Germplasm exploration for the genera *Manihot* and *Phaseolus* in western and central Guatemala.

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REPORT PREPARED BY

D.G. DEBOUCK
CIAT-IPGRI

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FACULTAD DE AGRONOMIA, UNIVERSIDAD DE SAN CARLOS
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SUMMARY

A germplasm exploration for the genera *Manihot* and *Phaseolus* has been carried out in western and central Guatemala. This seven-days exploration yielded 39 samples of bean germplasm for 8 species, including relatives of common (11), lima (7), scarlet runner (12) and year-bean (2). No populations of wild cassava were seen, but of *Cnidosculus*. These findings are discussed in view of plant domestication for these crops in Guatemala.

RESUMEN

Se llevó a cabo una exploración de germoplasma para los géneros *Manihot* y *Phaseolus* en las partes occidental y central de Guatemala. Durante la exploración de siete días, se encontraron 39 muestras de frijol, de las cuales 11 son del pariente silvestre del frijol común, 7 del frijol lima, 12 del frijol ayocote y 2 del frijol piligue. No se vieron poblaciones de yuca silvestre pero si de *Cnidosculus*. Se discute estos resultados con miras a la domesticación de estas plantas en Guatemala.

1. Objectives

This exploration was carried out in order to get the basic material to answer the question whether species of cassava and beans were actually domesticated in Guatemala. That question may actually cause surprise, because it has been long accepted that the area of Mexico- Guatemala is a primary center of diversity of cultivated plants and a cradle of agriculture (Bukasov, 1930; Harlan, 1992; Vavilov, 1931). The point we are after is whether Guatemala could have been a place of domestication different from Mexico or not, or put in other words is the Central American center of crop diversity more complex than suspected so far. With the use of molecular markers, and recent evidences accumulated on e.g. maize (Doebley, 1990), beans (Gepts, 1993), squashes (Nee, 1990), there are good reasons to believe that the structure of the Mesoamerican center as a 'center' is indeed a complex one, thus forcing us to reconsider different actions for the conservation and utilization of these plant resources. As discussed below, we shall see that multiple domestications in space/ time for the different crops are plausible for Central America.

We were also interested in documenting further certain aspects of biology, ecology, distribution and coevolution of some of these species in the field as a starting point for the conservation of these plant resources, either through *ex situ* or *in situ* methodologies or a blend of both. Our data could also help the national competent authorities to monitor genetic erosion of populations over time; such a monitoring has been considered a priority by national authorities (Lara, 1992).

The background to these objectives is as follows.

2. Background

This work is a continuity of an exploration carried out in 1985 by D.G. Debouck and Juan José Soto of ICTA-Chimaltenango with focus on the Cordillera Volcánica and the department of San Marcos (Debouck, 1986). It also complements an exploration done by D.G. Debouck and Francisco Javier Vasquez of ICTA-Recursos Genéticos in the central and eastern parts (Depts. of Chimaltenango, Chiquimula, El Progreso, Escuintla, Guatemala, Jalapa, Sacatepéquez and Santa Rosa) of that country in 1987 (Debouck, 1988).

Wild species of cassava reported so far for Guatemala include *Manihot aesculifolia* (HBK) Pohl and *M. rhomboidea* Mueller subsp. *rhomboidea* and subsp. *microcarpa* (Mueller) Rogers & Appan, both within section Parvibracteatae (Rogers and Appan, 1973). These authors stated: "*Manihot aesculifolia* is the closest relative of *M. esculenta*. (...) Plant breeders should find *M. aesculifolia* a rich source of genetic material for a variety of purposes." (Rogers & Appan, *op. cit.*, p. 45). On the other hand, Allem (1994) claims that there are two wild progenitors to cassava, *M. esculenta* Crantz subsp. *flabellifolia* (Pohl) Ciferri and *M. esculenta* Crantz subsp. *peruviana* (Mueller) Allem, basically distributed around the Amazon Basin. There is a third scenario to explain the origin of cassava: this cultigen would be a compilospecies, resulting from the assemblage of genomes coming from different wild species (Sauer, 1993). In this regard, after a study of cpDNA, Bertram (1993) notes: "The suggestion of reticulate evolution having occurred within the group is not unexpected given the widely held view that interspecific crosses are possible and that they do occur naturally, and perhaps readily, when cassava is grown in close proximity to wild relatives. Although the possibility exists that cassava is a polyphyletic assemblage associated with several different 'mother' species, no evidence for this assertion was obtained, as chloroplast polymorphism surveyed within the cultivated species was low "(Bertram, op. cit., p. 436). The same author also mentioned: "*Manihot aesculifolia*, in addition to its morphological similarity to the cultivated species, emerges, based on parsimony analysis of chloroplast sequences, as the member of the section most similar to a common ancestor with cassava. (...) Further collecting of *M. aesculifolia* in southern Central America is recommended, since populations of the species in that region may be less divergent than those from Mexico "(Bertram, op. cit., p. 433).

That cassava is an old crop in northern Guatemala is beyond doubt: "Estas raíces que son blancas, y mayores que las del camote, se comen cocidas, y es muy buena comida, y de mucha substancia. Para hacer el pan cazabe se ralla la yuca en rallas grandes, y hecha menudencia se mete en prensa, y allí le sacan todo el humor aquoso que tiene, ..." (Ximénez, 1722). One shall note that this way of preparing cassava might indeed refer to bitter types (Stone, 1984). In addition, it has a Maya name *'tsin'* (Lundell, 1939), and has been part of the pre-Hispanic Maya cropping systems (Turner II and Miksicek, 1984; Wiseman, 1978). It seems however absent in the highland region during pre-Hispanic period (Wauchope, 1948). Given that context, wild relatives of cassava from the Petén and the lower Motagua valley on the one hand, and from tropical dry valleys from inland Guatemala and the Pacific slope on the other hand would be equally interesting.

There are no germplasm collections of wild *Manihot* from Guatemala, so the starting point lies solely in the floristic knowledge of that country. The herbarium vouchers maintained there are not presently classified per families, thus making difficult the search for *Manihot* specimens, and so the preparation of a routing for exploration. The available information is the one compiled by Rogers and Appan (1973) in their monograph, on the base of herbarium specimens most of them being at the Field Museum of Chicago. It reads as follows:

Table 1 - Localities reported for *M. aesculifolia*
Steyermark 51316, Huehue., trail between Democracia and Sta. Ana.
Standley 73669, Zacapa, vicinity of Zacapa.
Standley 73683, Zacapa, vicinity of Zacapa.
Standley 73783, Zacapa, between Zacapa and Chiquimula.
Standley 73736, Chiq., near divide between Zacapa and Chiquim.
Standley 74305, Chiq., quebrada Shusho.
Aguilar 1373, Quiché, none.
Blake 7688, Izabal, Gualan.
Steyermark 47778, 47779, Suchitep., S of Alotenango.
Standley 79452, Santa Rosa, S of Guazacapan.

One can note the poor level of details about exact location of specimens: as an example, Alotenango is in the department of Sacatepéquez, not in Suchitepéquez! The same repeats itself with the other species (Tables 2 and 3).

Table 2 - Localities reported for *M. rhomboidea* subsp. *rhomboidea*
Melbus & Goodman 3652, Huehue., below San Antonio Huista.
Seler & Seler 2814, Huehue., Uaxackanal.
Steyermark 50614, Huehue., Cerro Pix Pix.
Steyermark 51474, Huehue., between Nentón and Miramar.

The sites of Cerro Pix Pix and Uaxackanal could not be defined with certainty.

Table 3 - Localities reported for *M. rhomboidea* subsp. *microcarpa*
Steyermark 50614, Huehue., Cerro Pix Pix.
Steyermark 50866, Huehue., along Río Cuilco.
Aguilar 1546, Quiché, none!
Deam 6097, Izabal, none!
Pittier 132, Baja Verapaz, Cuesta de Cachil.

It is a bit puzzling that the same herbarium number (*Steyermark 50614*) collected at the same locality is corresponding to two different subspecies! Taking into account the advanced stage of the dry season, it was decided to focus on the Pacific foothills and plains and on the western valley of Huehuetenango (rivers Selegua, Azul and Nentón).

Although important for Guatemala people as a food crop (McBryde, 1945; Standley and Steyermark, 1946), relatively little is known about the place of domestication of *Phaseolus coccineus* L.. Delgado Salinas (1988) stated "the center of origin of the crop is undoubtedly the Mexican mountains, ..., especially in the states of Puebla, Oaxaca and Chiapas. (...) It is clear that *P. coccineus* subsp. *coccineus* is a primary crop because it was domesticated directly from a wild plant. The putative ancestor is *P. coccineus* subsp. *formosus*. ..."(Delgado, *op. cit.*, p. 449). Now, it happens that this wild form also extends into Guatemala, where its distribution ends up in the highlands of Jalapa (Debouck, 1988). It is presently difficult to discard that Guatemala has not been place of domestication of that crop. Further progress will be possible if comprehensive collections of wild scarlet runner beans are made available.

As far as the lima bean is concerned, there are currently problems in identifying where the small-seeded cultivars of morphotypes called 'Sieva' and 'Potato' have been actually domesticated (Debouck et al., 1989; Maquet et al., 1993). However, there might be certain electromorphs specific to certain regions of the whole range of wild lima beans, thus pointing out to specific domestication spots (Maquet et al., 1990). One element to make progress on that aspect lies in the extending of the collecting effort to more populations of wild forms.

Although progress has been made recently on this question (Azurdia Pérez, 1994; Schmit and Debouck, 1991), whether there has been a single place of domestication of *P. polyanthus* or two (i.e. in Guatemala and western Mexico) is still debatable (Debouck, 1992), because not all electromorphs found in globulins in the cultivated materials match with those encountered in the Guatemalan wild forms. The collecting of additional wild populations in Guatemala could provide at least part of the answer to this question.

For the common bean, the possibility that it was actually domesticated in Guatemala apart from Mexico was raised by a work using RFLPs on mtDNA (Khairallah et al., 1992) in which a wild bean from Sacatepéquez was very similar to a landrace of Malawi belonging to the Mesoamerican gene pool. As we see later, the distribution of wild common bean populations has documented and sampled to a relatively good extent. Additional information about possible sites was obtained from a survey of herbarium voucher specimens (G. Freytag, pers. comm., 1994) from the Field Museum, Chicago (collected by i.e. Paul Standley, Julian Steyermark and Antonio Molina in the 1940s).

3. Itinerary and Timing

19 January 1995: travel Cali - Panama - Guatemala City. Visit to Facultad de Agronomía, Universidad de San Carlos de Guatemala; meeting with Ing. Efraín Medina Guerra, Dean of the Faculty. Route planning with Dr. César Azurdia Pérez and Ing. Edgar Martínez Tambito.

20 January: germplasm exploration: Dept. of Guatemala: Guatemala (1,500 masl) - Villa Nueva (1,300 m) - Ciudad San Cristobal (1,550 m) - Dept. of Chimaltenango: El Tejar (1,700 m) - Chimaltenango (1,680 m) - San Martín Jilotepeque - Chimaltenango (1,700 m) - Parramos (1,690m) - Concepción Calderas - Dept. of Sacatepéquez: San Miguel Dueñas (1,400 m) - Antigua Guatemala (1,450 m); 131 Km. Collections: # 3057 to 3062; # 1622.

21 January: Dept. of Sacatepéquez: Antigua Guatemala (1,450 m) - Alotenango (1,320 m) - Candelaria (1,030 m) - Dept. of Escuintla: El Rodeo (710 m) - Escuintla (300 m) - Siquinalá (320 m) - Santa Lucia (320 m) - Cocales (210 m) - Patulul (310 m) - San Julian (420 m) - Dept. of Sololá: Parcelamento Pampojila (1,410 m) - San Lucas Tolimán (1,510 m) - Agua Escondida (1,840 m) - Godínez (2,070 m) - Panajachel (1,500 m); 167 Km. Collections: # 3063 to 3067.

22 January: Dept. of Sololá: Panajachel (1,500 m) - Sololá (2,000 m) - Nahuala (2,380 m) - Dept. of Totonicapán: Cuatro Caminos (2,220 m) - Dept. of Quezaltenango: Chiquival (2,180 m) - Estancia de la Virgen - Dept. of Huehuetenango: Pucal (1,640 m) - Huehuetenango (1,800 m) - Canton El Progreso (1,940 m) - Aguacatán (1,630 m) - Huehuetenango (1,840 m); 204 Km. Collections: # 3068 to 3070.

23 January: Dept. of Huehuetenango: Huehuetenango (1,820 m) - Camojallito (1,870 m) - La Democracia (1,870 m) - Cuatro Caminos (680 m) - Buxup (800 m) - Jacaltenango (1,370 m) - San Antonio Huista (1,200 m) - Cuatro Caminos (700 m) - Huehuetenango (1,800 m); 265 Km. Collections: # 3071 to 3075.

24 January: Dept. of Huehuetenango: Huehuetenango (1,820 m) - Malacatancito (1,590 m) - Dept. of Quezaltenango: Quezaltenango (2,180 m) - Canton Chicua (2,380 m) - Almolonga (2,150 m) - Zunil (1,970 m) - Estancia de La Cruz (1,700 m) - Aguas Amargas (1,860 m) -

Estancia de La Cruz (1,690 m) - Quezaltenango (2,250 m); 143 Km. Collections: # 3076 to 3087.

25 January: Dept. of Quezaltenango: Quezaltenango (2,250 m) - Cantel (2,140 m) - Chicovix (2,030 m) - Zunil (1,980 m) - Aguas Georginas (2,300 m) - Zunil (1,980 m) - Santa María de Jesús (1,530 m) - Quezaltenango (2,250 m); 107 Km. Collections: # 3088 to 3094.

26 January: Dept. of Quezaltenango: Quezaltenango (2,250 m) - Cuatro Caminos (2,210 m) - Dept. of Sololá: Pamezabal (2,380 m) - Santa Clara La Laguna (1,930 m) - Los Encuentros (2,480 m) - Guatemala (1,530 m); 224 Km. Grand total: 1,241 Km. Collections: # 3095 to 3097.

27 January: classification and documentation of samples at Facultad de Agronomía, Universidad de San Carlos de Guatemala; meeting with Biol. Juan José Castillo Mont at the herbarium.

28 January: travel Guatemala City - Panama - Cali.

So, the area of work for this year, as dry season was already well advanced, includes the mountainous area of western Guatemala: the Cordillera Volcánica, the Tierras Altas, the extreme eastern part of the Sierra Madre, limiting to the north with the Sierra de Cuchumatanes, and to the east with Sierra de Chuacús (Anonymous, 1972). This area covers an inclined rectangle topping to the border with Mexico and ending up to Guatemala City, between 92º15'W - 90º30'W, and 14º20'N - 15º30'W. It includes the departments of Guatemala, Sacatepéquez (with ethnic group Cakchiquel), Chimaltenango (same), Sololá (same to the east; with ethnic group Quiché to the west), Totonicapán (with ethnic group Quiché), Quezaltenango (with ethnic group Quiché to the east, and ethnic group Mam to the west), and Huehuetenango (with ethnic group Mam to the south and west; Aguacateco to the east; Tzotzil Maya to the north).

In most of the area of work, climate is quite mild, with extreme temperatures only on the Pacific coast below 500 m (above 35ºC), and on the highest part of Cuchumatanes (with several frosts a year, but not below 2,000 m). Amount of rainfall occuring from May to October (some years starting earlier and/or finishing later), varies a lot, with more precipitation on the Cordillera Volcánica (e.g. with 5,000 mm east of Volcán Santo Tomás), less on the southern Cuchumatanes (aproxim. 2,000 mm). The areas of NW Huehuetenango and NE Chimaltenango are drier (1,000 mm and less) (Anonymous, 1972). One should also note a general moisture gradient from east to west, with more humid vegetation types on the west.

The area of work includes a large variety of vegetation types, mainly of the montane flora district (Anonymous, 1972). Out of the 14 life zones recognized for this country (Lara, 1992), seven occur in the area of work. Further, as discussed later on, some life zones should be subdivided, in order to better reflect their floristic composition; in that sense, the

'bosque húmedo Montano Bajo subtropical' present on the southern Pacific slope of the Cordillera Volcánica has obviously another floristic composition in comparison to the reportedly identical vegetation type on the northern slope of the same *sierra* de la Cruz S. and Sagastume L. (1983). The different montane forests have been reported as important reservoirs of genetic resources for crops of interest for the present study, namely three of the four genera considered here: *Persea, Phaseolus* and *Pouteria* (Smith et al., 1992).

Soils in the area of work have predominantly evolved from volcanic ashes, combining deposits of different ages on geological substrates of varied nature. Quaternary material dominate along the Cordillera Volcánica, while Paleozoic and Cretaceous granite and diorite form the substrate in the southern Cuchumatanes and Chuacús highlands (Anonymous, 1972). The Tierras Altas just north of the Cordillera Volcánica is of older volcanic deposits (Cenozoic). The valleys of Río Selegua and upper Chixoy in Huehuetenango are with sediments of Carboniferous and Permian eras. In the upper corner of our work area in Huehuetenango (Mpio. of Nentón), start the *tierra rossa* or rendzins at lower and higher altitudes, respectively, that is karstic soils developed on Cretaceous calcareous rocks. As a consequence, at our collection sites, with the exception of certain valleys and the Costa Sur Pacific plains, soils are often relatively young, poorly developed, with good to excellent drainage, and rich in a variety of chemicals.

Pressures on land and original vegetation can be considered as high everywhere with the exception of very steep places in the mountainous areas of western Sololá, southern San Marcos and northern Huehuetenango, but for different reasons: quickly expanding urban areas in the department of Guatemala south and west of the capital, coffee plantations on the southern slope of the Cordillera Volcánica, Old World vegetables and flowers for export in Chimaltenango, irrigated zones in southwestern Huehuetenango (Anonymous, 1972) and personal observations, 1987, 1995). Original land masses with natural vegetations are thus quickly turning into small patches.

4. Results and Discussion

Seed samples, as reported below by collection numbers, were equally shared by the Facultad de Agronomía, Universidad de San Carlos de Guatemala, and the Genetic Resources Unit, Centro Internacional de Agricultura Tropical. When seed amount was not sufficient to be shared between both institutions (case of # 3070 only), seed were left to Facultad de Agronomía, Universidad de San Carlos de Guatemala, for prior multiplication. Material # 3085 was found only as herbarium specimen (green pod stage). Fifty-one voucher herbarium specimens were collected during this trip for the following numbers: # 3064 (6 voucher specimens), 3070 (3), 3072 (3), 3073 (3), 3085 (10), 3093 (5), 3095 (10), and 3097 (11). They were left to the herbarium of the Facultad de Agronomía, Universidad de San Carlos de Guatemala, to be kept there and for distribution to other herbariums (e.g. MICH, MO) if so desired. Collection data were shared with the Facultad de Agronomía, Universidad de San Carlos de Guatemala. This report has been distributed to Facultad de

Agronomía, Universidad de San Carlos de Guatemala, CIAT and IPGRI. The following is an extended information under DGD responsibility.

For *Manihot* spp.

Going back to the previous herbarium records, for the regions to be visited, we had thus the following.

Table 4 - Localities reported for *M. aesculifolia*
Steyermark 51316, Huehue., trail between Democracia and Sta. Ana.
Steyermark 47778, 47779, Suchitep., S of Alotenango.

No plants resembling wild cassava were found in the sector south of Alotenango which is in Sacatepéquez. The vegetation type there is a tropical semideciduous forest with dry thickets on lava beds and tropical evergreen forest strips along streams and rivers or 'bosque muy húmedo subtropical cálido' bmh-S (c) according to de la Cruz S. and Sagastume L. (1983). According to Juan José Castillo Mont who has been collecting *Chamaedorea* palms throughout Guatemala (pers. comm., 1995) mainly in all kinds of tropical forests, no 'yuca cimarrona' has ever been seen in that forest on the Pacific slope, but in the Petén. One should note however that according to de la Cruz S. and Sagastume L. (1983) it is the same vegetation type that is also present in the southern part of the Petén! We have seen instead as living fences, namely around Patulul (310 masl), plants about to start blooming of *Cnidosculus chayamansa* called 'chaya' and used as vegetable (leaves used in soups). Although Rogers and Appan (1973) stated that *Cnidosculus* might share some affinities with *Manihot* though definitively distinct from the latter, it is almost impossible that these authors have confused the specimens of *M. aesculifolia* examined by them for the monograph with 'chaya' materials, even if voucher specimens were particularly scrappy.

We made actually the trail between La Democracia and Cuatro Caminos, and from there to Nentón, and then once back from San Antonio Huista, the trail between Santa Ana Huista and Cuatro Caminos, in view of crossing habitats of both *M. aesculifolia* and *M. rhomboidea* (see tables). On no circumstance did we find any wild cassava, but what we believe is another *Cnidosculus* species (# 3072), this time as wild. So, we cannot give an answer for the population referred by the herbarium sample *Steyermark 51316* nor for *Melbus & Goodman 3652*.

Table 5 - Localities reported for *M. rhomboidea* subsp. *rhomboidea*
Melbus & Goodman 3652, Huehue., below San Antonio Huista.
Steyermark 51474, Huehue., between Nentón and Miramar.

The collection # 3072 (Figure 1) is noteworthy for the following: it was not a dense population (just about 10 scattered individuals) while the two species mentioned above could form dense stands; the epidermis of the stem was with prickles (production of abundant latex and presence of 3 capsulas/ fruit indicate that we were dealing with an Euphorbiaceae plant, not a juvenile *Ceiba*!); panicles were with just a few floral insertions while they use to be multiflowered in the two species mentioned above. It was collected in order to "root" dendrograms in future phylogenetic studies of *Manihot*, and to have a better understanding of the generic affinities between *Cnidosculus* and *Manihot*.

For *Persea* spp.

Although a lot of collecting has been done for avocado (cfr the explorations by Popenoe: Rosengarten, 1991), we continue to document the location of noteworthy trees of *Persea americana* var. *guatemalensis*. Locations where this material was observed include:
1) Aldea Santa Isabel, north of Chimaltenango on road to San Martín Jilotepeque,
2) Aldea Chimachoy, south of Parramos on road to Concepción Calderas,
3) at site of # 3067, 7 Km SW of Agua Escondida, in the district of San Lucas Tolimán,
4) several locations in the valley of Río Bucá west of Aguacatán in Huehuetenango,
5) at site of # 3083, where the hot springs of Aguas Amargas, Zunil, in Quezaltenango.

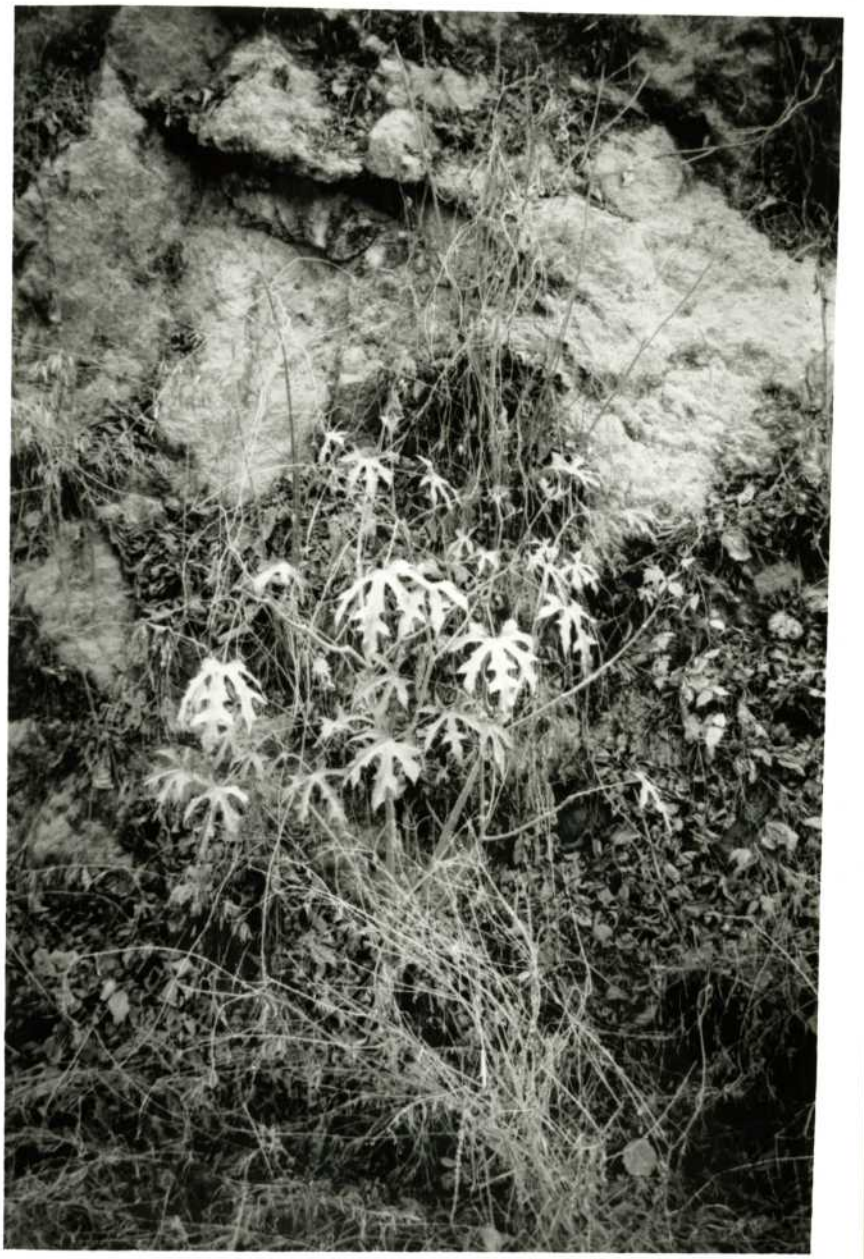

Figure 1 - Collection # 3072 in the Santa Ana Huista district of Huehuetenango, 13 Km NNE of Camojá. Leaves are abnormally bright because of the dust.

For *Phaseolus* spp.

There are currently 13 species reported for Guatemala, and we found 40 populations for 8 species in seven days of field work (Table 6).

Table 6 - Wild species ever reported for Guatemala	No. samples in '95
P. coccineus	12
P. leptostachyus	2
P. lunatus	7
P. macrolepis	1
P. microcarpus	0
P. oligospermus	0
P. parvifolius	0
P. pauciflorus	0
P. persistentus	0
P. polyanthus	2
P. tuerckheimii	2
P. vulgaris	11
P. xanthotrichus	3

The species *P. microcarpus, P. parvifolius, P. pauciflorus* are early materials (setting seed in October- November, or even earlier) and distributed mostly in the eastern part of Guatemala, while *P. oligospermus* and *P. persistentus* are maturing in November - December and distributed in the central/ eastern part of the country. In relation to the crop evolution problems to solve, these materials were not of high priority this year.

Phaseolus coccineus L., wild forms

We found this species especially in the western highlands of Guatemala. Although the material in the field was already dried (with no flowers for precise identification), it seems that we could organize our collections into three groups:

- group # 1: it corresponds to small plants, presumably scarlet flowered, found in oak and pine-oak forests of the inner slope of Cordillera Volcánica, several cliffs in the Tierras Altas and Sierra de Cuchumatanes,

- group # 2: it corresponds to taller plants, found in the montane forest with *Alnus* of Quezaltenango,

- group # 3: it corresponds to tall plants too, growing in oak-alder-pine forests of Huehuetenango.

The group # 1 corresponds to small plants (climbing stems 2-3 m high), presumably scarlet flowered (all flowers were gone at time of our visit), with 4-5 seeded pods with purplish streaks, found in oak- and pine-oak forests of the depts. of Sacatepéquez, Chimaltenango, Huehuetenango and Quezaltenango. It seems that a slight level of disturbance favours the extending of this group, provided that grazing and fire are limited. All populations found were heavily infested with *Apion* probably *aurichalceum* (damaging the beak part of the pod, but leaving 1-2 seeds intact). Some populations are locally eaten (# 3088; called "frijol de montaña"); this # 3088 is in fact a mixed collection, including a weedy type with 100-seed weight of 32.5 g.

The group # 2: it corresponds to taller plants (strong climbing stems of up to 6 m high), found at 1,800- 2,000 masl in the montane rain forest with *Alnus* of Quezaltenango. This forest corresponds to the 'Bosque húmedo Montano Bajo Subtropical' in transition to the 'Bosque muy húmedo Montano Bajo Subtropical' (according to the classification proposed by de la Cruz S. and Sagastume L., 1983). Other plants typical of these humid, somewhat cool habitats include the genera: *Perimenium, Senecio, Dahlia, Begonia, Cestrum, Fuschia, Eupatorium, Gallium, Selaginella* and different bromeliads. Only two collections fully dried # 3087 (Figure 2) and 3091 were found, both in the cañón of Río Samalá. As far as we can judge on only two populations, it seems that this material does not stand disturbance, and would not survive long once the primary forest has been cut down. Both populations were also heavily attacked by *Apion aurichalceum*.

Group # 3 corresponds to only one collection (# 3068), which may even be genetically contaminated with ordinary wild *P. coccineus* (# 3069) that was growing close by. This population was found at the locality of *Standley 81974* (voucher at the Field Museum of Chicago), and would thus correspond to the variant var. *guatemalensis* (G. Freytag, pers. comm., 1994). Searches for other populations near Malacatancito, Huehuetenango, in the same kind of forests were unsuccessful (because it was too late or because the populations have gone extinct already). According to an informant running a gasoline station in Huehuetenango City, Puente Los Alisos is the site of # 3068, turning one additional record (*Molina 30271*) void! Seed look particular in being relatively small (100-seed weight = 10.4 g) with a pinkish bayo background with brown-black speckles as in other wild beans. Plants, 4 m high climbers, were already fully dried.

Figure 2 - A few plants of collection # 3087 growing on a alder in eastern Quezaltenango. Mature pods marked by arrows.

Phaseolus leptostachyus Bentham

This is a common species mostly distributed in the western central part of Guatemala, less frequent to the east, for which we incidentally collect two additional populations (# 3070, 3073), both in Huehuetenango. Because of its capacity to stand some habitat degradation (but no fire nor overgrazing), and because of its hypothetical possibility to cross with other species (its 2n = 20 instead of 22), it was not high on our collecting checklist. It is a sprawling vine, with determinate guides (a trait uncommon in wild beans), thriving in pine and pine-oak forests of the 'Bosque húmedo Montano Bajo Subtropical' (bh-MB) (according to the classification proposed by de la Cruz S. and Sagastume L. (1983), that is in its continental and dry variants, in the range 800- 1,700 masl. All populations disclosed this year were heavily infested by *Apion* weevils.

Phaseolus lunatus L., wild forms

This is a rather frequent material on the Pacific coast of Guatemala, that cannot be collected in every exploration as it uses to mature later in comparison to most species. We were able to add seven populations to the known records for the country.

It dwells in the 'bosque muy húmedo subtropical cálido' bmh-S (c) according to de la Cruz S. and Sagastume L. (1983), that uses to occupy large areas on the Pacific piedmont and coastal plain prior to the large-scale planting of sugar cane, cotton, soybean and sorghum. Particularly because of the use of frequent fires for sugar cane cutting, it has become much rarer in the coastal area, but it is still found on river beds, along old pads, cliffs and lava waste lands. If left untouched, for instance on borders of coffee plantations, plants can do well and raise a height of 4 meters after a few years (see Figure 3 for # 3065). Certain populations also enter into the warm variants of 'Bosque húmedo Montano Bajo Subtropical' (such as # 3059, found at the highest altitude, 1,700 masl) or the humid variants of 'bosque seco subtropical 'bs-S' of de la Cruz S. and Sagastume L. (1983) (such as # 3071).

Population # 3058 shall be interesting to monitor because it thrives in what is likely to become a suburb of Guatemala City called Ciudad San Cristobal together with wild *P. vulgaris* # 3057).

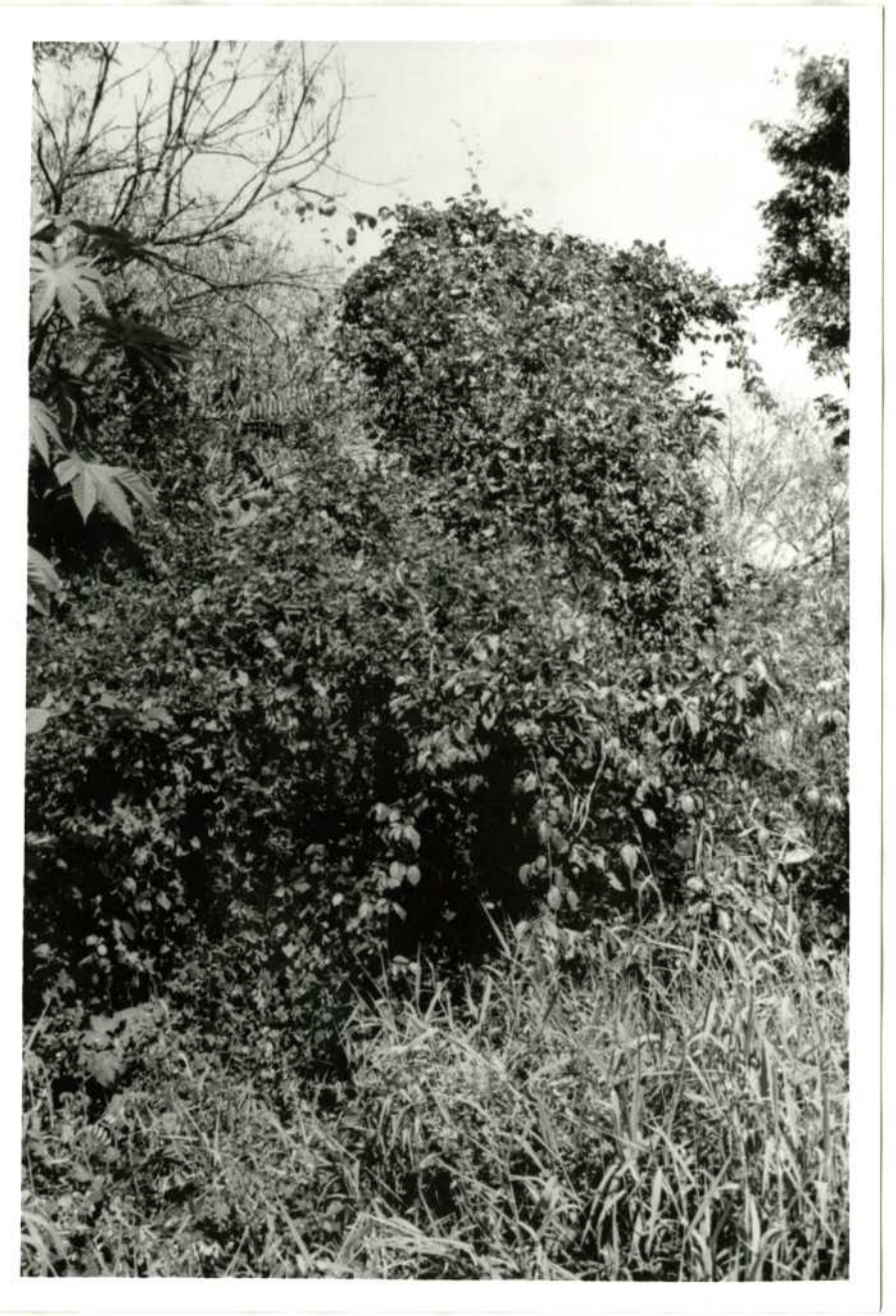

Figure 3 - Plants reaching 4 meters in population # 3065 of wild lima bean at the border between Suchitepéquez and Sololá.

Phaseolus macrolepis Piper

We added one seed collection (# 3095) of this endemic bean, for Sololá, where we have identified another population, close to Nahuala in 1985. Confirming earlier observations (Debouck, 1988), it seems that this species is restricted to the cool montane pine forest (classified as 'Bosque muy húmedo Montano Bajo Subtropical' (bmh-MB), according to de la Cruz S. and Sagastume L. (1983), disappearing once this forest is cut down or grazed (as we could see in the pine forest in the immediate surroundings of Pamezabal). Other genera seen in this climax vegetation include: as trees, *Cupressus* and *Alnus*; as companion herbaceous species: *Chlorophora, Esteria, Fuschia, Perimenium, Salvia, Saurauria, Solanum*.

Material was entering maturity, with most pods still green and even a few flowers. No damages by pod weevils were observed but black aphids.

Phaseolus polyanthus Greenman, wild forms

One of the purposes of this trip was to extend the knowledge about the distribution of the wild (and probably ancestral) form of what appeared to be the fifth cultigen within the genus *Phaseolus*. Prior to this trip, the distribution includes 6 populations distributed in eastern Sololá (1), western Chimaltenango, southern Sacatepéquez (2), and southwestern Guatemala (1) (Schmit and Debouck, 1991). We were able to extend it with one population for southeastern Sololá (# 3067) and one for eastern Quezaltenango (# 3093).

Early observations that this species is one of the typical vines growing in old growths of the lower montane forest called 'Bosque húmedo Montano Bajo Subtropical' (bh-MB) (according to the classification proposed by de la Cruz S. and Sagastume L. (1983) were fully confirmed by these new records. Such life zone occupies a small acreage on the Pacific slope of the Cordillera Volcánica, now quickly converted into coffee plantations. While benefitting a bit from natural openings, wild *P. polyanthus* does not survive long to intense clearings of the primary bh-MB.

The collection # 3067 indicates the presence of wild *P. polyanthus* south of Lake Atitlán (it was known from the northern side of the Lake prior to this trip, thanks to population # 1631). Noting that the lower montane forest bh-MB is distributed all around Lake Atitlán, we were interested in checking that further on the western side of the lake with the transect Santa Lucía Utatlán (2,400 masl) -Pamezabal -Santa Clara La Laguna (1,930 masl), in western Sololá. Unfortunately, we could not get to altitudes low enough in order to cross its range. Since the zone of Volcan San Pedro is still relatively little communicated, there is still a good chance to disclose it near San Pedro La Laguna. Population # 1631 (1,680 masl) found in 1985 is still there, although somewhat reduced by the converting of the dirty road into a brand new high speed way, from Panajachel to Sololá.

The collection # 3093 (Figure 4) probably marks the end to the West of the distribution of wild *P. polyanthus* on the Pacific slope of the Cordillera Volcánica. Indeed,

Figure 4 - Population # 3093 of wild *P. polyanthus* in the humid montane subtropical forest at the extreme of its range to the west in Cordillera Volcánica.

the vegetation zone bh-MB ends up at Santa María de Jesús in eastern Quezaltenango and does not extend further westward. One herbarium specimen (*Steyermark 37495*, at the Field Museum of Chicago), found on the southern slopes of Volcán Tajumulco at 1,300- 1,500 masl, could be of wild *P. polyanthus* (G. Freytag, pers. comm., 1994), as it could be cultivated or escaped. That later zone corresponds to the 'bosque muy húmedo Montano Bajo Subtropical' de la Cruz S. and Sagastume L. (1983), that is a much more humid zone in comparison to the former, where wild *P. polyanthus* would have trouble in dispersing its seed.

At the same place of # 3093, on another plant, we found a bayo pinkish variant (100-seed weight 40.9 g). We don't know whether it is part of the natural variation of the wild population (one with very squarish seeds, and relatively larger, 100-seed weight 39.6 g in comparison to other samples) or the result of introgression with cultivated or escaped *P. polyanthus* growing close-by. From previous observations (Azurdia Pérez, 1994; Debouck, 1988), we know that such introgression can occur.

When finishing up the classification of our samples, the writer was shown by Dr. C. Azurdia a sample collected on 19 January 1995 from a farm close to San Juan Chamelco, Alta Verapaz, and called '*num*'. It corresponds to cultivated *P. polyanthus* (not *P. coccineus* L., as reported elsewhere (Standley and Steyermark, 1946), under that vernacular name). It displays an interesting variegation with diferent spots of grey and black on bayo background, as it would have been crossed with wild *P. polyanthus*. Interestingly enough, Freytag and Vakili have collected in 1978 a wild *P. polyanthus* (F&V 78-Guat-132) from that area, thus extending the habitat of this taxon to the 'Bosque muy húmedo subtropical frío' de la Cruz S. and Sagastume L. (1983), restricted to the highlands surrounding Cobán and to the Sierra de Chuacús. More field work is necessary to confirm these data; in case they hold true, this would indicate a slightly wider range of wild *P. polyanthus*, with its presence on two mountainous ranges in inland Guatemala.

Phaseolus tuerckheimii Donnell-Smith

This late-maturing (seed available only from February onwards) wild bean is becoming a rare plant in Guatemala, as the primary montane forests where it thrieves are progressively cut down and replaced by secondary vegetations, other land uses such as pastures (frequent because of constant moisture) or even pure stands of pine or eucalypts exploited for timber. So, population # 1617 has been much reduced since our visit in 1985.

We were able to add two novel records for Guatemala, with populations # 3085 (found in Aguas Amargas, Dept. of Quezaltenango) and # 3097 (found up from Santa Clara La Laguna, Dept. of Sololá; Figure 5). They were found in primary, humid habitats of the montane forest 'bosque húmedo montano bajo subtropical' or bh-MB according to de la Cruz S. and Sagastume L. (1983), with *Alnus* and *Heliocarpus* trees, a few Bambusoideae, Marantaceae, Melastomataceae, and *Perimenium* and *Dahlia* as the most characteristic Compositae in such montane habitats.

Interestingly, it shows no damages of *Apion*, and its foliage velvet-like is generally free of diseases and pests.

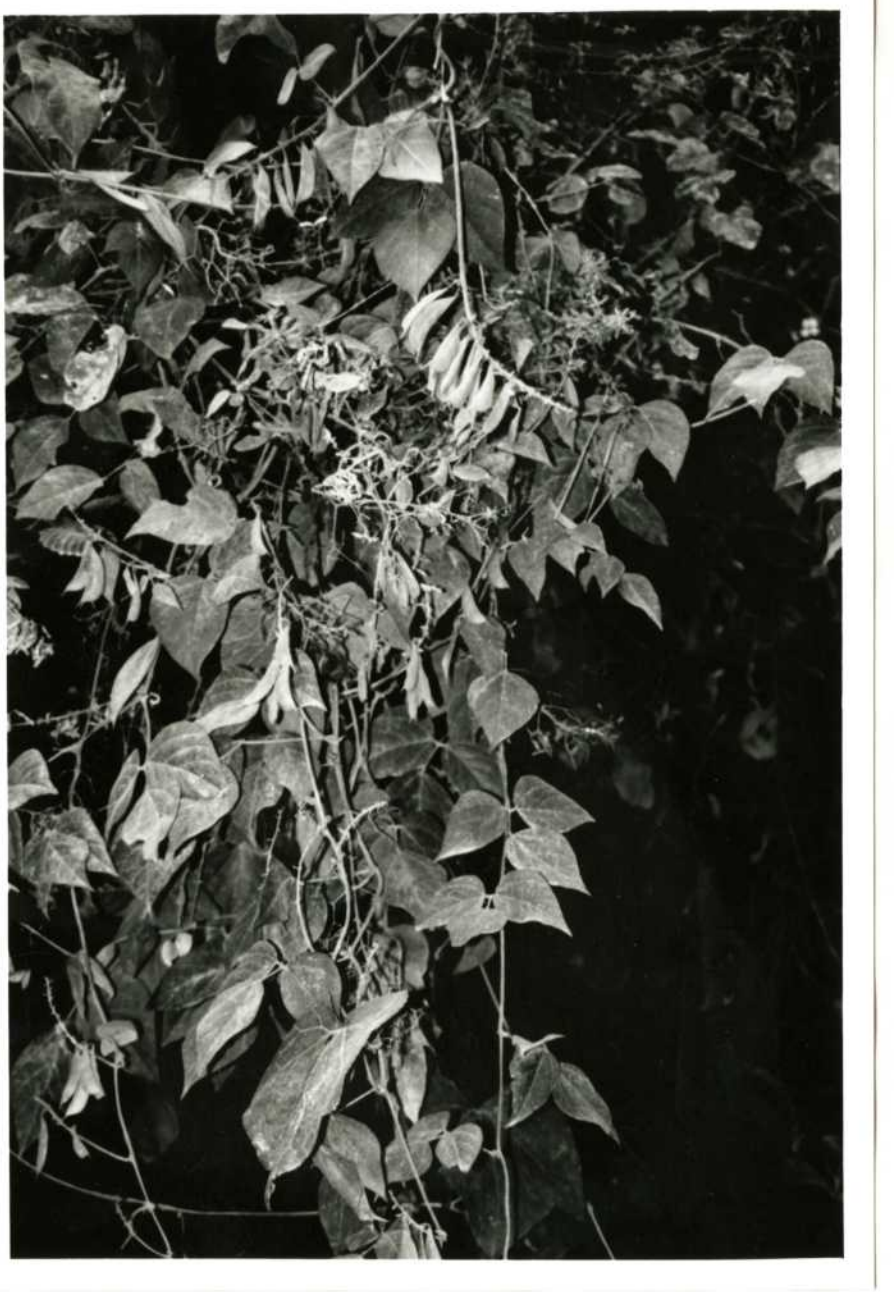

Figure 5 - Well-fruited racemes of *P. tuerckheimii* (population # 3097) in western Sololá.

Phaseolus vulgaris L.: wild and escaped forms

Another purpose of this trip was to extend the knowledge about distribution of this material in Guatemala, as a preamble for the definition of places of domestication for that country. A couple of collections, mainly from the central and the eastern parts of the mountainous Pacific *cordillera* (reported in Toro et al., 1990), have been already done that serve as a starting point for this work.

We have found 11 novel populations, two being escaped forms (# 3079 and 3082) and nine being wild forms (the others) (see annexes 1 and 2 for coordinates).

The populations # 3060 and 3061 are particularly interesting, given their location in E Chimaltenango, because they open the possibility to find wild *P. vulgaris* in the upper Río Motagua valley, that is in a drier habitat in comparison to the Cordillera Volcánica locations to the South. The population # 3066 seems to be the first record ever for the department of Sololá; it opens possibilities to find the wild bean at other locations around Lake Atitlán, particularly the eastern slopes of Volcán San Pedro and Volcán Santa Clara. The populations # 3078 and 3081 are perhaps those at the extreme of the range westward along the Pacific slope of the Cordillera Volcánica. As for wild *P. polyanthus*, the vegetation type, the lower montane forest bh-MB where wild bean occurs ends up in the valley of Río Samalá, between Santa María de Jesús in southeastern Quezaltenango, when we refer to the vegetation map de la Cruz S. and Sagastume L. (1983). One should note that wild *P. vulgaris* occupies a slightly drier ecotone within the lower montane forest bh-MB in comparison to the one occupied by *P. polyanthus*; for that reason, wild *P. vulgaris* thrieves on the northern slope of the Cordillera Volcánica while *P. polyanthus* does not. So, the lower montane forest bh-MB might be more complex than as presently considered.

It was rewarding to find # 3060 more or less where it was first found in 1936 by Paul C. Standley "along road from Chimaltenango to San Martín Jilotepeque (herbarium voucher *Standley 57988*, at the Field, Chicago). It was also rewarding to find # 3075 up from San Antonio Huista on road to Jacaltenango, perhaps slightly more distant from the village than what was previously reported by McBryde (1945). This geographer wrote: "In December 1941, I found a wild bean that was strickingly similar to *P. vulgaris* (no wild form of which had been previously recorded in botanical literature[1]), though it was considerably smaller than the common kidney bean. It was growing on a steep slope high above San Antonio Huista, along the trail leading from Jacaltenango, and at an altitude of about 1,500 m (4,921 ft.). Here, it was deriving mechanical support from stalks of teosinte, wild relative of

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[1]DGD note: Felix Webster McBryde did a good literature survey, because his book seems to be the true first mention of wild *P. vulgaris* in scientific literature for Mesoamerica. He probably did not have access to the one-page paper by Burkart (1941) published at the Faculty of Agronomy, Buenos Aires.

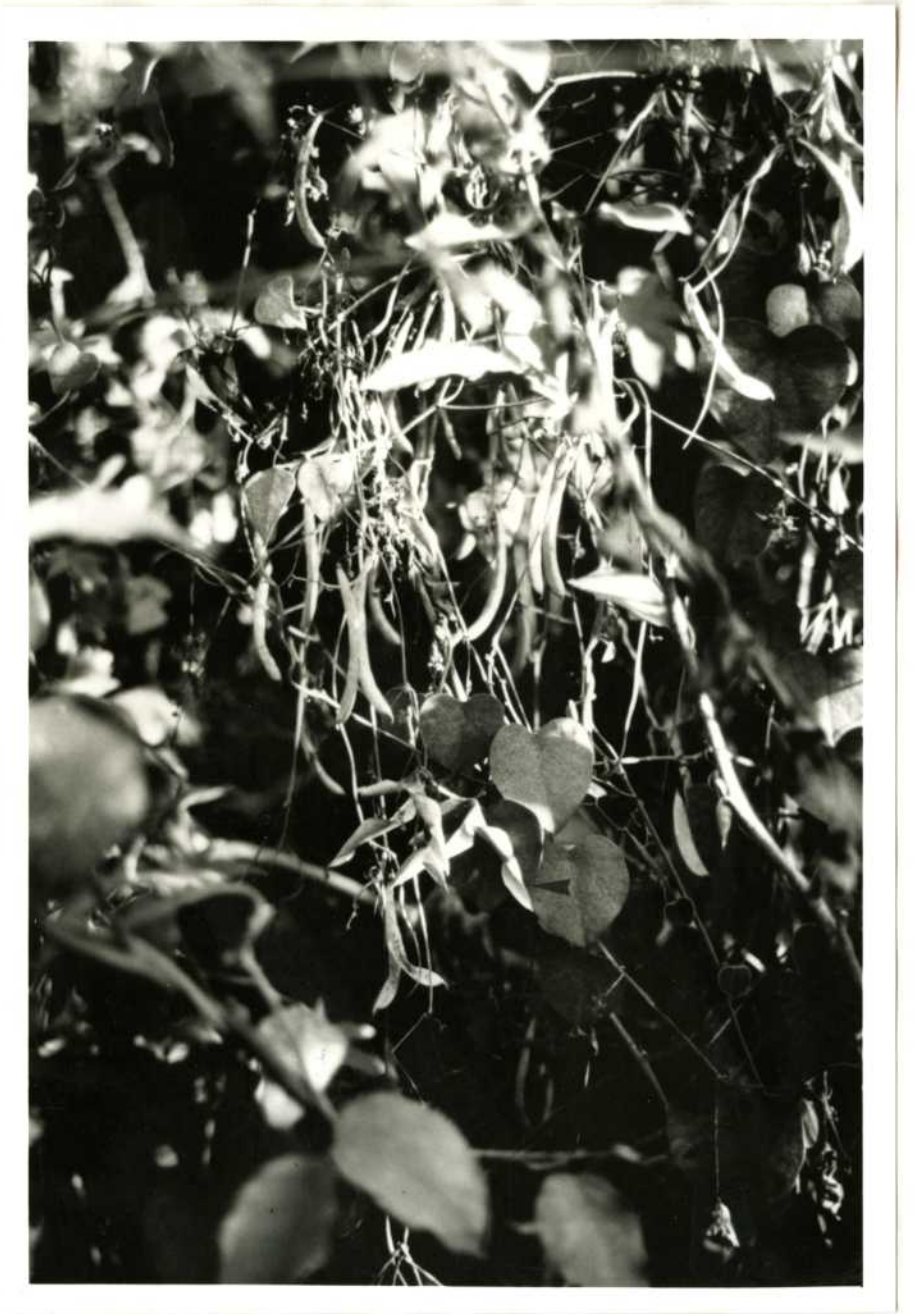

Figure 6 - A last look at population # 3057 of wild common bean; arrows mark pods of wild lima bean (#3058).

maize." (McBryde, op. cit., p. 135). We were less lucky in finding the teosinte, *Zea mays* subsp. *huehuetenangensis* (Iltis & Doebley) Doebley (Doebley, 1990), reported from that place and confirmed by Iltis et al. (1986): no plants were found, but it might be because the dry season was already well advanced in that part of Huehuetenango this year. The wild bean # 3075 was in dense stands, from 4 Km SW of Jacaltenango (1,540 masl) to San Antonio Huista over 3 Kms down to 1,350 m. We could however disclose a new population of wild bean # 3074 (where the teosinte has been found formerly: Wilkes, 1977), on another dirty road leading to Jacaltenango from Bujxup, when one passes from the Quebrada de Bujxup into the upper valley of Río Azul. One has to mention that only 6 plants of teosinte were seen while the wild common bean was abundant (more than sixty plants were sampled). The population # 3057 (Figure 6) should be monitored, because it was found in what could be one of the next suburbs of Guatemala City, Ciudad San Cristobal, where plots for housing were advertised.

Wild beans are a vine of the understory of the lower montane forest 'bosque húmedo Montano Bajo subtropical' in western Guatemala, entering also a somewhat drier variant the 'bosque húmedo subtropical templado' around Jacaltenango in Huehuetenango for collections # 3074 and 3075 (and obviously for eastern Guatemala), if we refer to the vegetation map of de la Cruz S. and Sagastume L. (1983). Tree genera in this climax vegetation include: *Pinus, Quercus, Cupressus, Alnus, Ipomoea, Tabebuia, Celtis, Glericidia* and *Persea*. Companion herbaceous species include: *Dahlia imperialis, Montanoa, Tagetes, Physalis, Solanum, Cestrum, Clethra, Eupatorium, Wigandia urens, Bocconea, Ipomoea, Senecio chenopoides, Lantana, Rubus, Vigna candida, Rhynchosia, Teramnus, Crotalaria.* Many of these species were also reported in similar plant associations in Mexico (Gentry, 1969). Worth mentionning is the fact that wild *P. vulgaris* can be found growing together with the following bean species: *P. leptostachyus* (# 3073), wild *P. coccineus* (# 3077, 3084), wild *P. lunatus* (# 3058, 3080).

Introgression with cultivated *P. vulgaris* landraces growing close by, as evidenced by larger seeds (with wild seed phenotypes) or by solid colours (with smaller seed size), has been found in # 3066, 3075, 3081 and 3083, that is in the departments of Sololá, Huehuetenango, Quezaltenango, respectively. Former cases of introgression were found in El Progreso and Jalapa (Debouck, 1988). It becomes difficult to argue that this phenomenon is purely fortuitous.

Wild bean is known by local people, and called "frijol bejuco" (# 3061), "frijolito" (# 3074), "frijol monte" (# 3083). They have been reported as edible, even "highly esteemed", and used as cooked beans and as snap beans (McBryde, 1945), but we could not confirm this information.

Phaseolus xanthotrichus Piper

We incidentally collect three additional samples of this species (# 3086, 3089 and 3094), all from Quezaltenango for which no records exist. This species is a unconspicuous

small vine (plant height generally below 1 m 50) in the understory of the montane forest 'bosque húmedo Montano Bajo Subtropical' according to the classification of de la Cruz S. and Sagastume L. (1983) with *Quercus, Alnus, Celtis, Heliocarpus, Aralia, Lobelia, Wigandia, Dahlia, Bocconea, Eupatorium, Ageratum, Tagetes, Bidens, Pitonia, Stizolobium, Rhynchosia, Asclepias, Winteringia.* It was already too late and material was overdried (adequate period being the first two weeks of December in years with normal rainfall). Confirming earlier observations (Debouck, 1988), no *Apion* damages were seen in these samples.

Material found in the field was already too dried to make good pathological evaluation. Pod weevil (tentatively *Apion godmani*) was observed in: # 3060, 3066, 3074, 3081, while bruchids (tentatively *Acanthoscelides* sp.) were seen in: # 3081. Bird damages on pods as reported on South American materials (Debouck et al., 1993) were seen in: # 3061, 3066, 3078.

For *Pouteria* spp.

In view of a starting activity by the Universidad de San Carlos on the economic species of Sapotaceae of Guatemala, we took note of localities where noteworthy trees of *Pouteria* were observed. These are different from sites reported before for Guatemala (Pennington, 1990), and include:
1) San Lucas Tolimán, at the exit of the village, 1 Km S of San Lucas on trail to the cross with national road 11 to Godínez,
2) Panajachel, in downtown Panajachel, just on the side of the Mercado Artesanal (branches of that tree were already cut down!),
3) one location in the valley of Río Bucá, 0.8 Km west of Aguacatán (on old road to Aguacatán) in Huehuetenango.
At the Faculty, we met with a student who was just coming with contrasting fruits of *P. viridis* (Pittier) Cronquist from the Cobán area in Alta Verapaz. This clearly indicates the broad range of this species in the central part of western Guatemala, that starts in southern Huehuetenango and extends to Alta Verapaz to the north and Lake Atitlán to the south.

5. Conclusions

We have now available a substantial amount of key germplasm to make progress on whether several native bean crops of Guatemala were actually domesticated in this country or not, and if positive where. We have extended collections significantly for *P. vulgaris* and *P. polyanthus* namely on the southern Pacific slope of the Cordillera Volcánica to the west, likely to be the only records apart those from Chiapas, Mexico. With the appropriate markers (Gepts, 1993), we shall now be able to better understand the region Chiapas-western Guatemala as place of possible domestication within the context of the Mesoamerican center.

Situation for wild cassava is in 1994-95 as it was for wild beans ten years ago. Given the current lack of good, reliable floristic information, search for wild cassava should be resumed on a different basis, and it is not certain that simultaneous germplasm explorations

for several genera shall be feasible (therefore one should be ready to bear the cost implications). Let us assume that for at least a certain number of populations of wild *Manihot* reported for Guatemala the records gathered by Rogers and Appan (1973) though vague are correct. Then, wild cassava species reported for Guatemala are distributed in three main vegetation types: i) the 'bosque muy húmedo subtropical cálido' bmh-S (c), ii) the 'bosque seco subtropical' bs-S, and iii) the 'bosque húmedo subtropical' (variants: 'templado' and 'calido') bh-S (t) and bh-S (c), according to de la Cruz S. and Sagastume L. (1983). With rainfalls ending in October in the dryest variants of these three vegetations, field surveys starting in October and November should allow to find cassava plants still green with their leaves and floral parts, thus enable to identify the species, to mark plants in the thickets and to deduce the appropriate date to come back for mature seeds. This methodology that has been successfully applied to bean germplasm in 1985, 1987 and 1995, should lead to the discovery of unique, novel cassava germplasm.

Acknowledgements

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Annex 1. List of germplasm collections by numbers.

Number,	Weight	Species	Longitude	Latitude	Altitude	Date
3057	4.2	vulgaris	90º34'W	14º37'N	1550 m	20/I/95
3058	10.4	lunatus	90º34'W	14º37'N	1550 m	20/I/95
3059	12.0	lunatus	90º46'W	14º38'N	1700 m	20/I/95
3060	4.7	vulgaris	90º47'W	14º42'N	1330 m	20/I/95
3061	4.7	vulgaris	90º47'W	14º43'N	1350 m	20/I/95
3062	10.8	coccineus	90º51'W	14º33'N	2080 m	20/I/95
3063	6.8	lunatus	90º48'W	14º21'N	520 m	21/I/95
3064	5.8	lunatus	91º11'W	14º24'N	230 m	21/I/95
3065	7.0	lunatus	91º08'W	14º31'N	750 m	21/I/95
3066	4.2	vulgaris	91º07'W	14º36'N	1330 m	21/I/95
3067	23.3	polyanth.	91º07'W	14º38'N	1630 m	21/I/95
3068	10.4	coccineus	91º22'W	15º21'N	2070 m	22/I/95
3069	8.0	coccineus	91º22'W	15º21'N	2070 m	22/I/95
3070	---	leptosta.	91º21'W	15º21'N	1910 m	22/I/95
3071	7.8	lunatus	91º54'W	15º41'N	590 m	23/I/95
3072	5.0	Cnido.sp.	91º54'W	15º41'N	600 m	23/I/95
3073	0.6	leptosta.	91º48'W	15º41'N	1000 m	23/I/95
3074	3.9	vulgaris	91º47'W	15º40'N	1180 m	23/I/95
3075	4.0	vulgaris	91º42'W	15º39'N	1540 m	23/I/95
3076	6.4	coccineus	91º31'W	14º49'N	2370 m	24/I/95
3077	9.5	coccineus	91º29'W	14º48'N	2070 m	24/I/95
3078	6.4	coccineus	91º29'W	14º47'N	2050 m	24/I/95
3079	11.8	vulgaris	91º29'W	14º47'N	2050 m	24/I/95
3080	10.5	lunatus	91º30'W	14º46'N	1750 m	24/I/95
3081	6.9	vulgaris	91º31'W	14º45'N	1730 m	24/I/95
3082	9.7	vulgaris	91º31'W	14º45'N	1740 m	24/I/95
3083	11.3	vulgaris	91º31'W	14º45'N	1760 m	24/I/95
3084	14.4	coccineus	91º31'W	14º45'N	1760 m	24/I/95
3085	---	tuerckhe.	91º31'W	14º45'N	1860 m	24/I/95
3086	1.6	xanthotr.	91º31'W	14º45'N	1860 m	24/I/95
3087	11.7	coccineus	91º31'W	14º45'N	1800 m	24/I/95
3088	7.1	coccineus	91º28'W	14º50'N	2180 m	25/I/95
3089	1.1	xanthotr.	91º29'W	14º46'N	2000 m	25/I/95
3090	11.0	coccineus	91º29'W	14º46'N	2010 m	25/I/95
3091	7.9	coccineus	91º29'W	14º45'N	2040 m	25/I/95
3092	10.2	coccineus	91º31'W	14º43'N	1570 m	25/I/95
3093	38.6	polyanth.	91º32'W	14º42'N	1460 m	25/I/95
3094	1.8	xanthotr.	91º32'W	14º42'N	1460 m	25/I/95
3095	7.8	macrolep.	91º17'W	14º44'N	2500 m	26/I/95
3096	6.3	coccineus	91º17'W	14º44'N	2350 m	26/I/95

3097	5.5	tuerckhe.	91º18'W	14º43'N	2230 m	26/I/95
s.n.	66.4	polyanth.	90º51'W	14º33'N	2080 m	20/I/95
1622	30.0	polyanth.	90º50'W	14º33'N	1940 m	20/I/95
s.n.	49.6	polyanth.	90º19'W	15º23'N	1300 m	19/I/95

N.B. Weight refers to 100 seed weight, for seeds chosen at random, or equivalent.

Annex 2. List of germplasm collections by species.

Cnidosculus sp.

Number	Department	Place
3072	Huehuetgo	Sta. Ana Huista, 13 Km NNE Camojá, 1 Km NE Pte. Río Selegua.

Phaseolus coccineus L.

Number	Department	Place
3062	Sacatepeq.	Sn Miguel Dueñas, 1 Km W Concepción Calderas.
3068	Huehuetgo	Aguacatán, 14 Km E Huehuetenango a Aguacatán, Pte. Los Cutes.
3069	Huehuetgo	Aguacatán, 14 Km E Huehuetenango a Aguacatán, Pte. Los Cutes.
3076	Quezaltgo	Quezaltenango, Cantón Chicua, 2 Km SW entr. carr. 9S a Zunil.
3077	Quezaltgo	Almolonga, 3 Km SE Almolonga.
3084	Quezaltgo	Zunil, 1.5 Km NE Estancia de la Cruz, Aguas Amargas.
3087	Quezaltgo	Zunil, 2.0 Km NE Estancia de la Cruz, Aguas Amargas.
3088	Quezaltgo	Cantel, 1.0 Km NNW Cantel, aldea Pachaj.
3090	Quezaltgo	Zunil, 2.0 Km S Zunil a Aguas Georginas.
3091	Quezaltgo	Zunil, 3.0 Km S Zunil a Aguas Georginas.
3092	Quezaltgo	Sta. María de Jesús, 10 Km SW Zunil.
3096	Sololá	Sta. Lucía Utatlán, 4 Km S Pamezabal.

Phaseolus leptostachyus Bentham

Number	Department	Place
3070	Huehuetgo	Aguacatán, 3 Km W Aguacatán.
3073	Huehuetgo	Jacaltenango, 4 Km SE Bujxup.

Phaseolus lunatus L.

Number	Department	Place
3058	Guatemala	Mixco, Cd. Sn Cristobal, 1Km S cruce carr. Guatemala-Mixco.
3059	Chimaltgo	El Tejar, Sn Miguel Morazán, 5 Km ESE Chimaltenango.
3063	Escuintla	Escuintla, 4 Km SE El Rodeo, 100 m N Pte. Río Guacalate.
3064	Suchitepq.	Patulul, 2 Km NE Cocales a Patulul.
3065	Suchitepq.	Patulul, 7 Km N Sn Julian.
3071	Huehuetgo	Sta. Ana Huista, 12 Km NNE Camojá, 100 m N Pte. Río Selegua.
3080	Quezaltgo	Zunil, 6 Km SW Zunil.

Phaseolus macrolepis Piper

Number	Department	Place
3095	Sololá	Sta. Lucía Utatlán, 3 Km S Pamezabal.

Phaseolus polyanthus Greenman

Number	Department	Place
3067	Sololá	Sn Lucas Tolimán, 3Km NE entronque a Sn Lucas carr. 11 a Godínez.
3093	Quezaltgo	Sta. María de Jesús, 0.5 Km E Sta. María de Jesús, represa El Dique.

Phaseolus tuerckheimii Donnell-Smith.

Number	Department	Place
3085	Quezaltgo	Zunil, 2.5 Km NE Estancia de la Cruz, balneario Aguas Amargas.
3097	Sololá	Sta. Clara La Laguna, 6 Km S Pamezabal.

Phaseolus vulgaris L.

Number	Department	Place
3057	Guatemala	Mixco, Cd. Sn Cristobal, 1Km S cruce carr. Guatemala-Mixco.
3060	Chimaltgo	Chimaltenango, La Planta, 12 Km N Chimaltenango.
3061	Chimaltgo	Sn Martin Jilotepeque, Pte. El Amate, Río Pixcaya.
3066	Sololá	Sn Lucas Tolimán, 5 Km SSE Sn Lucas.
3074	Huehuetgo	Jacaltenango, 7 Km SE Bujxup.
3075	Huehuetgo	Jacaltenango, 4 Km WSW Jacaltenango.
3078	Quezaltgo	Almolonga, 4 Km SE Almolonga.
3079	Quezaltgo	Almolonga, 4 Km SE Almolonga.
3081	Quezaltgo	Zunil, 7 Km SW Zunil.
3082	Quezaltgo	Zunil, 1 Km NE Estancia de la Cruz.
3083	Quezaltgo	Zunil, 1.5 Km NE Estancia de la Cruz, Aguas Amargas.

Phaseolus xanthotrichus Piper

Number	Department	Place
3086	Quezaltgo	Zunil, 2.5 Km NE Estancia de la Cruz, Aguas Amargas.
3089	Quezaltgo	Zunil, 1.0 Km S Zunil a Aguas Georginas.
3094	Quezaltgo	Sta. María de Jesús, 0.5 Km E Sta. María de Jesús, represa El Dique.