

CHROM. 9178

CANNABIS SATIVA L. (MARIJUANA)

VII. THE RELATIVE SPECIFICITY OF THE RIM TEST

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SUMMARY

A total of 526 non-marijuana plant samples representing 427 different plant species were subjected to the RIM test (Rutgers Identification for Marijuana test). Although a few samples gave Fast Blue B reactive spots when examined by thin-layer chromatography, the spots could easily be distinguished from the marijuana cannabinoid spots. No plants were found to exhibit false positive results and hence the method is considered to be relatively specific for marijuana.

INTRODUCTION

In 1973 the RIM test (Rutgers Identification for Marijuana test) was introduced as a simple and reliable method for detecting and identifying marijuana in suspect materials. The test combines histochemical and thin-layer chromatographic (TLC) components and a sample giving positive results in both these aspects is considered to contain marijuana¹. Briefly described, this test involves first mixing a few milligrams of crushed plant material with a minimum amount of chloral hydrate clearing solution, followed by brief heating of the resulting mixture (wet mount). This step, conveniently performed on a glass microscope slide, aids in the subsequent microscopic study step and also serves to extract into the clearing solution a group of unique phenolic constituents (heretofore found only in marijuana) known as cannabinoids. Next an aliquot of the clearing solution extract is removed from the wet mount and subjected to silica gel thin-layer co-chromatography with an authentic marijuana extract similarly prepared. Subsequent spraying of the developed chromatogram with Fast Blue B salt spray reagent (*o*-dianisidine diazotate) reveals any cannabinoids as pink to purple spots due to the known *para* coupling reaction of Fast Blue B salt with phenols². The wet mount is then treated with a Fast Blue B salt chromogenic reagent and normally, in the case of a marijuana-containing sample, the wet mount is observed macroscopically to acquire rapidly characteristic red to purple colors. Subsequently, microscopic examination of the wet mount is performed to note the presence of certain histological elements that are considered to be diagnostic for *C. sativa* (marijuana). Moreover, if marijuana is present, microscopy will reveal that

certain cannabinoid-rich plant tissues, particularly the glandular hairs, will be stained red-purple.

To study the specificity of the Fast Blue B reaction, de Faubert Maunder treated the dried petroleum ether extracts prepared from more than 200 botanicals with a Fast Blue B reagent. It was found that nutmeg and mace gave strong positive tests while henna and agrimony showed less intense positive tests^{3,4}. As a result, petroleum ether extracts of nutmeg and mace were compared with marijuana extracts by means of TLC. The presence of several Fast Blue B reactive spots in the nutmeg and mace extracts was noted but these spots could be easily distinguished from the cannabinoid spots on the chromatograms⁵.

The present study was prompted because it was considered important, for forensic reasons, to determine and document subsequently in the scientific literature those non-cannabis plants which might give false positive results as well as those plants which give negative results under the conditions of the RIM test procedure. Hence, to determine the specificity of the RIM test, a total of more than 500 different plant samples were subjected to the RIM test protocol and these results are now reported.

EXPERIMENTAL

Plant materials

Plants were randomly collected locally, dried at room temperature and ground to a coarse powder. Voucher specimens representing each collection are deposited in the herbarium of the College of Pharmacy, Rutgers University. These plants are designated by numbers prefixed by CNJ- (*viz.*, central New Jersey). The remaining plant samples tested were obtained commercially and these are designated by numbers alone. Authentic marijuana plant material was obtained from the Center for Studies on Narcotic Addiction and Drug Abuse, National Institute of Mental Health, Rockville, Md. The botanical nomenclature employed throughout this paper follows Fernald⁶ for the CNJ-numbered samples and Uphof⁷ for the commercial plant products.

Cannabinoid mixture for thin-layer chromatography

Cannabidiol, cannabinol and Δ^9 -tetrahydrocannabinol were obtained from the National Institute of Mental Health. A mixture of these substances in chloral hydrate clearing solution (chloral hydrate (75 g), propylene glycol or glycerin (10 ml) and distilled water, sufficient quantity to make 100 ml) was prepared to furnish a final concentration of 1 mg of each per ml of solution. Five microliters of this solution were spotted for the TLC studies together with the plant and marijuana extracts.

RIM test conditions

All plant samples were subjected to the RIM test procedure using the methods and materials described previously¹. To test for seasonal variations in phytoconstituents, different collections of the same plant species were tested whenever possible. These results are shown in Table I. Positive TLC data are shown in Figs. 1 and 2 and are further summarized in Table II.

RESULTS AND DISCUSSION

Microscopic aspects

All plant samples studied microscopically gave negative results according to

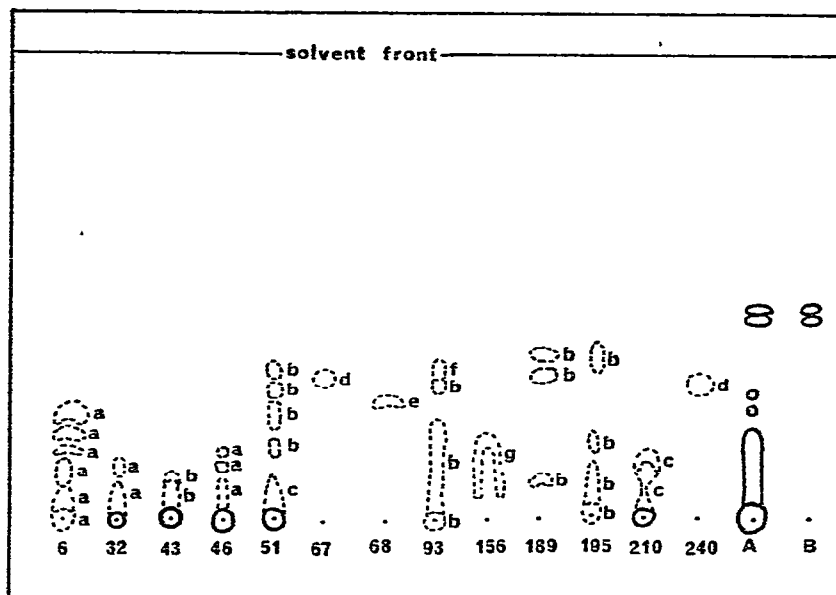


Fig. 1. TLC of chloral hydrate clearing solution extracts of some plant samples. The numbers refer to plant species listed in Tables I and II. A represents marijuana examined according to the RIM test protocol. B represents a 5- μ l sample of a mixture of the following authentic cannabinoids: cannabidiol, cannabinol and Δ^9 -tetrahydrocannabinol (1 mg of each per ml of chloral hydrate clearing solution). Spots shown by lettered broken lines exhibited various colors prior to spraying: a = purple, b = yellow, c = orange, d = olive green, e = gray, f = pale pink, g = blue. These colors were unchanged after spraying. Spots shown by solid lines gave pink to purple colors after spraying. All samples were applied in 5- μ l amounts to silica gel G plates, 0.25 mm thick; benzene was used as the solvent running a 25-min development. Spots were visualized with Fast Blue B spray reagent.

the criteria established for the RIM test. Thus, in no case were diagnostic histological elements noted nor were red to purple stained glandular hairs observed in any plant sample ordinarily expected to contain glandular hairs.

One point deserves comment, namely that approximately 40% of the plant samples [cf. Table I under Fast Blue B (macro)] gave weak to strong red to purple colors when their wet mounts were treated with the Fast Blue B salt chromogenic reagent. These colors apparently result from the reaction of the Fast Blue B salt with various chloral hydrate extractable plant phenolics (*viz.*, not necessarily cannabinoid phenolics). While these colors are always observed macroscopically when one is dealing with a marijuana-containing sample, they are in themselves not axiomatic with a positive RIM test. It must be re-emphasized that a positive microscopic test result is based on finding the presence of diagnostic histological elements characteristic of marijuana in the plant sample under study.

Chromatographic aspects

In studying more than 100 different marijuana samples according to the RIM test procedure, we have found that these samples consistently exhibit the high running spots shown in Figs. 1 and 2. These spots give pink to purple colors with Fast Blue B

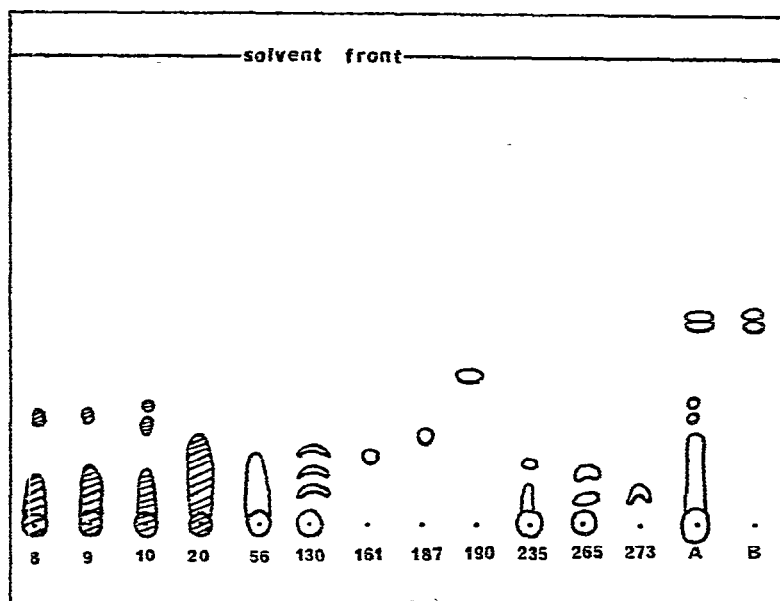


Fig. 2. TLC of chloral hydrate clearing solution extracts of some plant samples. Spots shown by solid lines with cross-hatching were yellow prior to spraying and gave pink to purple colors after spraying. Spots shown by solid lines gave pink to purple colors after spraying. Other conditions were as described in the legend of Fig. 1.

salt spray reagent and their presence on a chromatogram is considered to be diagnostic for marijuana. Although not shown in Figs. 1 and 2, many plants were found to exhibit Fast Blue B positive spots at or near the origins (R_F values less than 0.1). These spots are not considered to be important in terms of being confused with marijuana spots (*viz.*, false positives) and plants showing these low running spots were scored as giving negative TLC results (*cf.* Table I). The criteria for a "positive TLC plant" was arbitrarily designated as a plant showing one or more visible spots (either prior to or after spraying with Fast Blue B salt spray reagent) having R_F value(s) greater than 0.1. Accordingly, of the 526 different plant samples tested, only 25 could be classified as "positive TLC plants" and these could be divided into two groups.

The first group comprising 13 plants (*cf.* Fig. 1 and Table II) includes those that gave colored spots prior to spraying. These spots remained unchanged after spraying. Inspection of Fig. 1 indicates that these spots all run below the higher running characteristic marijuana spots and are easily distinguished from them. Moreover, the non-cannabis plants (extracts) shown in Fig. 1 were separately spiked with marijuana extracts and re-chromatographed under similar conditions. In all cases the high running marijuana spots were easily distinguished from the non-cannabinoid spots.

The second group comprising 12 plants (*cf.* Fig. 2 and Table II) includes those that gave Fast Blue B positive spots after spraying. Inspection of Fig. 2 indicates that these spots all run below the higher running characteristic marijuana spots and are

TABLE I

RESULTS OF PLANT SAMPLES SUBJECTED TO THE RIM TEST PROCEDURE

Numbers with CNJ prefixes refer to plants from central New Jersey; non-prefixed numbers refer to commercially available botanicals. Plant parts: ap = aerial parts; ap-fl = aerial parts, flowering; ap-fr = aerial parts, fruiting; ar = aril; ax-tw = aqueous extract of twigs; ba = balsam; bk = stem bark; bu = bulb; co = corm; cp-hr = capsule hair; fl = flower; fl-bd = flower bud; fl-tp = flowering top; fr = fruit; fr-pu = fruit pulp; ga = gall; gr = gum resin; gu = gum; hwd = heartwood; jc = juice; lf = leaf; lf-bd = leaf bud; lx = latex; olr = oleoresin; re = resin; ri = rind; rt = root; rt-bk = root bark; rz = rhizome; sd = seed; sp = spore; st = stem; sti = stipe; str = strobile; th = thallus; tp = top; tu = tuber; wd = wood; wp = whole plant; wp-fl = whole plant, flowering; wp-fr = whole plant, fruiting. TLC: + Indicates spot(s) observed macroscopically at 5 min after treatment of wet mount with Fast Blue B (macro); w = weak, m = moderate, s = strong pink to purple colors observed macroscopically at 5 min after treatment of wet mount with Fast Blue B chromogenic reagent; - indicates no significant color change was observed. Microscopic: - Indicates that microscopic study showed no characteristic marijuana-like diagnostic elements.

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscopic
Aceraceae	<i>Acer negundo</i> L.	CNJ- 92	ap	-	-	-
	<i>Acer palmatum</i> Thunb.	CNJ-344	ap-fr	-	-	-
	<i>Acer platanoides</i> L.	CNJ-122	ap	-	s	-
	<i>Acer saccharinum</i> L.	CNJ-109	ap	-	-	-
Anacardiaceae	<i>Cotinus coggygia</i> Scop.	CNJ-243	ap-fl	-	m	-
	<i>Rhus copallina</i> L.	CNJ-330	wp-fr	-	m	-
	<i>Rhus copallina</i> L.	CNJ-137	ap-fl	-	m	-
	<i>Rhus glabra</i> L.	CNJ- 41	ap-fl	-	m	-
	<i>Rhus glabra</i> L.	CNJ- 61	ap-fr	-	m	-
	<i>Rhus radicans</i> L.	CNJ-121	ap-fr	-	m	-
Apocynaceae	<i>Apocynum androsaemifolium</i> L.	CNJ-292	wp-fr	-	s	-
	<i>Apocynum cannabinum</i> L.	31	rz, rt	-	-	-
	<i>Aspidosperma quebracho-blanco</i> Schlecht.	254	bk	-	-	-
	<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz	259	rt	-	m	-
Aquifoliaceae	<i>Ilex glabra</i> L.	CNJ-371	ap-fr	-	-	-
	<i>Ilex opaca</i> Ait.	CNJ-244	ap	-	-	-
Araceae	<i>Ilex paraguariensis</i> St. Hil.	242	lf	-	-	-
	<i>Arisaema triphylla</i> (L.) Schott	CNJ-247	wp-fr	-	w	-
	<i>Aralia hispida</i> Vent.	CNJ-404	ap-fl	-	-	-
	<i>Aralia racemosa</i> L.	17	rz, rt	-	-	-
Araliaceae	<i>Panax quinquefolium</i> L.	111	rt	-	-	-

(Continued on p. 84)

TABLE 1 (continued)

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscopic
Asclepiadaceae	<i>Asclepias incarnata</i> L.	CNJ- 60	wp	—	w	—
	<i>Asclepias syriaca</i> L.	CNJ-248	ap-fl	—	—	—
	<i>Asclepias syriaca</i> L.	CNJ-294	wp-fl	—	—	—
	<i>Asclepias syriaca</i> L.	CNJ- 56	wp-fr	—	—	—
	<i>Asclepias tuberosa</i> L.	CNJ-382	wp-fl	—	w	—
	<i>Marsdenia reicheibachii</i> Triana	75	bk	—	w	—
Balsaminaceae	<i>Impatiens capensis</i> Meerb.	CNJ- 69	wp-fl	—	s	—
Berberidaceae	<i>Berberis thunbergii</i> DC.	CNJ-107	ap	—	—	—
	<i>Berberis thunbergii</i> DC.	CNJ-385	ap-fr	—	—	—
	<i>Caulophyllum thalictroides</i> (L.) Michx.	34	rz, rt	—	—	—
	<i>Podophyllum peltatum</i> L.	209	rz, rt	—	m	—
Betulaceae	<i>Betula lenta</i> L.	CNJ-186	ap	—	s	—
	<i>Betula lenta</i> L.	27	bk	—	s	—
	<i>Betula pendula</i> Roth	CNJ-232	ap-fr	—	m	—
	<i>Betula populifolia</i> Marsh.	CNJ-193	ap	—	s	—
	<i>Betula populifolia</i> Marsh.	CNJ-273	ap-fr	—	m	—
Bignoniaceae	<i>Campsis radicans</i> (L.) Seem.	CNJ-274	ap-fl	—	—	—
	<i>Catalpa bignonioides</i> Walt.	CNJ-310	ap	—	—	—
	<i>Catalpa bignonioides</i> Walt.	CNJ-166	ap-fr	—	—	—
Bixaceae	<i>Bixa orellana</i> L.	15	ar	—	—	—
	<i>Cochlospermum religiosum</i> (L.) Alston	152	gu	—	—	—
Boraginaceae	<i>Alkanna tinctoria</i> (L.) Tausch	6	rt	+	—	—
	<i>Echium vulgare</i> L.	CNJ- 35	wp-fl	—	—	—
	<i>Pulmonaria officinalis</i> L.	206	lf	—	—	—
	<i>Symphytum officinale</i> L.	74	rz, rt	—	—	—
Burseraceae	<i>Boswellia carteri</i> Birdw.	149	gr	—	—	—
	<i>Commiphora</i> sp.	146	olr	—	—	—
Buxaceae	<i>Buxus harlandii</i> Hance	278	lf	—	—	—
Campanulaceae	<i>Lobelia inflata</i> L.	204	ap-fl	—	—	—
Cannaceae	<i>Canna</i> sp.	CNJ- 2	co	—	—	—
Caprifoliaceae	<i>Lonicera</i> sp.	CNJ-169	ap	—	—	—
	<i>Lonicera japonica</i> Thunb.	CNJ- 18	ap-fl	—	—	—
	<i>Lonicera tartarica</i> L.	CNJ-215	ap-fl	—	—	—

<i>Lonicera tartarica</i> L.	CNJ-257	ap-fr	—	—	—
<i>Sambucus canadensis</i> L.	CNJ-256	ap-fl	w	—	—
<i>Sambucus canadensis</i> L.	CNJ-130	ap-fr	m	—	—
<i>Sambucus canadensis</i> L.	127	fr	—	—	—
<i>Sambucus canadensis</i> L.	128	fl	—	—	—
<i>Sambucus ebulus</i> L.	103	rt	—	—	—
<i>Viburnum</i> sp.	CNJ-312	ap-fr	s	—	—
<i>Viburnum acerifolium</i> L.	CNJ-283	ap-fl	s	—	—
<i>Viburnum acerifolium</i> L.	CNJ-30	ap-fr	s	—	—
<i>Viburnum dentatum</i> L.	CNJ-303	ap-fr	s	—	—
<i>Viburnum trilobum</i> Marsh.	165	bk	w	—	—
<i>Viburnum prunifolium</i> L.	CNJ-210	ap-fl	s	—	—
<i>Viburnum prunifolium</i> L.	CNJ-284	ap-fr	s	—	—
<i>Viburnum prunifolium</i> L.	30	bk	—	—	—
<i>Viburnum prunifolium</i> L.	CNJ-218	ap-fl	s	—	—
<i>Weigela japonica</i> Thunb.	CNJ-200	ap-fr	m	—	—
<i>Cerastium vulgatum</i> L.	CNJ-11	wp-fl	—	—	—
<i>Dianthus armeria</i> L.	CNJ-14	wp-fl	—	—	—
<i>Saponaria officinalis</i> L.	CNJ-71	wp-fl	—	—	—
<i>Saponaria officinalis</i> L.	CNJ-297	wp-fr	—	—	—
<i>Silene cucubulus</i> Wibel	CNJ-26	wp-fl	—	—	—
<i>Silene noctiflora</i> L.	CNJ-207	wp-fl	—	—	—
<i>Euonymus alatus</i> (Thunb.) Sieb.	CNJ-142	ap	s	—	—
<i>Euonymus alatus</i> (Thunb.) Sieb.	CNJ-227	ap-fl	s	—	—
<i>Euonymus atropurpureus</i> Jacq.	164	bk	—	—	—
<i>Chenopodium ambrosioides</i> L. var. <i>anthelminticum</i> (L.) A. Gray	60	fr	s	—	—
<i>Clethra alnifolia</i> L.	CNJ-406	ap-fr	s	—	—
<i>Commelina communis</i> L.	CNJ-337	wp-fl	—	—	—
<i>Achillea millefolium</i> L.	CNJ-55	wp-fl	—	—	—
<i>Achillea millefolium</i> L.	182	fl	—	—	—
<i>Ambrosia trifida</i> L.	CNJ-84	wp-fl	—	—	—
<i>Ambrosia trifida</i> L.	CNJ-313	wp-fr	—	—	—
<i>Ambrosia trifida</i> L.	CNJ-194	ap-fl	—	—	—
<i>Arctium</i> sp.	CNJ-213	ap	—	—	—
<i>Arctium lappa</i> L.	44	rt	—	—	—
<i>Arctium minus</i> (Hill) Bernh.	CNJ-91	wp-fr	—	—	—

(Continued on p. 86)

TABLE 1 (continued)

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscopic
	<i>Arnica montana</i> L.	18	fl	—	—	—
	<i>Artemisia absinthium</i> L.	231	wp-fl	—	—	—
	<i>Artemisia dracunculoides</i> L.	186	lf	—	—	—
	<i>Artemisia ludoviciana</i> Nutt.	CNJ-346	wp-fl	—	—	—
	<i>Artemisia vulgaris</i> L.	CNJ-349	wp-fl	—	—	—
	<i>Aster cordifolius</i> L.	CNJ-364	wp-fl	—	—	—
	<i>Aster ericoides</i> L.	CNJ-325	wp-fr	—	—	—
	<i>Aster linariifolius</i> L.	CNJ-390	wp-fl	—	—	—
	<i>Aster linariifolius</i> L.	CNJ-370	ap-fr	—	—	—
	<i>Aster novae-angliae</i> L.	CNJ-365	ap-fl	—	—	—
	<i>Aster pilosus</i> Willd.	CNJ-373	wp-fl	—	—	—
	<i>Aster simplex</i> Willd.	CNJ-362	ap	—	—	—
	<i>Baccharis halimifolia</i> L.	CNJ-290	ap	—	—	—
	<i>Bidens polycephala</i> Blake	CNJ-340	wp-fl	—	—	—
	<i>Bidens polycephala</i> Blake	CNJ-157	wp-fr	—	—	—
	<i>Carthamus tinctoria</i> L.	220	fl	—	—	—
	<i>Centaurea dubia</i> Suter.	CNJ-416	wp-fl	—	—	—
	<i>Centaurea dubia</i> Suter.	CNJ-418	fl	—	—	—
	<i>Centaurea jacea</i> L.	CNJ-307	wp-fl	—	—	—
	<i>Centaurea jacea</i> L.	CNJ-383	wp-fl	—	—	—
	<i>Centaurea maculosa</i> Lam.	245	fl	—	—	—
	<i>Chrysanthemum cinerariifolium</i> (Trev.) Vis.	CNJ-231	wp-fl	—	—	—
	<i>Chrysanthemum leucanthemum</i> L.	CNJ-264	wp-fl	—	—	—
	<i>Cichorium intybus</i> L.	CNJ-66	ap-fl	—	—	—
	<i>Cirsium vulgare</i> (Savi) Tenore	133	rz, rt	—	—	—
	<i>Echinacea pallida</i> (Nutt.) Raf.	CNJ-320	wp-fr	—	—	—
	<i>Erechtites hieracifolia</i> (L.) Raf.	CNJ-190	wp-fl	—	w	—
	<i>Erigeron annuus</i> (L.) Pers.	CNJ-80	wp-fl	—	—	—
	<i>Erigeron canadensis</i> L.	CNJ-81	wp-fl	—	—	—
	<i>Eupatorium maculatum</i> L.	37	lf, fl-tp	—	—	—
	<i>Eupatorium perfoliatum</i> L.	CNJ-300	ap-fl	—	—	—
	<i>Eupatorium purpureum</i> L.	CNJ-88	wp-fl	—	—	—
	<i>Eupatorium rugosum</i> Houtt.	105	lf, fl-tp	—	—	—
	<i>Grindelia camporum</i> Greene			—	—	—

<i>Hieracium florentinum</i> All.	CNJ-376	wp-fl	—	—	—
<i>Hieracium floribundum</i> Wimm. & Grab.	CNJ- 7	wp-fl	—	—	—
<i>Hieracium pratense</i> Tausch	CNJ- 8	wp-fl	—	—	—
<i>Inula helenium</i> L.	126	rz, rt	—	—	—
<i>Krigia virginia</i> (L.) Willd.	CNJ-386	wp-fl	—	—	—
<i>Lactuca floridana</i> (L.) Gaertn.	CNJ-153	wp-fl	—	—	—
<i>Lactuca scariola</i> L.	CNJ-317	wp-fr	—	—	—
<i>Marricaria chamonilla</i> L.	59	fl	—	—	—
<i>Rudbeckia hirta</i> L.	CNJ- 43	wp-fl	—	—	—
<i>Silphium perfoliatum</i> L.	CNJ-308	ap-fl	—	—	—
<i>Solidago</i> sp.	CNJ- 38	ap	—	—	—
<i>Solidago graninifolia</i> (L.) Salisb.	CNJ-348	wp-fl	—	—	—
<i>Solidago juncea</i> Ait.	CNJ-306	wp-fl	—	—	—
<i>Solidago tenuifolia</i> Pursh	CNJ-183	wp-fl	—	—	—
<i>Sonchus oleraceus</i> Bieb.	CNJ- 68	wp-fl	—	—	—
<i>Tanacetum vulgare</i> L.	CNJ-342	ap-fl	—	—	—
<i>Tanacetum vulgare</i> L.	187	lf	+	—	—
<i>Taraxacum officinale</i> Weber	92	rt	—	—	—
<i>Tussilago farfara</i> L.	CNJ-208	wp	—	—	—
<i>Tussilago farfara</i> L.	73	lf	—	—	—
<i>Vernonia noveboracensis</i> (L.) Michx.	CNJ-326	wp-fl	—	—	—
<i>Convolvulus sepium</i> L.	CNJ- 48	wp-fl	—	—	—
<i>Impomoea purga</i> (Wender) Hayne	104	rt	—	—	—
<i>Impomoea purga</i> (Wender) Hayne	257	re	—	—	—
<i>Ipomoea pandurata</i> (L.) G. F. W. Mey.	CNJ-327	wp-fl	—	w	—
<i>Ipomoea turpelum</i> R. Br.	172	rt, st	—	—	—
<i>Cornus amomum</i> Mill.	CNJ- 45	ap	—	s	—
<i>Cornus florida</i> L.	CNJ- 72	ap-fr	—	m	—
<i>Cornus racemosa</i> Lam.	CNJ- 17	ap-fl	—	s	—
<i>Cornus racemosa</i> Lam.	CNJ- 40	ap-fr	—	s	—
<i>Cornus stolonifera</i> Michx.	CNJ- 62	ap	—	s	—
<i>Cornus stolonifera</i> Michx.	CNJ-305	ap-fr	—	s	—
<i>Alnus serrulata</i> (Ait.) Willd.	CNJ-131	wp-fr	—	—	—
<i>Barbarea vulgaris</i> R. Br.	CNJ- 1	wp-fl	—	—	—
<i>Brassica hirta</i> Moench	215	sd	—	—	—
<i>Brassica nigra</i> (L.) Koch	228	sd	—	—	—

Convolvulaceae

Cornaceae

Corylaceae

Cruciferae

TABLE I (continued)

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscopic
Cucurbitaceae	<i>Cardaria draba</i> (L.) Desv.	CNJ-219	ap-fr	—	—	—
	<i>Hesperis matronalis</i> L.	CNJ-214	ap-fl	—	—	—
	<i>Raphanus raphanistrum</i> L.	CNJ-20	wp-fr	—	—	—
	<i>Raphanus raphanistrum</i> L.	CNJ-224	wp-fl	—	—	—
	<i>Bryonia alba</i> L.	39	rt	—	—	—
Cyperaceae	<i>Citradlus colocynthis</i> (L.) Schrad.	72	fr-pu	—	—	—
	<i>Citradlus vulgaris</i> Schrad.	163	sd	—	m	—
	<i>Cyperus strigosus</i> L.	CNJ-155	wp-fr	—	m	—
	<i>Dioscorea villosa</i> L.	177	rt	—	—	—
	<i>Equisetum</i> sp.	136	ap	—	—	—
Dioscoreaceae	<i>Aretostaphylos uva-ursi</i> (L.) Spreng.	171	lf	—	m	—
	<i>Gaultheria procumbens</i> L.	178	lf	—	—	—
	<i>Kalmia latifolia</i> L.	CNJ-21	ap-fl	—	s	—
	<i>Rhododendron</i> sp.	CNJ-172	ap	—	s	—
	<i>Vaccinium stanineum</i> L.	CNJ-53	ap	—	w	—
Ericaceae	<i>Vaccinium vacillans</i> Torr.	CNJ-181	ap-fr	—	s	—
	<i>Euphorbia cyparissias</i> L.	CNJ-361	wp	—	—	—
	<i>Euphorbia cyparissias</i> L.	CNJ-392	wp-fl	—	m	—
	<i>Euphorbia esula</i> L.	CNJ-36	wp	—	s	—
	<i>Euphorbia esula</i> L.	CNJ-5	wp-fl	—	—	—
Euphorbiaceae	<i>Euphorbia maculata</i> L.	CNJ-358	wp-fl	—	—	—
	<i>Euphorbia resinifera</i> Berg.	124	lx	—	—	—
	<i>Mallotus philippensis</i> Muell. Arg.	93	cp-hr	+	—	—
	<i>Ricinus communis</i> L.	55	sd	—	—	—
	<i>Castanea dentata</i> (Marsh.) Borkh.	61	lf	—	—	—
Fagaceae	<i>Quercus alba</i> L.	162	bk	—	m	—
	<i>Quercus lusitanica</i> Lam.	CNJ-57	ap-fr	—	m	—
	<i>Quercus infectaria</i> Oliv.	114	ga	—	—	—
	<i>Quercus palustris</i> Muenchh.	CNJ-133	ap	—	s	—
	<i>Quercus rubra</i> L.	258	bk	—	m	—
Fucaceae	<i>Fucus</i> sp.	33	th	—	—	—
	<i>Dicentra canadensis</i> (Goldie) Walp.	170	tu	—	—	—
	<i>Gentiana lutea</i> L.	112	rz, rt	—	—	—

Geraniaceae	<i>Menyanthes trifoliata</i> L.	41	lf	—	—	—
	<i>Geranium maculatum</i> L.	80	rz	—	s	—
	<i>Chondrus crispus</i> (L.) Stackh.	64	wp	—	—	—
Gigartinaceae	<i>Ephedra sinica</i> Stapf	120	wp	—	m	—
	<i>Ephedra sinica</i> Stapf	121	st	—	m	—
Gramineae	98	rz, rt	—	—	—	—
	<i>Agropyron repens</i> (L.) Beauv.	CNJ-318	wp-fr	—	—	—
	<i>Dactylis glomerata</i> L.	CNJ-276	wp-fl	—	—	—
	<i>Phleum pratense</i> L.	CNJ-167	wp-fl	—	—	—
	<i>Phragmites communis</i> Trin.	CNJ-339	wp-fr	—	—	—
	<i>Setaria faberii</i> Herm.	166	rt	—	—	—
	<i>Vetiveria zizanioides</i> Stapf	CNJ-319	wp-fr	—	—	—
	<i>Zea mays</i> L.	CNJ-350	sd	—	—	—
	<i>Zea mays</i> L.	155	gr	—	—	—
	<i>Garcinia hanburyi</i> Hook. f.	CNJ-407	wp-fl	—	s	—
Hamamelidaceae	<i>Hypericum perforatum</i> L.	CNJ-282	ap	—	s	—
	<i>Hamamelis virginiana</i> L.	176	lf	—	m	—
	<i>Hamamelis virginiana</i> L.	CNJ-140	ap-fr	—	s	—
Hippocastanaceae	<i>Liquidambar styraciflua</i> L.	CNJ-233	ap-fr	—	m	—
Hydrophyllaceae	<i>Aesculus hippocastanum</i> L.	122	lf	—	m	—
	<i>Eriodictyon californicum</i> (Hook. & Arn.) Torr.	241	rz	—	—	—
Iridaceae	<i>Iris florentina</i> L.	CNJ-230	wp	—	w	—
	<i>Iris pseudacorus</i> L.	CNJ-391	wp-fr	—	—	—
	<i>Sisyrinchium angustifolium</i> Mill.	35	rz	—	m	—
	<i>Iris versicolor</i> L.	CNJ-185	ap-fr	—	s	—
	<i>Carya glabra</i> (Mill.) Sweet	CNJ-408	lf, tw	—	m	—
	<i>Carya ovata</i> (Mill.) K. Koch	CNJ-409	bk	—	w	—
	<i>Carya ovata</i> (Mill.) K. Koch	CNJ-410	wd	—	—	—
	<i>Juglans chinensis</i> L.	46	rt-bk	+	—	—
	<i>Juglans nigra</i> L.	32	bk	+	—	—
	<i>Juglans nigra</i> L.	CNJ-100	ap-fr	—	—	—
Labiateae	<i>Glechoma hederacea</i> L.	CNJ-217	wp	—	m	—
	<i>Leonurus cardiaca</i> L.	225	ap	—	—	—
	<i>Lycopus americanus</i> Muhl.	CNJ-159	wp	—	s	—
	<i>Majorana hortensis</i> Moench	233	lf	—	—	—
	<i>Melissa officinalis</i> L.	202	lf, fl-tp	—	—	—

(Continued on p. 90)

TABLE I (continued)

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscopic
Lauraceae	<i>Mentha cardiaca</i> Baker	CNJ-191	wp-fl	—	m	—
	<i>Mentha spicata</i> L.	270	lf, fl-tp	—	—	—
	<i>Origanum vulgare</i> L.	240	ap	+	—	—
	<i>Pogostemon cablin</i> Benth.	243	lf	—	—	—
	<i>Prunella vulgaris</i> L.	CNJ-316	wp-fl	—	—	—
	<i>Pycnanthemum flexuosum</i> (Walt.) BSP.	CNJ-311	wp-fl	—	—	—
	<i>Rosmarinus officinalis</i> L.	264	lf	—	—	—
	<i>Satureja hortensis</i> L.	190	lf, fl-tp	+	—	—
	<i>Thymus vulgaris</i> L.	189	lf, fl-tp	+	—	—
	<i>Cinnamomum cassia</i> Blume	53	bk	—	s	—
	<i>Cinnamomum loureirii</i> Nees	66	bk	—	—	—
	<i>Laurus nobilis</i> L.	22	lf	—	—	—
	<i>Lindera benzoin</i> (L.) Blume	CNJ-154	ap-fr	—	m	—
	<i>Sassafras albidum</i> (Nutt.) Nees	CNJ-189	ap	—	s	—
	<i>Albizzia julibrissin</i> Durazzini	CNJ- 98	ap-fl	—	w	—
	<i>Anorpha fruticosa</i> L.	CNJ-400	ap-fl	—	m	—
	<i>Cassia fistula</i> L.	54	fr	—	—	—
	<i>Cassia nictitans</i> L.	CNJ-336	wp-fr	—	m	—
	<i>Ceratonia siliqua</i> L.	58	fr	—	s	—
Leguminosae	<i>Cercis canadensis</i> L.	CNJ-211	ap-fl	—	s	—
	<i>Cladrastis lutea</i> (Michx. f.) K. Koch	CNJ- 9	ap-fl	—	—	—
	<i>Coronilla varia</i> L.	CNJ-240	wp-fl	—	w	—
	<i>Cytisus scoparius</i> (L.) Link	38	tp	—	—	—
	<i>Desmodium illinoense</i> Darl.	CNJ-321	wp-fl	—	m	—
	<i>Dipteryx odorata</i> Willd.	184	sd	—	w	—
	<i>Gleditsia triacanthos</i> L.	CNJ-115	ap	—	m	—
	<i>Glycyrrhiza glabra</i> L.	130	rz, rt	+	m	—
	<i>Haematoxylon campechianum</i> L.	145	hwd	—	—	—
	<i>Krameria triandra</i> Ruiz & Pav.	266	rt	—	m	—
	<i>Laburnum anagyroides</i> Med.	CNJ-216	ap-fl	—	—	—
	<i>Lathyrus latifolius</i> L.	CNJ- 24	wp-fl	—	—	—
	<i>Lathyrus latifolius</i> L.	CNJ-298	wp-fr	—	—	—
	<i>Lespedeza cuneata</i> (Dumont) G. Don	CNJ-363	ap-fl	—	—	—

<i>Lotus corniculatus</i> L.	CNJ- 22	wp-fl	-	-	-
<i>Melilotus alba</i> Desr.	CNJ- 75	wp-fl	-	-	-
<i>Melilotus officinalis</i> (L.) Lam.	CNJ- 6	wp-fl	-	-	-
<i>Pilocarpus jaborandi</i> Holmes	198	lf	-	-	m
<i>Piscidia erythrina</i> L.	99	bk	-	-	-
<i>Pterocarpus marsupium</i> Roxb.	150	jc	-	-	w
<i>Pterocarpus santalinus</i> L. f.	262	hwd	-	-	s
<i>Sophora japonica</i> L.	CNJ-119	ap	-	-	s
<i>Trifolium arvense</i> L.	CNJ-419	wp-fl	-	-	-
<i>Trifolium hybridum</i> L.	CNJ-324	wp-fl	-	-	-
<i>Trifolium pratense</i> L.	CNJ-315	wp-fr	-	-	-
<i>Trigonella foenum-graecum</i> L.	119	sd	-	-	m
<i>Vicia cracca</i> L.	CNJ- 4	wp-fl	-	-	-
<i>Wisteria sinensis</i> (Sims) Sweet	CNJ-209	ap-fl	-	-	m
<i>Zanthoxylum americanum</i> Mill.	251	bk	-	-	-
<i>Allium vineale</i> L.	CNJ- 31	wp-fr	-	-	-
<i>Aloe vera</i> L.	10	jc	+	+	-
<i>Aloe ferox</i> Mill.	9	jc	+	+	-
<i>Aloe perryi</i> Baker	8	jc	+	+	-
<i>Asparagus officinalis</i> L.	CNJ-162	wp-fr	-	-	-
<i>Asparagus officinalis</i> L.	CNJ-277	ap-fr	-	-	-
<i>Chamaelirium luteum</i> (L.) A. Gray	143	rz, rt	-	-	-
<i>Colchicum autumnale</i> L.	71	co	-	-	-
<i>Convallaria majalis</i> L.	199	rz, rt	-	-	-
<i>Hennerocallis fidva</i> L.	CNJ- 32	wp-fl	-	-	-
<i>Hennerocallis fulva</i> L.	CNJ-249	ap-fl	-	-	-
<i>Muscaria botryoides</i> (L.) Mill.	CNJ-221	wp-fl	-	-	-
<i>Schoenocaulon officinale</i> A. Gray	268	sd	-	-	m
<i>Smilachia racemosa</i> (L.) Desf.	CNJ-223	wp-fl	-	-	-
<i>Smilax</i> sp.	269	rt	-	-	-
<i>Trillium</i> sp.	26	rt	-	-	-
<i>Urginea scilla</i> Steinh.	174	bu	-	-	-
<i>Veratrum viride</i> Ait.	142	rz, rt	-	-	m
<i>Yucca filamentosa</i> L.	CNJ-272	wp-fl	-	-	-
<i>Gelsemium sempervirens</i> (L.) Ait. f.	113	rz, rt	-	-	-
<i>Spigelia marilandica</i> L.	246	rz, rt	-	-	-
<i>Strychnos nux-vomica</i> L.	236	sd	-	-	-

Liliaceae

Loganiaceae

(Continued on p. 92)

TABLE 1 (continued)

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscopic
Loranthaceae	<i>Phoradendron flavescens</i> (Pursh) Nutt.	222	wp	—	—	—
	<i>Viscum album</i> L.	226	wp	—	—	—
Lycopodiaceae	<i>Lycopodium clavatum</i> L.	207	sp	—	—	—
Lythraceae	<i>Lawsonia alba</i> Lam.	140	fl	—	—	—
	<i>Lythrum salicaria</i> L.	CNJ-47	wp-fl	—	—	—
	<i>Lythrum salicaria</i> L.	CNJ-314	ap-fl	—	m	—
Magnoliaceae	<i>Illicium anisatum</i> L.	196	fr	—	m	—
	<i>Magnolia acuminata</i> L.	CNJ-176	ap-fr	—	—	—
	<i>Magnolia tripetala</i> L.	CNJ-295	ap-fr	—	—	—
	<i>Magnolia tripetala</i> L.	CNJ-333	fr, sd	—	—	—
	<i>Magnolia virginiana</i> L.	CNJ-178	ap-fr	—	—	—
Malvaceae	<i>Althea officinalis</i> L.	11	rt	—	—	—
	<i>Althea rosea</i> Cav.	CNJ-203	wp-fl	—	—	—
	<i>Gossypium hirsutum</i> L.	79	rt-bk	—	—	—
	<i>Hibiscus palustris</i> L.	CNJ-149	ap-fr	—	s	—
	<i>Hibiscus syriacus</i> L.	CNJ-83	wp-fl	—	s	—
	<i>Hibiscus trionum</i> L.	CNJ-366	wp-fr	—	s	—
	<i>Hibiscus trionum</i> L.	CNJ-367	fr	—	m	—
	<i>Malva sylvestris</i> L.	217	lf	—	—	—
Menispermaceae	<i>Anamirta paniculata</i> Colebr.	68	fr	+	—	—
	<i>Chondrodendron tomentosum</i> Ruiz & Pav.	244	rt	—	—	—
Monimaceae	<i>Peumus boldus</i> Molina	36	lf	—	m	—
Moraceae	<i>Broussonetia papyrifera</i> (L.) Vent.	CNJ-34	ap	—	—	—
	<i>Humulus lupulus</i> L.	138	str	—	—	—
	<i>Maclura pomifera</i> (Raf.) Schneid.	CNJ-110	ap-fr	—	—	—
	<i>Morus alba</i> L.	CNJ-101	ap	—	m	—
	<i>Morus alba</i> L.	CNJ-278	ap-fr	—	m	—
	<i>Morus rubra</i> L.	CNJ-104	ap	—	w	—
	<i>Morus rubra</i> L.	CNJ-44	ap-fr	—	—	—
Myricaceae	<i>Myrica asplenifolia</i> L.	CNJ-275	wp	—	s	—
	<i>Myrica pensylvanica</i> L.	CNJ-323	ap	—	s	—
	<i>Myrica pensylvanica</i> L.	CNJ-50	ap-fr	—	s	—
	<i>Myrica pensylvanica</i> L.	CNJ-289	wp-fr	—	m	—

Myristicaceae	<i>Myristica fragrans</i> Houtt.	235	sd	+	s
Myrtaceae	<i>Myristica fragrans</i> Houtt.	273	ar	+	m
	<i>Eugenia caryophyllata</i> Thunb.	67	fl-bd	+	—
	<i>Eucalyptus globulus</i> Labill.	123	lf	—	m
	<i>Pinetia officinalis</i> Lindl.	7	fr	—	m
Nymphaeaceae	<i>Nymphaea odorata</i> Ait.	CNJ-301	ap-fl	—	m
Nyssaceae	<i>Nyssa sylvatica</i> Marsh.	CNJ-136	ap	—	—
	<i>Nyssa sylvatica</i> Marsh.	CNJ-138	ap-fr	—	—
	<i>Clitonanthus virginicus</i> L.	117	rt-bk	—	—
Oleaceae	<i>Forsythia suspensa</i> (Thunb.) Vahl var. <i>fortune</i> Rehd.	CNJ-225	ap-fl	—	s
	<i>Fraxinus</i> sp.	CNJ-128	ap	—	—
	<i>Fraxinus americanus</i> L.	CNJ-125	ap	—	—
	<i>Fraxinus americanus</i> L.	CNJ-143	ap-fr	—	—
	<i>Fraxinus pennsylvanica</i> Marsh.	CNJ-152	ap-fr	—	—
	<i>Ligustrum anuvense</i> Carr.	CNJ-165	ap-fr	—	—
	<i>Ligustrum ovalifolium</i> Hassk.	CNJ-388	ap	—	—
	<i>Ligustrum ovalifolium</i> Hassk.	CNJ-29	ap-fl	—	s
	<i>Syringa vulgaris</i> L.	CNJ-103	ap	—	—
Onagraceae	<i>Epilobium ciliatum</i> Raf.	CNJ-341	wp-fl	—	—
	<i>Oenothera biennis</i> L.	CNJ-94	wp-fl	—	w
	<i>Oenothera parviflora</i> L.	CNJ-331	wp-fl	—	w
	<i>Oenothera speciosa</i> Nutt.	CNJ-293	wp-fl	—	w
Orchidaceae	<i>Calypso bulbosa</i> Oakes	201	rz, rt	—	—
Orobanchaceae	<i>Conopholis americana</i> (L.) Wallr.	CNJ-420	ap-fr	—	—
Osmundaceae	<i>Osmunda cinnamomea</i> L.	CNJ-222	wp	—	m
Oxalidaceae	<i>Oxalis stricta</i> L.	CNJ-252	wp-fl	—	w
Palmaceae	<i>Areca catechu</i> L.	16	sd	—	m
Papaveraceae	<i>Chelidonium majus</i> L.	106	wp	—	—
	<i>Sanguinaria canadensis</i> L.	129	rz	—	—
Parneliaceae	<i>Rocella</i> sp.	82	wp	—	s
Phytolaccaceae	<i>Phytolacca americana</i> L.	CNJ-46	wp-fr	—	—
	<i>Phytolacca americana</i> L.	249	rt	—	m
Pinaceae	<i>Juniperus communis</i> L.	101	fr	—	—
	<i>Juniperus sabina</i> L.	267	lf, tp	—	—
	<i>Juniperus virginiana</i> L.	CNJ-250	ap	—	s
	<i>Juniperus virginiana</i> L.	CNJ-64	wp-fr	—	s

(Continued on p. 94)

TABLE I (continued)

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscope
	<i>Picea engelmannii</i> (Parry) Engelm.	45	olr	—	—	—
	<i>Pinus mugo</i> Turra	CNJ-248	lf	—	m	—
	<i>Pinus mugo</i> Turra	CNJ-268	ap	—	s	—
	<i>Pinus palustris</i> Mill.	265	re	+	—	—
	<i>Pinus rigida</i> Mill.	CNJ-260	lf	—	m	—
	<i>Pinus rigida</i> Mill.	CNJ-281	ap	—	s	—
	<i>Pinus strobus</i> L.	161	bk	+	m	—
	<i>Pinus sylvestris</i> L.	CNJ-280	ap	—	s	—
	<i>Tsuga canadensis</i> (L.) Carr.	141	bk	—	s	—
	<i>Piper angustifolium</i> Ruiz & Pav.	229	sd	—	—	—
Piperaceae	<i>Piper cubeba</i> L.	81	fr	—	—	—
	<i>Piper methysticum</i> Forst.	88	rt	—	—	—
Plantaginaceae	<i>Plantago psyllium</i> L.	252	sd	—	—	—
	<i>Plantago rugelii</i> Dene.	CNJ-322	wp-fr	—	—	—
Platanaceae	<i>Platanus occidentalis</i> L.	CNJ-144	ap-fr	—	m	—
Polygonaceae	<i>Polygonum cespitosum</i> Blume	CNJ-357	ap-fl	—	m	—
	<i>Polygonum cespitosum</i> Blume	CNJ-95	ap	—	s	—
	<i>Polygonum cespitosum</i> Blume	CNJ-286	wp-fl	—	w	—
	<i>Polygonum cuspidatum</i> Sieb. & Zucc.	CNJ-353	lf, st	—	w	—
	<i>Polygonum cuspidatum</i> Sieb. & Zucc.	CNJ-351	fl, sd	—	—	—
	<i>Polygonum pennsylvanicum</i> L.	CNJ-168	wp-fl	—	s	—
	<i>Rheum officinale</i> Baill.	195	rz, rt	+	s	—
	<i>Rumex acetosella</i> L.	CNJ-228	wp-fr	—	m	—
	<i>Rumex crispus</i> L.	CNJ-67	wp-fr	—	s	—
Polypodiaceae	<i>Adiantum petatum</i> L.	214	sti	—	—	—
	<i>Dryopteris filix-mas</i> (L.) Schott	210	sti	+	m	—
Polyporaceae	<i>Polyporus officinalis</i> (Vill.) Fries	5	wp	—	—	—
Pontederiaceae	<i>Pontederia cordata</i> L.	CNJ-135	wp-fl	—	s	—
Portulacaceae	<i>Claytonia virginica</i> L.	CNJ-220	wp-fl	—	—	—
Primulaceae	<i>Anagallis arvensis</i> L.	CNJ-237	wp-fl	—	m	—
	<i>Lysimachia quadrifolia</i> L.	CNJ-405	wp	—	s	—
	<i>Aconitum napellus</i> L.	2	rt	—	—	—
Ranunculaceae	<i>Adonis vernalis</i> L.	3	ap	—	—	—

<i>Anemone pulsatilla</i> L.	253	wp	-	-	-
<i>Cnicifluga racemosa</i> (L.) Nutt.	29	rz, rt	-	-	-
<i>Cnicifluga racemosa</i> (L.) Nutt.	CNJ-245	wp-fl	-	-	-
<i>Clenatis dioscoreifolia</i> Levl. & Van.	CNJ-345	ap-fl	-	-	-
<i>Delphinium ajacis</i> L.	CNJ-238	wp	-	m	-
<i>Delphinium ajacis</i> L.	200	sd	-	m	-
<i>Hydrastis canadensis</i> L.	109	rz, rt	-	-	-
<i>Ranunculus bulbosus</i> L.	CNJ-380	wp-fl	-	-	-
<i>Thalictrum polygamum</i> Muhl.	CNJ-206	wp-fl	-	-	-
<i>Thalictrum polygamum</i> Muhl.	CNJ-134	wp-fr	-	-	-
<i>Ceanothus americanus</i> L.	102	rt-bk	-	m	-
<i>Rhamnus californicus</i> L.	43	fr	+	-	-
<i>Rhamnus frangula</i> L.	42	bk	-	-	-
<i>Rhamnus frangula</i> L.	CNJ-241	ap-fl	-	w	-
<i>Rhamnus purshiana</i> DC.	51	bk	+	-	-
<i>Anelanchier laevis</i> Wieg.	CNJ-126	ap	-	s	-
<i>Crataegus</i> sp.	CNJ-235	ap	-	s	-
<i>Crataegus</i> sp.	CNJ- 76	ap-fr	-	s	-
<i>Crataegus</i> sp.	144	fr	-	-	-
<i>Cydonia oblonga</i> Mill.	256	sd	-	-	-
<i>Malus</i> sp.	CNJ-139	ap-fr	-	s	-
<i>Malus</i> sp.	CNJ-236	ap-fl	-	s	-
<i>Malus</i> sp.	CNJ-182	ap-fr	-	s	-
<i>Physocarpus opulifolius</i> (L.) Maxim.	CNJ-402	ap-fl	-	s	-
<i>Physocarpus opulifolius</i> (L.) Maxim.	CNJ- 27	ap-fr	-	s	-
<i>Potentilla recta</i> L.	CNJ- 12	wp-fl	-	s	-
<i>Potentilla simplex</i> Michx.	CNJ-204	wp-fl	-	s	-
<i>Prunus</i> sp.	CNJ-123	ap	-	s	-
<i>Prunus avium</i> L.	CNJ-106	ap	-	s	-
<i>Prunus avium</i> L.	CNJ-266	ap-fr	-	s	-
<i>Prunus cerasus</i> L.	CNJ-141	ap	-	s	-
<i>Prunus domestica</i> L.	CNJ-105	ap	-	s	-
<i>Prunus serotina</i> Ehrh.	CNJ-111	ap	-	s	-
<i>Prunus serotina</i> Ehrh.	CNJ-120	ap-fr	-	s	-
<i>Prunus serotina</i> Ehrh.	179	bk	-	s	-
<i>Prunus virginiana</i> L.	CNJ- 74	ap	-	s	-

Rhamnaceae

Rosaceae

TABLE I (continued)

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscopic
Rubiaceae	<i>Pyrus</i> sp.	CNJ-259	ap-fr	—	s	—
	<i>Pyrus communis</i> L.	CNJ- 58	ap	—	—	—
	<i>Pyrus coronaria</i> L.	CNJ- 51	ap	—	s	—
	<i>Pyrus floribunda</i> L.	CNJ- 42	ap-fr	—	—	—
	<i>Rosa</i> sp.	CNJ-270	ap-fl	—	s	—
	<i>Rosa palustris</i> Marsh.	CNJ-148	ap	—	s	—
	<i>Rosa palustris</i> Marsh.	CNJ-150	ap-fl	—	s	—
	<i>Rubus</i> sp.	CNJ-147	ap	—	s	—
	<i>Rubus</i> sp.	28	rz, rt-bk	—	w	—
	<i>Rubus flagellaris</i> L.	CNJ-255	ap-fr	—	s	—
	<i>Rubus hispidus</i> L.	CNJ-254	wp-fr	—	s	—
	<i>Rubus occidentalis</i> L.	260	fr	—	—	—
	<i>Spiraea tomentosa</i> L.	CNJ- 54	wp-fl	—	s	—
	<i>Spiraea vanhouttei</i> Zabel	CNJ-212	ap-fl	—	s	—
	<i>Spiraea vanhouttei</i> Zabel	CNJ-239	wp-fl	—	s	—
	<i>Cephaelis ipecacuanha</i> (Brot.) A. Rich	193	rt	—	—	—
	<i>Chelidonia</i> sp.	65	bk, rt-bk	—	—	—
	<i>Coffea arabica</i> L.	275	sd	—	—	—
	<i>Pausinystalia yohimba</i> Pierre	181	bk	—	—	—
	<i>Galium aparine</i> L.	CNJ- 3	wp-fl	—	—	—
	<i>Rubia tinctorum</i> L.	218	rt	—	—	—
Rutaceae	<i>Uncaria gambir</i> Roxb.	56	ax-tw	+	s	—
	<i>Darosna betulina</i> (Thunb.) Bartl. & Wendl.	40	lf	—	—	—
	<i>Citrus aurantium</i> L.	238	ri	—	s	—
	<i>Citrus aurantium</i> L.	237	fl	—	—	—
	<i>Citrus limon</i> Burm.	205	ri	—	—	—
Sulaceae	<i>Citrus sinensis</i> Osbeck	239	ri	—	—	—
	<i>Populus alba</i> L.	CNJ-328	ap	—	s	—
	<i>Populus balsamifera</i> Muenchh.	20	lf-bd	+	s	—
	<i>Salix</i> sp.	CNJ-229	ap	—	s	—
	<i>Salix babylonica</i> L.	CNJ-124	ap	—	s	—
Santalaceae	<i>Santalum album</i> L.	271	hwd	—	—	—
Supindaceae	<i>Paulinia cupana</i> Kunth.	83	sd	—	s	—

Saxifragaceae	<i>Hydrangea paniculata</i> Sieb.	CNJ-170	ap-fl	—	s
	<i>Philadelphus coronarius</i> L.	CNJ-196	ap-fr	—	m
	<i>Digitalis purpurea</i> L.	95	lf	—	—
	<i>Linaria vulgaris</i> Hill.	CNJ-288	wp-fl	—	—
Scrophulariaceae	<i>Penstemon digitalis</i> Nutt.	CNJ-205	wp-fl	—	—
	<i>Scrophularia lanceolata</i> Pursh	CNJ- 86	wp-fr	—	—
	<i>Verbascum blattaria</i> L.	CNJ- 15	wp-fl	—	—
	<i>Verbascum thapsus</i> L.	CNJ-304	wp-fl	—	s
	<i>Verbascum thapsus</i> L.	CNJ-251	wp	—	—
	<i>Verbascum thapsus</i> L.	227	lf	—	—
	<i>Verbascum thapsus</i> L.	232	fl	—	—
	<i>Veronica virginica</i> L.	86	rt	—	—
	<i>Alantulus altissima</i> (Mill.) Swingle	CNJ-302	ap-fr	—	—
	<i>Pteris excelsa</i> (Sw.) Planch.	255	hwd	—	—
Simaroubaceae	<i>Atropa belladonna</i> L.	23	lf	—	—
	<i>Atropa belladonna</i> L.	24	rt	—	—
	<i>Capsicum frutescens</i> L.	48	fr	—	—
Solanaceae	<i>Hyoscyamus niger</i> L.	191	lf, fl-4p	—	—
	<i>Lycium halimifolium</i> Mill.	CNJ-173	ap-fl	—	—
	<i>Lycopersicon esculentum</i> Mill.	274	lf	—	—
	<i>Nicotiana tabacum</i> L.	277	lf	—	—
	<i>Solanum carolinense</i> L.	CNJ- 33	wp-fl	—	—
	<i>Solanum carolinense</i> L.	137	fr	—	—
	<i>Solanum dulcamara</i> L.	CNJ- 13	wp-fl	—	—
	<i>Staphylea trifolia</i> L.	CNJ-359	ap-fr	—	—
	<i>Cela nitida</i> Schott & Endl.	87	sd	—	—
	<i>Theobroma cacao</i> L.	70	sd	—	m
Staphyleaceae	<i>Styrax benzoin</i> Dryand.	25	ba	—	—
Sterculiaceae	<i>Canella sinensis</i> (L.) O. Ktze.	276	lf	—	s
	<i>Franklinia alataniala</i> Marsh.	CNJ-296	ap-fl	—	m
Thymelaeaceae	<i>Daphne mezereum</i> L.	219	bk	—	m
	<i>Tilia americana</i> L.	208	lf, fl	—	—
	<i>Tilia europaea</i> L.	CNJ-164	ap-fr	—	m
Turneraceae	<i>Turnera diffusa</i> Willd.	91	lf	—	w
	<i>Celtis occidentalis</i> L.	CNJ-332	ap-fr	—	—
	<i>Ulmus fulva</i> Michx.	132	bk	—	w

(Continued on p. 98)

TABLE I (continued)

Family	Botanical name	Plant accession number	Plant part(s)	TLC	Fast Blue B (macro)	Microscopic
Umbelliferae	<i>Anni visnaga</i> (L.) Lam.	89	sd	—	—	—
	<i>Anethum graveolens</i> L.	96	fr	—	w	—
	<i>Angelica archangelica</i> L.	12	rz, rt	—	w	—
	<i>Aplium graveolens</i> L.	57	fr	—	—	—
	<i>Carum carvi</i> L.	49	fr	—	w	—
	<i>Contum maculatum</i> L.	76	lf	—	—	—
	<i>Contum maculatum</i> L.	77	fr	—	—	—
	<i>Cortlandrum sativum</i> L.	78	fr	—	—	—
	<i>Cuminum cyminum</i> L.	90	fr	—	—	—
	<i>Daucus carota</i> L.	CNJ-146	wp-fl	—	—	—
	<i>Daucus carota</i> L.	CNJ-412	fl	—	w	—
	<i>Daucus carota</i> L.	CNJ-413	lf	—	—	—
	<i>Daucus carota</i> L.	CNJ-414	st	—	—	—
	<i>Daucus carota</i> L.	CNJ-415	rt	—	—	—
	<i>Daucus carota</i> L.	19	olr	—	—	—
	<i>Ferula assafoetida</i> L.	125	fr	—	m	—
	<i>Foeniculum vulgare</i> Mill.	CNJ-242	wp-fr	—	—	—
	<i>Heracleum lanatum</i> Michx.	CNJ-334	fr, sd	—	w	—
	<i>Heracleum lanatum</i> Michx.	CNJ-93	wp-fr	—	—	—
Valerianaceae	<i>Pastinaca sativa</i> L.	14	fr	—	—	—
	<i>Plinipinella anisum</i> L.	160	rt	—	—	—
Verbenaceae	<i>Valeriana wallichii</i> DC.	CNJ-82	wp-fl	—	—	—
	<i>Verbena hastata</i> L.	CNJ-299	ap-fl	—	—	—
Violaceae	<i>Verbena hastata</i> L.	135	ap	—	—	—
	<i>Viola tricolor</i> L.	167	fl	—	—	—
Vitaceae	<i>Parthenocissus quinquefolia</i> (L.) Planch.	CNJ-184	ap-fr	—	s	—
	<i>Vitis labrusca</i> L.	CNJ-271	ap-fr	—	—	—
Zingiberaceae	<i>Vitis riparia</i> Michx.	CNJ-177	ap	—	s	—
	<i>Aframomum melegueta</i> (Rose.) K. Schum.	107	sd	—	—	—
Zygophyllaceae	<i>Circumia longa</i> L.	169	rz	—	—	—
	<i>Elettaria cardamomum</i> (L.) Maton	50	sd	—	—	—
Zygophyllaceae	<i>Zingiber officinale</i> Rose.	110	rz	—	—	—
	<i>Guaiacum officinale</i> L.	156	re	+	—	—

TABLE II

SUMMARY OF PLANTS GIVING POSITIVE TLC RESULTS IN FIGS. 1 AND 2

Plant accession number	Family	Botanical source	Common name
6	Boraginaceae	<i>Alkanna tinctoria</i> (L.) Tausch	Alkanet root
8	Liliaceae	<i>Aloe perryi</i> Baker	Socotrine aloe
9	Liliaceae	<i>Aloe ferox</i> Mill.	Cape aloe
10	Liliaceae	<i>Aloe vera</i> L.	Curaçao aloe
20	Salicaceae	<i>Populus balsamifera</i> Muenchh.	Balm of Gilead bud
32	Juglandaceae	<i>Juglans nigra</i> L.	Black walnut bark
43	Rhamnaceae	<i>Rhamnus catharticus</i> L.	Buckthorn berry
46	Juglandaceae	<i>Juglans cinerea</i> L.	Butternut root
51	Rhamnaceae	<i>Rhamnus purshiana</i> DC.	Cascara bark
56	Rubiaceae	<i>Uncaria gambir</i> Roxb.	Pale catechu
67	Myrtaceae	<i>Eugenia caryophyllata</i> Thunb.	Clove
68	Menispermaceae	<i>Anamirta paniculata</i> Colebr.	Fishberry
93	Euphorbiaceae	<i>Mallotus philippensis</i> Muell. Arg.	Kamala
130	Leguminosae	<i>Glycyrrhiza glabra</i> L.	Licorice root
156	Zygophyllaceae	<i>Guaiacum officinale</i> L.	Guaiac gum
161	Pinaceae	<i>Pinus strobus</i> L.	White pine bark
187	Compositae	<i>Tanacetum vulgare</i> L.	Tansy
189	Labiatae	<i>Thymus vulgaris</i> L.	Thyme
190	Labiatae	<i>Satureja hortensis</i> L.	Summer savory
195	Polygonaceae	<i>Rheum officinale</i> Baill.	Chinese rhubarb
210	Polypodiaceae	<i>Dryopteris filix-mas</i> (L.) Schott	Male fern
235	Myristicaceae	<i>Myristica fragrans</i> Houtt.	Nutmeg
240	Labiatae	<i>Origanum vulgare</i> L.	Wild marjoram
265	Pinaceae	<i>Pinus palustris</i> Mill.	Rosin
273	Myristicaceae	<i>Myristica fragrans</i> Houtt.	Mace

easily distinguished from them (*viz.*, no false positive positives). Moreover, the non-cannabis plants (extracts) shown in Fig. 2 were separately spiked with marijuana extracts and re-chromatographed under similar conditions. In all cases the high running marijuana spots were easily distinguished from the non-cannabinoid spots. Accordingly, all plant samples studied by TLC gave negative results according to the criteria established for the RIM test.

Specificity

A total of 526 non-marijuana plant samples representing 427 different plant species were subjected to the RIM test. No plants were found to exhibit false positive results and hence the RIM test appears to be relatively specific for marijuana.

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REFERENCES

- 1 A. B. Segelman, *J. Chromatogr.*, 82 (1973) 151.
- 2 F. Korte and H. Sieper, *J. Chromatogr.*, 13 (1964) 90.
- 3 M. J. de Faubert Maunder, *J. Ass. Pub. Anal.*, 7 (1969) 24.
- 4 M. J. de Faubert Maunder, *Bull. Narcotics*, 21 (1969) 37.
- 5 J. E. Forrest and R. A. Heacock, *J. Chromatogr.*, 89 (1974) 113.
- 6 M. L. Fernald, *Gray's Manual of Botany*, Van Nostrand, New York, 18th ed 1970.
- 7 J. C. T. Uphof, *Dictionary of Economic Plants*, Cramer, Würzburg, 2nd ed., 1968

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