	12.273	16.97	4.12	7-21 cm
Spike Width	22	3.636	0.62	0.79	2-5 mm
Petiole Length	22	8.500	27.12	5.21	0-20 mm
# of Leaf Clefts	22	0.000	0.00	0.00	0
Length of Cleft	22	0.000	0.00	0.00	0 mm
Leaf Length	22	44.318	188.80	13.74	20-65 mm
Leaf Width	22	5.909	6.66	2.58	2-12 mm
Corolla Tube Length	19	4.316	0.56	0.75	4-7 mm
Bract Length	22	3.818	0.25	0.50	3-5 mm
Calyx Length	22	3.909	0.28	0.53	3-5 mm
Nutlet Length	16	2.406	0.17	0.42	2-3 mm
V. simplex #3					
Plant Height	16	33.688	40.76	6.38	27-42 cm
Spike Length	20	12.650	24.66	4.97	5-20 cm
Spike Width	20	3.150	0.24	0.49	2-4 mm
Petiole Length	20	7.200	7.22	2.69	2-10 mm
# of Leaf Clefts	20	0.000	0.00	0.00	0
Length of Cleft	20	0.000	0.00	0.00	0 mm
Leaf Length	20	45.100	125.46	11.20	30-70 mm
Leaf Width	20	5.650	5.40	2.32	3-10 mm
Corolla Tube Length	19	4.263	0.20	0.45	4-5 mm
Bract Length	20	3.350	0.24	0.49	3-4 mm
Calyx Length	20	3.500	0.26	0.52	3-4 mm
Nutlet Length	13	2.077	0.04	0.19	3-4 mm

Appendix C. continued.

V. simplex #4	N	MEAN	VAR.	S. D.	RANGE
Plant Height	21	36.905	95.19	9.76	26-62 cm
Spike Length	23	11.478	16.53	4.07	5-20 cm
Spike Width	24	3.625	0.68	0.82	2-5 mm
Petiole Length	23	8.870	13.39	3.66	0-20 mm
# of Leaf Clefts	0	0.000	0.00	0.00	0
Length of Cleft	0	0.000	0.00	0.00	0 mm
Leaf Length	23	50.391	202.25	14.22	20-90 mm
Leaf Width	23	6.304	6.49	2.55	2-11 mm
Corolla Tube Length	19	4.263	0.32	0.56	4-6 mm
Bract Length	24	3.667	0.32	0.56	3-5 mm
Calyx Length	24	3.833	0.23	0.48	3-5 mm
Nutlet Length	16	2.188	0.13	0.36	2-3 mm
V. simplex #5					
Plant Height	21	34.905	125.49	11.20	24-61 cm
Spike Length	25	12.680	17.48	4.18	6-22 cm
Spike Width	25	3.040	0.62	0.79	2-5 cm
Petiole Length	24	8.083	15.91	3.99	0-20 mm
# of Leaf Clefts	25	0.000	0.00	0.00	0
Length of Cleft	25	0.000	0.00	0.00	0 mm
Leaf Length	25	51.400	186.42	13.65	30-70 mm
Leaf Width	25	6.680	6.81	2.61	3-13 mm
Corolla Tube Length	18	4.444	0.49	0.70	3-5 mm
Bract Length	25	3.680	0.39	0.63	2-5 mm
Calyx Length	25	3.760	0.19	0.44	3-4 mm
Nutlet Length	17	2.074	0.31	0.56	2-3 mm

Appendix C. continued.

V. simplex #6	N	MEAN	VAR.	S. D.	RANGE
Plant Height	28	36.607	109.88	10.48	23-66 cm
Spike Length	28	12.643	14.53	3.81	7-18 cm
Spike Width	28	3.643	0.76	0.87	2-5 mm
Petiole Length	29	9.517	14.04	3.75	4-20 mm
# of Leaf Clefts	29	0.000	0.00	0.00	0
Length of Cleft	29	0.000	0.00	0.00	0 mm
Leaf Length	28	47.786	138.40	11.76	30-75 mm
Leaf Width	28	6.964	8.33	2.89	3-15 mm
Corolla Tube Length	26	4.346	0.31	0.56	3-5 mm
Bract Length	29	3.586	0.32	0.57	3-5 mm
Calyx Length	29	3.827	0.29	0.54	3-5 mm
Nutlet Length	21	2.214	0.11	0.34	2-3 mm
V. simplex #7					
Plant Height	17	37.118	81.36	9.02	24-56 cm
Spike Length	18	14.778	13.24	3.64	10-23 cm
Spike Width	18	3.333	0.94	0.97	2-5 mm
Petiole Length	18	7.500	11.56	3.40	0-10 mm
# of Leaf Clefts	18	0.000	0.00	0.00	0
Length of Cleft	18	0.000	0.00	0.00	0 mm
Leaf Length	18	46.389	114.14	10.68	30-70 mm
Leaf Width	18	5.611	3.90	1.97	3-10 mm
Corolla Tube Length	17	4.118	0.11	0.33	4-5 mm
Bract Length	18	3.556	0.26	0.51	3-4 mm
Calyx Length	18	3.722	0.21	0.46	3-4 mm
Nutlet Length	17	2.176	0.09	0.30	2-3 mm

Appendix C. continued.

V. simplex #8	N	MEAN	VAR.	S. D.	RANGE
Plant Height	15	42.533	153.41	12.39	30-65 cm
Spike Length	19	13.316	24.12	4.91	9-28 cm
Spike Width	19	3.474	0.71	0.84	2-5 mm
Petiole Length	19	9.895	13.65	3.70	2-19 mm
# of Leaf Clefts	19	0.000	0.00	0.00	0
Length of Cleft	19	0.000	0.00	0.00	0 mm
Leaf Length	19	53.000	135.44	11.64	22-75 mm
Leaf Width	19	6.895	5.32	2.31	4-10 mm
Corolla Tube Length	19	4.105	0.99	0.32	4-5 mm
Bract Length	19	3.158	0.58	0.76	2-5 mm
Calyx Length	19	3.579	0.37	0.61	3-5 mm
Nutlet Length	16	2.000	0.00	0.00	2 mm
V. simplex #9					
Plant Height	15	32.467	131.70	11.48	20-43 cm
Spike Length	16	11.813	12.83	3.58	7-18 cm
Spike Width	16	3.375	0.65	0.81	2-5 mm
Petiole Length	16	6.938	10.06	3.17	2-15 mm
# of Leaf Clefts	16	0.000	0.00	0.00	0
Length of Cleft	16	0.000	0.00	0.00	0 mm
Leaf Length	16	43.625	108.92	10.44	25-70 mm
Leaf Width	16	4.938	3.13	1.77	2-9 mm
Corolla Tube Length	16	4.125	0.12	0.34	4-5 mm
Bract Length	16	3.438	0.26	0.51	3-4 mm
Calyx Length	16	3.563	0.26	0.51	3-4 mm
Nutlet Length	12	2.167	0.11	0.33	2-3 mm

Appendix C. continued.

V. stricta #1	N	MEAN	VAR.	S. D.	RANGE
Plant Height	9	50.778	170.19	13.05	30-76cm
Spike Length	10	16.300	44.90	6.70	10-26 cm
Spike Width	10	5.200	0.40	0.63	4-6 mm
Petiole Length	11	0.000	0.00	0 .00	0 mm
# of Leaf Clefts	11	0.000	0.00	0 .00	0
Length of Cleft	11	0.000	0.00	0.00	0 mm
Leaf Length	11	49.82	28.37	5.33	40-60 mm
Leaf Width	11	23.73	17.62	4.20	19-30 mm
Corolla Tube Length	11	6.000	0.60	0.77	5-7 mm
Bract Length	11	4.455	0.27	0.52	4-5 mm
Calyx Length	11	4.364	0.25	0.50	4-5 mm
Nutlet Length	6	2.917	0.04	0.20	2.5-3 mm
V. stricta #2					
Plant Height	12	63.583	267.54	16.36	40-90 cm
Spike Length	25	15.720	33.71	5.81	8-29 cm
Spike Width	25	5.280	0.88	0.94	4-7 mm
Petiole Length	25	0.000	0.00	0.00	0 mm
# of Leaf Clefts	25	0.000	0.00	0.00	0
Length of Cleft	25	0.000	0.00	0.00	0 mm
Leaf Length	25	57.480	148.34	12.18	40-75 mm
Leaf Width	25	27.560	34.67	5.89	20-41 mm
Corolla Tube Length	22	6.136	0.88	0.94	4-7 mm
Bract Length	25	4.640	0.41	0.64	3-6 mm
Calyx Length	25	4.640	0.41	0.64	3-6 mm
Nutlet Length	16	2.781	0.13	0.36	2-3 mm

Appendix C. continued.

V. stricta #3	N	MEAN	VAR.	S. D.	RANGE
Plant Height	5	72.600	230.80	15.19	58-90 cm
Spike Length	9	15.000	25.50	5.05	9-25 cm
Spike Width	9	6.111	3.86	1.96	5-11 mm
Petiole Length	9	0.000	0.00	0.00	0 mm
# of Leaf Clefts	9	0.000	0.00	0.00	0
Length of Cleft	9	0	0	0	0 mm
Leaf Length	9	64.889	185.11	13.61	55-99 mm
Leaf Width	9	31.667	60.75	7.79	22-50 mm
Corolla Tube Length	9	5.555	0.78	0.88	4-7 mm
Bract Length	9	4.333	0.25	0.50	4-5 mm
Calyx Length	9	4.333	0.25	0.50	4-5 mm
Nutlet Length	4	3.000	0.00	0.00	3 mm
V. stricta #4					
Plant Height	8	63.250	241.36	15.54	40-82 cm
Spike Length	12	17.083	30.27	5.50	9-25 cm
Spike Width	12	4.417	0.81	0.90	4-7 mm
Petiole Length	12	0.000	0.00	0.00	0 mm
# of Leaf Clefts	12	0.000	0.00	0.00	0
Length of Cleft	12	0.000	0.00	0.00	0 mm
Leaf Length	12	46.417	78.81	8.88	36-70 mm
Leaf Width	12	25.083	39.90	6.32	17-30 mm
Corolla Tube Length	11	6.455	0.87	0.93	5-8 mm
Bract Length	12	4.667	0.42	0.65	3-5 mm
Calyx Length	12	4.833	0.33	0.58	4-6 mm
Nutlet Length	5	2.900	0.05	0.22	2.5-3 mm

Appendix C. continued.

V. stricta #5	N	MEAN	VAR.	S. D.	RANGE
Plant Height	6	51.333	279.47	16.72	30-68 cm
Spike Length	10	14.100	35.43	5.95	7-21 cm
Spike Width	10	5.600	0.93	0.97	4-7 mm
Petiole Length	10	0.000	0.00	0.00	0 mm
# of Leaf Clefts	10	0.000	0.00	0.00	0
Length of Cleft	10	0.000	0.00	0.00	0 mm
Leaf Length	10	52.000	212.22	14.57	30-75 mm
Leaf Width	10	26.100	61.88	7.87	14-30 mm
Corolla Tube Length	10	5.700	1.13	1.06	4-7 mm
Bract Length	10	4.300	0.45	0.67	3-5 mm
Calyx Length	10	4.300	0.45	0.67	3-5 mm
Nutlet Length	8	2.938	0.03	0.18	2.5-3 mm
V. stricta #6					
Plant Height	12	54.750	192.57	13.87	40-74 cm
Spike Length	17	13.118	34.86	5.90	4-24 cm
Spike Width	17	5.353	0.62	0.79	4-7 mm
Petiole Length	17	0.000	0.00	0.00	0 mm
# of Leaf Clefts	17	0.000	0.000	0.00	0
Length of Cleft	17	0.000	0.00	0.00	0 mm
Leaf Length	17	54.235	151.82	12.32	40-85 mm
Leaf Width	17	28.706	60.10	7.75	15-46 mm
Corolla Tube Length	16	5.750	1.13	1.06	4-7 mm
Bract Length	17	4.412	0.38	0.62	4-6 mm
Calyx Length	17	4.471	0.51	0.72	4-6 mm
Nutlet Length	8	2.875	0.13	0.35	2-3 mm

Appendix C. continued.

V. stricta #7	N	MEAN	VAR.	S. D.	RANGE
Plant Height	20	57.350	258.13	16.07	27-90 cm
Spike Length	25	12.440	29.09	5.39	5-28 cm
Spike Width	25	5.480	1.76	1.33	3-8 mm
Petiole Length	25	0.000	0.00	0.00	0 mm
# of Leaf Clefts	25	0.000	0.00	0.00	0
Length of Cleft	25	0.000	0.00	0.00	0 mm
Leaf Length	25	50.600	70.92	8.42	35-70 mm
Leaf Width	25	25.360	42.16	6.49	14-32 mm
Corolla Tube Length	23	6.261	0.75	0.86	5-8 mm
Bract Length	25	4.520	0.43	0.65	3-6 mm
Calyx Length	25	4.640	0.49	0.70	3-6 mm
Nutlet Length	11	2.818	0.11	0.34	2-3 mm
V. stricta #8					
Plant Height	10	60.500	349.17	18.69	37-85 cm
Spike Length	17	12.882	12.99	3.60	7-19 cm
Spike Width	17	4.824	1.40	1.19	3-7 mm
Petiole Length	18	0.000	0.00	0.00	0 mm
# of Leaf Clefts	18	0.000	0.00	0.00	0
Length of Cleft	18	0.000	0.00	0.00	0 mm
Leaf Length	18	57.667	162.82	12.76	34-85 mm
Leaf Width	18	29.778	95.59	9.78	15-55 mm
Corolla Tube Length	18	5.611	1.44	1.20	4-8 mm
Bract Length	18	4.167	0.62	0.79	3-5 mm
Calyx Length	18	4.278	0.57	0.75	3-5 mm
Nutlet Length	8	2.750	0.14	0.38	2-3 mm

Appendix C. continued.

V. stricta #9	N	MEAN	VAR.	S. D.	RANGE
Plant Height	14	60.214	220.95	14.86	39-85 cm
Spike Length	24	13.167	28.49	5.34	5-26 cm
Spike Width	24	4.542	0.69	0.83	3-7 mm
Petiole Length	24	0.000	0.00	0.00	0 mm
# of Leaf Clefts	24	0.000	0.00	0.00	0
Length of Cleft	24	0.000	0.00	0.00	0 mm
Leaf Length	24	52.833	101.45	10.07	30-72 mm
Leaf Width	24	25.375	63.49	7.97	15-50 mm
Corolla Tube Length	23	6.087	0.63	0.79	5-8 mm
Bract Length	24	4.708	0.56	0.75	3-6 mm
Calyx Length	24	4.667	0.49	0.70	4-6 mm
Nutlet Length	10	2.950	0.03	0.16	2.5-3 mm
V. stricta #10					
Plant Height	10	59.500	462.50	21.51	29-90 cm
Spike Length	19	15.211	69.18	8.317	3-30 cm
Spike Width	19	5.526	0.60	0.77	4-7 mm
Petiole Length	19	0.000	0.00	0.00	0 mm
# of Leaf Clefts	19	0.000	0.00	0.00	0
Length of Cleft	19	0.000	0.00	0.00	0 mm
Leaf Length	19	54.000	102.33	10.12	35-75 mm
Leaf Width	19	26.368	40.80	6.39	20-40 mm
Corolla Tube Length	16	6.250	0.60	0.77	5-7 mm
Bract Length	19	4.579	0.48	0.69	3-5 mm
Calyx Length	19	4.737	0.43	0.65	3-6 mm
Nutlet Length	10	2.800	0.18	0.42	2-3 mm

Appendix C. continued.

V. stricta #11	N	MEAN	VAR.	S. D.	RANGE
Plant Height	14	65.429	106.73	10.33	48-90 cm
Spike Length	23	16.913	93.90	9.69	3-27 cm
Spike Width	23	5.217	1.09	1.04	3-7 mm
Petiole Length	23	0.000	0.00	0.00	0 mm
# of Leaf Clefts	23	0.000	0.00	0.00	0
Length of Cleft	23	0.000	0.00	0.00	0 mm
Leaf Length	23	56.217	134.09	11.58	30-75 mm
Leaf Width	23	26.522	68.99	8.31	11-45 mm
Corolla Tube Length	22	5.682	0.89	0.95	4-8 mm
Bract Length	23	4.391	0.52	0.72	3-6 mm
Calyx Length	23	4.391	0.52	0.72	3-6 mm
Nutlet Length	11	2.910	0.04	0.20	2.5-3 mm
V. stricta #12					
Plant Height	12	71.000	166.73	12.91	50-95 cm
Spike Length	17	13.824	36.90	6.07	5-29 cm
Spike Width	17	4.941	1.68	1.30	3-7 mm
Petiole Length	17	0.000	0.00	0.00	0 mm
# of Leaf Clefts	17	0.000	0.00	0.00	0
Length of Cleft	17	0.000	0.00	0.00	0 mm
Leaf Length	17	63.471	198.01	14.07	45-100mm
Leaf Width	17	28.529	138.26	11.76	19-50 mm
Corolla Tube Length	15	5.467	1.27	1.13	4-7 mm
Bract Length	17	4.118	0.49	0.70	3-5 mm
Calyx Length	17	4.000	0.50	0.71	3-5 mm
Nutlet Length	8	2.9375	0.03	0.18	2.5-3 mm

Appendix C. continued.

V. stricta #13	N	MEAN	VAR.	S. D.	RANGE
Plant Height	7	75.710	267.57	16.36	57-98 cm
Spike Length	10	15.600	12.27	3.50	11-21 cm
Spike Width	10	5.100	2.322	1.52	3-8 mm
Petiole Length	10	0.000	0.00	0.00	0 mm
# of Leaf Clefts	10	0.000	0.00	0.00	0
Length of Cleft	10	0.000	0.00	0.00	0 mm
Leaf Length	10	62.500	245.83	15.68	40-85 mm
Leaf Width	10	30.300	132.90	11.53	13-49 mm
Corolla Tube Length	9	5.889	1.36	1.17	4-8 mm
Bract Length	10	4.300	0.90	0.95	3-6 mm
Calyx Length	10	4.300	0.90	0.95	3-6 mm
Nutlet Length	6	2.833	0.17	0.41	2-3 mm
V. stricta #14					
Plant Height	5	68.200	479.20	21.89	38-98 cm
Spike Length	15	16.867	45.98	6.78	8-26 cm
Spike Width	15	5.800	0.46	0.68	5-7 mm
Petiole Length	15	0.000	0.00	0.00	0 mm
# of Leaf Clefts	15	0.000	0.00	0.00	0
Length of Cleft	15	0.000	0.00	0.00	0 mm
Leaf Length	15	63.600	298.83	17.29	40-98 mm
Leaf Width	15	33.733	79.35	8.91	20-55 mm
Corolla Tube Length	12	5.583	0.27	0.51	5-6 mm
Bract Length	15	4.200	0.31	0.56	3-5 mm
Calyx Length	15	4.467	0.27	0.52	4-5 mm
Nutlet Length	9	2.833	0.13	0.35	2-3 mm

Appendix C. continued.

V. stricta #15	N	MEAN	VAR.	S. D.	RANGE
Plant Height	15	63.867	316.267	17.78	35-95 cm
Spike Length	23	13.783	55.451	7.45	3-32 cm
Spike Width	24	6.125	1.42	1.19	4-8 mm
Petiole Length	25	0.000	0.00	0.00	0 mm
# of Leaf Clefts	25	0.000	0.00	0.00	0
Length of Cleft	25	0.000	0.00	0.00	0 mm
Leaf Length	25	59.040	137.46	11.72	30-80 mm
Leaf Width	25	32.040	95.37	9.77	17-50 mm
Corolla Tube Length	21	5.667	1.03	1.02	4-7 mm
Bract Length	25	4.440	0.26	0.51	4-5 mm
Calyx Length	25	4.640	0.41	0.64	4-6 mm
Nutlet Length	11	3.000	0.00	0.00	3 mm
V. stricta #16					
Plant Height	8	73.625	273.41	16.535	49-93 cm
Spike Length	11	14.636	44.25	6.652	9-27 cm
Spike Width	11	4.545	0.47	0.69	3-5 mm
Petiole Length	11	0.000	0.00	0.00	0 mm
# of Leaf Clefts	11	0.000	0.00	0.00	0
Length of Cleft	11	0.000	0.00	0.00	0 mm
Leaf Length	11	57.000	90.00	9.49	42-70 mm
Leaf Width	11	26.909	56.89	7.54	15-35 mm
Corolla Tube Length	11	5.818	0.56	0.75	4-7 mm
Bract Length	11	4.364	0.25	0.40	4-5 mm
Calyx Length	11	4.364	0.25	0.50	4-5 mm
Nutlet Length	4	3.000	0.00	0.00	3 mm

Appendix C. continued.

V. urticifolia #1	N	MEAN	VAR.	S. D.	RANGE
Plant Height	13	74.385	304.42	17.45	48-99 cm
Spike Length	25	15.200	21.25	4.61	8-25 cm
Spike Width	25	2.080	0.24	0.49	1-3 mm
Petiole Length	25	14.120	22.03	4.69	10-30 mm
# of Leaf Clefts	25	0.000	0.00	0.00	0
Length of Cleft	25	0.000	0.00	0.00	0 mm
Leaf Length	25	83.640	209.16	14.46	40-103 mm
Leaf Width	25	38.840	90.64	9.52	20-60 mm
Corolla Tube Length	19	2.000	0.00	0.00	2 mm
Bract Length	25	1.000	0.00	0.00	1 mm
Calyx Length	25	1.920	0.08	0.28	1-2 mm
Nutlet Length	17	1.718	0.11	0.33	1-2 mm
V. urticifolia #2					
Plant Height	3	92.000	93.00	9.64	81-99 cm
Spike Length	12	14.333	10.06	3.17	7-18 cm
Spike Width	12	1.917	0.27	0.51	1-3 mm
Petiole Length	12	17.667	68.42	8.27	10-40 mm
# of Leaf Clefts	12	0.000	0.00	0.00	0
Length of Cleft	12	0.000	0.00	0.00	0 mm
Leaf Length	12	81.833	281.97	16.79	55-99 mm
Leaf Width	12	33.833	101.24	10.06	22-52 mm
Corolla Tube Length	11	2.000	0.00	0.00	2 mm
Bract Length	12	1.000	0.00	0.00	1 mm
Calyx Length	12	2.000	0.00	0.00	2 mm
Nutlet Length	6	1.450	0.12	0.34	1-2 mm

Appendix C. continued.

V. urticifolia #3	N	MEAN	VAR.	S. D.	RANGE
Plant Height	4	89.000	48.67	6.98	79-95 cm
Spike Length	20	15.050	14.16	3.76	8-19 cm
Spike Width	15	1.933	0.67	0.26	1-3 mm
Petiole Length	20	16.800	37.75	6.14	9-30 mm
# of Leaf Clefts	0	0.000	0.00	0.00	0
Length of Cleft	0	0.000	0.00	0.00	0 mm
Leaf Length	20	83.900	190.52	13.80	50-99 mm
Leaf Width	20	35.100	100.00	10.00	20-60 mm
Corolla Tube Length	20	2.000	0.00	0.00	2 mm
Bract Length	20	1.000	0.00	0.00	1 mm
Calyx Length	20	1.900	0.31	0.55	1-3 mm
Nutlet Length	11	1.682	0.16	0.40	1-2 mm
V. urticifolia #4					
Plant Height	8	83.500	396.57	19.91	55-108 cm
Spike Length	20	15.550	46.05	6.79	6-28 cm
Spike Width	20	2.050	0.26	0.51	1-3 mm
Petiole Length	19	14.053	31.61	5.62	6-30 mm
# of Leaf Clefts	20	0.000	0.00	0.00	0
Length of Cleft	20	0.000	0.00	0.00	0 mm
Leaf Length	20	85.050	96.47	9.82	60-97 mm
Leaf Width	20	36.250	95.04	9.75	16-55 mm
Corolla Tube Length	16	2.000	0.00	0.00	2 mm
Bract Length	20	1.000	0.00	0.00	1 mm
Calyx Length	20	2.000	0.00	0.00	2 mm
Nutlet Length	11	1.818	0.06	0.25	1.5-2 mm

Appendix C. continued.

V. urticifolia #5	N	MEAN	VAR.	S. D.	RANGE
Plant Height	5	63.400	272.80	16.52	51-91 cm
Spike Length	13	12.538	16.27	4.03	6-15 cm
Spike Width	13	2.154	0.47	0.69	1-4 mm
Petiole Length	14	14.857	18.75	4.33	10-20 mm
# of Leaf Clefts	14	0.000	0.00	0.00	0
Length of Cleft	14	0.000	0.00	0.00	0 mm
Leaf Length	14	83.786	199.72	14.13	50-110 mm
Leaf Width	14	39.929	73.46	8.57	30-52 mm
Corolla Tube Length	13	2.000	0.00	0.00	2 mm
Bract Length	14	1.000	0.00	0.00	1 mm
Calyx Length	14	1.714	0.18	0.43	1-2 mm
Nutlet Length	7	1.528	0.22	0.47	1-2 mm
V. urticifolia #6					
Plant Height	7	69.571	560.95	23.68	49-120 cm
Spike Length	15	14.733	38.71	6.23	8-28 cm
Spike Width	15	2.000	0.00	0.00	2 mm
Petiole Length	15	15.200	55.03	7.42	5-32 mm
# of Leaf Clefts	15	0.000	0.00	0.00	0
Length of Cleft	15	0.000	0.00	0.00	0 mm
Leaf Length	14	85.571	156.26	12.500	60-99 mm
Leaf Width	14	30.714	113.60	10.659	21-59 mm
Corolla Tube Length	14	2.000	0.00	0.00	2 mm
Bract Length	14	1.000	0.00	0.00	1 mm
Calyx Length	14	2.000	0.00	0.00	2 mm
Nutlet Length	9	1.388	0.11	0.33	1-2 mm

Appendix C. continued.

V. urticifolia #7	N	MEAN	VAR.	S. D.	RANGE
Plant Height	4	86.500	669.67	25.88	62-123 cm
Spike Length	10	16.500	20.50	4.53	10-27 cm
Spike Width	10	1.700	0.23	0.48	1-2 mm
Petiole Length	10	16.100	24.77	4.98	7-22 mm
# of Leaf Clefts	10	0.000	0.00	0.00	0
Length of Cleft	10	0.000	0.00	0.00	0 mm
Leaf Length	10	87.900	47.88	6.92	80-98 mm
Leaf Width	10	37.400	116.71	10.80	24-56 mm
Corolla Tube Length	7	2.000	0.00	0.00	2 mm
Bract Length	10	1.000	0.00	0.00	1 mm
Calyx Length	10	1.700	0.23	0.48	1-2 mm
Nutlet Length	6	1.583	0.04	0.20	1.5-2 mm
V. urticifolia #8					
Plant Height	6	75.167	431.77	20.78	46-98 cm
Spike Length	12	17.000	44.18	6.65	8-25 cm
Spike Width	12	2.000	0.00	0.00	0
Petiole Length	11	13.455	20.07	4.48	7-20 mm
# of Leaf Clefts	12	0.000	0.00	0.00	0
Length of Cleft	12	0.000	0.00	0.00	0 mm
Leaf Length	12	80.083	326.81	18.08	40-99 mm
Leaf Width	12	35.333	161.33	12.70	20-53 mm
Corolla Tube Length	8	2.000	0.29	0.53	1-3 mm
Bract Length	12	1.000	0.00	0.00	1 mm
Calyx Length	12	1.833	0.15	0.39	1-2 mm
Nutlet Length	10	1.300	0.03	0.18	1.1.5 mm

Appendix C. continued.

V. urticifolia #9	N	MEAN	VAR.	S. D.	RANGE
Plant Height	12	63.000	878.00	29.63	33-116 cm
Spike Length	22	12.364	32.24	5.68	4-27 cm
Spike Width	22	2.000	0.00	0.00	2 mm
Petiole Length	23	15.826	38.88	6.24	7-30 mm
# of Leaf Clefts	23	0.000	0.00	0.00	0
Length of Cleft	23	0.000	0.00	0.00	0 mm
Leaf Length	23	80.043	308.86	17.57	50-99 mm
Leaf Width	23	35.261	130.29	11.41	19-60 mm
Corolla Tube Length	12	2.000	0.00	0.00	2 mm
Bract Length	23	1.000	0.00	0.00	1 mm
Calyx Length	23	1.870	0.12	0.34	1-2 mm
Nutlet Length	15	1.353	0.07	0.27	1-2 mm
V. urticifolia #10					
Plant Height		-99			
Spike Length	12	11.417	31.17	5.58	4-22 cm
Spike Width	12	1.917	0.27	0.51	1-3 cm
Petiole Length	12	16.500	36.27	6.02	9-25 mm
# of Leaf Clefts	12	0.000	0.00	0.00	0
Length of Cleft	12	0.000	0.00	0.00	0 mm
Leaf Length	12	84.750	226.93	15.064	55-99 mm
Leaf Width	12	31.667	38.42	6.199	20-39 mm
Corolla Tube Length	9	2.000	0.00	0.00	2 mm
Bract Length	12	1.000	0.00	0.00	1 mm
Calyx Length	12	2.000	0.00	0.00	2 mm
Nutlet Length	7	1.271	0.05	0.23	1-1.5 mm

Appendix D. Grand Means of the Members of the Verbena stricta complex.

Verbena bracteata	N	MEAN	VAR.	S. D.	RANGE
Plant Height	275	23.950	81.00	9.00	9-55 cm
Spike Length	297	8.161	10.69	3.27	5-15 cm
Spike Width	297	7.758	2.62	1.62	2-10 mm
Petiole Length	293	5.296	7.73	2.78	2-20 mm
# of Leaf Clefts	291	1.203	2.10	1.45	0-3
Length of Cleft	291	5.780	11.70	3.42	0-18 mm
Leaf Length	291	24.660	75.17	8.67	8-55 mm
Leaf Width	291	14.017	36.97	6.08	4-28 mm
Corolla Tube Length	208	3.611	0.53	0.73	2-8 mm
Bract Length	297	7.070	1.66	1.29	4-11 mm
Calyx Length	298	2.876	0.21	0.46	2-4 mm
Nutlet Length	255	2.000	0.00	0.00	2 mm
Verbena halei					
Plant Height	180	49.006	180.63	13.44	26-75 cm
Spike Length	204	16.461	28.41	5.33	4-38 cm
Spike Width	204	2.142	0.14	0.38	2-4 mm
Petiole Length	179	14.140	70.73	8.41	3-30 mm
# of Leaf Clefts	172	3.052	1.08	1.04	0-7
Length of Cleft	172	7.965	25.70	5.07	0-25 mm
Leaf Length	177	34.288	145.68	12.07	15-105 mm
Leaf Width	177	15.576	54.91	7.41	2-35 mm
Corolla Tube Length	187	3.743	0.35	0.59	2-7 mm
Bract Length	204	1.973	0.13	0.36	1-3 mm
Calyx Length	204	2.953	0.20	0.45	2-4 mm
Nutlet Length	205	2.000	0.00	0.00	2 mm

Appendix D. Continued.

Verbena hastata	N	MEAN	VAR.	S. D.	RANGE
Plant Height	131	74.748	591.46	24.32	17-150 cm
Spike Length	297	9.517	268.63	16.39	2-70 cm
Spike Width	295	2.686	0.50	0.71	2-5 mm
Petiole Length	297	12.703	25.20	5.02	3-25 mm
# of Leaf Clefts	9(294)	1.000	0.00	0.00	1
Length of Cleft	9(294)	12.556	13.03	3.61	8-20 mm
Leaf Length	295	79.783	251.22	15.85	30-115 mm
Leaf Width	295	20.695	38.94	6.24	7-38 mm
Corolla Tube Length	255	3.043	0.50	0.71	2-5 mm
Bract Length	296	1.537	0.42	0.65	1-3 mm
Calyx Length	299	2.181	0.18	0.43	1-3 mm
Nutlet Length	225	1.964	0.03	0.17	1-2 mm
Verbena lasiostachys					
Plant Height	97	54.742	331.97	18.22	17-115 cm
Spike Length	171	15.018	31.70	5.63	4-43 cm
Spike Width	171	4.614	0.94	0.97	3-10 mm
Petiole Length	168	11.399	36.24	6.02	0-35 mm
# of Leaf Clefts	160	3.981	3.65	1.91	0-15
Length of Cleft	160	6.000	15.60	3.95	0-20 mm
Leaf Length	165	46.806	256.00	18.00	20-90 mm
Leaf Width	165	24.910	97.02	9.85	9-60 mm
Corolla Tube Length	156	3.721	0.34	0.58	2-5 mm
Bract Length	171	2.444	0.30	0.55	1-4 mm
Calyx Length	171	3.082	0.29	0.54	2-4 mm
Nutlet Length	113	1.489	0.11	0.33	1-2 mm

Appendix D. Continued.

Verbena neomexicana	N	MEAN	VAR.	S. D.	RANGE
Plant Height	108	35.509	200.22	14.15	10-71 cm
Spike Length	119	13.891	29.27	5.41	4-29 cm
Spike Width	119	3.571	1.44	1.20	2-7 mm
Petiole Length	114	7.263	38.69	6.22	0-30 mm
# of Leaf Clefts	118	2.025	2.89	1.70	0-10
Length of Cleft	118	3.483	11.90	3.45	0-20 mm
Leaf Length	118	25.771	90.25	9.50	7-60 mm
Leaf Width	118	10.576	37.95	6.16	2-30 mm
Corolla Tube Length	99	4.586	0.79	0.89	3-7 mm
Bract Length	118	3.025	0.36	0.60	2-5 mm
Calyx Length	119	3.261	0.46	0.68	2-5 mm
Nutlet Length	74	2.000	0.00	0.00	2 mm
Verbena officinalis					
Plant Height	69	49.594	247.43	15.73	22-90 cm
Spike Length	88	14.534	30.47	5.52	5-20 cm
Spike Width	88	2.091	0.11	0.33	1-3 mm
Petiole Length	85	9.929	45.83	6.77	3-40 mm
# of Leaf Clefts	84	2.643	1.93	1.39	0-9
Length of Cleft	84	6.500	14.59	3.82	0-20 mm
Leaf Length	85	34.506	132.71	11.52	15-65 mm
Leaf Width	85	18.235	55.35	7.44	5-40 mm
Corolla Tube Length	79	3.089	0.52	0.72	2-5 mm
Bract Length	88	1.597	0.30	0.55	1-3 mm
Calyx Length	88	2.227	0.25	0.50	1-4 mm
Nutlet Length	72	2.00	0.00	0.00	2 mm

Appendix D. Continued.

Verbena robusta	N	MEAN	VAR.	S. D.	RANGE
Plant Height	25	56.800	480.05	21.91	27-97 cm
Spike Length	61	11.582	21.07	4.59	4-26 cm
Spike Width	61	5.377	1.04	1.02	4-9 mm
Petiole Length	60	9.517	43.69	6.61	2-35 mm
# of Leaf Clefts	57	3.228	1.44	1.20	2-8
Length of Cleft	57	5.386	10.50	3.24	2-20 mm
Leaf Length	60	48.600	305.55	17.48	15-110 mm
Leaf Width	60	24.433	90.06	9.49	8-52 mm
Corolla Tube Length	55	3.727	0.50	0.71	2-5 mm
Bract Length	61	2.746	0.32	0.57	2-4 mm
Calyx Length	61	2.885	0.20	0.45	2-4 mm
Nutlet Length	44	1.505	0.05	0.23	1-2 mm
Verbena simplex					
Plant Height	205	36.044	105.47	10.27	21-72 cm
Spike Length	228	12.772	31.58	5.62	5-25 cm
Spike Width	228	3.386	0.69	0.83	2-5 mm
Petiole Length	228	8.509	16.65	4.08	0-20 mm
# of Leaf Clefts	228	0.000	0.00	0.00	0
Length of Cleft	228	0.000	0.00	0.00	0 mm
Leaf Length	228	47.539	153.76	12.40	20-80 mm
Leaf Width	228	6.307	8.76	2.96	3-15 mm
Corolla Tube Length	205	4.288	0.34	0.58	3-6 mm
Bract Length	228	3.616	0.36	0.60	2-6 mm
Calyx Length	230	3.761	0.28	0.53	3-6 mm
Nutlet Length	166	2.199	0.11	0.33	2-3 mm

Appendix D. Continued.

Verbena stricta	N	MEAN	VAR.	S. D.	RANGE
Plant Height	172	62.413	295.50	17.19	29-90 cm
Spike Length	282	14.840	45.02	6.71	4-43 cm
Spike Width	282	5.248	1.23	1.11	3-9 mm
Petiole Length	18(285)	5.056	7.13	2.67	2-10 mm
# of Leaf Clefts	12(285)	1.000	0.00	0.00	1
Length of Cleft	12(285)	6.250	11.30	3.36	2-12 mm
Leaf Length	286	56.378	153.26	12.38	30-100 mm
Leaf Width	286	28.273	70.56	8.40	14-50 mm
Corolla Tube Length	261	5.885	0.88	0.94	4-8 mm
Bract Length	287	4.443	0.45	0.67	3-6 mm
Calyx Length	287	4.505	0.45	0.67	3-6 mm
Nutlet Length	145	2.886	0.07	0.27	2-3 mm
Verbena urticifolia					
Plant Height	92	76.783	533.15	23.09	33-140 cm
Spike Length	245	14.958	50.98	7.14	8-90 cm
Spike Width	245	2.061	0.21	0.46	1-3 mm
Petiole Length	243	14.881	31.70	5.63	5-30 mm
# of Leaf Clefts	245	0.000	0.00	0.00	0
Length of Cleft	245	0.000	0.00	0.00	0 mm
Leaf Length	246	81.935	222.90	14.93	40-110 mm
Leaf Width	246	33.943	102.21	10.11	15-60 mm
Corolla Tube Length	191	1.963	0.07	0.26	1-3 mm
Bract Length	248	1.000	0.00	0.00	1 mm
Calyx Length	248	1.859	0.14	0.37	1-3 mm
Nutlet Length	166	1.496	0.11	0.33	1-2 mm

Appendix E. Hybrid Specimens measured.

hastata x stricta

1) B.F. Bush 14088, Leavensworth, KS

2) B. Shimek s.n., Dickinson Co, IOWA

3) F. Thorne 87, LaSalle Co, ILL.

4) H. Eggert s.n., St. Louis Co., MO.

hastata x urticifolia

5) L.H. Pammel s.n., Clayton Co, IOWA

6) H. Eggert s.n., St. Louis Co, MO

7) J.K. Small s.n., Luzerne Co, PA

8) M.S. Bebb s.n., Fountaindale, ILL

hybrids ?

9) Patterson s.n., Oquawka, ILL

10) Patterson s.n., Oquawka, ILL

11) Patterson s.n., Oquawka, ILL

stricta x simplex

12) L.H. Pammel s.n., Clinton Co, IOWA

13) B. Shimek s.h., Black Hawk Co, IOWA

14) E.L. Braun s.n., Cook Co, ILL

bracteata x stricta

15) Patterson s.n., Oquawka, ILL

16) Patterson s.n., Oquawka, ILL

17) Patterson s.n., Oquawka, ILL

stricta x halei

18) G.L. Fisher 33129, Harris Co., TX

Appendix E continued.

hastata x *simplex*

19) M.L. Bebb s.n., Fountaindale, ILL

20) H.H. Smith 979, Iron Co, MO

stricta x *urticifolia*

21) H. Eggert s.n., Cairo, ILL

22) ? ? , IND.

bracteata x *urticifolia*

23) Patterson s.n., Oquauka, ILL

24) M.S. Bebb s.n., Foutaindale, ILL.