

## MULTIPURPOSE FUNCTIONS OF HOME GARDENS FOR FAMILY SUBSISTENCE

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**Abstract:** The floristic composition, species similarity and adopted management practices of 24 home gardens in central Mexico were studied. We investigated the multifunctional role of home gardens and their species richness and focused on food and medicinal plants because they were the largest contributors to families' needs. Data were obtained by interviewing home garden owners, walking through each home garden, and recording field observations. The floristic composition, use, and management practices were documented. The similarity between home gardens was estimated by listing the most frequently mentioned and most important plants. A total of 189 species were recorded, which were classified into eight use types, mainly corresponding to ornamental (48 %), edible (32 %), religious (20 %), and medicinal (20 %) plants. Some species presented more than one application. The similarity between home gardens based on the most cited and important species was 40 %. In 62 % of the home gardens, > 42 % of the species were edible. Among the recorded plants, 84 % were cultivated, 17 % were enhanced, 15 % were tolerated, and 4.2 % were protected. Plants were obtained through purchase, exchange and collection and included exotic species. Plant production was performed predominantly for self-supply, but 25 % of the owners sold corn, squash, ciruela and escoba surplus. The resources provided by the home gardens met the food preferences of the families. Medicinal plants were less important, and ornamental plants represented a luxury. The importance of home gardens as areas with multiple functions, including self-supply and improvement of family life, is highlighted.

**Key words:** edible plants, medicinal, ornamental, plant exchange, relaxation.

**Resumen:** Se estudiaron la composición florística, semejanza de especies y las prácticas de manejo en 24 huertos familiares del centro de México. Investigamos el papel multifuncional de los huertos, la riqueza de especies y nos enfocamos en las plantas alimenticias y medicinales, porque son las que más contribuyen a las necesidades familiares. Los datos se obtuvieron por entrevistas al responsable del manejo del huerto, caminando en cada huerto y registrando observaciones de campo. Se documentó la composición florística, uso y manejo. Se enfatizó en las plantas alimenticias y medicinales debido a que son las que más contribuyen a las necesidades familiares. Con las listas de plantas más mencionadas y más importantes se calculó la semejanza entre huertos. Se registraron 189, clasificadas en ocho tipos de uso, principalmente el ornamental (48 %), el alimenticio (32 %), el religioso (20 %) y el medicinal (20 %). Hay especies con más de un uso. La semejanza entre huertos por las especies más citadas e importantes fue de 40 %. En el 62 % de los huertos, > 42 % de las especies fueron alimenticias. El 84 % de las plantas fueron cultivadas, 17 % fueron fomentadas, 15 % fueron toleradas y 4.2 % fueron protegidas. La obtención de plantas fue a través de compra, intercambio y recolección, e incluye especies provenientes del extranjero. La producción se destina al autoabasto, pero el 25 % de los propietarios, vende los excedentes de maíz, calabaza, ciruela y escoba. Los recursos que brindan los huertos familiares satisfacen las preferencias alimentarias de las familias. Las plantas medicinales son menos importantes. Las plantas ornamentales representan un lujo. Se resalta la importancia del huerto como espacio de función múltiple, de autoabasto y mejora en la vida familiar.

**Palabras clave:** plantas alimenticias, intercambio de plantas, medicinales, ornato, relajación.

Home gardens are sustainable agroecosystems characterized by high diversity and their role as reservoirs for the storage and handling of germplasm (Cano-Ramirez *et al.*, 2012; Maroyi, 2013). Home garden species typi-

cally have multiple uses, meeting family needs for food, medicine, shade, religious rituals and ornamental purposes (Blanckaert *et al.*, 2004; Abebe *et al.*, 2010; Boege, 2010), and these species can be cultivated, tolerated, enhanced, and

protected (Casas *et al.*, 1997; Toledo *et al.*, 2003). Tolerance includes practices within human-made environments that are directly related to the conservation of useful plants that existed before the environments were transformed. Enhancement consists of different strategies that increase the population density of useful plants. Protection includes conscious care activities, such as the elimination of competitors and predators, fertilization, pruning, and protection against frost.

Some of the roles of home gardens are of a socio-cultural nature, such as coexistence and the generation of alternative livelihood (Abebe *et al.*, 2010; Boege, 2010), in addition to the aesthetic and religious use of their components (Lope-Alzina and Howard, 2012; FAO, 2000). However, the species composition has changed over time as a result of urbanization and modernization (Caballero, 1992; Mariaca, 2012). Currently, the floristic composition of home gardens tends toward ornamental plants (Blanckaert *et al.*, 2004; Neulinger *et al.*, 2013).

Decisions regarding the composition, structure, use, and management of the plant resources of home gardens are dynamic and vary among people. These decisions are related to the needs the plants fulfill and the human cultural importance attributed to the plants (Thomas and Van Damme, 2010). Not all plants receive the same attention. The choice of certain species is associated with their use in community celebrations or as foods consumed in everyday life and the use of certain species to treat diseases for generations (Cano-Ramírez *et al.*, 2012). A plant's use value and the time invested in taking care of home gardens are influenced by people's satisfaction, mainly with respect to the direct consumption of products by households and their commercialization (Albuquerque *et al.*, 2005; Blancas *et al.*, 2013). In Latin America, the purpose of home gardens is related to the edible, medicinal and aesthetic uses of a particular species, which are the most common factors due to the high frequency of these uses (Srithi *et al.*, 2012). In Mexico, where most studies have been conducted on the Yucatan Peninsula, Caballero (1992) observed relative similarity in the floristic composition of home gardens among villas, but variation between regions. Neulinger *et al.* (2013) reported a clear differentiation of the floristic composition between Mestizo and Maya home gardens. In Morelos, Mexico, home garden plant resource management has been documented as an indicator of the ecological and economic sustainability of the system (Colín *et al.*, 2012).

In this study, the floristic composition of home gardens, the similarity between them, the applied management practices and the contribution of edible and medicinal species to household subsistence in Tilzapota village, Morelos, were analyzed. We explored the hypotheses that home gardens have multiple uses, and that a higher floristic richness and greater number of edible and medicinal plants improve the familial subsistence.

## Materials and Methods

**Study area.** Tilzapota is located in central Mexico, in the municipality of Puente de Ixtla, southern Morelos (Figure 1), between  $18^{\circ} 37' 02''$  and  $18^{\circ} 38' 32''$  north and  $99^{\circ} 17' 27''$  and  $99^{\circ} 19' 26''$  west, with an average elevation of 1,004 m. This region exhibits a warm sub-humid climate of the Awo"(w)(i')g type, a mean annual temperature of  $22^{\circ}\text{C}$ , and an average annual rainfall of 800 mm (García, 2004). The vegetation is described as a tropical deciduous forest, with relics of oak forest (Rzedowski, 1978). Tilzapota was founded in 1919 and has 4,789 inhabitants (INEGI, 2010a), whose activities are dedicated to mining, livestock, irrigation and wet season agriculture. The land tenure is communal; sorghum (*Sorghum bicolor* Moech), corn (*Zea mays* L.), sugarcane (*Saccharum officinarum* L.) and beans (*Phaseolus* sp L.) are grown for sale and direct consumption. Migration to the USA has generated dynamic communication and knowledge exchange regarding the management of home gardens.

**Sampling design.** Home gardens (HGs) were identified and counted (a total of 267) using orthophotos at a scale of 1:10,000 (INEGI, 2010b). A sample of 24 HGs was randomly selected without replacement (Figure 2). Field information from these home gardens was collected from 2011 to 2013.

**Information collection and analysis.** Semi-structured interviews with the 24 home garden owners were performed based on Bernard's (2006) methodology. In the first interview, each interviewee was asked the following questions to obtain a list of the most frequently mentioned home garden plants: "What plants do you use?"; "What are their uses?"; and "Which are the three most important plants?" Subsequently, the similarity between the most frequently listed species and the most important species of the 24 home gardens was calculated using the Sorenson index (Magurran, 1988):

$$IS_s = [2C/A+B] \times 100$$

where  $A$  = total species in sample 1,  $B$  = total species in sample 2, and  $C$  = number of exclusive species in both sam-

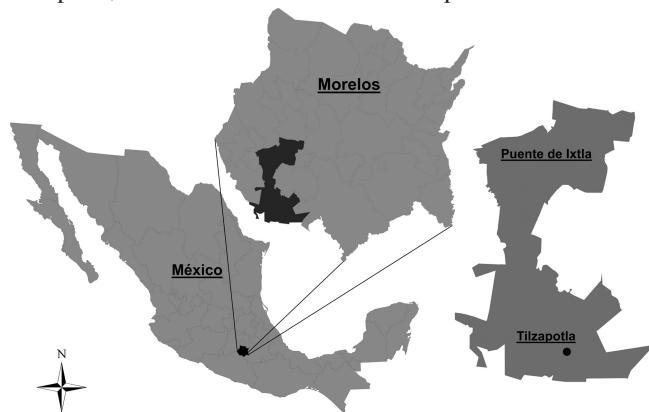


Figure 1. Location map of Tilzapota, Morelos.

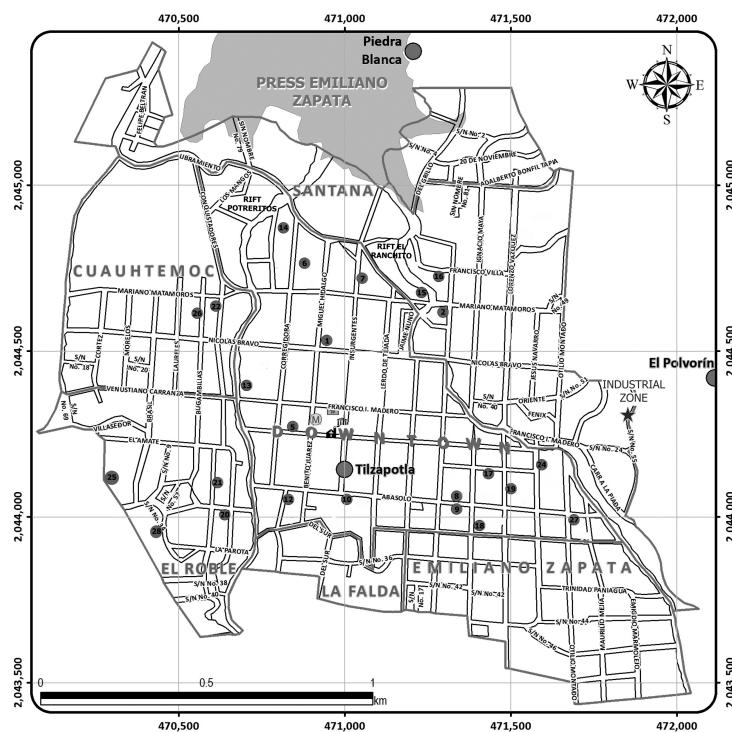


Figure 2. Map of Tilzapota, with number of homegardens visited.

ples. Because of the prevalence of edible plants recorded in these interviews, a second stage of interviews and field observations was conducted, and information on edible plants was obtained based on four questions of interest: “Which part of the plants do you use?”, “How do you prepare it?”, “How do you preserve these parts?”, and “What is the frequency of use?” For medicinal plants, the following questions were also asked: “Which part of the plant do you use?”, “How do you prepare it?”, and “What illnesses does this plant treat?” The illnesses were classified using the *Atlas de Plantas de la Medicina Tradicional Mexicana* (Argueta, 2009), and the frequency at which the plant was mentioned was also recorded.

Trail walks were carried out, and the occurrence of plant species was documented to describe the floristic composition and use. To analyze similarity in terms of floristic composition, a presence-absence matrix of species was developed. For this analysis, 137 species were considered; the remaining species were removed because their presence was considered rare, and they did not contribute to the floristic differentiation among home gardens. A similarity analysis

was performed using the Jaccard coefficient and NTSYS-pc ver. 2.1 software (Rohlf, 2000).

All plants were classified according to their use and management type (Bye, 1993; Casas *et al.*, 1997.) as enhanced, tolerated, protected, or cultivated. The place of origin of the plants, the time spent gardening, and the name of who cared for the home garden were recorded. The collection practices were determined by asking what visual and/or sensory characteristics were considered during this activity. In addition, we asked about product use, price and sales level. The “level of sales” category is a qualitative classification of the frequency at which a particular species is mentioned with respect to sales and is classified as high, regular or low. The spatial arrangement of the home garden management zones was described, and the size of the home gardens was recorded.

The importance of the home garden was based on its age, and the reasons for its establishment were explained. The botanical material was identified with the support of the Herbarium staff (HUMO) of the Universidad Autónoma del Estado de Morelos (UAEM). The species nomenclature was authenticated using the Tropicos® ([www.tropicos.org](http://www.tropicos.org)) Mis-

Table 1. Taxonomic summary and categories of plants use in homegardens of Tilzapota.

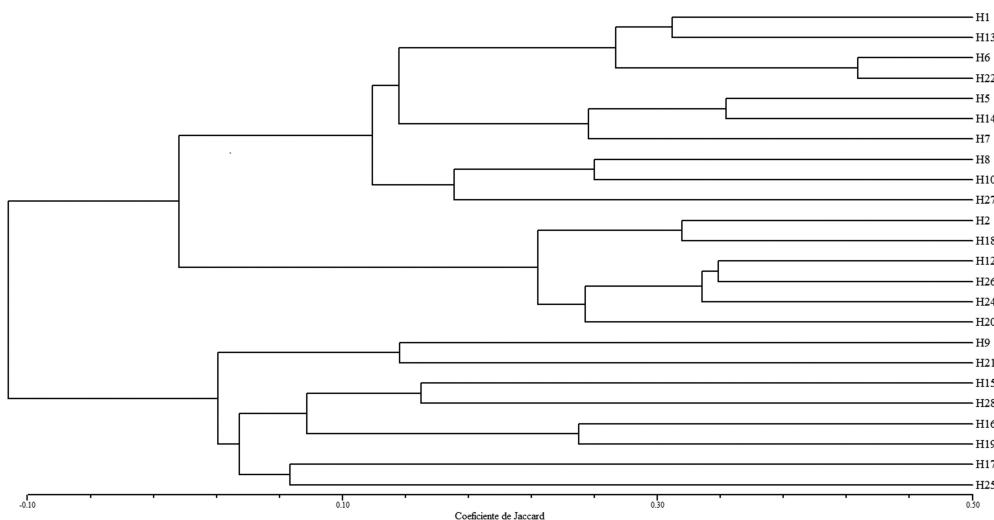
| Uses and taxonomic category | Ornate | Edible | Religious | Medicinal | Shaded | Domestic | Repellent | Biological control |
|-----------------------------|--------|--------|-----------|-----------|--------|----------|-----------|--------------------|
| Species                     | 91     | 61     | 46        | 39        | 5      | 3        | 1         | 1                  |
| Genera                      | 75     | 47     | 36        | 36        | 5      | 1        | 1         | 1                  |
| Families                    | 46     | 33     | 24        | 23        | 5      | 1        | 1         | 1                  |

**Table 2.** Number of species / (%) by use and size's categories of home gardens.

| Home gardens | Age home gardens | Size M <sup>2</sup> | Total of species | Ornamental | Food    | Medicinal | Religious | Shade  | Domestic | Repellent | Biological control |
|--------------|------------------|---------------------|------------------|------------|---------|-----------|-----------|--------|----------|-----------|--------------------|
| 1            | 32               | 765                 | 53               | 16 (30)    | 33 (62) | 5 (9)     | 1 (2)     | 1 (2)  |          |           |                    |
| 2            | 30               | 200                 | 35               | 23 (66)    | 9 (26)  | 3 (8)     | 0         |        |          |           |                    |
| 5            | 28               | 1200                | 42               | 15 (36)    | 25 (59) | 2 (5)     | 3         |        |          |           |                    |
| 6            | 22               | 1800                | 89               | 49 (55)    | 30 (34) | 10 (11)   | 0         | 1 (1)  |          |           |                    |
| 7            | 47               | 730                 | 38               | 22 (58)    | 12 (31) | 6 (16)    | 4 (10)    |        |          |           |                    |
| 8            | 45               | 330                 | 30               | 13 (43)    | 14 (46) | 4 (13)    | 4 (13)    |        |          |           |                    |
| 9            | 26               | 300                 | 21               | 0          | 15 (71) | 8 (38)    | 0         |        |          |           |                    |
| 10           | 30               | 400                 | 51               | 32 (63)    | 18 (35) | 2 (4)     | 8 (16)    |        |          |           |                    |
| 12           | 15               | 270                 | 64               | 44 (69)    | 12 (19) | 4 (6)     | 0         |        |          |           |                    |
| 13           | 54               | 998                 | 89               | 38 (43)    | 39 (43) | 22 (25)   | 4 (4)     | 2 (2)  | 1 (1)    |           | 1 (1)              |
| 14           | 21               | 1200                | 56               | 22 (39)    | 29 (52) | 5 (9)     | 3 (5)     | 1 (2)  |          |           |                    |
| 15           | 40               | 800                 | 42               | 7 (17)     | 29 (69) | 5 (12)    | 0         |        |          |           |                    |
| 16           | 6                | 200                 | 24               | 10 (42)    | 12 (50) | 2 (8)     | 0         |        |          |           |                    |
| 17           | 7                | 300                 | 14               | 5 (36)     | 5 (36)  | 2 (14)    | 0         |        |          |           |                    |
| 18           | 19               | 200                 | 46               | 31 (67)    | 12 (26) | 3 (6)     | 0         |        |          |           |                    |
| 19           | 1                | 240                 | 14               | 3 (21)     | 10 (71) | 0         | 0         |        |          |           |                    |
| 20           | 25               | 150                 | 38               | 25 (66)    | 9 (24)  | 5 (13)    | 0         |        |          |           |                    |
| 21           | 50               | 150                 | 21               | 13 (62)    | 5 (24)  | 3 (14)    | 2         |        |          |           |                    |
| 22           | 10               | 800                 | 103              | 62 (60)    | 32 (31) | 9 (9)     | 30 (29)   | 2 (2)  | 3 (3)    |           |                    |
| 24           | 30               | 600                 | 55               | 31 (56)    | 18 (33) | 6 (11)    | 4 (7)     |        |          | 1 (2)     |                    |
| 25           | 15               | 70                  | 12               | 10 (83)    | 2 (17)  | 0         | 0         | 3 (25) |          |           |                    |
| 26           | 7                | 300                 | 58               | 33 (57)    | 15 (26) | 8 (14)    | 0         | 2 (3)  |          |           |                    |
| 27           | 33               | 300                 | 34               | 18 (53)    | 19 (56) | 2 (6)     | 0         |        |          |           |                    |
| 28           | 23               | 200                 | 24               | 11 (46)    | 11 (46) | 2 (8)     | 2 (8)     | 1 (4)  |          |           |                    |

**Table 3.** Floristic composition of 24 homegardens of Tilzapota, Mexico.

| GROUP | HOME GARDENS | SOU GROUP  | SPECIES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|--------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I     | H1 to H27    | H1 to H22  | <i>Acalypha hispida</i> , <i>Adiantum</i> sp., <i>Aloe barbadensis</i> , <i>Annona muricata</i> , <i>Anthurium</i> sp., <i>Aralia poliscias</i> , <i>Codiaeum</i> sp., <i>Carica papaya</i> , <i>Citrus aurantifolia</i> , <i>Musa paradisiaca</i> , <i>Pithecellobium dulce</i> , <i>Psidium guava</i> , <i>Verbesina crocata</i>                                                                                                                                                      |
|       |              | H5 to H7   | <i>Adiantum</i> sp., <i>Aglaonema pictum</i> , <i>Aloe barbadensis</i> , <i>Aralia poliscias</i> , <i>Artemisia ludoviciana</i> , <i>Bougainvillea glabra</i> , <i>Citrus aurantifolia</i> , <i>Citrus limetta</i> , <i>Coryphantha buamama</i> , <i>Dieffenbachia</i> sp., <i>Leucaena leucocephala</i> , <i>Mangifera indica</i> , <i>Nephrolepis</i> sp., <i>Opuntia</i> sp., <i>Pithecellobium dulce</i> , <i>Teloxys ambrosioides</i> , <i>Verbesina crocata</i> , <i>Zea mays</i> |
|       |              | H8 to H27  | <i>Acalypha hispida</i> , <i>Achimenes</i> sp., <i>Adiantum</i> sp., <i>Aloe barbadensis</i> , <i>Citrus aurantifolia</i> , <i>Codiaeum</i> sp., <i>Hippeastrum</i> sp., <i>Lagerstroemia</i> sp., <i>Mangifera indica</i> , <i>Murraya paniculata</i> , <i>Nephrolepis</i> sp., <i>Pithecellobium dulce</i> , <i>Psidium guava</i> , <i>Ricinus communis</i> , <i>Spondias mombin</i> , <i>Teloxys ambrosioides</i> , <i>Verbesina crocata</i>                                         |
|       |              | H2 to H18  | <i>Achimenes</i> sp., <i>Aloe barbadensis</i> , <i>Capsicum annuum</i> , <i>Citrus aurantifolia</i> , <i>Codiaeum</i> sp., <i>Ficus</i> sp., <i>Howea forsteniana</i> , <i>Mangifera indica</i> , <i>Teloxys ambrosioides</i>                                                                                                                                                                                                                                                           |
| II    | H2 to H20    | H12 to H20 | <i>Adiantum</i> sp., <i>Aloe barbadensis</i> , <i>Begonia</i> sp., <i>Bougainvillea glabra</i> , <i>Capsicum annuum</i> , <i>Citrus aurantifolia</i> , <i>Citrus nobilis</i> , <i>Codiaeum</i> sp., <i>Dieffenbachia</i> sp., <i>Ficus</i> sp., <i>Howea forsteniana</i> , <i>Ruta chalepensis</i> , <i>Teloxys ambrosioides</i> , <i>Tournefortia hirsutissima</i> , <i>Vinca rosea</i>                                                                                                |
|       |              | H9 to H21  | <i>Capsicum annuum</i> , <i>Mentha canadensis</i> , <i>Ocimum basilicum</i>                                                                                                                                                                                                                                                                                                                                                                                                             |
| III   | H9 to H25    | H15 to H19 | <i>Byrsinima crassifolia</i> , <i>Citrus nobilis</i> , <i>Leucaena esculenta</i> , <i>Mangifera indica</i> , <i>Musa paradisiaca</i>                                                                                                                                                                                                                                                                                                                                                    |
|       |              | H17 to H25 | <i>Citrus aurantifolia</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |



**Figure 3.** Similarity of the 24 homogardens of Tilzapota, Mexico, based on the presence-absence of species

souri Botanical Garden (2014) database, and taxon authorities are noted according to Villaseñor *et al.* (2008).

## Results

**Composition and uses.** A total of 189 species, 158 genera and 69 families of plants (Appendix 1) were documented. The richest families were Araceae (15), Euphorbiaceae and Lamiaceae (11) and Crassulaceae and Bignoniaceae (10). Eight use types were documented (Table 1), the richest of which were ornamental (48 %), edible (32 %), religious (24 %) and medicinal (20 %). Food production was the main use in 45 % of home gardens (Table 2). A total of 46 (24 %) species with more than one use (Appendix 1) were recorded. There were botanical families that included species with two and three use classifications.

*Similarity in species composition.* There was low similarity in the species composition between home gardens, and some differences were found (Table 3, Figure 3). Three groups were recognized (Table 3). The first group was the largest and included nine out of 24 home gardens. All of the home gardens in groups I, II and III contained lime trees (*Citrus aurantifolia*), and group III was distinct due to including many fruit trees, such as guamúchil (*Pithecellobium dulce*), banana (*Musa paradisiaca*), guayaba (*Psidium guajava*), and ciruela (*Spondias mombin*). The H15 – H19 subgroup of group III shared fruit trees, and the single shared species subgroup, H27 – H25, of group II corresponded to *Citrus aurantifolia*. The H12 – H20 subgroup species and H8 – H27 subgroup of group I were distinct from the other home gardens because they included a large number of ornamental plants.

*Frequency of mention.* The species that was most commonly mentioned, by 70 % of the interviewees in the semi-struct-

tured interviews, was lime (*Citrus aurantifolia*), followed by wormseed (*Teloxys ambrosioides*), peppermint (*Mentha canadensis*), and ciruela (*Spondias mombin*), which were mentioned by 41.6 % of the interviewees. Furthermore, the three species reported as the most important were lime, mango (*Mangifera indica*) and wormseed. The similarity between the most frequently mentioned and important species among the home gardens was 40 %, based on the Sorensen index.

**Edible plants.** Between 24 and 60 % of the species from the home gardens were edible (Table 2). Fruit was the most consumed botanical structure (75 %), followed by leaves (Table 4). Some fruits, such as ciruela and guaje (*Leucaena esculenta* subsp. *esculenta*), were preserved through drying techniques, whereas others, such as nanche (*Byrsonima crassifolia*), ciruela and passion fruit (*Passiflora edulis*), were preserved through freezing. Limes were used daily, whereas mango, ciruela and guaje were consumed in the harvest season between January-April. Other fruits, such as wormseed, were used two to three times per week.

**Medicinal plants.** Medicinal plants (mainly *Pereskia aculeata*) were reportedly used in relation to cancer (nine responses) and as anti-inflammatories (seven) and digestives (six), for respiratory improvement (five), and in rituals referred to as “limpias” (eight). Medicinal plants were mentioned by 20 % of the interviewees and were cultivated by 90 % of them. The number of medicinal species in home gardens ranged from two to 22 (Table 2). The most common method of use was the preparation of tea leaves, followed by fresh consumption.

*Home garden management.* Some species were subjected to more than one form of management: 84 % of plants were cultivated, 17 % were enhanced, 15 % were tolerated, and 4.2 % were protected. Among these plants, the ornamental,

**Table 4.** Ways of preparing edible plants in homegardens of Tilzapota, Morelos.

| Common name | Scientific name               | Number of ways of preparation | Used botany structure                                | Ways of preparation                                                                                                                                                                    |
|-------------|-------------------------------|-------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Corn        | <i>Zea mays</i>               | 9                             | Partially dry caryopses<br>Dry caryopses<br>Dry leaf | Tortillas, boiled or roasted corn, tlaxcales, atole, esquites, soup, the leaf and the seed used in tamales (various).                                                                  |
| Squash      | <i>Cucurbita argyrosperma</i> | 8                             | Flower<br>Unripe fruit<br>Fruit Ripe<br>Seed         | Flower and fruit in stews, boiled fruit, sweetened with piloncillo (panela) or crystallized with brown sugar, in tamales with corn and beans, roasted seed, ground seed in green mole. |
| Ciruela     | <i>Spondias purpurea</i>      | 8                             | Fresh fruit<br>Dry fruit                             | Fresh fruit, dried fruit in atole, tamales, canned, fresh fruit in stews, snacks, sauces.                                                                                              |
| Mango       | <i>Mangifera indica</i>       | 5                             | Fruit                                                | Fruit, fresh fruit water, salad, sauce, popsicles.                                                                                                                                     |
| Lime        | <i>Citrus aurantifolia</i>    | 5                             | Fruit                                                | Fresh fruit water, stews, salads, domestic use, desserts.                                                                                                                              |
| Guaje       | <i>Leucaena esculenta</i>     | 3                             | Fresh seed<br>Dry seed                               | Fresh, dried or roasted seed in stews or to complement the dish.                                                                                                                       |

edible, ritual and medicinal uses were the most common, as shown in figure 4, and the enhanced, tolerated and protected methods of management and cultivation prevailed.

**Plant collection.** Some plants were purchased in regional markets, exchanged, given away or collected from nature, such as capitaneja (*Verbesina crocata*), biznaga (*Coryphantha bumamma*), borrego (*Acacia acatlensis*), nopal (*Opuntia* sp.), jarilla (*Senecio salignus*), and bonete (*Jacaratia mexicana*). Chili (*Capsicum annuum*) seeds, corn, and some ornamental species were also traded, sometimes from the United States of America because 26 % of the Tilzapota population is migrant and travel with plants and food. These migrants return annually and eat dishes made with corn, squash, ciruela, and other seasonal fruits. An indirect function of the home garden is the social practice of growing food for the palate and to enjoy in popular gatherings, a tradition that strengthens plant species use.

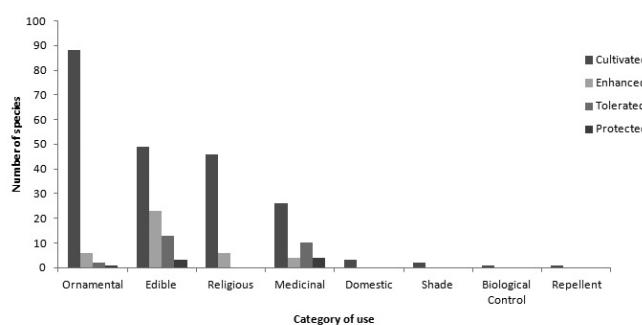
**Caring for the home gardens and time spent in them.** The home gardens were attended by women (15; 66 %), men (4; 12.5 %) or both (5; 20.8 %). Children did not participate in home garden care, but they assisted with harvesting at

certain times. The home garden care activities included the maintenance of “cajetes” (holes where the plants are seated), the changing of the potting soil once or twice each year using home garden compost or forest soil, and fertilization with organic products (sheep manure, poultry manure or bat guano), or chemicals (NPK). To lessen the effect of drought, the frequency of irrigation was increased, and shades were erected to protect plants from direct radiation, or pots were relocated to protect plants from the sun. In 62 % of cases, pests were eradicated using stem pruning and lime application. The average daily time invested in home garden care was 40 min, which equated to 3.7 hr/wk.

**Harvesting.** Fruit color and texture were considered in harvesting, which was performed directly by hand or with the use of a tool, basket, blanket or chicol (a stick with a basket; Table 5).

**Destination of products.** The production was predominantly destined for self-supply, and only 25 % of owners sold the surplus from their home gardens (Table 6). The home gardens provided components of the daily diet; 54 % of owners planted crops that included corn, beans (*Phaseolus vulgaris*), squash, and fruit, such as nanche (*Byrsonima crassifolia*), guamúchil (*Pithecellobium dulce*), and papaya (*Carica papaya*), which were temporarily enhanced and protected in the home gardens.

**Spatial arrangement.** Common areas in the home gardens were recorded and are described as follows. While the home gardens differed in size (Table 2), an average area of 520 m<sup>2</sup> was typically divided into five areas: ornamental plants, condiments near the house, medicinal plants, corn/squash crops, and fruit trees, which were located farthest from the house (Figure 5). The common areas were used according to space availability in the home gardens. Tolerated species,

**Figure 4.** Use categories and management ways in homegardens of Tilzapota, Morelos.

**Table 5.** Useful species and collection forms in homegardens of Tilzapota.

| Scientific name                                      | Common name  | Characteristics considered in the collection                                     | Collection instruments |
|------------------------------------------------------|--------------|----------------------------------------------------------------------------------|------------------------|
| <i>Annona muricata</i>                               | Soursop      | Color and texture                                                                | By hand /Basket        |
| <i>Anona diversifolia</i>                            | Ilama        | Presence of cracks at the level of the pedicel                                   | By hand                |
| <i>Byrsinima crassifolia</i>                         | Nanche       | Fallen fruit                                                                     | By hand                |
| <i>Citrus aurantifolia</i>                           | Lime         | Smooth texture                                                                   | By hand / Chicol       |
| <i>Citrus nobilis</i> Lour.                          | Tangerine    | Color                                                                            | Chicol                 |
| <i>Cucurbita argyrosperma</i>                        | Squash       | The flower at dawn. The fruit changes from green to brown when the vine is dried | By hand                |
| <i>Diospyros ebenaster</i>                           | Black Sapote | Adherence of calyx                                                               | Chicol                 |
| <i>Leucaena leucocephala</i><br>spp. <i>glabrata</i> | White Guaje  | Full pod                                                                         | Chicol                 |
| <i>Mangifera indica</i>                              | Mango        | Color                                                                            | Chicol                 |
| <i>Manilkara zapota</i>                              | Sapodilla    | Soft texture                                                                     | By hand                |
| <i>Pithecellobium dulce</i>                          | Guamúchil    | Color and dehiscent pod                                                          | Chicol                 |
| <i>Spondias mombin</i>                               | Ciruela      | Color                                                                            | Chicol and blanket     |
| <i>Tamarindus indica</i>                             | Tamarind     | Crispy peel                                                                      | By hand                |
| <i>Cucumis melo</i>                                  | Melon        | Color                                                                            | By hand                |
| <i>Citrulus lanatus</i>                              | Watermelon   | A week after its growth stopped                                                  | By hand                |

such as cuatecomate (*Crescentia alata*), guaje, guamúchil and cuaubote (*Guazuma ulmifolia*), and other crops, such as nopal, functioned as a living fence. A space was assigned for species destined for sale, such as escoba (*Schkuria pinnata* var. *virgata*) and Mexican marigold (*Tagetes erecta*). In addition, there was a resting area for family gatherings and shared work, and a designated space for domestic animals, such as poultry or sheep, was common.

**Importance of home gardens.** The average age of the home gardens was 20 years. The predominant importance was de-

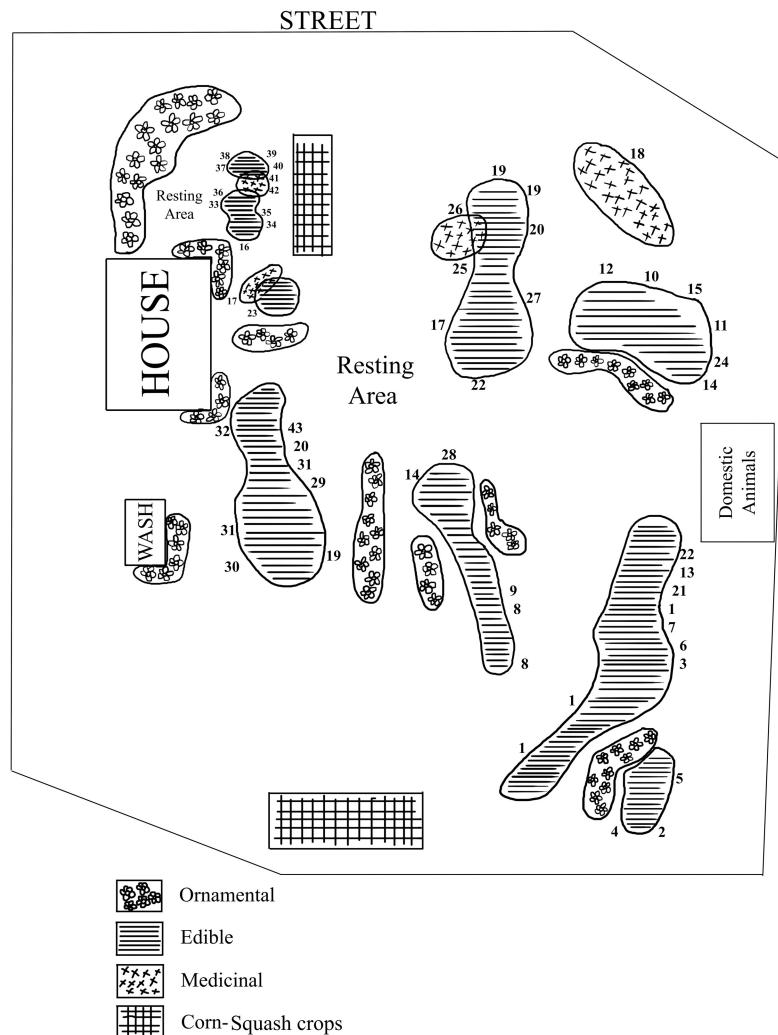
scribed in terms of intangible benefits; e.g., 100 % of the interviewees considered caring for the home garden as family and relaxing time, with women expressing their preference in terms of shapes and colors, such as red. Flowers with a variety of colors were appreciated for religious festivities.

## Discussion

**Composition and plant use.** The species richness found in Tilzapota represents 55 % of that documented in ten home gardens of a Mayan community (387 species) (Lope-Alzina

**Table 6.** Name's family and specie, common name, unitary trading, price in US dollar (exchange rate in May-June 2014), part of trade plant, fruit maturity, degree of trading, of useful products trading of homegardens (\*= container used for measuring = a can of sardines).

| Family        | Specie                        | Common name  | Unitary trading | \$/Kg            | \$           | Part of plant | Fresh or dried | Degree of trading |
|---------------|-------------------------------|--------------|-----------------|------------------|--------------|---------------|----------------|-------------------|
| Anacardiaceae | <i>Mangifera indica</i>       | mango        | kg              | 1.5 /1,000 g     | 1.5          | fruit         | fresh          | low               |
|               | <i>Spondias mombin</i>        | ciruela      | *sardine        | 0.53/250 g       | 2.1          | fruit         | fresh          | low               |
| Ebenaceae     | <i>Diospyros ebenaster</i>    | black sapote | kg              | 1.5 /1,000 g     | 1.5          | fruit         | fresh          | low               |
|               | <i>Leucaena esculenta</i>     | red guaje    | bunch           | 0.76 /160 g      | 4.7          | fruit         | fresh          | low               |
| Fabaceae      |                               |              | *sardine        | 1.5 /500 g       | 3            | seed          | dried          | low               |
|               |                               |              | *sardine        | 1.5 /280 g       | 5.3          | fruit         | fresh          | low               |
| Cucurbitaceae | <i>Pithecellobium dulce</i>   | guamúchil    | *sardine        | 0.76 /10 flowers | 0.07**       | flower        | fresh          | low               |
|               | <i>Cucurbita argyrosperma</i> | squash       | bunch           | 0.76 /10 flowers | 0.25**       | fruit         | fresh          | regular           |
| Malpighiaceae |                               |              | piece           | 0.76 /3 Pieces.  | .05          | fruit         | dried          | low               |
|               |                               |              | piece           | 1.5 /3,000 g     | .05          | fruit         | fresh          | low               |
| Asteraceae    | <i>Byrsinima crassifolia</i>  | nanche       | *sardine        | 0.76 /500 g      | 1.5          | fruit         | fresh          | low               |
|               | <i>Schkuria pinnata</i>       | escoba       | piece           | 1.5 /piece       | 1.5          | whole plant   | dried          | low               |
| Caricaceae    | <i>Carica papaya</i>          | papaya       | piece           | price/ local     | price/ local | fruit         | fresh          | low               |
|               |                               |              | market          | market           |              |               |                |                   |
| Rutaceae      | <i>Citrus sinensis</i>        | orange       | bucket          | 0.76 /10 kg      | 7.6          | fruit         | fresh          | low               |
| Sapotaceae    | <i>Manilkara zapota</i>       | sapodilla    | *sardine        | 1.5 /500 gr      | 3            | fruit         | fresh          | low               |
| Fabaceae      | <i>Tamarindus indica</i>      | tamarind     | *sardine        | 0.76 /260 gr     | 2.9          | fruit         | dried          | low               |
| Poaceae       | <i>Zea mays</i>               | Corn         | piece           | 0.15 /piece      | .15          | fruit         | fresh          | high              |



**Figure 5.** Topology of a homegarden in Tilzapotla, Morelos. 1. Ciruela, 2. Grangel, 3. Mexican honeysuckle, 4. Lemongrass, 5. Squash, 6. Capitaneja, 7. Oregano, 8. Ilama, 9. Tamarind, 10 Pineapple, 11. Banana, 12. Cuayotomate, 13. Tomato, 14. Papaya, 15. Tlachichinole, 16. Marjoram, 17 Guava, 18. Chapulixtle, 19. Lime, 20. Orange, 21. Tangerine, 22. Pomegranate, 23. Verbena, 24. Uña de gato, 25. Lemon, 26. Neem, 27. Lemandalin, 28. Soy bean, 29. Grapefruit, 30. Aloe vera, 31. Ginger, 32. Nanche, 33. Elderberry, 34. Sapodilla, 35. Horse-tail, 36 Rose of Castile, 37. Chili, 38. Wormseed, 39. Basil, 40. Rosemary, 41. Thyme, 42. Sagewort, 43. Soursop.

and Howard, 2012). This information demonstrates the high biological diversity of this agroecosystem in southeastern Mexico, which is influenced by a humid tropical climate, compared with the dry tropical climate of Morelos.

The results of the current study agree with those of Caballero *et al.* (2010), who reported Rutaceae and Fabaceae to be the most common families in the edible category and Asteraceae and Lamiaceae to be the most common families in the medicinal category within Mexico's catalogue of useful plants. The observed floristic composition was similar to the home gardens of San Rafael Coxatlán, Puebla, due to the dominance of ornamental plants (56 %) (Blancaert *et al.*, 2004) and to the arrangement of plants in front of home garden perimeters in Calakmul, Mexico. This setting indicated the residents' preference for flowers as well as their ability to care for gardens, displaying

the beauty of the flowers. According to Neulinger *et al.* (2013), the ornamental plant selection provides attractive and aesthetic value, which indicates prestige for families. This is equivalent to "luxury", a term associated with the maintenance of plants without any use other than enjoyment (Moreno-Calles *et al.*, 2013). The ornamental quality of Tilzapotla's home gardens differed from that in other regions; these home gardens were mainly used for food security, to improve families' nutrition, and for economic growth in some cases (Casas *et al.*, 1996; Pulido *et al.*, 2008; Cano-Ramírez *et al.*, 2012).

*Similarity in species composition.* The obtained results did not indicate similarity in the floristic composition between home gardens. However, there was a marked presence of certain edible plants growing spontaneously, and these

plants were tolerated based on their use value. This finding suggests that there was an interaction between the plants in home gardens and those in the surrounding vegetation.

*Frequency of mention.* There was a similarity between the most frequently cited and most important home garden species. Edible plants, which are the most commonly used because they are part of the diet, were documented in all of Tilzapota's home gardens. The edible plants used by the interviewees coincided with those used in Zimbabwe (Maroyi, 2013) in terms of their importance as nutritious foods. The health benefits of these plants were highlighted by the increased consumption of fresh home garden products. Some people do not consider traditional medicinal use to be a core contribution of home gardens because medicinal plants are only occasionally used compared with edible plants, which are frequently consumed. This is likely due to the easy access to healthcare services implemented by the government and the confidence in free allopathic medicine. Nevertheless, medicinal plants were cultivated by 90 % of the interviewees to treat ailments that included serious illnesses, such as cancer. Kuhnlein (2014) stated that the preference for fast food over natural food leads to chronic diseases (e.g. cancer, cardiovascular diseases, diabetes). To treat these diseases, people grow medicinal herbs in their home garden. Medicinal plants function as a complement to medical treatment. Some of the home garden plants were not used immediately but were stored for possible future usage, confirming that they are tolerated medicinal species that will be required at some point in the future.

*Management.* Practices such as farming and protection as well as the collection methods for useful species indicate families' dedication to and interest in continuing to employ useful species. The average time invested in performing various tasks in the home garden coincides with data presented by Kabir and Weeb (2009) from Bangladesh, Asia. Some interviewees considered their available time insufficient for collecting the necessary products because they also had other activities that required attention.

The benefit that owners derive from home gardens impacts the decisions made regarding resource management, similar to the findings reported by Thomas and Van Damme (2010). Therefore, plant management in home gardens is common in indigenous communities in both Bolivia and Tilzapota.

*Destination of the products.* Most of the products of the home gardens were destined for self-supply. The home garden products supplemented the economy and strengthened the protection of these agroecosystems. While a limited amount of home garden products were sold, their indirect value was significant for the families and beneficial for their economy because people obtain products that are used daily without having to spend money to obtain them. An impor-

tant decision was to focus greater attention on those species with economic rewards, especially fruit.

*Spatial arrangement.* No clear topological distribution pattern was observed in the studied areas, except for ornamental plants, which were arranged in a linear pattern, mainly around the house. These plants provide aesthetic value and prestige for the families. The division of space included an area for sharing the management of the harvest. The beneficiaries adapted spaces according to the specific requirements of the plants, such as the level of solar exposure. There was a trend in the location of edible plants; i.e., the owners grew these plants in small groups to facilitate handling.

*Importance of home gardens.* Irrespective of age, the importance of home gardens lies in their function as a recreational area. However, the value assigned to these agroecosystems by owners includes tangible benefits, such as the provision of food, medicine and shade and use for religious purposes.

This study demonstrates the multiple applications of useful plant resources based on the roles they play in family life. It was confirmed that even though ornamental plants dominated home gardens, the most frequently mentioned and important species were edible plants. Furthermore, edible plants in combination with medicinal plants received greater attention, indicating that these plants have an essential function in the users' daily lives. The number of edible species indicates actual and specific needs, such as required foods and dietary preferences. We confirmed the hypothesis that the home gardens of Tilzapota play a multi-functional role and exhibit high species richness and a large number of edible and medicinal plants, which contribute to household livelihood. In addition, it was confirmed that edible species support the fulfillment of requirements for self-supply. Therefore, these agroecosystems represent an alternative to meet a family's needs.

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**Appendix 1.** Inventory of species identified in homegardens of Tilzapota, Morelos: scientific name, common name (English and Spanish), management status: C = Cultivated, T = Tolerated, F = Enhanced, P = Protected. Use: O = Ornamental, A = Edible, M = Medicinal, S = Shaded, Re = Repellent, CB = Biological Control, D = Domestic, R = Religious and Growth Habit, H = Herb, a = Bush, A = Tree. \* Species with more than one use. \*\* Species for sale.

| Family               | Scientific name                                                | Common name                               | Management | Use  | Habit | No. Folio |
|----------------------|----------------------------------------------------------------|-------------------------------------------|------------|------|-------|-----------|
| <b>Acanthaceae</b>   | * <i>Jacobinia carnea</i> (Lindl.) G.Nicholson                 | Plum flower, Plumero rosa                 | C          | O, R | H     | 32884     |
|                      | <i>J. spicigera</i> (Schltdl.) L.H.Bailey                      | Mexican honeysuckle, Muicle               | C          | M, R | H     | 32885     |
|                      | <i>Odontonema</i> Nees                                         | Firespike, Cerillo                        | C, F       | O, R | H     | 32886     |
| <b>Adiantaceae</b>   | <i>Adiantum</i> L.                                             | Fern, Helecho                             | C, F       | O    | H     | 32887     |
| <b>Agavaceae</b>     | <i>Sansevieria</i> Thunb.                                      | Snake plant, Viborilla                    | C          | O    | H     | 32888     |
| <b>Amarilidaceae</b> | * <i>Hippeastrum</i> Herb.                                     | Amaryllis, Mancuerna                      | C          | O, R | H     | 32889     |
| <b>Anacardiaceae</b> | <i>Mangifera indica</i> L.**                                   | Mango, Mango                              | C, F       | A    | A     | 32890     |
|                      | <i>Spondias mombin</i> L.                                      | Red ciruela, Ciruela roja                 | C, T, F    | A    | A     | 32891     |
| <b>Annonaceae</b>    | <i>Annona muricata</i> L.                                      | Soursop, Guanábana                        | C, F       | A    | A     | 32892     |
|                      | <i>A. diversifolia</i> Safford                                 | Ilama, Ilama                              | C          | A    | H     | 32893     |
| <b>Apiaceae</b>      | <i>Coriandrum sativum</i> L.                                   | Coriander, Cilantro                       | C, F       | A    | H     | 32894     |
|                      | <i>Petroselinum crispum</i> (Mill.) Fuss                       | Parsley, Perejil                          | C          | A    | H     | 32895     |
| <b>Apocynaceae</b>   | <i>Adenium obesum</i> (Forssk.) Roem & Schult.                 | Pegahueso de casa                         | C, F       | M    | A     | 32896     |
|                      | <i>Carissa grandiflora</i> (E.Mey.) A.DC.                      | Carissa, Carisa                           | C          | A    | H     | 32897     |
|                      | * <i>Catharanthus roseus</i> (L.) G.Don                        | Madagascar periwinkle, Ninfa              | C          | O, R | H     | 32898     |
|                      | * <i>Nerium oleander</i> L.                                    | Oleander, Delfa                           | C          | O, R | H     | 32899     |
|                      | * <i>Plumeria rubra</i> L.                                     | White Cacaloxóchitl, Cacaloxóchitl blanco | C          | O, R | A     | 32900     |
|                      | <i>Stemmadenia obovata</i> var. <i>mollis</i> (Benth.) Woodson | Tepechile                                 |            | O    | A     | 32901     |
|                      | <i>Thevetia ovata</i> (Cav.) A.DC.                             | Yoyote                                    | T          | M    | A     | 32902     |
|                      | * <i>Vinca rosea</i> L.                                        | Vinca, Ninfa                              | C, F       | O, R | H     | 32903     |
|                      | <i>Araceae</i>                                                 | Chinesse evergreens, Hoja pinta           | C          | O    | H     | 32904     |
| <b>Araceae</b>       | * <i>Anthurium</i> Schott                                      | Anthurium, Anturio                        | C          | O, R | H     | 32905     |
|                      | <i>Dieffenbachia</i> Schott                                    | Dumb cane, Gracena                        | C          | O    | H     | 32906     |
|                      | <i>Philodendron</i> Schott                                     | Teléfono                                  | C          | O    | H     | 32907     |
|                      | * <i>Spathiphyllum</i> Schott                                  | Moses in the cradle, Cuna de moisés       | C          | O, R | H     | 32908     |
|                      | <i>Syngonium neglectum</i> Schott                              | Singonio                                  | C          | O    | H     | 32909     |
|                      | <i>S.salvadorensis</i> Schott                                  | Aralia                                    | C          | O    | H     | 32910     |
|                      | <i>Xanthosoma</i> Schott                                       | Elephant ear, Hoja elegante               | C          | O    | H     | 32911     |
|                      | * <i>Zantedeschia</i> Spreng.                                  | Alcatrás                                  | C          | O, R | H     | 32912     |
|                      | <i>Aralia polystachys</i> Spreng. ex Seem                      | Large Buena suerte, Buena suerte grande   | C          | O    | H     | 32913     |
| <b>Araliaceae</b>    | <i>Schefflera</i> J.R.Forst. & G.Forst.                        | Aralia                                    | C          | O    | H     | 32914     |

## Appendix 1. Continuation

| Family                  | Scientific name                                                                   | Common name                           | Management | Use     | Habit | No. Folio |
|-------------------------|-----------------------------------------------------------------------------------|---------------------------------------|------------|---------|-------|-----------|
| <b>Araucariaceae</b>    | <i>Araucaria heterophylla</i> (Salisb.) Franco                                    | Star pine, Araucaria                  | C          | O       | H     | 32915     |
| <b>Arecaceae</b>        | <i>Brahea dulcis</i> (Kunth) Mart.                                                | Brahea palm,<br>Palma brahea          | T          | O       | A     | 32916     |
|                         | <i>Chamaedora elegans</i> Mart.                                                   | Palm, Palma                           | C          | O       | H     | 32917     |
|                         | * <i>Cocos nucifera</i> L.                                                        | Coconut,                              | C, F       | A,      | A     | 32918     |
|                         | <i>Howea forsteniana</i> (F.Muell.) Becc.                                         | Ornamental Palma,<br>Palma ornamental | C          | O       | A     | 32919     |
| <b>Aristolochiaceae</b> | <i>Aristolochia</i> L.                                                            | NN                                    | C          | O       | H     | 32920     |
| <b>Asclepiadaceae</b>   | <i>Huernia</i> R.Br.                                                              | NN                                    | C          | O       | H     | 32921     |
|                         | <i>Stapelia</i> L.                                                                | Carrión flowers, Huele feo            | C          | O       | H     | 32922     |
|                         | <i>Asparagus densiflorus</i> (Kunth) Jessop                                       | Asparagus, Espárrago                  | C          | O       | H     | 32923     |
|                         | <i>A. plumosus</i> Baker                                                          | Mouse tail plant,<br>Cola de ratón    | C          | O       | H     | 32924     |
|                         | <i>Beuacarnea recurvata</i> Lem.                                                  | Ponytail plant,<br>Pata de elefante   | C          | O       | H     | 32925     |
|                         | <i>Echeandia scabrella</i> (Benth.) Cruden                                        | NN                                    | C          | O       | H     | 32926     |
|                         | <i>Protasparagus setaceus</i> (Kunth) Oberm.                                      | Asparagus, Espárrago                  | C          | O       | H     | 32927     |
|                         | <i>Duranta erecta</i> L.                                                          | Duranta                               | C          | O       | H     | 32928     |
| <b>Asparagaceae</b>     | <i>Yucca alaifolia</i> L.                                                         | Isote                                 | C          | A       | A     | 32929     |
| <b>Asphodelaceae</b>    | * <i>Aloe barbadensis</i> Mill.                                                   | Aloe, Zábila                          | C, F       | A, M, R | H     | 32930     |
| <b>Asteliaceae</b>      | <i>Cordyline</i> Comm. ex R.Br.                                                   | Muñeca                                | C          | O       | H     | 32931     |
| <b>Asteraceae</b>       | <i>Artemisia ludoviciana</i> subsp. <i>mexicana</i> (Willd. ex Spreng.) D.D.Keck. | Estafiate                             | C, F       | M       | H     | 32932     |
|                         | <i>Brickellia</i> Elliott                                                         | Brickellbushes Prodigiosa             | P          | M       | a     | 32933     |
|                         | <i>Porophyllum obtusifolium</i> DC.                                               | Pipitzca                              | C          | A       | H     | 32934     |
|                         | <i>P. ruderale</i> var. <i>macrocephalum</i> (DC.) Cronquist                      | Pápalo                                | C, T       | A       | H     | 32935     |
|                         | <i>Schkuria pinnata</i> (Lam.) Kuntze ex Thell.**                                 | Escoba                                | C          | D       | H     | 32936     |
|                         | <i>Senecio salignus</i> DC.                                                       | Jarilla                               | C          | M, R    | H     | 32937     |
|                         | <i>Tagetes erecta</i> L.                                                          | Mexican marigold,<br>Cempazúchitl     | C          | R       | H     | 32939     |
|                         | * <i>Verbesina crocata</i> (Cav.) Less.                                           | Capitaneja                            | P          | A, M    | H     | 32940     |
|                         | * <i>Zinnia peruviana</i> (L.) L.                                                 | San Miguel                            | C          | O, R    | H     | 32941     |
|                         | <i>Begonia</i> <i>Falciloba</i> Liebm.                                            | Begonia                               | C          | O       | H     | 32942     |
| <b>Begoniaceae</b>      | <i>B. heracleifolia</i> Schleidl. & Cham.                                         | Begonia                               | C          | O       | H     | 32943     |
|                         | <i>B. incarnata</i> Link & Otto.                                                  | Begonia                               | C          | O       | H     | 32944     |
| <b>Bignoniaceae</b>     | <i>Crescentia alata</i> Kunth                                                     | Mexican calabash, Cirán               | T          | M       | A     | 32945     |
|                         | * <i>C. cujete</i> L.                                                             | Cuatecomante manso                    | T          | M, CB   | A     | 32946     |
|                         | * <i>Jacaranda mimosifolia</i> D.Don                                              | Jacaranda                             | C          | O, R    | A     | 32947     |
|                         | * <i>Parmentiera aculeata</i> (Kunth) Seem.                                       | Cuajilote                             | T          | A, M    | A     | 32948     |

## Appendix 1. Continuation

| Family                | Scientific name                                                                                                                                                                                   | Common name                                                                           | Management                     | Use                         | Habit                 | No. Folio                                 |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------|-----------------------------|-----------------------|-------------------------------------------|
|                       | * <i>P. edulis</i> Raf.<br><i>Podranea ricasoliana</i><br>Tantani) Sarg.                                                                                                                          | Cuajilote<br>NN                                                                       | T<br>C                         | A, M, R<br>O                | A<br>H                | 32949<br>32950                            |
|                       | * <i>Tabebuia impetiginosa</i> (M. Martens ex DC.) Standl.                                                                                                                                        | Tlamiahual                                                                            | T                              | S, R                        | A                     | 32951                                     |
|                       | * <i>T. millsii</i> (Miranda) A.H.Gentry.                                                                                                                                                         | Yellow tulip,<br>Tulipán amarillo                                                     | C                              | O, R                        | A                     | 32952                                     |
|                       | * <i>Tecoma stans</i> (L.) Juss. ex Kunth                                                                                                                                                         | Yellow trumpetbush,<br>Tronadora                                                      | P                              | O, R                        | A                     | 32953                                     |
| <b>Boraginaceae</b>   | <i>Ehretia tinifolia</i> L.<br>* <i>Turnerfortia hirsutissima</i> L.                                                                                                                              | Palo prieto<br>Tlachichinol                                                           | T<br>P                         | S<br>A, M                   | A<br>H                | 32954<br>32955                            |
| <b>Bromeliaceae</b>   | <i>Ananas bracteatus</i> (Lindl.) Schult. & Schult. f.<br><i>Bromelia karatas</i> L.                                                                                                              | Pineapple, Piña<br>Timbiriche                                                         | C, F<br>T                      | O<br>A                      | H                     | 32956<br>32957                            |
| <b>Cactaceae</b>      | <i>Opuntia</i> Mill.<br><i>Coryphantha bumamma</i> (Ehrenb.) Britton & Rose<br><i>Pereskia aculeata</i> Mill.                                                                                     | Prickly Pear Cactus, Nopal<br>Bisnaga                                                 | C, T<br>P                      | A<br>M                      | a<br>H                | 32958<br>32959                            |
|                       |                                                                                                                                                                                                   | Uña de gato                                                                           | C                              | M                           | H                     | 32972                                     |
| <b>Caprifoliaceae</b> | * <i>Sambucus mexicana</i> C.Presl.<br>ex DC.                                                                                                                                                     | Sauco                                                                                 | C                              | M, R                        | a                     | 32960                                     |
| <b>Caricaceae</b>     | <i>Carica papaya</i> L.<br><i>Jacaratia mexicana</i> A.DC.                                                                                                                                        | Papaya<br>Bonete                                                                      | C, F<br>T                      | A<br>A                      | A<br>A                | 32961<br>32962                            |
| <b>Chenopodiaceae</b> | <i>Teloxys ambrosioides</i> (L.) W.A.Weber                                                                                                                                                        | Wormseed, Epazote                                                                     | C, F                           | A                           | H                     | 32963                                     |
| <b>Commelinaceae</b>  | <i>Tradescantia pallida</i> (Rose)<br>D.R.Hunt<br><i>Tinantia erecta</i> (Jacq.) Schltdl.                                                                                                         | Purple secretia, Lluvia<br>NN                                                         | C<br>C                         | O<br>O                      | H                     | 32964<br>32965                            |
| <b>Crassulaceae</b>   | * <i>Kalanchoe daigremontiana</i> Raym.- Hamet & H.Perr.<br><i>K. pinnata</i> (Lam.) Pers.<br>* <i>K. blosfeldiana</i> Poelln.<br><i>Sedum morganianum</i> E.Walther<br><i>S. praealtum</i> A.DC. | Kalanchoe<br>Sinvergüenza<br>Cerillo<br>Donkey tail,<br>Cola de burro<br>Siempre viva | C, F<br>C<br>C, F<br>C<br>C, F | O, R<br>M<br>O, R<br>O<br>M | H<br>H<br>H<br>H<br>H | 32967<br>32968<br>32969<br>32970<br>32971 |
| <b>Cucurbitaceae</b>  | <i>Citrullus lanatus</i> (Thunb.) Mansf.<br><i>Cucumis melo</i> L.<br>* <i>Cucurbita argyrosperma</i> K. Koch**<br><i>Luffa cylindrica</i> (L.) M.Roem                                            | Watermelon, Sandía<br>Melon, Melón<br>Squash, Calabaza<br>Sponge gourd, Estropajo     | C, F<br>C, F<br>C, F<br>C      | A<br>A<br>A, R<br>D         | H<br>H<br>H<br>H      | 32973<br>32974<br>32975<br>32976          |
| <b>Cycadaceae</b>     | <i>Cycas</i> L.                                                                                                                                                                                   | Cyca                                                                                  | C                              | O                           | H                     | 32977                                     |
| <b>Davalliaceae</b>   | <i>Nephrolepis</i> Schott                                                                                                                                                                         | Fern, Helecho                                                                         | C, F                           | O                           | H                     | 32978                                     |
| <b>Ebenaceae</b>      | <i>Diospyros ebenaster</i> Retz.**                                                                                                                                                                | Black Sapote,<br>Zapote negro                                                         | C, F                           | A                           | A                     | 32979                                     |

## Appendix 1. Continuation

| Family               | Scientific name                                                                                                                                                                                                                                                                                                                                                                        | Common name                                                                                                                         | Management                           | Use                                           | Habit                                | No. Folio                                                            |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------------------|--------------------------------------|----------------------------------------------------------------------|
| <b>Equisetaceae</b>  | <i>Equisetum myriochaetum</i> Schlecht. & Cham.                                                                                                                                                                                                                                                                                                                                        | Mexican Giant Horsetail, Cola de caballo                                                                                            | C                                    | M                                             | H                                    | 32980                                                                |
| <b>Ericaceae</b>     | * <i>Rhododendron</i> sp                                                                                                                                                                                                                                                                                                                                                               | Azalea, Azalia                                                                                                                      | C                                    | O, R                                          | H                                    | 32981                                                                |
| <b>Euphorbiaceae</b> | <i>Acalypha hispida</i> Burm. f.<br>* <i>Cnidoscolus chayamansa</i><br><i>Codiaeum</i> Rumph. ex. A.Juss.<br><i>C. variegatum</i> (L.) Rumph.<br>ex. A.Juss.<br>* <i>Euphorbia pulcherrima</i> Willd.<br><i>Ricinus communis</i> L.                                                                                                                                                    | Fox tail, Cordón<br>Chaya<br>Crito<br>Crito<br>Poinsettia<br>Castor Oil Plant,<br>Higuerilla                                        | C<br>C<br>C<br>C<br>C<br>T           | O<br>A, M<br>O<br>O<br>O, R<br>M              | H<br>H<br>H<br>H<br>H<br>H           | 32982<br>32983<br>32984<br>32985<br>32986<br>32987                   |
| <b>Fabaceae</b>      | <i>Acacia acatlensis</i> Benth.<br><i>Enterolobium cyclocarpum</i> (Jacq.) Griseb.<br><i>Haematoxylum brasiletto</i> G.Karst.<br><i>Leucaena esculenta</i> (Moc. & Sessé ex A.DC) Benth.<br>ssp. <i>esculenta</i> **<br><i>L. leucocephala</i> (Lam.) de Wit.<br>spp. <i>glabrata</i> (Rose) Zárate**<br><i>Pithecellobium dulce</i> (Roxb.) Benth.**<br><i>Tamarindus indica</i> L.** | Borrego<br>Parota<br>Palo de brasil<br>Red guaje,<br>Guaje rojo<br>White guaje,<br>Guaje blanco<br>Guamúchil<br>Tamarind, Tamarindo | T<br>T<br>T<br>T<br>T<br>T           | A<br>S<br>No data<br>A<br>A<br>A              | A<br>A<br>A<br>A<br>A<br>A           | 32988<br>32989<br>32990<br>32991<br>32992<br>32993<br>32994          |
| <b>Geraniaceae</b>   | * <i>Pelargonium domesticus</i> L.H.Bailey<br>* <i>Achimenes</i> Pers.<br><i>Saintpaulia</i> H.Wendl.                                                                                                                                                                                                                                                                                  | Geranium, Geranio<br>Chinos<br>African Violet, Violeta                                                                              | C<br>C, F<br>C                       | O, R<br>O, R<br>O                             | H<br>H<br>H                          | 32995<br>32996<br>32997                                              |
| <b>Heliconiaceae</b> | <i>Heliconia</i> L.                                                                                                                                                                                                                                                                                                                                                                    | Platanillo                                                                                                                          | C                                    | R                                             | H                                    | 32998                                                                |
| <b>Iridaceae</b>     | <i>Tigridia</i> Juss.                                                                                                                                                                                                                                                                                                                                                                  | NN                                                                                                                                  | C                                    | O                                             | H                                    | 32999                                                                |
| <b>Lamiaceae</b>     | <i>Coleus</i> Lour.<br><i>Marrubium vulgare</i> L.<br>* <i>Mentha canadensis</i> L.<br><i>Ocimum basilicum</i> L.<br><i>Origanum majorana</i> L.<br><i>O. vulgare</i> L.<br>* <i>Plectranthus</i> L'Her<br>* <i>Rosmarinus officinalis</i> L.                                                                                                                                          | Coleo<br>Manrrubio<br>Spearmint, Hierbabuena<br>Basil, Albahaca<br>Marjoram, Mejorana<br>Oregano<br>Begonia<br>Rosemary, Romero     | C<br>T<br>C<br>C<br>C<br>C<br>C<br>C | O<br>M<br>A, M<br>M<br>A<br>A<br>O, R<br>M, A | H<br>H<br>H<br>H<br>H<br>H<br>H<br>H | 33000<br>33001<br>33002<br>33004<br>33005<br>33006<br>33007<br>33008 |
| <b>Lauraceae</b>     | <i>Persea americana</i> Mill.<br><i>Chlorophytum comosum</i> (Thunb.) Jacques                                                                                                                                                                                                                                                                                                          | Avocado, Aguacate<br>Spider plant,<br>Mala madre                                                                                    | C<br>C                               | A<br>O                                        | A<br>H                               | 33009<br>33010                                                       |
| <b>Lythraceae</b>    | * <i>Lagerstroemia</i> L.                                                                                                                                                                                                                                                                                                                                                              | Crape myrtle Astronómica                                                                                                            | C                                    | O, R                                          | a                                    | 33011                                                                |
| <b>Malpighiaceae</b> | Byrsonima crassifolia (L.) Kunth**<br><i>Malpighia mexicana</i> Juss.                                                                                                                                                                                                                                                                                                                  | Nanche<br>Guachocote                                                                                                                | C, F<br>T                            | A<br>A                                        | A<br>A                               | 33012<br>33013                                                       |
| <b>Malvaceae</b>     | * <i>Hibiscus rosa-sinensis</i> L.                                                                                                                                                                                                                                                                                                                                                     | Tulip, Tulipán                                                                                                                      | C                                    | O, R                                          | A                                    | 33014                                                                |

## Appendix 1. Continuation

| Family                | Scientific name                                                                                                                                                                                   | Common name                                                                                                                                 | Management                     | Use                         | Habit                 | No. Folio                                 |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------|-----------------------|-------------------------------------------|
| <b>Marantaceae</b>    | <i>Maranta leuconeura</i> E.Morren                                                                                                                                                                | Prayer plant, Maranta                                                                                                                       | C                              | O                           |                       | 33015                                     |
| <b>Meliaceae</b>      | <i>Azadirachta indica</i> A.Juss                                                                                                                                                                  | Neem, Nim                                                                                                                                   | C, F                           | M, R                        | A                     | 33016                                     |
| <b>Moraceae</b>       | <i>Ficus benjamina</i> L.<br><i>F. carica</i> L.<br><i>F. reticulata</i> Thunb.                                                                                                                   | Ficus<br>Fig, Higo<br>Indian Laurel                                                                                                         | C<br>C<br>C                    | O<br>A<br>S                 | A<br>A<br>A           | 33017<br>33018<br>33019                   |
| <b>Musaceae</b>       | <i>Musa paradisiaca</i> L.                                                                                                                                                                        | Banana, Plátano                                                                                                                             | C                              | A                           | a                     | 33020                                     |
| <b>Myrtaceae</b>      | * <i>Psidium guajava</i> L.                                                                                                                                                                       | Guava, Guayaba                                                                                                                              | C                              | A, M                        | A                     | 33022                                     |
| <b>Nyctaginaceae</b>  | * <i>Bougainvillaea glabra</i> Choisy<br>* <i>Mirabilis jalapa</i> L.                                                                                                                             | Bugambilia<br>Marvel of Peru, Maravilla                                                                                                     | C<br>C                         | O, M, R<br>O, R             | H<br>H                | 33023<br>33024                            |
| <b>Oleaceae</b>       | * <i>Jasminum officinale</i> L.                                                                                                                                                                   | Jasmine, Jazmín                                                                                                                             | C                              | O, R                        | H                     | 33025                                     |
| <b>Opiliaceae</b>     | <i>Agonandra racemosa</i> (DC.) Standl.                                                                                                                                                           | Pega hueso                                                                                                                                  | C, F                           | M                           | A                     | 33026                                     |
| <b>Palmaceae</b>      | <i>Howea</i> Hook. f.                                                                                                                                                                             | Ornamental palm                                                                                                                             | C                              | O                           | A                     | 33027                                     |
| <b>Papaveraceae</b>   | <i>Argemone mexicana</i> L.                                                                                                                                                                       | Chicalote                                                                                                                                   | T                              | No data                     | H                     | 33028                                     |
| <b>Passifloraceae</b> | <i>Passiflora edulis</i> Sims                                                                                                                                                                     | Passion Fruit, Maracuyá                                                                                                                     | C                              | A, R                        | H                     | 33029                                     |
| <b>Piperaceae</b>     | <i>Peperomia</i> Ruiz y Pav.<br><br><i>Piper amalago</i> L.<br><i>P. auritum</i> Kunth                                                                                                            | Radiator plant,<br>Pilea plateada<br><br>Cordoncillo<br>Hoja santa                                                                          | C<br>C<br>C, F                 | O<br>M<br>A                 | H<br>H<br>H           | 33030<br>33031<br>33032                   |
| <b>Poaceae</b>        | <i>Bambusa vulgaris</i> Schrad.<br><i>Cymbopogon citratus</i><br>(DC.ex Nees) Stapf<br><i>Saccharum officinaram</i> L.<br><br>* <i>Zea mays</i> L.**                                              | Bamboo, Bambú<br>Lemon grass,<br>Té limón<br>Sugarcane,<br>Caña de azúcar<br><br>Corn, Maíz                                                 | C<br>C<br>C<br>C, F            | O<br>A<br>A<br>A, R         | H<br>H<br>H<br>H      | 33034<br>33035<br>33036<br>33037          |
| <b>Portulacaceae</b>  | <i>Portulaca grandiflora</i> Hook.<br><br><i>Portulaca oleracea</i> L.                                                                                                                            | Moss-rose Purslane,<br>Amor de un rato<br><br>Verdolaga                                                                                     | C<br>P                         | O, R<br>A                   | H<br>H                | 33039<br>33038                            |
| <b>Punicaceae</b>     | <i>Punica granatum</i> L.                                                                                                                                                                         | Pomegranate, Granada                                                                                                                        | C                              | A                           | a                     | 33041                                     |
| <b>Rosaceae</b>       | <i>Prunus persica</i> (L.) Batsch<br><i>Rosa</i> L.                                                                                                                                               | Peach, Durazno<br>Rose, Rosa                                                                                                                | C<br>C, F                      | A<br>O, R                   | A<br>H                | 33042<br>33043                            |
| <b>Rubiaceae</b>      | * <i>Mussaenda</i> L.<br>* <i>Gardenia</i> J.Ellis                                                                                                                                                | Mosaenda<br>Gardenia                                                                                                                        | C<br>C                         | O, R<br>O, R                | H<br>H                | 33044<br>33045                            |
| <b>Rutaceae</b>       | * <i>Casimiroa edulis</i> La Llave y Lex.<br><br>* <i>Citrus aurantifolia</i> (Christm.)<br>Swingle<br><i>C. limetta</i> Risso<br><i>C. limonia</i> (L.) Osbeck<br><i>C. maxima</i> (Burm.) Merr. | White Sapote,<br>Zapote blanco<br><br>Key Lime,<br>Limón agrio<br><br>Sweet Lime, Lima<br>Lemandarin, Limón real<br><br>Grapefruit, Toronja | C, F<br>C, F<br>C<br>C<br>C, F | A, M<br>A, D<br>A<br>A<br>A | A<br>A<br>A<br>A<br>A | 33046<br>33047<br>33048<br>33049<br>33050 |

## Appendix 1. Continuation

| Family                  | Scientific name                                             | Common name                         | Management | Use  | Habit | No. Folio |
|-------------------------|-------------------------------------------------------------|-------------------------------------|------------|------|-------|-----------|
| <b>Sapindaceae</b>      | <i>C. nobilis</i> Lour.                                     | Tangerine, Mandarina                | C, F       | A, R | A     | 33051     |
|                         | <i>C. sinensis</i> (L.) Osbeck**                            | Sweet orange,<br>Naranjo dulce      | C, F       | A    | A     | 33052     |
|                         | <i>Murraya paniculata</i> (L.) Jack                         | Limonaria                           | C          | O    | H     | 33053     |
|                         | <i>Ruta chalepensis</i> L.                                  | Fringed rue, Ruda                   | C          | M    | H     | 33054     |
| <b>Sapindaceae</b>      | <i>Dodonea viscosa</i> Jacq.                                | Chapulixtle                         | T          | M    | a     | 33055     |
| <b>Sapotaceae</b>       | <i>Manilkara zapota</i> (L.) P.Royen**                      | Sapodilla, Chicozapote              | C          | A    | A     | 33056     |
|                         | <i>Pouteria sapota</i> (Jacq.)                              | Mamey                               | C          | A    | A     | 33057     |
|                         | H.E.Moore & Stearn                                          |                                     |            |      |       |           |
|                         | <i>Sideroxylon capiri</i> (A.DC.) Pittier                   | Capire                              | C          | O    | A     | 33058     |
| <b>Scrophulariaceae</b> | <i>Penstemon</i> Schmidel                                   | Salvia                              | C          | M    | H     | 33059     |
| <b>Solanaceae</b>       | <i>*Brugmansia candida</i> Pers.                            | Floripondio                         | C          | O, R | H     | 33060     |
|                         | <i>Capsicum annuum</i> L.                                   | Piquin pepper,<br>Chile piquing     | C, F       | A    | H     | 33061     |
|                         | <i>Lycopersicon esculentum</i> Mill.                        | Tomato, Jitomate                    | C, F       | A    | H     | 33062     |
|                         | <i>Physalis ixocarpa</i> Brot.<br>ex Hornem.                | Tomatillo, Tomate                   | C, F       | A    | H     | 33063     |
|                         | <i>P. philadelphica</i> Lam.<br>(Brot. ex Hornem) Sobr.     |                                     |            |      |       |           |
|                         | <i>Solanum seaforthianum</i> Andrews                        | Guindilla                           | C          | O    | H     | 33064     |
| <b>Sterculiaceae</b>    | <i>Guazuma ulmifolia</i> Lam.                               | Cuahulote                           | T          | M    | A     | 33065     |
| <b>Strelitziaceae</b>   | <i>Strelitzia</i> Aiton                                     | Bird of paradise,<br>Ave de paraíso | C          | O, R | H     | 33021     |
| <b>Urticaceae</b>       | <i>Pilea</i> Lindl.                                         | NN                                  | C          | O    | H     | 33066     |
| <b>Verbenaceae</b>      | <i>*Lantana camara</i> L.                                   | Yellow sage                         | C          | O, R | H     | 33067     |
|                         | <i>Lippia alba</i> (Mill.) N.E.Br.<br>ex Britton & P.Wilson | Salvia                              | C          | O    | H     | 33068     |
|                         | <i>L. dulcis</i> Trevir.                                    | Hierba dulce                        | C          | M    | H     | 33069     |
|                         | <i>Verbena carolina</i> L.                                  | Verbena                             | P          | M    | H     | 33070     |
|                         | <i>Vitex mollis</i> Kunth                                   | Cuayotomate                         | T          | M    | A     | 33071     |
| <b>Zingiberaceae</b>    | <i>Zingiber officinale</i> Roscoe                           | Ginger, Jengibre                    | C, F       | A    | H     | 33072     |