

Jaltomata chihuahuensis (Solanaceae): A New Combination and Observations on Ecology and Ethnobotany

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ABSTRACT. The new combination *Jaltomata chihuahuensis* (Bitter) Mione & Bye is based on *Saracha chihuahuensis* Bitter. This species is distributed in Mexico at the northern end of the Sierra Madre Occidental in the states of Chihuahua, Durango, and Sonora. Morphological characters, artificial hybridizations, and distinct names applied by the Tarahumara, all indicate that *J. chihuahuensis* is distinct from the more widely distributed but sympatric *J. procumbens*. Fruits of *J. chihuahuensis* are consumed raw by the Tarahumara people and are either purple or green at maturity. Chromosome number: $n = 12$.

Jaltomata is a diverse genus of about 30 species of herbs and small shrubs that are distributed from Arizona, U.S.A., to southern Bolivia, on the Galápagos Islands, and in the Greater Antilles. This paper is part of ongoing series of studies of the taxonomy, phylogeny, breeding biology, and ethnobotany of this genus (D'Arcy et al., 1992; Davis, 1986; Davis & Bye, 1982; Knapp et al., 1991; Mione, 1992; Mione & Coe, 1992; Mione et al., 1993; Mione et al., 1994).

Ethnoecology. There are two races of *Jaltomata chihuahuensis*, one with purple fruits and the other with green fruits. Without mature fruits the two races appear to be morphologically indistinguishable. Based on greenhouse and garden studies of three accessions, we are certain that plants do not produce both types of fruits, nor do the mature green fruits become purple with age or exposure to sunlight. Information obtained (by R. B.) from the Tarahumara during ethnoecological studies in Chihuahua, Mexico, agrees with these observations. Based on greenhouse studies, fruits of the purple race are typically green when they drop and then become purple within a few days.

The two races may occupy different niches. Preliminary observations (by R. B.) are that the green-fruited race tends to occur among white volcanic

rocks in soil with higher apparent organic matter. The purple-fruited race, however, is not found among white volcanic rocks nor in soil with high organic matter. The rootstock ("camote") of the purple-fruited race is eaten by the Tarahumara (Davis & Bye, 1982: 232). Further study is needed to explore the possibility of niche specificity of the two races.

Jaltomata procumbens (Cavanilles) J. L. Gentry, a widespread species that is common within the smaller range of *J. chihuahuensis*, is generally called "rurusí," "rurusí," "ruruši," or "turusí" by the Tarahumara (e.g., Bye 9875, 9889, COLO; Davis 1124, 1127, MO; Brambila, 1976; Pennington, 1963). *Jaltomata chihuahuensis*, on the other hand, is often referred to as "metárusi" or "me'táresi" (which is a "jaltomate rastrero" or creeping jaltomate, Brambila, 1976); these names are probably derived from the Tarahumara verb "me'tárema" ("to be creeping"). Some Tarahumara believe "metárusi" to be a class of "rurusí" (Bye, unpublished). Thus the Tarahumara recognize the distinction between *J. procumbens* and *J. chihuahuensis*.

In most *Jaltomata* species, at maturity fruits remain attached to the parent plant for at least a few days, and the accrescent calyx darkens when the fruit ripens. The color of the calyx (purple to brown) stands in contrast with the foliage and presumably serves, along with the brightly colored fruit, as a beacon to diurnal fruit consumers/dispersers. However, the fruits of *J. chihuahuensis* fall at maturity and the calyx remains green. Unlike most species of *Jaltomata*, which exhibit articulation at the base of the pedicel, articulation is at the attachment of the fruit; the calyx-pedicel unit remains attached to the plant for at least several days after the fruit drops. Human selection may result in a change from fruits falling free of the parent plant in wild species to fruits remaining attached to the parent

plant at maturity (e.g., the nonshattering rachis of domesticated cereals, Heiser, 1990). The consumption of fruits by the indigenous people, perhaps subjecting the plants to human selection, has not had this effect on *J. chihuahuensis*.

Fruits falling free at maturity is among the features of the syndrome of saurochory (reptile dispersal) (van der Pijl, 1969), and saurochory is thus a possibility for *J. chihuahuensis*, if not now then possibly prior to extensive utilization by humans. Alternatively, fruits falling free at maturity may indicate no adaptation for dispersal, and may merely have become fixed by genetic drift at some time when population size was small. In any case, fruits falling free at maturity suggests that this species is not regularly bird dispersed, although it is possible that birds feed on the fruits that have fallen to the ground. The Tarahumara Indians consume the fruits that fall to the ground, and it is likely that seeds survive the human digestive tract and so become dispersed by humans (Davis & Bye, 1982; Davis, 1986).

Humans have selected for light color in diverse domesticates (e.g., white lupines, quinoa, sheep, and camels) (Heiser, pers. comm.; Zeuner, 1963). It is thus possible that green-fruited mutant(s) within *J. chihuahuensis* were selected by humans, giving rise to the green-fruited race. Evidence that may be considered as strengthening this scenario is that to humans green fruits are sweeter than purple fruits (Bye, unpublished). Alternatively, humans may have had nothing to do with the establishment of the green-fruited race but may merely have begun to regularly consume the fruits.

Phylogenetic placement. Based on chloroplast DNA restriction sites there are two principal, sister phylogenetic groups within *Jaltomata* (Mione et al., 1994). The "Mesoamerican" group, having its center of diversity in Mexico, is widely distributed from the southwestern United States to Bolivia. The "South American" group is distributed in Andean South America, the Greater Antilles, and the Galápagos Islands. Within the Mesoamerican clade the rarest and most morphologically distinct species, *J. grandiflora* (Robinson & Greenmann) D'Arcy, Davis & Mione, forms the most basal branch, and *J. chihuahuensis* forms the second to most basal branch (Mione et al., 1994).

Artificial hybridizations. Crosses were made in a pollinator-free greenhouse (by T. M.). Flowers used as pollen recipients were emasculated prior to anther dehiscence. No fruits were set from 18 crosses of *J. procumbens* with *J. chihuahuensis* (pollen source), nor from 12 of the reciprocal crosses. Two accessions of *J. chihuahuensis* were used (Bye

14243 green fruits, Davis 1180 purple fruits). Six accessions of *J. procumbens* from Mexico were used (Davis 1189A, 1191, 1124, MO; Bye 9889, 10033, 10084, COLO), the latter four from Chihuahua. The following observations may be considered controls for the above crosses. Both *J. chihuahuensis* and *J. procumbens* abundantly self-set fruit in a pollinator-free greenhouse. Within *J. chihuahuensis* an uncounted number of interaccession crosses have been successful (for study of the genetic control of fruit color), and within *J. procumbens* intraccession and interaccession crosses virtually always result in fruit set.

Taxonomy. *Jaltomata chihuahuensis* has been considered to be a synonym of *J. procumbens* (Morton, 1938; Davis, 1986, discussed as the prostrate morph/form of *J. procumbens*; Nee, 1986). Our decision to recognize this species and make the following new combination was based on morphological characters of both living plants (in the greenhouse and garden as well as in the field) and herbarium specimens, artificial hybridizations, and chloroplast DNA (Mione et al., 1994). Chromosome counts of $n = 12$ were obtained for both *J. chihuahuensis* (Davis 1180) and *J. procumbens* (Bye 10033). Meiocytes were stained by crushing immature anthers with a fine dissecting needle in a drop of filtered acetic carmine.

On pressed specimens of *Jaltomata chihuahuensis* the fruit is usually partially hidden by the calyx, because on living plants fruits are pendent and the calyx (an upside-down, five-lobed funnel) hides the fruit from side view (Fig. 1). On pressed specimens of *J. procumbens*, however, the calyx is more likely to lie flat against the sheet because on living plants the fruiting calyx is rotate (Fig. 1). Table 1 compares selected morphological characters of *J. chihuahuensis* and *J. procumbens*. Based on hundreds of measurements made on plants grown during several years, these two species cannot be distinguished (due to overlapping ranges) with any one of the following characters: number of flowers per inflorescence, peduncle length, pedicel length, calyx diameter, corolla diameter, stamen length, anther length, style width at midlength, fruit length or width, or seed length.

Jaltomata chihuahuensis (Bitter) Mione & Bye, comb. nov. Basionym: *Saracha chihuahuensis* Bitter, Repert. Spec. Nov. Regni Veg. 18: 108. 1922. TYPE: Mexico. Chihuahua, [Mpio. Casas Grandes]: "bei Colonia Garcia in der Sierra Madre, 2400 m." 18 July 1899, C. H. T. Townsend & C. M. Barber 91 (lectotype, selected here, MO; isotypes, K, NY, P; holotype designated by Bitter *l.c.* as "hb. Berol." presumed destroyed).

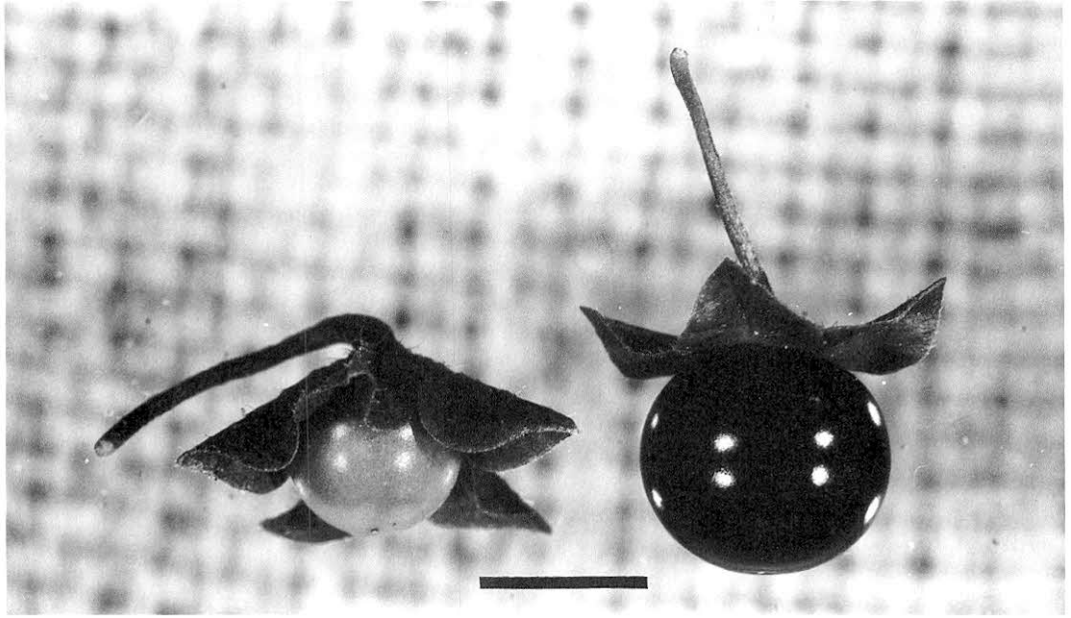


Figure 1. Mature fruits of *Jaltomata chihuahuensis* (left, *R. A. Bye 18329*) and *J. procumbens* (right, *R. A. Bye 10084*). Photos taken in Connecticut from plants grown from seed collected in Chihuahua, Mexico. Bar = 1 cm.

Other specimens examined. MEXICO. **Chihuahua:** Mpio. Bocoyna, Bocoyna valley, between Bocoyna and Creel, 2200 m, 13 July 1973, *R. A. Bye 4201B* (ECON); Creel, railroad crossing, 20 July 1973, *R. A. Bye 4295* (COLO); Creel and Río Oteros, along the mesa ridge, 19 Sep. 1973, *R. A. Bye 5253* (COLO); Creel and San Ignacio, 7300', 15 Sep. 1973, *R. A. Bye 5069* (COLO, ECON, MEXU); Creel, 7200', 29 June 1977, *T. Davis 700* (MO); Creel, rd. from Creel to Cusárare, 19 Aug. 1984, *T. Davis 1182* (MO); Gonogochic, 7400', 23 May 1973, *R. A. Bye 3832* (ECON); Gonogochic, 7400', 19 July 1973, *R. A. Bye 4286* (ECON); Gonogochic region E of Creel, 7400',

21 July 1973, *R. A. Bye 4309* (COLO, ECON); Gonogochic, 7400', 7 Sep. 1973, *R. A. Bye 4910* (ECON); Gonogochic, E of Creel, 2250 m, 13 Oct. 1980, *R. A. Bye 9863* (COLO); Gonogochic school, 12 July 1974, *R. A. Bye 6286* (COLO); Gonogochic, 2280 m, 12 Aug. 1977, *R. A. Bye 7931* (COLO, MEXU); Gonogochic, ejido San Ignacio Arareco, 2250 m, 17 Oct. 1980, *R. A. Bye 10007* (COLO, MO); Gonogochic, ejido San Ignacio Arareco, 2250 m, 23 Oct. 1980, *R. A. Bye 10094* (COLO, MO); Río Oteros, 2194 m, 29 June 1977, *T. Davis 705* (MO); San Ignacio Arareco, near Creel airstrip, 7300', 9 Aug. 1972, *R. A. Bye 2699* (COLO, MEXU); San Ignacio, 17 Oct. 1977, *R.*

Table 1. Comparison of some characters of *Jaltomata chihuahuensis* and *J. procumbens* in northern Mexico.¹

Character	<i>J. chihuahuensis</i>	<i>J. procumbens</i>
Habit	prostrate	erect
Vesture	hirsute stems, leaves and buds	variable
Calyx (fruiting) color	green	green and purple
Calyx (fruiting) lobe shape	obtuse or obtuse-acuminate	triangular to broadly triangular
Corolla lobing	5 lobes	5 lobes alternating with 5 lobules
Position of corolla lobes during hermaphroditic phase ²	often retrorse	rotate
Outward angle of filaments relative to style, during day of anther dehiscence ²	0° to 15°	45°
Mature fruit color	purple or green	black/dark purple
Time of fruit drop	at or just before fruit maturity	at least several days after fruit maturity

¹ Specimens studied for this table were all collected in Chihuahua, Mexico.

² Flowers are pistillate with very short filaments and undehisced anthers during their first day open. During the next day filaments elongate and anthers then dehisce, the flower becoming functionally hermaphroditic.

A. Bye & *W. A. Weber* 8290 (COLO, MEXU): San Ignacio Arareco, NW of Gonogochic, 21 Aug. 1978, *R. A. Bye* 8722 (COLO, NY); San Ignacio Arareco, cerca de la cueva de Sebastian Gloria, 2330 m, 9 Sep. 1987, *R. A. Bye* & *T. P. Ramamoorthy* 15691 (MEXU); San Ignacio Arareco, cerca limite con Creel, SE de Cueva de Sebastian Gloria, 2360 m, 11 Oct. 1991, *R. A. Bye et al.* 18329 (MEXU); San Juanito, near km 17 on San Juanito-Basaseachi Rd., 13 Oct. 1980, *R. A. Bye* 9858 (COLO, MO); San Juanito, between San Juanito and Basaseachi, near km 48, 12 Oct. 1980, *R. A. Bye* 9859 (COLO, MO); Mpio. Guachochi, Arroyo Colorado, S of Creel, 2225 m, 1 July 1977, *T. Davis* 711 (MO); Barranca de Cobre, 1828 m, 1 July 1977, *T. Davis* 713 (MO); Cabañas del Cobre, 2343 m, 23 June 1982, *T. Davis et al.* 1101 (MO); Cumbre de Hualayua, 29 Sep. 1894, *C. Lumholtz s.n.* (GH, US); Cusárare, S of Creel, ravine near the new SSA water tank, 11 Sep. 1973, *R. A. Bye* 5013 (COLO); Cusárare, along path to falls, 29 June 1977, *T. Davis* 709 (MO); Cusárare, corn field next to church, 23 June 1982, *T. Davis* 1107 (MO); La Bufa-Guachochi junction, 19 Aug. 1984, *T. Davis* 1179, 1180 (source of *J. chihuahuensis* DNA in Mione et al., 1994), and 1181 (MO); Norogachi, along arroyo, 2033 m, 31 May 1984, *T. Davis et al.* 1129 (MO); Bridge over río Urique, along Creel-Guachochic Road, 22 Oct. 1980, *R. A. Bye* 10087 (COLO); Río Urique, al lado S de Barranca del Cobre, ca. km 61 de camino Creel-Guachochi, 1740 m, 7 Oct. 1985, *R. A. Bye* & *E. Linares* 14243 (source of *J. chihuahuensis* DNA in Mione et al., 1994) (COLO, MO); Samachique, 6890', 22 July 1971, *R. A. Bye* 1608 (COLO, GH); Samachique, along Creel-La Bufa Rd., ca. 0.2 rd. mi. from Samachique road junction, 19 Oct. 1980, *R. A. Bye* 10034 (COLO, MO); Mpio. Guerrero, W of La Junta on Mexico 16, near Campo Miñaca, above arroyo, 12 Oct. 1980, *R. A. Bye* 9835 (COLO); Mpio. Madera, Chuhuchupa, Aug.-Sep. 1936, *Harde LeSueur* 890 (F, US); Chu-huichupa, 29 Sep. 1939, *C. H. Muller* 3569 (GH); Mpio. Ocampo, Cascada de Basaseachi, 13 Oct. 1980, *R. A. Bye* 9837 (COLO); Cascada de Basaseachic, 3 km al SE de Basaseachic, 1960 m, 26 Sep. 1983, *R. Torres C. & P. Tenorio L.* 3765 (MEXU, MO, NY). **Durango:** Mpio. El Salto, 17 mi. W of El Salto, 12 Aug. 1956, *U. T. Waterfall* 12701 (F); El Salto, hwy. 40, 2500 m, 29 July 1991, *Mayfield et al.* 1075 (MEXU); Mil Diez, 2 km N de El Salto, 2200 m, 27 June 1982, *R. Hernández M. & P. Tenorio* 7424; Mpio. Santiago Papasquiaro, Laguna la Chaparra, 18 July 1982, *P. Tenorio L. & C. Romero de T.* 1075 (MEXU); Paraje Bajío de Vacas, ejido de Hacienditas, 2700 m, 27 July 1990, *A. Benítez* 1570 (MEXU); Mpio. Tepehuanaes, Buenos Aires-Mesa de Navar, 2570 m, 19 Dec. 1989, *A. Benítez* 618 (MEXU); Buenos Aires, 36 km al W de Tepehuanaes, 22 July 1982, *P. Tenorio L. & C. Romero de T.* 1173 (MEXU, MO). **Sonora:** Mpio. Bavispe, Las Tierritas de El Temblor, Sierra de El Tigre, Aug. 1940, *S. S. White* 3432 (GH).

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