AGASTACHE MEXICANA SUBSP. XOLOCOTZIANA (LAMIACEAE), A NEW TAXON FROM THE MEXICAN MEDICINAL PLANTS.

Robert Bye, Edelmira Linares, T. P. Ramamoorthy, Federico García, Ofelia Collera, Guadalupe Palomino, and Victor Corona

Universidad Nacional Autónoma de México
04510 México, DF, MEXICO

ABSTRACT. Ethnobotanical studies in Mexican markets revealed a new taxon of a cultivated plant, Agastache mexicana subsp. xolocotziana, differing from the typical A. mexicana morphologically, chemically and pharmacologically.

RESUMEN. Estudios etnobotánicos realizados en los mercados de México dieron a conocer un nuevo taxon de una planta medicinal cultivada, Agastache mexicana subsp. xolocotziana, la cual difiere del típico A. mexicana morfologicamente, quimicamente y farmacologicamente.

Agastache section Brittonastrum is centered in Mexico and adjacent United States. Fourteen species are divided into three series (Sanders, 1979). While conducting research on the botanical diversity in markets in central Mexico (Bye and Linares, 1983), the authors encountered what appeared to be a simple mutant of A. mexicana (HBK.) Lint & Epling of A. series Mexicanae. Subsequent collaborative studies suggest that it deserves taxonomic recognition as:

Agastache mexicana subsp. **xolocotziana** Bye, Linares et Ramamoorthy subsp. nov. A. mexicanae affinis, a qua corolla alba differt. Typus: MEXICO: México: mpio. Atlautla, San Juan Tepecoculco, 17 Sep 1984 Bye, Davis & Williams 13021 (holotypus MEXU).

Perennial herbs to 1.5 m tall with slender spreading rhizomes. The stem erect, branched, 4-angled, puberulous with white hairs, some of them reflexed. Leaves with petioles 0.5-1.5 cm long, the blades ovate-lanceolate, 2-2.5 cm long, 1-2.1 cm wide, generally acute at apex, obtuse to cuneate at base,

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RB, EL, GP & VC: Jardín Botánico, Apdo. Post. 70-614;
TPR: Herbario Nacional, Apdo. Post. 70-233;
FG & OC: Instituto de Química.

crenate-serrate except near tip where sometimes entire, largest teeth 2-2.5 mm long and these gradually reduced towards apex, surfaces glandular punctate, particularly below, often puberulent above, with 3-5 pairs of veins. The inflorescences terminating branchches, of interrupted verticils of many-flowered cymes; the internodes separating verticils 1-6 cm long, indumentum as in stem, the bracts to 1.7 cm long, linear-lanceolate, the bracteoles to 1 cm long, similar to bracts. The pedicels upto 0.4 cm long, white pilose. The calyx 1-1.3 cm long, hirtellous to pilose, the tube 7-8 mm long, teeth to 3 mm long, triangular acute, the upper set slightly longer than the lower. The corolla white, to 2.4 cm long, the tube to 1.8 cm long, dilated about 1/3 the distance from the base, 3-5 mm wide at throat, the upper lip bilobed, the lobes rounded, the lower of three lobes, the laterals smaller, 2 by 2 mm, rounded, the middle larger, extended into a flaring undulate 5 by 5 mm, large limb with a 2 mm wide and short claw bearing a few scattered trichomes on the upper surface. The stamens didynamous, exserted, the anther ca. 1 mm long. The style to 2.8 cm long, bifid at tip with the upper arm slightly longer. The ovules barely 0.5 mm high. The nutlets ca. 2.5 mm long, ca. 1 mm wide. Chromosome number 2n = 18. Cultivated throughout the year, and flowering from June through September. Distribution: cultivated in east-central Neovolcanic Axis, Mexico. TYPE: MEXICO: México: mpio. Atlautla, San Juan Tepecoculco, 17 Sep 1984 Robert Bye, Tilton Davis IV, & David Williams 13021 (holotype MEXU; isotypes to be distributed).

Efraim Hernández Xolocotzi, for whom we dedicate this new taxon, has been an inspiration to all of us interested in useful plants of Mexico. We take this opportunity to honor him with this plant which reflects his philosophy as we perceive it: 1) interdisciplinary approach to ethnobotany 2) importance of markets in ethnobotanical studies, 3) the evolutionary influence of indigenous peoples on the Mexican flora and 4) ethnobotany in the service to Mexican peoples.

SPECIMENS EXAMINED: **MEXICO**: DISTRITO FEDERAL: Delegación V. Carranza, Mercado Sonora. Origin: San Juan Tepecoculco, México, 23 Jul 1983 Bye & Linares 12214; Origin: Ozumba, México, 29 Sep 1985 Bye & Linares 14138; Origin: Santa Catarina del Monte, México, 23 Jun 1986 Bye & Linares 14631; Origin: state of México, 17 Jul 1980 Galindo 1 (IMSSM); Origin: Cholula, Puebla, 13 Jun 1986 Bye, Linares & Flores 14576. Delegación Milpa Alta, Mercado Milpa Alta. Origin: Santa Ana Tlacotenco, 28 Sep 1985 Bye & Linares 14128. MEXICO: Mpio. Atlautla, San Juan Tepecoculco, 2 Feb 1982 Bye &

Linares 10701, 17 Sep 1984 Bye, Davis & Williams 13020, 13021, 18 Jan 1985 Bye, Linares & Ramamoorthy 13566, 5 Jun 1985 Bye & Linares 13714; Mpio. Toluca, Toluca, Mercado Benito Juárez. Origin: Mercado Sonora, Distrito Federal, 23 Sep 1984 Bye & Linares 13044; San Andres Timilpan, Barrio Iturbide, 1 Oct 1983 Camacho 390 (IMSSM). MORELOS: Mpio. Cuernavaca, Cuernavaca, 25 May 1985 Bye & Linares 13690; Mpio. Tepoztlán, San Juan Tlacotenco, 21 Jun 1985 Bye, Linares, Ramamoorthy & Meraz 13782. Except those collections from IMSSM, these specimens are deposited in MEXU and the duplicates will be distributed.

This plant is generally called **toronjil blanco** and is part of the medicinal plant complex, **los tres toronjiles.** The other members of this complex are **toronjil morado** or **toronjil rojo** (Agastache mexicana) or Mexican giant hyssop (Bailey and Bailey, 1976) and **toronjil azul** or **toronjil chino** (Dracocephalum moldavica L.), an annual cultivated herb of Eurasian origin.

The infusion of **toronjil blanco** along with other plants is valued in treating various gastrointestinal, nervous, and cardiovascular ailments (Baytelman, 1979; Gali, 1984; González, 1981; Linares et al., 1984; Martínez, 1969) as well as such cultural bound illnesses as "espanto" and "susto" (González, 1981; Sandoval, 1977). The herb is drunk as an aromatic tea after meals. **Toronjil morado** has a pungent licorice flavor and aroma while **toronjil blanco** has a subtle lemon fragrance. Both of these **toronjiles** can be used fresh or dried while **toronjil azul** is employed only fresh because of the loss of its aromatic properties upon drying. The native **toronjiles** are preferred to the foreign types (e.g. **toronjil europeo** or **meliza** (Melissa officianalis L.) (Sociedad Farmaceútica de México, 1904). On the "hot-cold" spectrum of indigenous medical systems, the **toronjiles** are classified as "fresh."

Both native **toronjiles** are cultivated in monocultures of small plots and home gardens for domestic consumption and sale. Occasionally wild plants are collected but this practice has decreased considerably in recent years due to the extinction of the local populations. Both forms are said to have been introduced into cultivation by transplanting wild plants and subsequently dividing the rhizomes for vegetative propagation. Field work with **toronjil** collectors in the mountains south and east of the Valley of Mexico failed to encounter any wild populations of **toronjil blanco** while a few depauperate **toronjil morado** populations were found. Plantings of both **toronjiles** are

subject to diebacks, fungal infections and insect predation. Propagation of new plants from seeds has not been practiced because the herbs are said to be most aromatic prior to and during anthesis at which they are harvested.

Although the magenta red flower form has been cited in early post-conquest documents (De la Cruz, 1964; Hernández, 1959) as **tlalahuehuetl** and **tlalamatl**, respectively, the white flower form did not appear in the literature until the first half of the 20th century (Martínez, 1939).

Agastache mexicana subsp. xolocotziana differs from the typical A. mexicana in several characters. Morphologically, the most visual character distinguishing it is its white corolla (rather than red). Among other morphological features are the presence of trichomes on the claw of the corolla's lower lip (rather than absence), the near complete nature of crenation on the margin (rather than serration confined to the lower half of the margin), and the acute leaf apex (rather than acuminate). The subspecies xolocotziana shares with the typical subspecies such characteristics as general inflorescence and floral structure, herbaceous perennial habit, pine-oak forest habitat and same chromosome number ($2n=18$). Although **toronjil blanco** shares some of the common chemical constituents with A. mexicana, it has the following unique compounds: breviflorine, a clerodane type diterpenoid; flavonoids, chrysine and pratol; and essential oil principally formed of bornil acetate (Contreras et al., 1986). Pharmacologically, infusions of **toronjil blanco** produced effects opposite those of **toronjil morado** (Galindo, 1982). These infusions of 25 gm of dried herb in 300 ml of double distilled water contracted markedly the aorta, bladder, intestinal and uterine muscles and increased considerably the amplitude to contraction in frog hearts. Horticulturally, stem rooting of **toronjil blanco** was significantly lower than that of **toronjil morado** based upon different propagation treatments and measuring primary and secondary roots, root length and root diameter (Chávez, 1986).

The origin and phylogenetic relationship of **toronjil blanco** is currently under study. As a working hypothesis we suggest that it is a product of hybridization and introgression between A. mexicana and A. palmeri (Robins.) Lint & Epling with which Roger Sanders (pers. comm.) concurs. Agastache mexicana has an interrupted inflorescence of relatively long flowers pollinated by specialist bees and hummingbirds. It is found on Transvolcanic Axis which runs perpen-

dicular to the Sierra Madre from Michoacán to Veracruz. Agastache palmeri has a compact inflorescence of short flowers pollinated by generalist bees. It is distributed in the Sierra Madre Oriental from Coahuila to the Sierra's prolongation in southern Puebla, northern Oaxaca and adjacent Veracruz. Agastache palmeri var. breviflora (Regel) Sanders is narrowly sympatric with A. mexicana. Sanders (1979, p.232) identified two wild putative hybrids from Hidalgo (Jimate s.n., ENCB) and México (Paray 1590, ENCB). However, the authors consider these two specimens to fall within the normal range of typical A. mexicana and, consequently, do not share the diagnostic features of subsp. xolocotziana.

The speciation of Agastache section Brittonastrum has been characterized by geographical isolation and depletion of variability followed occasionally by hybridization, introgression and further isolation (Sanders, 1979). During glaciation, it is thought that ancestors of the species of A. series Mexicanae migrated south along the Cordilleras. Subsequent range reduction, isolation and selection by pollinators (in particular hummingbirds) lead to rapid divergence. It is possible that an A. mexicana - A. palmeri hybrid product survived during the present interglacial period and was subsequently selected and isolated by its cultivation by humans in pre- or post-Conquest Mexico. Although unknown to the authors in the wild state, it has been documented in cultivation in Distrito Federal, Morelos, and the State of México, all on the Transvolcanic Axis. Preliminary interform crosses (between **toronjil morado** and **toronjil blanco** and reciprocals) are less fertile (n=54, seed set = 30%; n=29, seed set = 21%, respectively) than intraform **blanco** crosses (n=17, seed set = 47%). Future field, garden and laboratory studies should clarify the origin and relationship of A. mexicana subsp. xolocotziana.

Because of the cultural and economic importance of **toronjil blanco** and its biological differences and reproductive isolation, we think that it is worthy of taxonomic status. Because it is strongly associated with humans and its survival depends upon cultivation, we have selected the classification philosophy with a genetic perspective that was proposed by Harlan and de Wet (1971). **Toronjil blanco** and **toronjil morado** belong to the same gene pool (gp-1). The cultivated (and genetically altered) races of **toronjil blanco** belong to subsp. xolocotziana, while spontaneous races (including unselected transplants) of **toronjil morado** or **rojo** are classified as A. mexicana subsp. mexicana.

Two actions are urgently needed with respect to both subspecies of Agastache mexicana. First, native populations should be located and protected from over exploitation and habitat destruction. Second, direct interaction is needed to propagate the various races under cultivation. In order to justify more human effort in the conservation of **toronjil**, commerialization could be initiated for both subspecies so as to make cultivation more attractive economically than wild collection. These and other species are valued for domestic consumption and in local markets; some species are even exported to other regions of Mexico and the world. Chemical analysis of **toronjil blanco** have indicated the relatively high production of certain compounds of pharmaceutical, pesticide and perfumary value. If these substances are the results of hybridization, the elucidation of the evolutionary origin of **toronjil blanco** can be a guide to future breeding programs.

Specific data on the biosystematics, chemistry, cytogenetics, ethnobotany and horticulture will be published in the future by the collaborators and their students.

ACKNOWLEDGEMENTS

The herb vendors, campesinos and native health practitioners shared generously their knowledge, experiences, plants and hospitality. The staff and students associated with the Jardín Botánico, Herbario Nacional (MEXU), Instituto de Biología, Instituto de Química and Facultad de Ciencias of the Universidad Nacional Autónoma de México, Escuela Nacional de Ciencias Biologicas of the Instituto Politecnico Nacional (ENCB), Unidad de Investigación Biomédica en Medicina Tradicional y Desarrollo de Medicamentos of the Instituto Mexicano de Seguro Social (IMSSM), and Jardín Botánico Medicinal y Museo de Medicina Tradicional (Morelos) of the Instituto Nacional de Antropología e Historia assisted in various parts of the study. We are particularly indebted to the following students: Bernarda Contreras Trejo, Carmen Yenitzia Chávez Carpio, Alejandro Díaz, Lilia Patricia Espiritu V., Carlos Guido Formosa, Noé Meraz Cruz, Laura Elizabeth Nava Ramirez, Ernesto Olmos Cabrera, and Martha L. Rodriguez Morales. Roger W. Sanders kindly shared his knowledge and opinions with us. B. L. Turner, W. A. Weber, and Margarita Aviles helped in various ways. F. Chiang assisted with the Latin diagnosis. Financial support for chemical analysis was provided by CONACyT PCCBBNA 021142.

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