Rubber Content of

MISCELLANEOUS PLANTS

Production Research Report No. 10

Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

CONTENTS

In addition to the contributions by the author and other personnel of the USDA laboratory, special attention should be called to the contribution by A. V. McMullan, now with the International Cooperation Administration in Costa Rica, who supervised the laboratory and made most of the analyses. All botanical identifications were made in the Division of Plant Exploration and Introduction (now the Plant Introduction Section of the Crops Research Division). The rubber work had been under that Division prior to receiving separate status at the beginning of World War II.

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Rubber Content of MISCELLANEOUS PLANTS

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Need for New Sources of Crude Rubber

The United States Department of Agriculture has been interested in natural sources of crude rubber since the latter part of the 19th century. Department scientists in the opening years of this century made a detailed survey of the cultivation of the Castilla rubbertree in Mexico (*2*).[1] At that time they urged caution to American investors who were putting millions of dollars into highly speculative Mexican rubber plantations.

The United States Department of Commerce has also been interested for many years in sources of rubber and in its ever-growing economic importance. The strategic importance of rubber was forcibly emphasized during World War I when encircled Germany tried desperately but unsuccessfully to synthesize a satisfactory substitute for the natural rubber it no longer could import.

Following the end of that war, this country recognized that rubber had become a strategic commodity and that, with regard to its sources of supply, the position of the United States might be as precarious as that of Germany. Industrialists Harvey S. Firestone and Henry Ford joined with inventor Thomas G. Edison and the then Secretary of Commerce Herbert Hoover to inform the American public as to the growing importance of rubber and the strategic liability of depending on sources on the the other side of the world. "America," they said, "should produce its own rubber."

[1] Italic numbers in parentheses refer to Literature Cited, p. 24.

Congress recognized the problem, and in 1922 it granted the Secretary of Commerce an appropriation of $500,000 to investigate sources of crude rubber. Of this sum, $100,000 could be allocated to the Department of Agriculture to investigate rubber production in the Western Hemisphere and the Philippine Islands. This allocation from the Department of Commerce constituted the first funds received by the Department of Agriculture that were earmarked specifically for investigating the production of rubber. This first allocation has been supplemented by direct annual appropriations since then.

The Department of Commerce made a worldwide survey of rubber production and marketing and published the results of its surveys in its Trade Promotion Series (*3*, *6*, *13*, *14*, *15*, *16*, *18*). Specialists from the Department of Agriculture assisted in the surveys made by the Department of Commerce in the Western Hemisphere and in the Philippines. The Department of Agriculture published reports by its specialists on surveys in Brazil, Dutch Guiana, and the island of Trinidad (*7*, *12*, *17*). Simultaneously with the survey of existing sources of rubber, the Department of Agriculture initiated research on rubber production in the Western Hemisphere. Tapping experiments were started on a small planting of rubbertrees on the northern coast of Haiti (*10*). These plantings consisted of Castilla, Ficus, Funtumia, Hevea, and other rubber-bearing plants. Only the Hevea rubbertree was found worthy of continued study.

In the United States, experimental plantings were started at Coconut Grove, Fla., and at Bard, Calif. Many tropical rubber-bearing plants were imported and studied under cultivation in Florida. The plantings at Bard, Calif., were used principally for the study of desert rubber-bearing plants, the chief of which was the desert milkweed, *Asclepias subulata*. The work of a private company with the desert rubber-bearing shrub *Parthenium argentatum* was kept under observation, but it was not felt necessary to divert any of the limited government funds to duplicate work already underway at private expense.

Public Reaction

The speculative boom in rubber planting in Mexico during the early years of the 20th century resulted in the loss of many millions of dollars by investors in the United States. It did serve to awaken the American public to the growing importance of rubber. The appeals of Firestone, Ford, Edison, and Hoover in the 1920's quickly found an answering chord among people of every age and position in the United States. Rubber became an important category in school curricula, and government agencies were flooded with requests for information from school children and their teachers. Educational pamphlets and exhibits became important parts of the informational material supplied correspondents by the large rubber-manufacturing companies.

Men, women, and children began to think in terms of "America should produce its own rubber." They knew that most of our natural rubber was obtained from the Para rubbertree. Moreover, the impression persisted that Brazil was the chief source of our rubber for many years after the increase in plantation production in the Far East placed Brazilian production in a position of relative unimportance.

Hundreds of plants throughout the world have been used as sources of crude rubber to a lesser or greater degree. In the United States, Hall and Goodspeed (*4*) and Hall and Long (*5*) of the University of California made surveys of native plants of the West that contained rubber and reported a surprising number as having significant amounts. Every plant that had a milky juice, a gummy exudate, a sticky feeling, or just no other apparent use became suspect as a potential source of rubber.

The Department of Agriculture, having assumed responsibility for investigating the production of rubber in the Americas, became recipient of inquiries as to sources of rubber. Individuals throughout the country became interested in studying the plants around them and speculating as to their potential value as sources of rubber. From 1920 to 1945, hundreds of people went to considerable personal trouble and expense to collect and furnish the Department with plants that they hoped might contain significant quantities of rubber. Many samples were supplied to the Department direct; some were furnished through other agencies in the Government; and some were supplied through members of Congress. Wherever possible, the Department made a botanical identification of the plants and a chemical analysis to determine the rubber content. Then, it furnished the individual submitting the sample with that information, together with such additional information regarding the plant as a possible source of rubber as might already be available.

Without doubt, many of the individuals who furnished samples of suspected rubber-bearing plants to the Department for analysis were imbued with the prospect of personal gain. Others were chiefly interested in performing a patriotic service.

Type of Material Analyzed

Specimens submitted to the Department for analysis varied considerably. In most cases, the collector gathered the available plant material, wrapped it up, and mailed it to the Department. Often such material arrived in a state of decay that made identification difficult and analysis uncertain. In many cases, insufficient material was sent for definite botanical identification. In some cases, evidently an effort was made to prevent identification in the hope of obtaining exclusive information that might lead to personal gain. In some cases, ground samples were submitted; sometimes extracts; often only a gum or resin; once a sample of Hevea latex was submitted as coming from poinsettia. To void furnishing reports that might be misleading, botanical specimens

were requested of plants from which questionable gums, resins, or latex were received.

Many of the specimens were received from Department personnel engaged in other activities but interested in collecting and submitting samples of interesting looking plants that they encountered in the course of their regular activities. The Department of Agriculture has made no specific survey of possible rubber-bearing plants other than that made by Mildred M. Pladeck, who was assigned to collect samples of native species of goldenrod within a 100-mile radius of Washington, D. C. A preliminary report was published in 1933 (*11*). For the sake of completeness, the published material is combined with that from subsequent collections in the present report.

During World War II, the Department cooperated with the Board of Economic Warfare, the Rubber Development Corporation, and other wartime agencies engaged in determining what new sources of rubber could be found in Latin America and other still-free areas of the world. Employees of these agencies, either directly supervised by the Department of Agriculture or in cooperation with the Department, submitted samples of rubbers and other gums for chemical determination of the rubber content. In the course of their search for new sources of rubber from already recognized plants, these individuals also found other plants that might be valuable in extending knowledge of the type and range of rubber-bearing plants. These plants are included in this report.

Whenever possible, samples were subdivided into the different plant parts in order to record where the rubber was formed in the different plants. However, that was not always possible, and it was necessary to analyze a composite sample of the material submitted. Such samples could not be assumed to represent a composite of the plant from which they were collected and certainly would not be considered as representative of the species. Such specimens are designated in this report as "whole" and thus are representative of the whole sample submitted. This would mean that more than just leaves or twigs or other specific portions of the plant were analyzed. However, it might mean only leaves and twigs from a bush or even a tree. If rubber is reported in such samples, there is a fair assumption that under some conditions rubber is formed in that species. If the report is that no rubber was found in such samples, it may or may not indicate that that species does not form rubber.

No coordinated survey of American rubber-bearing plants was attempted. The samples received had been collected without regard to seasonal variation in rubber content. Many plants do not accumulate rubber during periods of active growth. Rubber accumulation occurs in periods of retarded or suspended growth in most Temperate Zone plants. Analyses included in this report were of plants collected at random when the interest of the collectors dictated. It is quite probable

that in many cases higher rubber contents would have been found if the collections had been made at more favorable seasons.

The address given by the collector is shown as the point of origin of the sample unless information included with any sample indicated that it was collected elsewhere. Inclusion of plants in these lists indicates that to the best of our knowledge the plants were growing in the State or States indicated as the origin of the individual samples. The plants may have been wild or cultivated, native or introduced.

Methods of Analysis

At first, the gravimetric method of analysis described by Hall and Goodspeed (*4*) was used for determining the rubber content of the specimens. This is essentially a 3-hour extraction of a 5-gram ground sample with acetone, followed by a 3-hour extraction with benzene. After drying, the benzene extract was weighed direct as rubber. Later, when tests showed that the 3-hour period was insufficient to assure complete extraction. the length of the extraction periods was increased. It also was found that adding 1 percent of trichloroacetic acid to the benzene speeded up the solution of the rubber. No record was kept of the precise details of the analysis used on these miscellaneous samples. The method of analysis currently used in routine research tests was used.

In many cases, the benzene extract did not have the characteristics of true rubber. If time permitted and the sample was of some interest, the extract would be redissolved in benzene and either be precipitated with alcohol or be treated to transform the rubber into a bromide. Formation of a bromide insoluble in 95-percent alcohol was considered proof of the identity of the extract as rubber. The benzene extracts of only a few of these miscellaneous plants were checked in this manner, however, because of the time involved.

Chemically, rubber is polyisoprene. Gutta, a second polyisoprene, is also formed in plants. Both rubber, *cis*-polyisoprene, and gutta, *trans*-polyisoprene, are soluble in benzene and insoluble in acetone. The methods of analysis used in our laboratory would not differentiate between these materials. Examining the benzene extract from each specimen and noting its physical character were standard practices. The leathery extract from *Eucommia ulmoides* was known to be gutta rather than rubber, and similar extracts from other plants were assumed to be also. This was true particularly with regard to plants belonging to the Sapotaceae. A precise determination of rubber and gutta could not be made with the facilities in our laboratory. For the purpose of general testing of miscellaneous plants, the benzene extract was designated as rubber. That designation is followed in this report.

There was a significant variation in the character of the benzene extracts of plants. Some of this variation was attributed to differences

in the molecular weights of the rubber from different plants or from different parts of the same plant. In general, rubber extracts with high molecular weight are stiffer and less sticky than those with low molecular weight. Soft, sticky extracts were also sometimes attributed to ineffective extraction of the resinous nonrubber materials by acetone or to the oxidation of the rubber during the extraction period. It was on the basis of this examination that a determination was made as to whether further examination by precipitation or bromination was desirable.

Only the analyses made in the Washington, D. C., laboratories (transferred to Beltsville, Md., in 1942) are reported herein. Additional miscellaneous analyses were made for correspondents in the research laboratories in California. Those analyses have not been segregated from the research data and are not included.

Presentation of Data

Table 1 gives the results of the analyses of miscellaneous plants tested for correspondents from the continental United States and are not included in formal research activities. Nearly half the species were of the Compositae family, with fair representation from Apocynaceae, Asclepiadaceae, and Euphorbiaceae—all known to contain important rubber-bearing plants. Most of the other families are represented by only one or two species. Table 2 summarizes the total plants tested and the number that contained rubber. Table 3 gives a tabulation of the families represented, the number of species tested in each family, the number of tests made, the number that contained rubber, and the number that showed no trace of rubber.

Table 4 shows the results of analyses of plants submitted from outside the continental limits of the United States. These samples were submitted largely by individuals with considerable knowledge of rubber production, and the botanical range of the specimens was restricted almost entirely to plant families known to contain rubber-bearing plants. A total of 54 species from 33 genera, representing 7 plant families, was tested. A tabulation by family is presented in table 5.

TABLE 1.—*Rubber content of miscellaneous native and introduced plants collected in continental United States, analyzed 1920–45*

Genus and species	Family	State where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Acacia sp	Leguminosae	California	Gum	1	0		
Acer platanoides L	Aceraceae	Maryland	Leaves	1	.17		
Acokanthera spectabilis (Sond.) Benth	Apocynaceae	No record	do	1	.17		
Adenophora sp	Campanulaceae	District of Columbia	Roots	1	.20		
Aesculus glabra Willd	Aesculaceae	Virginia	Leaves	1	0		
			Stems	1	0		
			Buckeyes	1	0		
Aganosma acuminata (Roxb.) G. Don	Apocynaceae	No record	Leaves	1	2.03		
Ailanthus altissima (Mill.) Swingle	Simaroubaceae	North Carolina	Whole	1	4.96		
			Extract	1	6.07		
Allium cepa L	Liliaceae	West Virginia	Whole	1	.14		
Amsonia ciliata Walt	Apocynaceae	Georgia	do	1	.21		
tabernaemontana Walt	do	Massachusetts	do	1	.37		
sp	do	Texas	do	1	.58		
Apios americana Medic	Leguminosae	Georgia, New Jersey, Michigan	Tubers	4	.25	0.46	0.31
			Whole	3	.41	.56	.47
Aplopappus ciliatus (Nutt.) DC	Compositae	Texas	Leaves	1	1.06		
			Stems	1	.06		
divaricatus (Nutt.) Gray	do	South Carolina	Whole	1	.59		
heterophyllus (Gray) Blake	do	New Mexico	do	1	.56		
tenuisectus (Greene) Blake	do	Arizona	do	1	.26		
Apocynum androsaemifolium L	Apocynaceae	New Jersey, Florida, New Hampshire	Leaves	2	.45	.53	.49
			Stems	2	.10	.14	.12
			Whole	1	.56		
cannabinum L	do	Colorado, Maryland, New Hampshire, and Virginia.	Leaves	5	.50	1.42	.78
			Stems	5	.14	.23	.17
			Roots	2	.23	.32	.11
			Whole	2	.35	.56	.18
sibiricum Jaeq	do	New Mexico	Leaves	1	.82		
			Stems	1	.23		
sp	do	Arkansas, California, Kentucky	Leaves	2	.29	.63	.46
			Stems	2	.20	.26	.23
			Whole	1	.88		
Aristolochia ringens Vahl	Aristolochiaceae	No record	Leaves	1	.96		
Artemisia aromatica A. Nels	Compositae	Arizona	Leaves	1	1.44		
			Stems	1	.12		
			Roots	1	.05		
bigelovii Gray	do	do	Whole	1	.09		
canadensis Michx	do	do	Leaves	1	.36		
			Stems	1	.02		
dracunculoides Pursh	do	New Mexico	Leaves	1	.51		
			Stems	1	.24		

TABLE 1.—*Rubber content of miscellaneous native and introduced plants collected in continental United States, analyzed 1920–45*—Continued

Genus and species	Family	State where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Artemisia aromatica A. Nels.—Continued							
filifolia Torr	Compositae	New Mexico	Leaves	1	.38		
			Stems	1	.11		
gnaphalodes Nutt	do	Arizona	Leaves	2	.19	.28	.23
			Stems	2	.05	.12	.08
ludoviciana Nutt	do	Georgia	Leaves	1	.52		
stelleriana Bess	do	District of Columbia	Leaves	1	1.84		
			Stems	1	.14		
tridentata Nutt	do	Montana, New Mexico	Leaves	1	.37		
			Stems	1	.03		
			Whole	1	.62		
wrightii Gray	do	Arizona	Leaves	1	.39		
			Stems	1	.09		
Asclepias amplexicaulis J. E. Sm	Asclepiadaceae	North Carolina, Oklahoma	Leaves	2	2.36	4.26	3.31
			Stems	2	.28	.29	.28
brachystephana Engelm	do	Texas	Whole	1	.24		
capricornu Woodson	do	do	Leaves	1	1.06		
			Stems	1	.14		
			Roots	1	.03		
curassavica L	do	Florida	Leaves	1	1.11		
			Stems	1	.25		
			Roots	1	.08		
engelmanniana Woodson	do	Texas	Leaves	1	.46		
			Stems	1	0		
			Roots	1	0		
eriocarpa Benth	do	California	Whole	1	1.37		
erosa Torr	do	do	Leaves	1	1.60		
galioides H. B. K	do	Texas	Whole	1	.24		
humistrata Walt	do	Florida	Leaves	1	2.91		
			Stems	1	.12		
incarnata L	do	Texas	Leaves	2	(1)	1.11	.56
			Stems	2	0	.21	.10
			Roots	2	0	.13	.06
Asclepias latifolia Raf	do	Arizona, Texas	Leaves	4	1.89	4.46	2.47
			Stems	4	.18	.62	.35
			Roots	2	.03	.04	.04
lindheimeri Engelm. & Gray	do	Texas	Tubers	1	.06		
			Whole	1	.23		
speciosa Torr	do	Colorado, Idaho	Leaves	2	(1)	1.32	.66
			Stems	2	(1)	.37	.18
			Gum	1	6.07		
			Leaves	1	.25		
subulata Decne	do	California	Whole	4	3.28	4.23	3.79

sullivantii Engelm	do	Texas	Whole	1	1.15		
syriaca L	do	Delaware, Illinois, Kentucky, Massachusetts, New York, Pennsylvania, Virginia, District of Columbia.	Leaves	8	1.54	4.84	2.40
			Stems	6	.02	.50	.32
			Whole	3	.52	2.26	1.15
viridiflora Raf	do	Oklahoma	Leaves	1	1.57		
			Stems	1	.15		
sp	do	Idaho, Missouri	Latex	1	7.54		
			Whole	1	.25		
Asclepiodora viridis (Walt.) Gray	do	No record	Whole	1	.67		
Ascophyllum mackaii (Turner) Holmes & Batters	Fucaceae	Connecticut	do	1	0		
Aster punicens L	Compositae	Maryland	do	2	1.61	3.57	2.59
reticulatus Pursh	do	South Carolina	Leaves	1	.34		
			Stems	1	.06		
			Roots	1	.04		
spinosus Benth	do	Texas	Whole	1	.23		
sp	do	Georgia	do	1	4.44		
Baccharis glutinosa Pers	do	Texas	Leaves	1	1.25		
			Stems	1	.09		
			Roots	1	0		
halimifolia L	do	Mississippi	Leaves	2	0	.44	.22
			Stems	1	.05		
			Branches	1	0		
neglecta Britton	do	Texas	Whole	1	0		
Balsamorrhiza sp	do	Utah	do	1	.06		
Beaumontia grandiflora (Roth) Wall	Apocynaceae	Florida	Leaves	1	.77		
			Stems	1	0		
Berberis trifoliolata Moric	Berberidaceae	Texas	Leaves	1	0		
			Stems	1	0		
			Roots	1	0		
Boerhaavia spicata Chois	Nyctaginaceae	Arizona	Whole	1	.34		
Borrichia frutescens (L.) DC	Compositae	Texas	do	1	.37		
Brickellia dentata (DC.) Sch. Bip	do	do	do	1	.09		
Bryophyllum crenatum Baker	Crassulaceae	South Carolina	Leaves	1	0		
Bumelia spinosa A. DC	Sapotaceae	Texas	Leaves	1	2.08		
			Stems	1	.04		
			Bark	1	.75		
texana Buckl	do	do	Stems	1	.10		
			Bark	1	.81		
tenax (L.) Willd	do	Florida	Leaves	1	.14		
Calotropis gigantea (L.) R. Br	Asclepiadaceae	No record	do	1	1.99		
procera Ait	do	do	Leaves	1	.61		
			Twigs	1	.78		
Campanula persicifolia L	Campanulaceae	Oregon	Leaves	1	(1)		
			Stems	1	(1)		
			Roots	1	0		
			Gum	1	0		
sp	do	Maryland	Leaves	1	1.17		
			Stems	1	.23		
Canna sp	Cannaceae	Arkansas	Leaves	1	.38		
Ceanothus velutinus Dougl	Sapindaceae	Oregon	Leaves	2	.08	.12	.10
			Stems	2	.05	.10	.07

See footnote at end of table.

TABLE 1.—*Rubber content of miscellaneous native and introduced plants collected in continental United States, analyzed 1920–45*—Continued

Genus and species	Family	State where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Celastrus sp.	Celastraceae	Maryland	Leaves	1	.35		
			Stems	1	.34		
			Roots	1	.03		
Centaurea americana Nutt.	Compositae	Texas	Whole	1	.04		
Cereus sp.	Cactaceae	California	do	1	0		
Chondrilla juncea L.	Compositae	District of Columbia	Stems	1	.40		
			Roots	1	.51		
Chondrophora virgata (Nutt.) Greene	do	Florida	Whole	2	1.45	1.56	1.50
			Roots	1	.31		
Chrysopsis aspera Shuttlw.	do	South Carolina	Whole	1	.50		
mariana (L.) Nutt.	do	Maryland	Leaves	1	2.84		
			Stems	1	.24		
			Whole	3	.39	3.14	2.21
Chrysothamnus bigelovii (Gray) Greene	do	New Mexico	Stems	9	.34	1.60	.86
			Gum	2	22.48	29.45	25.96
			Whole	4	.42	1.44	.90
nauseosus (Pall.) Britton	do	Montana, Nevada, New Mexico, North Carolina	Stems	5	.19	1.90	1.12
			Roots	1	1.08		
			Whole	4	.20	1.26	.54
Chrysothamnus parryi var. *attenuatus* (Jones) Kittell.	do	New Mexico	Stems	4	.20	.86	.44
			Whole	2	.23	.48	.36
viscidiflorus (Hook.) Nutt.	do	Wyoming	Whole	1	.04		
			Stems	1	1.71		
sp.	do	New Mexico	Branches	2	.16	.19	.18
			Whole	2	.18	.36	.27
Cichorium intybus L.	do	Maryland	Whole	1	0		
Cleome sp.	Capparidaceae	No record	do	1	.20		
Commelina erecta L.	Commelinaceae	Texas	do	1	.21		
Conyza coulteri Gray	Compositae	New Mexico	do	1	.46		
Croton monanthogynus Michx.	Euphorbiaceae	Texas	do	1	.03		
neomexicanus Muell. Arg.	do	do	do	1	0		
parksii Croizat	do	do	do	1	.04		
punctatus Jacq.	do	do	do	1	[1]		
Cytisus linifolius Lam.	Leguminosae	California	do	1	.11		
Dioscorea batatas Decne.	Dioscoriaceae	Georgia	Tubers	1	.12		
bulbifera L.	do	No record	do	1	.09		
glauca Muhl.	do	Kentucky, Virginia	do	2	0	.03	.02
Diospyros sp.	Ebenaceae	Louisiana	Gum	1	0		
Dirca palustris L.	Thymelaeaceae	Arkansas, Virginia	Stems	1	.32		
			Whole	1	.10		
Ecdysanthera utilis Hay. & Kaw.	Apocynaceae	Florida	Leaves	1	.33		
			Whole	2	.12	.18	.15

Elaeodendron capense Eckl. & Zeyh	Celastraceae	No record	Leaves	1	2.33		
			Branches	1	.12		
quadrangulatum Reiss	do	do	Leaves	1	.05		
Encelia farinosa Gray	Compositae	Arizona	Leaves	1	.20		
			Stems	2	.04	.13	.08
			Roots	1	.06		
frutescens Gray	do	California	Leaves	1	.46		
			Stems	1	.02		
Epilobium angustifolium L	Onagraceae	Colorado	Leaves	1	.62		
			Stems	1	.03		
Equisetum arvense L	Equisetaceae	No record	Whole	1	.09		
pracaltum Raf	do	Virginia	do	1	0		
Erigeron canadensis L	Compositae	Florida	Leaves	1	4.67		
			Twigs	1	.52		
			Stems	1	.05		
			Roots	1	.02		
pusillus Nutt	do	South Carolina	Leaves	1	.46		
			Stems	1	.05		
			Whole	1	.70		
Erithalis fruticosa L	Rubiaceae	No record	Leaves	2	.33	2.33	1.33
Eucommia ulmoides Oliv	Eucommiaceae	Maryland, New York	Leaves	3	2.37	3.89	3.15
			Twigs	2	.52	.93	.72
			Bark	2	1.14	5.32	3.28
			Whole	1	1.66		
Euonymus sp	Celastraceae	Georgia	Stems	2	.37	.41	.39
Eupatorium altissimum L	Compositae	Maryland	Leaves	1	.94		
			Whole	1	.26		
capillifolium (Lam.) Small	do	Georgia, Texas	Stems	2	.01	.01	.01
			Whole	1	.94		
compositifolium Walt	do	Texas	Leaves	1	1.52		
serotinum Michx	do	No record	Whole	1	.04		
sp	do	South Carolina	Leaves	1	1.01		
Euphorbia ammannioides H. B. K	Euphorbiaceae	Texas	Whole	1	.12		
arkansana Engelm. & Gray	do	Alabama	do	1	(1)		
bicolor Engelm. & Gray	do	Texas	do	1	.19		
chamaesyce L	do	do	do	1	.04		
corollata L	do	Illinois, Oklahoma	do	2	.22	.23	.22
			Leaves	1	(1)		
			Whole	2	.12	.12	.12
cyparissias L	do	Massachusetts, New York, Ohio, Pennsylvania, Utah, West Virginia, District of Columbia.	Leaves	1	0		
			Stems	1	0		
			Roots	1	.60		
			Whole	6	.14	.72	.49
dentata Michx	do	Texas	Whole	1	.04		
esula L	do	Minnesota	Leaves	1	.41		
			Whole	2	.06	.32	.19
havanensis Willd	do	Louisiana	Stems	2	.04	.06	.05
			Roots	2	.06	.14	.10
heptagona L	do	California	Whole	1	.30		

See footnote at end of table.

TABLE 1.—*Rubber content of miscellaneous native and introduced plants collected in continental United States, analyzed 1920–45*—Continued

Genus and species	Family	State where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Euphorbia ammannioides H. B. K.—Continued							
heterophylla L.	Euphorbiaceae	Arkansas, Florida, Mississippi	Leaves	1	.42		
			Stems	2	.11	.42	.26
			Roots	1	.06		
			Whole	1	.77		
hyssopifolia L.	do	Texas	Whole	1	.21		
lata Engelm.	do	do	do	1	.09		
lathyris L.	do	California, Oregon, Pennsylvania, Washington, District of Columbia.	Leaves	3	.12	.30	.22
			Stems	3	0	.23	.12
			Roots	3	.01	.04	.02
			Whole	4	.08	.20	.12
maculata L.	do	Oklahoma, Virginia	Whole	2	.09	.34	.21
marginata Pursh	do	Nevada, Ohio, Texas	Leaves	2	.46	.54	.50
			Stems	3	0	.18	.07
			Roots	2	.02	.02	.02
			Gum	1	1.04		
			Whole	1	.35		
mauretanica L.	do	California	Whole	1	1.19		
misera Benth.	do	do	Stems	1	.14		
			Roots	1	.14		
			Whole	1	.27		
nutans Lag.	do	Alabama	Leaves	1	.29		
			Stems	1	.14		
peplis L.	do	California	Whole	1	.21		
polychroma Kern	do	Connecticut	Leaves	1	0		
polyphylla Engelm.	do	Missouri	Whole	1	.18		
prostrata Ait.	do	Texas	do	2	.11	.13	.12
pulcherrima Willd.	do	California, Florida, Texas	Leaves	3	.08	.63	.43
			Stems	5	.02	.14	.08
			Lower	8	.02	.13	.07
			Middle	8	.06	.19	.11
			Upper	8	.13	.39	.23
			Twigs	1	.11		
			Gum	1	6.30		
serpens H.B.K.	do	Texas	Whole	2	.15	.22	.18
serrula Engelm.	do	do	do	4	.23	.27	.25
stictospora Engelm.	do	do	do	2	.08	.10	.09
supina Raf.	do	Indiana	do	1	0		
tirucalli L.	do	California	Stems	1	.39		
			Twigs	1	1.09		
			Branches	1	.36		
			Gum	2	2.41	7.72	5.03
			Whole	1	.40		

wrightii Torr. & Gray	do	Texas	Stems	1	0		
			Roots	1	.17		
Ficus aurea Nutt	Moraceae	Florida	Leaves	1	.65		
			Stems	1	.56		
benghalensis L	do	do	Gum	1	76.64		
capensis Thunb	do	No record	Whole	1	.18		
carica L	do	Texas	do	1	.01		
heterophylla L. f	do	California	Branch	1	0		
hispida L. f	do	No record	Leaves	1	.35		
rubiginosa Desf	do	California	Leaves	1	1.21		
			Fruit	1	.18		
Flaveria linearis Lag	Compositae	Florida	Whole	1	.41		
Fouquieria splendens Engelm	Fouquieriaceae	Arizona	Bark	1	.13		
Fucus sp	Fucaceae	Connecticut	Whole	1	0		
Gigartina sp	Rhodophyceae	California	do	1	0		
Glottidium vesicarium (Jacq.) Harper	Leguminosae	Mississippi	Stems	1	.15		
			Roots	1	.14		
Gnaphalium obtusifolium L	Compositae	South Carolina	Whole	2	.28	2.32	1.30
purpurascens DC	do	do	do	1	.37		
purpureum L	do	Arkansas	do	1	1.08		
Grindelia grandiflora Hook	do	Texas	do	1	.40		
			Leaves	1	3.57		
squarrosa (Pursh) Dunal	do	Montana	Stems	1	.57		
			Roots	1	.03		
			Flowers	1	.20		
			Leaves	1	.48		
sp	do	California, Colorado	Stems	1	.11		
			Whole	1	.14		
Gutierrezia sarothrae (Pursh) Britt. & Rusby	do	Colorado	Whole	1	.17		
Helenium sp	do	No record	do	1	0		
Heterotheca subaxillaris (Lam.) Britt. & Rusby	do	South Carolina	do	1	.25		
Hibiscus esculentus L	Malvaceae	Georgia	Pods	1	0		
Hosta ventricosa (Salisb.) Stearn	Liliaceae	New York	Whole	1	.28		
Hymenopappus scabiosaeus L'Herit	Compositae	Texas	do	1	.09		
Hymenoxys odorata DC	do	No record	do	1	.16		
richardsonii (Hook.) Ckll	do	New Mexico	Stems	5	.08	1.62	1.70
			Roots	5	1.08	6.30	3.25
rusbyi (Gray) Ckll	do	Arizona	Whole	1	.28		
sp	do	Nevada	do	1	2.40		
Ipomoea batatas (L.) Lam	Convolvulaceae	Florida	Tuber	1	.05		
Iva sp	Ambrosiaceae	No record	Leaves	1	.57		
Jatropha berlandieri Torr	Euphorbiceae	Texas	Whole	1	.11		
multifida L	do	No record	Leaves	1	.52		
			Stems	3	.14	.26	.21
spathulata (Orteg.) Muell. Arg	do	Texas	Roots	2	.08	.11	.10
			Whole	2	.13	.27	.20
texana Muell. Arg	do	Oklahoma, Texas	Roots	2	.05	.13	.09
			Whole	1	.10		
Jussiaea peruviana L	Onagraccae	No record	Leaves	3	.89	2.76	
			Leaves	1	.73		
sp	do	Maryland	Stems	1	.09		
			Roots	1	.09		

TABLE 1.—*Rubber content of miscellaneous native and introduced plants collected in continental United States, analyzed 1920–45*—Continued

Genus and species	Family	State where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Kopsia arborea Blume	Apocynaceae	No record	Leaves	10	2.46	6.81	
Lachnostoma arizonicum Gray	Asclepiadaceae	Arizona	Leaves	1	2.98		
			Stems	2	.35	.42	.38
			Pods	2	.27	.38	.32
Lactuca canadensis L	Compositae	Illinois, Maryland, Missouri, North Carolina, Oklahoma, Tennessee.	Leaves	3	.11	.68	.43
			Stems	3	.12	.41	.25
			Whole	4	.04	.33	.19
			Gum	1	4.36		
floridana (L.) Gaertn	do	Tennessee	Leaves	1	.39		
			Stems	1	.06		
indica L	do	Maryland	Leaves	1	.16		
			Stems	1	.14		
ludoviciana (Nutt.) Riddell	do	Texas	Whole	1	.04		
sativa L	do	New Jersey, Utah	Gum	1	10.26		
			Whole	1	.24		
serriola L	do	Georgia, Nevada, New Mexico, Ohio, Oklahoma, Texas.	Leaves	4	.34	.59	.42
			Stems	4	.01	.15	.08
			Roots	3	.01	.05	.04
			Whole	2	.22	.28	.25
			Gum	1	4.86		
spicata (Lam.) Hitchc	do	New Jersey, Tennessee	Leaves	1	.24		
			Stems	1	.02		
			Whole	1	.39		
sp	do	Connecticut, Pennsylvania, District of Columbia	Leaves	1	(1)		
			Stems	1	(1)		
			Gum	1	8.08		
			Whole	1	.20		
sp. (celtuce)	do	North Carolina, Pennsylvania	Whole	3	.13	.28	.18
Larrea divaricata Cav	Zygophyllaceae	Texas	do	1	.20		
Leucophyllum texanum Benth	Scrophulariaceae	do	do	1	.05		
Liatris spicata (L.) Willd	Compositae	Maryland	do	1	.17		
Liquidambar sp	Hamamelidaceae	Virginia	Wood	1	0		
Lobelia cardinalis L	Lobeliaceae	Maryland	Whole	1	.41		
elongata Small	do	District of Columbia	do	1	.31		
Lygodesmia grandiflora Torr. & Gray	Compositae	Colorado, New Mexico	Roots	1	5.47		
			Whole	1	.64		
juncea D. Don	do	South Dakota	Whole	1	.06		
texana (Torr. & Gray) Greene	do	Texas	Roots	1	.05		
			Whole	1	.09		
sp	do	Montana	Whole	1	.19		

Maclura pomifera (Raf.) Schneid	Moraceae	Kansas, Louisiana, Virginia	Fruit	3	.13	.30	.23
			Whole	1	.09		
			Cooked	1	.50		
Macrocystis pyrifera (L.) C. Ag	Laminariaceae	California	Whole	1	.07		
Madia glomerata Hook	Compositae	Utah	do	1	.17		
Martynia louisiana Mill	Martyniaceae	Maryland	Leaves	1	0		
			Pods	1	0		
Matelea lanata (Zuce.) Woodson	Asclepiadaceae	do	Whole	1	.25		
Metastelma scoparium (Nutt.) Vail	do	Florida	do	1	.36		
sp	do	do	do	1	.97		
Morus sp	Moraceae	Louisiana	Gum	1	1.48		
Nelumbo nucifera Gaertn	Nymphaeaceae	Mississippi	Whole	1	.03		
Nerium oleander L	Apocynaceae	Texas	Leaves	2	.21	.57	.39
			Stems	2	(1)	.27	.14
Nicotiana trigonophylla Dunal	Solanaceae	Arizona	Whole	1	.21		
Oenothera biennis L	Onagraceae	Michigan, North Carolina, New Hampshire	Leaves	2	.17	.69	.43
			Stems	4	0	.26	.08
			Branches	1	.01		
			Roots	2	0	.02	.01
			Pods	1	.02		
			Whole	2	.31	2.14	1.22
sp	do	North Carolina	Whole	1	.09		
Onosmodium virginianum (L.) A. DC	Boraginaceae	South Carolina	Leaves	1	.60		
			Stems	1	.02		
Opuntia sp	Cactaceae	Kansas, Tennessee	Whole	1	0		
			Juice	1	0		
Parkinsonia aculeata L	Leguminosae	Texas	Whole	1	0		
Parthenium incanum H. B. K	Compositae	do	do	1	.28		
lyratum Gray	do	do	Leaves	2	.57	.83	.70
			Stems	2	.64	.94	.79
			Roots	2	.77	.81	.79
Pedilanthus macrocarpus Benth	Euphorbiaceae	California	Whole	1	.25		
padifolius Poit	do	No record	do	1	.23		
tithymaloides Poit	do	do	do	1	.27		
sp	do	Arizona, California, Florida	Twigs	1	.54		
			Whole	3	.44	.68	.53
Peltandra virginica (L.) Schott & Endl	Araceae	Florida	Fruit	1	.08		
Periploca graeca L	Asclepiadaceae	Maryland	Leaves	1	2.08		
			Stems	1	1.15		
Phaseolus vulgaris L	Leguminosae	California	Hulls	1	.13		
Phytolacca americana L	Phytolaceaceae	Pennsylvania	Leaves	1	.28		
Plantago major L	Plantaginaceae	North Carolina	Leaves	1	.28		
sp	do	Pennsylvania	Whole	1	.16		
Pluchea foetida (L.) DC	Compositae	Florida	Leaves	1	3.36		
			Stems	1	.14		
			Whole	1	.82		
Portulaca oleracea L	Portulacaceae	New York	Whole	1	0		
Prunus sp	Rosaceae	Michigan, West Virginia, Wisconsin	Inner bark	1	.02		
			Gum	1	0		
			Whole	1	.02		

See footnote at end of table.

TABLE 1.—*Rubber content of miscellaneous native and introduced plants collected in continental United States, analyzed 1920–45*—Continued

Genus and species	Family	State where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Pteridium aquilinum (L.) Kuhn	Polypodiaceae	Arizona, Idaho, Maryland, Oregon, Washington.	Roots	6	.02	.06	.04
			Whole	2	.06	.09	.08
Pterocaulon pycnostachyum (Michx.) Ell	Compositae	South Carolina	Leaves	1	1.28		
			Stems	1	.23		
Pyrrhopappus carolinianus (Walt.) DC	do	Oklahoma	Whole	1	.28		
multicaulis DC	do	Texas	do	1	.15		
Rhus glabra L	Anacardiaceae	Missouri, New Mexico, Tennessee	Roots	1	.18		
			Whole	2	.08	.26	.17
typhina L	do	Tennessee	Whole	1	.04		
Sabal louisiana (Darby) Bomhard	Arecaceae	Texas	Juice	1	.01		
Salpiglossis sp	Solanaceae	California	Flowers	1	0		
Sambucus coerulea Raf	Adoxaceae	do	Leaves	1	.24		
			Stems	1	.09		
racemosa L	do	New York	Leaves	1	1.45		
			Stems	1	.06		
			Berries	1	.33		
sp	do	Connecticut, Pennsylvania	Gum	2	(1)	5.06	
Santolina chamaecyparissus L	Compositae	Maryland, Pennsylvania	Whole	2	.15	.31	.23
Sarcobatus vermiculatus (Hook.) Torr	Chenopodiaceae	Colorado	Stems	3	.04	.07	.06
Scorzonera hispanica L	Compositae	District of Columbia	Leaves	1	.33		
			Roots	1	.15		
Secamone sp	Asclepiadaceae	Maryland	Whole	1	.16		
Sedum sp	Crassulaceae	Illinois	do	1	.20		
Senecio ambrosioidies Rydb	Compositae	Colorado	Leaves	1	.66		
			Stems	1	.06		
			Roots	1	.04		
smallii Britton	do	South Carolina	Leaves	1	.51		
			Stems	1	.13		
			Roots	1	.22		
tridenticulatus Rydb	do	Utah	Whole	1	.07		
Smilax laurifolia L	do	North Carolina	Whole	1	.45		
rotundifolia L	do	Alabama, Georgia, North Carolina, Tennessee	Fruit	4	.16	.64	.32
			Seed coating	2	.50	3.46	1.98
sp	do	North Carolina, Massachusetts, Oklahoma	Whole	1	.39		
			Fruit	2	(1)	1.19	
Solidago altissima L	do	Maryland, South Carolina, Virginia, District of Columbia.	Leaves	12	1.38	6.34	3.37
			Stems	12	.02	.27	.10
			Roots	3	.03	.09	.06
			Whole	14	.42	1.42	.82
angustifolia Ell	do	Florida	Whole	1	.65		

arguta Ait	do	New Hampshire, Vermont, Virginia	Leaves	1	1.02		
			Stems	1	.21		
			Whole	5	.08	1.60	.61
bicolor L	do	Maryland, South Carolina, Virginia	Leaves	3	.89	1.20	1.03
			Stems	3	.04	.25	.12
			Whole	5	.23	1.96	.87
caesia L	do	Maryland	Leaves	1	2.46		
			Stems	1	.33		
			Whole	2	.86	2.00	1.43
calcicola Fern	do	New Hampshire	Whole	1	.44		
canadensis L	do	Maryland, New Hampshire, New York, Vermont	do	8	.37	.98	.57
chapmanii Gray	do	South Carolina	Leaves	1	3.11		
elongata Nutt	do	California	Whole	1	1.02		
erecta Pursh	do	Virginia	Leaves	1	.80		
			Stems	1	.01		
			Whole	3	.20	1.65	.81
fistulosa Mill	do	Florida, Maryland, South Carolina	Leaves	4	2.08	4.48	2.99
			Stems	4	.03	.08	.05
			Roots	3	.03	.10	.05
			Whole	5	.63	1.39	.88
flexicaulis L	do	Maryland	Leaves	3	1.47	4.49	3.14
			Stems	2	.12	.30	.21
			Whole	3	.47	1.18	.79
graminifolia (L.) Salisb	do	Maryland, New Hampshire, New York, South Carolina, District of Columbia	Leaves	3	.74	1.07	.95
			Stems	2	.01	.28	.14
			Whole	5	.34	1.68	.77
juncea Ait	do	Maryland, New Hampshire, Virginia	Leaves	2	.93	1.38	1.16
			Stems	2	.07	.36	.22
			Whole	4	.21	1.15	.57
macrophylla Pursh	do	New Hampshire, Vermont	Leaves	5	.16	.67	.41
			Whole	1	.32		
microcephala (Greene) Bush	do	Florida, South Carolina	Leaves	5	2.63	3.53	3.00
			Stems	5	(1)	.20	.10
			Roots	2	.04	.11	.08
			Whole	5	.60	1.01	.72
monticola Torr. & Gray	do	Virginia	Whole	1	2.18		
neglecta Torr. & Gray	do	Maryland	Leaves	1	3.36		
			Stems	1	.28		
			Whole	2	.98	1.96	1.42
nemoralis Ait	do	Maryland, New Hampshire	Leaves	3	2.38	2.80	2.54
			Stems	2	.11	.26	.18
			Whole	3	.50	.69	.60
odora Ait	do	Georgia, Maryland	Leaves	5	1.09	2.53	2.33
			Stems	3	.08	.35	.24
			Whole	3	.61	1.21	.99
ohioensis Riddell	do	New York	Leaves	1	.59		
pauciflosculosa (Michx.) Gray	do	Alabama, Florida	Leaves	2	.96	1.72	1.34
			Stems	2	0	.07	.04
patula Ait	do	New York	Leaves	1	1.67		
			Whole	1	.87		

See footnote at end of table.

TABLE 1.—*Rubber content of miscellaneous native and introduced plants collected in continental United States, analyzed 1920–45*—Continued

Genus and species	Family	State where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Solidago altissima L—Continued							
puberula Nutt	Compositae	Maryland, Pennsylvania, Virginia	Leaves	6	.99	2.35	1.61
			Stems	5	.26	.30	.28
			Whole	5	.19	.37	.27
racemosa Greene	do	Virginia, South Carolina	Leaves	4	.75	1.72	1.26
			Stems	1	.06		
			Whole	1	.27		
randii (Porter) Britt	do	Vermont	Whole	1	.37		
rigida L	do	District of Columbia	Leaves	2	3.00	3.10	3.05
			Stems	1	.25		
			Whole	1	.99		
rugosa Mill	do	Maryland, New Hampshire, New York, Virginia, District of Columbia	Leaves	9	2.63	3.94	3.14
			Stems	6	.01	.29	.19
			Whole	8	.75	1.55	1.09
sempervirens L	do	Maryland, South Carolina	Leaves	7	1.74	3.94	2.84
			Stems	3	.09	.37	.18
			Whole	4	.35	.91	.56
gigantea Ait	do	Maryland, New Hampshire, New York, Virginia	Leaves	8	2.40	6.70	4.12
			Stems	6	.05	.27	.12
			Whole	8	.53	1.58	.89
sparsiflora Gray	do	Arizona	Whole	1	1.11		
speciosa Nutt	do	Maryland	Leaves	2	2.50	3.12	2.81
			Stems	2	.29	.40	.34
			Whole	2	.23	.76	.50
squarrosa Muhl	do	New Hampshire, Virginia	Leaves	4	.56	2.32	1.28
			Stems	1	.30		
			Whole	1	.23		
stricta Ait	do	Louisiana, South Carolina	Leaves	3	1.59	2.87	2.64
			Stems	1	.10		
			Roots	1	.12		
			Whole	1	.30		
tenuifolia Pursh	do	Maryland, South Carolina	Leaves	2	2.50	2.91	2.72
			Stems	1	.09		
			Roots	1	.02		
			Whole	2	.58	.76	.67
tortifolia Ell	do	Florida, South Carolina	Leaves	1	2.95		
			Whole	2	1.26	1.75	1.50
uliginosa Nutt	do	Maine	Whole	2	.81	.90	.86
ulmifolia Muhl	do	Maryland, Virginia	Leaves	2	1.28	1.84	1.56
			Stems	2	.04	.27	.16
			Whole	3	.64	.88	.75
uniligulata (DC.) Porter	do	New York, Vermont	Leaves	6	.31	1.21	.99

Sonchus arvensis L	do	Illinois, Minnesota	Leaves	2	.10	.31	.20
			Stems	2	.09	.27	.18
			Whole	2	.38	1.16	.77
asper (L.) Hill	do	District of Columbia	Whole	1	.22		
oleraceus L	do	Florida, New York, Texas	Leaves	1	.50		
			Stems	1	.07		
			Whole	3	.14	.42	.29
Sophora secundiflora Lag	Leguminosae	Texas	Pods	1	.23		
Stephanomeria virgata Benth	Compositae	California	Leaves	1	.30		
			Stems	1	.10		
			Roots	1	.19		
			Juice	1	.03		
			Whole	1	.20		
Stillingia spathulata (Muell. Arg.) Small	Euphorbiaceae	No record	Whole	1	.10		
texana I. M. Johnst	do	Texas	do	1	0		
treculeana (Muell. Arg.) I. M. Johnst	do	do	do	1	.04		
Symplocarpus foetidus (L.) Nutt	Araceae	Pennsylvania	do	1	.09		
Taraxacum sp	Compositae	Maryland, New Jersey	Roots	4	.18	.36	.30
Thevetia grandiflora	Apocynaceae	No record	Whole	1	.62		
peruviana (Pers.) Merr	do	Texas	Leaves	1	.44		
			Stems	1	.19		
			Whole	1	.23		
sp	do	do	Gum	1	11.57		
Tidestromia lanuginosa (Nutt.) Standl	Amaranthaceae	do	Whole	1	0		
Tradescantia canaliculata Raf	Commelinaceae	Illinois, Indiana, Missouri, Ohio	Stems	1	.30		
			Roots	1	.07		
			Whole	3	.26	.59	.46
foliosa Small	do	Florida	Whole	1	.68		
occidentalis (Britton) Smyth	do	Wisconsin	do	1	.14		
Tragopogon dubius Scop	Compositae	Kansas, Montana	Leaves	1	.48		
			Stems	1	.02		
			Whole	2	.18	.23	.20
porrifolius L	do	California, Nebraska, Nevada	Leaves	2	.32	.45	.38
			Roots	2	.10	.11	.10
			Whole	1	.10		
pratensis L	do	Michigan	Leaves	1	.35		
			Stems	1	.12		
			Roots	1	.18		
sp	do	Oregon	Whole	1	.12		
Urceola esculenta Benth	Apocynaceae	Florida	Leaves	1	4.98		
			Twigs	1	.16		
			Stems	1	.13		
Varilla texana Gray	Compositae	Texas	Whole	1	.09		
Verbesina occidentalis (L.) Walt	do	Maryland	do	1	1.32		
Vinca major L	Apocynaceae	Arizona	Leaves	2	.62	1.57	1.10
			Stems	2	.17	.22	.20
Wyethia amplexicaulis Nutt	Compositae	Colorado	Leaves	1	.16		
			Stems	1	.04		
Zinnia sp	do	Maryland	Whole	1	.98		

[1] Trace.

TABLE 2.—*Total plants tested in table 1 and number containing rubber*

Plants tested	Samples containing—			
	Rubber		No rubber	Total
	Above 0.10 percent	Below 0.10 percent		
Families	34	10	11	55
Genera	105	17	19	141
Species	240	34	29	303

TABLE 3.—*List of plant families from table 1, showing number of species tested, number of samples analyzed, and number of samples containing rubber or no rubber*

Family	Species	Tests	Samples containing—	
			Rubber [1]	No rubber [2]
	Number	*Number*	*Number*	*Number*
Aceraceae	1	1	1	.....
Adoxaceae	2	7	7	.....
Aesculaceae	1	3	.....	3
Amaranthaceae	1	1	.....	1
Ambrosiaceae	1	1	1	.....
Anacardiaceae	2	4	4	.....
Apocynaceae	15	62	61	1
Araceae [3]	2	2	2	.....
Arecaceae [3]	1	1	1	.....
Aristolochiaceae	1	1	1	.....
Asclepiadaceae	25	84	80	4
Berberidaceae	1	3	.....	3
Boraginaceae	1	2	2	.....
Cactaceae	2	3	.....	3
Campanulaceae	2	6	4	2
Cannaceae	1	1	1	.....
Capparidaceae	1	1	1	.....
Celastraceae	4	8	8	.....
Chenopodiaceae [3]	1	3	3	.....
Commelinaceae	4	8	8	.....
Compositae	131	575	568	7
Convolvulaceae	1	1	1	.....
Crassulaceae	2	2	1	1
Dioscoriaceae	3	4	3	1
Ebenaceae	1	1	.....	1
Equisetaceae [3]	2	2	1	1
Eucommiaceae	1	8	8	.....
Euphorbiaceae	44	144	135	9
Fouquieriaceae	1	1	1	.....
Fucaceae	2	2	.....	2
Hamamelidaceae	1	1	.....	1
Laminariaceae [3]	1	1	1	.....
Leguminosae	7	14	12	2
Liliaceae	2	2	2	.....
Lobeliaceae	2	2	2	.....
Malvaceae	1	1	.....	1
Martyniaceae	1	2	2	.....
Moraceae	9	15	14	1
Nyctaginaceae	1	1	1	.....
Nymphaeaceae [3]	1	1	1	.....
Onagraceae	3	20	18	2
Phytolaccaceae	1	1	1	.....
Plantaginaceae	1	2	2	.....
Polypodiaceae [3]	1	8	8	.....
Portulacaceae	1	1	.....	1
Rhodophyceae	1	1	.....	1
Rosaceae [3]	1	3	2	1
Rubiaceae	1	2	2	.....
Sapindaceae	1	4	4	.....
Sapotaceae	3	6	6	.....
Scrophulariaceae [3]	1	1	1	.....
Simaroubaceae	1	2	2	.....
Solanaceae	2	2	1	1
Thymelaeaceae	1	2	2	.....
Zygophyllaceae	1	1	1	.....

[1] A trace or more rubber found in at least 1 sample.
[2] No rubber found in any sample.
[3] No analysis higher than 0.10 percent.

TABLE 4.—*Rubber content of miscellaneous plants collected from outside continental United States*

Genus and species	Family	Place where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Artocarpus sp.	Moraceae	Haiti, P. R.	Latex	2	3.54	3.83	3.68
Bumelia laetevirens Heusl.	Sapotaceae	Sonora, Mexico	Fruit	1	4.70		
Caesalpinia cacalaco Humb. & Bonpl	Leguminosae	Sinaloa, Mexico	Pod	1	.15		
			Stem	1	.27		
Calotropis sp.	Asclepiadaceae	Venezuela	Leaves	1	.78		
			Stems	1	.14		
Cameraria oblougifolia Britton	Apocynaceae	Puerto Rico	Twigs	1	.77		
			Stems	1	.34		
Carissa grandiflora A.DC.	do	No record	Whole	2	2.03	2.28	2.18
Castilla elastica Cerv	Moraceae	Mexico	Bark	6	.36	.85	.54
			Trunk	2	.09	.16	.12
Echites sp.	Apocynaceae	Puerto Rico	Whole	1	1.01		
Elaeophorbia drupifera (Thonn.) Stapf	Euphorbiaceae	Cuba	Leaves	1	.26		
			Gum	1	3.30		
Euphorbia antisyphilitica Zucc.	do	do	Gum	1	12.58		
			Twigs	1	1.27		
colletioides Benth.	do	Sonora, Mexico	Whole	1	.27		
fulva Stapf	do	Jalisco, Mexico	Gum	1	18.12		
heptagona L.	do	No record	Whole	1	.37		
			Gum	1	6.04		
lactea Haw.	do	Dominican Republic	Bark	1	.11		
			Wood	1	0		
lactiflua Phil.	do	Chile	Gum	2	8.34	9.00	8.67
lancifolia Schlecht.	do	No record	Whole	1	.40		
laro Drake.	do	Cuba	Twigs	1	1.01		
			Gum	2	4.90	5.62	5.26
latifolia C. A. Mey.	do	do	Gum	1	.12		
neriifolia L.	do	do	Gum	2	2.05	2.27	2.16
			Whole	1	.22		
portulacoides L.	do	Argentina	Roots	1	1.02		
schlechtendalii Boiss.	do	Tamaulipas, Mexico	Leaves	1	.25		
			Stems	1	.04		
tiracalli L.	do	Cuba	Twigs	1	1.09		
			Gum	1	7.72		
sp.	do	Saudi Arabia	Bark:				
			Inner	1	0		
			Outer	1	(1)		

See footnote at end of table.

TABLE 4.—*Rubber content of miscellaneous plants collected from outside continental United States*—Continued

Genus and species	Family	Place where collected	Samples		Rubber content		
			Part	Number	Least	Most	Mean
					Percent	*Percent*	*Percent*
Ficus amara Noronha	Moraceae	New Caledonia	Gum	1	7.12		
elastica Roxb	do	New Caledonia	do	1	88.40		
		Tamaulipas, Mexico	do	1	61.53		
		Guatemala	do	1	83.88		
jimenezii Standl	do	El Salvador	do	1	9.43		
petiolaris H. B. K	do	Sonora, Mexico	Leaves	1	.36		
			Stems	1	.44		
sp	do	Chihuahua, Mexico	Gum	2	4.44	5.79	5.12
Flourensia resinosa (Brandeg.) Blake	Compositae	Hidalgo, Mexico	Whole	1	.56		
Forsteronia portoricensis Woodson	Apocynaceae	Puerto Rico	do	1	.24		
Hancornia speciosa Gomez	do	Paraguay	Gum	1	82.04		
Himatanthus articulatus (Vahl) Woodson	do	British Guiana	Leaves	1	.66		
			Pods	1	.70		
			Bark	1	.56		
atropha albomaculata Pax	Euphorbiaceae	Argentina	Whole	1	1.00		
sp. (chilte)	do	Durango, Mexico	Gum	2	14.58	30.95	22.76
		Jalisco, Mexico	do	2	20.43	21.63	21.03
		Sinaloa, Mexico	do	9	19.74	33.74	26.83
Lucuma sp	Sapotaceae	Peru	do	1	92.26		
Marsdenia edulis S. Wats	Asclepiadaceae	Sonora, Mexico	Leaves	1	2.79		
			Stems	1	.54		
macrophylla Fourna	do	Tamaulipas, Mexico	Leaves	1	3.39		
			Stems	1	.80		
verrucosa Decne	do	Madagascar	Pod	1	3.03		
sp	do	Sinaloa, Mexico	Leaves	1	3.40		
Mascarenhasia elastica K. Schum	Apocynaceae	Cuba	Gum	1	67.76		
Matelea lanata (Zucc.) Woodson	Asclepiadaceae	Nayarit, Mexico	Leaves	1	3.68		
			Stems	1	.37		
			Fruit	1	1.04		
Micrandra siphonioides Benth	Euphorbiaceae	Venezuela	Gum	1	85.74		
Mimusops balata Gaertn. f	Sapotaceae	Dominican Republic	do	1	10.21		
globosa Gaertn. f	do	Haiti	do	2	13.18	13.41	13.30
sp	do	Dominican Republic	do	1	13.50		
Montanoa rosei Rob. & Greenm	Compositae	Sonora, Mexico	Leaves	1	.28		
			Stems	1	.06		
Morrenia odorata Lindl	Asclepiadaceae	Argentina	Stems	1	.61		
Parthenium incanum H.B.K	Compositae	Nuevo Leon, Mexico	Whole	1	.34		
Pedilanthus rubescens Brandeg	Euphorbiaceae	Sinaloa, Mexico	Stems	1	.40		
Plumeria acutifolia Poir	Apocynaceae	Tamaulipas, Mexico	Leaves	1	.73		
			Stems	1	.36		
		Mexico	Gum	2	2.75	4.56	3.66

mollis H.B.K	do	Sonora, Mexico	Fruit	1	.36		
			Stems	1	.61		
		Mexico	Gum	3	6.33	10.99	8.22
Sapium aucuparium Jacq	Euphorbiaceae	Colombia	Whole	1	.17		
		Argentina	Stems	1	.09		
biloculare (S. Wats.) Pax	do	Sonora, Mexico	Leaves	1	.20		
			Stems	1	.07		
			Leaves	3	.22	1.38	.65
			Stems	2	.21	.38	.30
sp	do	Ecuador	Bark	4	.74	1.78	1.18
			Gum	5	52.88	78.50	66.77
Scorzonera pulchra Lomack	Compositae	Iraq	Roots	1	.76		
			Gum	1	11.57		
Solidago chilensis Meyen	do	Argentina	Leaves	1	3.76		
			Stems	1	.04		
Stemmadenia donnell-smithii (Rose) Woodson	do	Honduras, Guatemala	Gum	2	8.26	12.56	10.41
			Leaves	1	5.21		
palmeri Rose & Standl	do	Sinaloa, Mexico	Twigs	1	.69		
			Whole	1	7.83		
			Fruit	1	.86		
sp	do	Guatemala	Twigs	1	.14		
			Gum	2	13.58	19.44	16.51
			Leaves	1	1.10		
Thevetia ovata A.DC	Apocynaceae	Jalisco, Mexico	Branches	1	.54		
			Leaves	1	5.85		
sp	do	Nayarit, Mexico	Branches	1	.46		
			Fruit	1	.34		
			Fruit	1	.50		
Vincetoxicum sp	Asclepiadaceae	Guatemala	Whole	1	.27		

[1] Trace.

TABLE 5.—*List of plant families from table 4, showing number of species tested, number of samples analyzed, and number of samples with and without rubber*

Family	Species	Tests	Samples containing—	
			Rubber	No rubber
	Number	*Number*	*Number*	*Number*
Apocynaceae	10	25	25	.....
Asclepiadaceae	7	14	14	.....
Compositae	7	17	17	.....
Euphorbiaceae	19	61	59	2
Leguminosae	1	2	2	.....
Moraceae	6	19	19	.....
Sapotaceae	4	6	6	.....

Conclusions

No new valuable rubber crop has been found. However, much information of scientific value has resulted. Through this extensive but uncoordinated survey more information is available about plants that accumulate rubber. Together with the surveys of Hall and Goodspeed (*4*), Hall and Long (*5*), Buehrer and Benson (*1*), Mitchell, Rice, and Roderick (*8*), Moxon and Whitehead (*9*), and the much more extensive but as yet unpublished work of Thomas G. Edison, this survey gives a comprehensive view of the plants in the United States that synthesize rubber.

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