

Report on Bioprospecting for *Phaseolus* germplasm in Costa Rica, December 2015.

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Cooperative work between the Estación Experimental ‘Fabio Baudrit Moreno’ of the Universidad de Costa Rica (UCR), and the International Center for Tropical Agriculture (CIAT), with the support of the Global Crop Diversity Trust (GCDT), in the framework of the Crop Wild Relatives Project.

1. Introduction and Background

In the context of the Crop Wild Relatives project, given current and future needs of bean breeding, the ‘Crop Trust’ (GCDT) logically stresses the importance of the wild forms of the five cultivated species and the wild species of their secondary gene pools. Such taxa have useful diversity for the breeders, namely in relation to resistance to diseases (for example white mold: Schwartz et al. 2014), pests (bruchids: van Schoonhoven et al. 1983), abiotic stresses (salinity: Bayuelo-Jiménez et al. 2002), and yield (Acosta-Gallegos et al. 2007). This importance raises the double question about which species should be considered first, and which populations should be considered next. Under the current knowledge of the genus (Delgado-Salinas et al. 2006; Freytag & Debouck 2002), answering this question means priority on the wild forms of *P. acutifolius*, *P. coccineus*, *P. dumosus*, *P. lunatus* and *P. vulgaris*, and then the wild species of their secondary gene pools. When considering Costa Rica, one should note that the number of *Phaseolus sensu stricto* species has doubled over the last twenty years because of field work (Araya-Villalobos et al. 2015), and it would be premature to conclude that the current number of species (Table 1) is the final count.

Table 1 – *Phaseolus* species currently known to be present in Costa Rica.

Sections ¹	Clade ²	Species	Total
<i>Acutifolii</i>	B	<i>acutifolius</i> (only as cultivated species in Guanacaste area?)	1
<i>Bracteati</i>	A	<i>talamancensis</i>	1
<i>Brevilegumeni</i>	A	<i>albicarminus</i> , <i>anguciana</i> , <i>hygrophilus</i> , <i>oligospermus</i> , <i>tuerckheimii</i>	5
<i>Falcati</i>	A	<i>leptostachyus</i>	1
no section	A	<i>microcarpus</i>	1
<i>Paniculati</i>	B	<i>lunatus</i>	1
<i>Phaseoli</i>	B	<i>coccineus</i> , <i>costaricensis</i> , <i>dumosus</i> , <i>vulgaris</i>	4
<i>Xanthotricha</i>	A	<i>xanthotrichus</i>	1
8 out of 14	2	15 out of 79	15

¹: sections as defined in Freytag & Debouck 2002; ²: clades as defined in Delgado-Salinas et al. 2006.

Phylogenetically, the species of the sections *Bracteati*, *Brevilegumeni*, *Falcati*, *Xanthotricha* and *P. microcarpus*, all in clade A, are far too distant from the clade B where the cultivated bean species are found (Delgado-Salinas et al. 2006; Porch et al. 2013), and with no possibility of gene transfer with help of current technologies. For genebanks therefore a low representativeness of such species would suffice, in addition to efforts of *in situ* conservation. One should note that the late additions to the Costa Rican flora were made in sections *Bracteati* (e.g. *P. talamancensis*: Torres-González et al. 2001) and *Brevilegumeni* (e.g. *P. hygrophilus*: Salcedo-Castaño et al. 2011).

Under the current knowledge, the section *Acutifolii* would be represented only by *P. acutifolius* and as cultivated form in the NW Guanacaste Province (Zamora 2010), being its southernmost extension in traditional Mesoamerica. The section *Paniculati* would be represented only by *P. lunatus*, even though its wild form is relatively common throughout the country (Debouck 2015c; Zamora 2010). The section

Phaseoli includes wild *P. vulgaris*, weedy *P. coccineus* and *P. dumosus*, and the wild species *P. costaricensis* (Debouck 2015d; Zamora 2010).

The number and location of populations to be sampled is given preferentially by the study of Herbaria holding Neotropical Phaseoleae (Annex 1), out of which identity and site are confirmed to the extent possible. This approach is complemented by the study of collections existing in genebanks. Indeed, the risk in explorations of areas from which germplasm already exists in genebanks, is to collect the same material one more time. Plant explorers should thus be well aware of what has been already collected and increased by genebanks, and thus take good note of geographic coordinates of previous populations (Table 2).

Table 2 - Populations known and present in genebanks for the taxa of interest.

Species	No. populations known	No. populations in CIAT genebank and available
<i>P. costaricensis</i>	51	20
<i>P. lunatus</i> (wild)	86	18
<i>P. vulgaris</i> (wild)	25	23

2. Justification

In the *Phaseoli*, *P. costaricensis* is of high priority because it has been found resistant to white mold (Singh et al. 2013). Resistance to three additional diseases has been found in one accession in contrast to other accessions (Schwartz et al. 2014); this means that for genebanks a systematic survey of all populations should be done.

Lima bean are of high interest to genebanks, because of the tolerance to drought and heat found in the Mesoamerican germplasm as compared to common bean (Rachie 1973). In addition, some populations of wild *P. lunatus* have been reported as tolerant to salinity (Bayuelo-Jiménez et al. 2002). The fact that not all populations were found salinity tolerant indicates that a systematic survey should be done. Further, the hypothesis of a domestication event of the Lima bean in Costa Rica has been proposed (Andueza-Noh et al. 2013), stressing further the need to complete the survey of wild forms (and landraces) for that country.

Wild *P. vulgaris* of Costa Rica are genetically unique as compared to other wild populations of Central America, and would be related to the wild populations of northwestern Peru (Chacón-Sánchez et al. 2007). That uniqueness justifies its interest to genebanks; in addition, the number of populations would be quite low (perhaps less than 30 in total for the country).

Rapid urbanization in the Central Valley (Matamoros-Delgado & Elizonda-Castillo 1996) and use of herbicides in coffee plantations (Baudoin et al. 2004) put at risk all wild bean populations present in the 'bh-MB' ecological zone (low montane humid forest: Bolaños & Watson 1993), from which most populations of the three taxa of interest to the 'Crop Trust' have been reported so far (Araya-Villalobos et al. 2001).

3. Methodology

During the preparation, a significant number of Herbaria hosting plants from the Neotropics have been visited (Annex 1). A personal visit was preferred instead of obtaining voucher specimens on loan, since a Curator will rarely let all specimens go for months. In addition, side studies of other legume genera on site could be rewarding (see the case of *P. microcarpus* below). A voucher specimen eventually means a population found at a particular location, although it could have been visited twice (or more) by botanists. That information has been compiled into files accessible on CIAT genebank website (<http://www.ciat.cgiar.org/urg>, then Publications, then PRG Files, then 'Cahiers de Phaséologie'). These

data mean the kind and number of populations with potential germplasm worth collecting if the population still exists at the time of the visit.

During the field work, the methodology is the one of transects through vegetation/ topographic gradients (Debouck 1988), including the sites and populations already identified by herbarium voucher specimens. A combination of topographic (Instituto Geográfico Nacional 1988) and vegetation maps (Bolaños & Watson 1993; Tosi 1969) were used, even though both kinds of maps are out of date. A GIS approach could be used too, although in many cases we do not have the minimum number (ten/ twelve) of populations to build the statistical model (Jones et al. 1997; Ramírez-Villegas et al. 2010). The priority is to collect seed for germplasm conservation; if the state of the material in the field is appropriate herbarium voucher specimens is collected too for museums of natural history such as CR and USJ. This methodology does not imply any risk of loss for the population; in case of scarcity only one sample is taken, and with digital images of reproductive parts the identification of taxa is possible in most cases.

This methodology may imply two visits: the first one to identify populations of the different species and take note of their phenology, and the second one to harvest some seed. Appropriate timing may be October for the early species (e.g. *leptostachyus*, *xanthotrichus*), December for the intermediate (e.g. *vulgaris*), and February-March for the late species (e.g. *costaricensis*, *lunatus*, *tuerckheimii*). It is important to note that in 2015 because of the climatic oscillation ‘El Niño’ affecting the Pacific eastern shore side from California down to Peru rainfalls came later and in reduced amounts. Collectors might thus find nothing, or fewer plants (if the rains were insufficient for a normal germination), or late flowering plants (because the rains came later than normal).

4. Results

4.1. General

A total of 18 populations for six species were found during this exploration (Annex 2: Tables 3 and 4). Out of these, as compared to previous records documented in 83 Herbaria (Annex 1), 17 can be considered as novel populations and thus new records for Costa Rica. Herbarium voucher specimens were made for all populations (only one for #3258 given the scarcity of plant material) and remitted to the National Herbarium of Costa Rica (CR). The exploration extended from December 7-12, and the routes (for a total of 1,187 km) were as follows:

December 7: Province of Heredia, cantón Santo Domingo- Province of San José, El Empalme (San Cristobal)- Sta María (Dota)- San Marcos (Tarrazú)- San Cayetano (San Marcos)- San Lorenzo San Marcos -(Tarrazú)

December 8: Province of San José, Matecaña- San Carlos- Bajo San José- Río Zapotal- Quebrada San Rafael- San Rafael Abajo- Carrizales- San Isidro- San Francisco- Province of Puntarenas, Quepos.

December 9: Province of Puntarenas, Quepos- Parque Nacional Manuel Antonio- Jaco- Puerto Caldera- Puesto SINAC Zona Protectora Tivives- Playa Coralillo- Punta Morales-Province of Guanacaste, Santa Cruz.

December 10: Province of Guanacaste, Santa Cruz- Arado- Reserva Natural Cerro Vista al Mar- Guindos Norte- Cerro Brujo- Arado- Nicoya.

December 11: Province of Guanacaste, Nicoya- Carmona- San Rafael de Carmona- Bella Vista- Cerro Azul- El Porvenir- Los Angeles- Quebrada Grande- Jabillo- San Jorge- San Francisco de Coyote- Pueblo Nuevo- Bejuco- San Gabriel- Río de Oro- Huacas- Hojancha- Province of Alajuela, San Ramón.

December 12: Province of Alajuela, San Ramón- La Palmita- Llano Bonito- Lourdes, Naranjo: Cirrú Sur- San Jerónimo- Valverde Vega: San Juan de Sarchí- Sarchí Norte- San Pedro- Trojas- Finca Dos Lados- Sarchí Sur- Grecia: San Juan de Grecia- San Luís de Grecia- El Cajón- San Miguel Abajo- San Miguel Arriba- Grecia- Province of Heredia, Santo Domingo.

4.2. By species

Phaseolus costaricensis Freytag & Debouck

Two populations (#3259, 3268) were found during this exploration. As compared to the previous records, they can be considered as additions to the flora of Costa Rica, although population #3268 is close to #3122 found in 1998. Once established on fertile soils derived from old volcanic ashes plants can be big lianas reaching heights superior to 8 meters (Fig. 1). Both collection sites would be in the bmh-MB (lower montane wet forest: Bolaños & Watson 1993) or biotic unit 27 (tropical temperate with 3-month dry season: Herrera-Soto & Gómez-Pignataro 1993), where it has been found previously (Araya-Villalobos et al. 2001).



Figure 1 – Population #3268 of *P. costaricensis* with intense fuchsia flowers, showing how big can grow a plant if left intact.

P. leptostachyus Bentham

This species is less common in Herbaria for Costa Rica as compared to Mexico (Debouck 2015a) perhaps because it reaches there its southernmost distribution. Two novel populations (#3255 and 3261) were disclosed, because for the former the known populations growing close by were from Monterrey and Acosta, and for the latter the previously known populations were found in the vicinity of Cañas and Bagaces (Debouck 2015a). In contrast to population # 3255 with regular pods for the species, the population # 3261 displayed short wide and 3-seeded pods. Population # 3261 (Fig. 2) seems to be a new record for the entire area of the low mountains of Nicoya. The sites correspond to bmh-P and bmh-MB (premontane wet forest and lower montane wet forest, respectively: Bolaños & Watson 1993) and biotic units 27 and 41 (humid temperate and humid subtropical, respectively: Herrera-Soto & Gómez-Pignataro 1993), where the dry season would be of 4 months at least.



Figure 2 – Population #3261 of *P. leptostachyus* found in the northern part of Bosque Nacional Diríá, Santa Cruz, Guanacaste.

Phaseolus lunatus L.

We added nine more populations to the number known for the country. Being a late flowering species, several populations were found at early flowering stage, and due to the lower amount of rain with low plant density per population. It is a rather common species found in many climatic variants of the premontane and lower montane levels with a dry season of 3 to 6 months, if the land is free of grazing, wild fires and vegetation change (in that sense Figure 3 is for the record in order to check presence in 2025). Is a 6-month dry season the limit? Our brief visit to Punta Morales with a tropical forest with no understory may say so. Our attempts to locate wild Lima bean on beaches did not succeed so far in Costa Rica in contrast to the population of Montelimar, Managua, in Nicaragua. It seems not present in the immediate surrounding of mangroves (as verified in Parque Nacional Manuel Antonio) or (coral derived) sand beaches (as verified in Punta Coralillo), where it is replaced by *Leptospron adenanthum*.



Figure 3 – Population #3269 of *P. lunatus* close to Llano Bonito, in the county of Zarcerro, Alfaro Ruíz, Alajuela.

Phaseolus microcarpus Mart.

While there were a couple of records of this species in Nicaragua (Debouck 2015; Delgado-Salinas 2001), we wondered whether it went further south from Lake Nicaragua that is a barrier for many plant species (*Pinus* for example: Graham 2011). The suspicion of its presence in Costa Rica came about because of the following specimen observed in March 2013 at the INBio Herbarium (INB).

“Instituto Nacional de Biodiversidad Herbario (INB) [cachet à l’encre bleue sur la planche]. /// INB0004136116. Flora de Costa Rica. Fabaceae/ Pap. dup.= 2. *Desmodium*. Guanacaste: Santa Cruz. No protegida. Cuenca del Tempisque. Rumbo a Cerros Brujo y Vista al Mar desde Arado. 10:12:29.0000N. 85:35:58.0000W. 200 m. Hierba más o menos rastrera; flores rosadas. B Hammel 24516, I Pérez. 16/mar/2008. Instituto Nacional de Biodiversidad (INB), en colaboración con el Missouri Botanical Garden (MO). /// Instituto Nacional de Biodiversidad Herbario (INB). Fabaceae/ Pap. B. Hammel 24516. *Phaseolus lunatus* L., det. N. Zamora, 11/dic/2008. /// DGD: *microcarpus*, une plante entière avec racine herbacée pivotante, 6 racèmes, en floraison, jgo, go vertes, go sèches, folioles terminales 23x24 mm avec lobe basal. [INB; 13-III-2013].”

It was not a *Desmodium* neither a wild Lima bean, but a quite complete specimen of *P. microcarpus* with six racemes.



Figure 4 - Close-up of pods of *P. microcarpus* (population # 3263), usually one-seeded (width = 1 cm).

The population that we found (#3263) was at 511 masl and with different coordinates (Lat. 10° 10' 33.0"N. Long. 85° 37' 22.8"W), and could thus be considered as the second population known for Costa Rica, confirming the presence of this species in the country. It was found at pod filling stage and some plants were already at seed dispersal stage (Fig. 4) (in sharp contrast with the population disclosed by B. Hammel & I. Pérez: see above). In contrast to many populations found in Nicaragua, this one (#3263) did not display lobed leaflets. This population was found in a relatively intact track of humid transition forest on the northern slope of Cerro Brujo. According to Tosi (1969) and Bolaños & Watson (1993), the site matches with a bmh-P (premontane wet forest), while for Herrera-Soto & Gómez-Pignataro (1993) it corresponds to biotic unit 41 (humid subtropical with a 5-month dry season). The distinction is worth making because the former ecological zone is relatively large in Costa Rica, while the latter is quite limited (namely three spots in Nicoya Peninsula and W of Cordillera de Guanacaste and Cordillera de Tilarán), perhaps explaining the absence of this species in Herbaria up to 2008.

Phaseolus vulgaris L.

The southern part of San José province yielded three new populations (#3256, 3257, 3258), found at flowering- early pod filling stage. The sector was not surveyed in our former work. The sites matches with biotic unit 27 (humid temperate with 3-4 month dry season: Herrera-Soto & Gómez-Pignataro 1993), and absence of any kind of stresses. The work by Herrera-Soto & Gómez-Pignataro (1993) shows only seven spots of biotic unit 27 across Costa Rica: i) Zarcero (#3120, 3121, 3122 of previous work: Araya-Villalobos et al. 2001), ii) San José de la Montaña (#3106), iii) Dulce Nombre de Cartago, iv) Cot (#3126), v) Tarbaca

(#2097, 3135, 3147), vi) San Isidro de Tarrazú (#3256, 3257, 3258), and vii) Santa María de Dota (#3168) (Debouck 2015d). Populations #3256 and 3257 showed symptoms of *Uromyces* rust.



Figure 5 - Population #3256 of wild *P. vulgaris* at flowering- pod filling stage.

Phaseolus xanthotrichus Piper

We were able to add one more population (#3253) from the southern Tarrazú area (new for the area apparently: Debouck 2014), namely from coffee plantations near San Cayetano, where the species is at risk because of the spray of herbicides. The population displayed symptoms of *Cercospora* infection (Schwartz 1980), while the coffee plantation had symptoms of leaf spot ojo de gallo (*Mycena citricolor*) (Boucher 1983). In contrast with many wild bean species, *P. xanthotrichus* thrives well in the shade. The ecology matches with that of bmh-MB (lower montane wet forest: Bolaños & Watson 1993).



Figure 6 – Population #3253 of *P. xanthotrichus*, a native legume in the middle of coffee plantations in Tarrazú, San José.

5. Discussion

The afore-mentioned results elicit the following points for discussion. The **first** point relates to an indicator set by the Crop Trust, namely the number of novel populations in relation to the number of populations already known and those sampled. In this regard, the coverage of *P. costaricensis* and wild *P. vulgaris* seems to approach the limit for the country, while many populations of wild Lima bean are still to be disclosed *de novo*. For the former we added two populations to a total of 51 known for the country (Table 2) (Debouck 2015d), while for the latter we added three more populations to a total of 25 known. The reason seems to be in the number of land areas with the appropriate climate/ vegetation type and still occupied by that kind of vegetation in 2015. For wild *P. vulgaris* the bh-MB with adequate soil fertility yields theoretically three areas (Tosi 1969 and Bolaños & Watson 1993) and seven according to Herrera-Soto & Gómez-Pignataro (1993). In contrast, wild *P. lunatus* seems to be a more robust species with a broader adaptation, occupying the bh-T up to the bh-MB (Araya-Villalobos et al. 2001; Baudoin et al. 2004), and therefore with many more populations still to be disclosed and sampled. The soil fertility factor seems important because the area NE of Sarchi Norte although appropriate from climate/ altitude viewpoints seems of too low fertility due to past eruptive products of Poás Volcano. A **second** point worth mentioning is the confirmation of presence of *P. microcarpus* in Costa Rica, and with it our claim that the list of bean species might not be closed yet. Starting as far north as Durango in Mexico (Debouck 2015b), this species does extend its range from the Pacific departments of León, Managua and Masaya in Nicaragua (Debouck 2015b; Delgado-Salinas 2001) into Guanacaste. Its presence might be an additional indication that the

Nicaraguan Corridor has been in place for 2.6 mi years (Graham 2010). Not being a big plant with conspicuous flowers and pods, it is not easy to spot in drying vegetation, and it could well have escaped attention of former collectors. Further field work will tell whether it is widespread in NW Costa Rica or restricted to the Vista del Mar mountainous range. In this regard, the altitude range of the two populations (i.e. *B Hammel et al. 24516* and *DGD et al. 3263*) of 200 and 511 masl, respectively, is a very valuable information to start with. **Third**, outside protected areas the landscape is still green, even lush and colorful with *Cordyline* (dracaena), *Codiaeum* (croton), *Alpinia* (antorcha) as in the surroundings of Parque Manuel Antonio (province of Puntarenas, cantón Aguirre, distrito Quepos). Much of the original flora is gone however, for example significant land of the Parrita or Tusubres (province of Puntarenas, cantón Garabito, distrito Jacó) valleys has been converted into plantations of African oil palm, lowlands of Coyote into teak plantations, and soil is bare in the coffee plantations of Tarrazú! (province of San José, cantón Tarrazú) Given the importance of the population perspective afore-mentioned, the Crop Trust initiative is timely.

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Annex 1 – List of Museums of Natural History and Herbaria studied, and dates of visit.
(acronyms after *Index Herbariorum*, Holmgren et al. 1981; month and year)

1. A: Arnold Herbarium; it is together with the herbaria ECON and GH at Harvard University, Cambridge, Massachusetts, USA (Jul-2006).
2. AGUAT: herbarium of the Universidad de San Carlos, Guatemala City, Guatemala (Nov-1987; Aug-2007; Apr-2011).
3. AHUC: herbarium of the Department of Agronomy of the University of California; it is together with the herbarium DAV of the University of California-Davis, Davis, USA (Sep-2008).
4. ANSM: herbarium of the Agricultural University ‘Antonio Narro’, Saltillo, Coahuila, Mexico (Dec-2011).
5. ARIZ: herbarium of the University of Arizona, Tucson, USA (Feb-1979; Sep-2012).
6. ASU: herbarium of the Arizona State University, Tempe, USA (Sep-2015).
7. BA: herbarium of the Museo Argentino de Historial Natural, Buenos Aires, Argentina (Aug-2010).
8. BAA: herbarium of the Facultad de Agronomía, Universidad de Buenos Aires, Argentina (Mar-1985; Oct-2006).
9. BAB: herbario del Instituto Nacional de Tecnología Agropecuaria, Castelar, Argentina (Aug-2010).
10. BAFC: herbarium of the Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina (Mar-1985).
11. BACP: herbarium of the Centro de Estudios Farmacológicos y de Principios Naturales; it is in the Argentinean Museum of Natural History, Buenos Aires, Argentina (Aug-2010).
12. BM: herbarium of the British Museum, London, England (Aug-1985; Dec-2006).
13. BR: herbarium of the National Botanical Garden, Meise, Belgium (Jun-2005; Oct-2005; Oct-2007).
14. BRIT: herbarium of the Botanical Research Institute of Texas, Fort Worth, USA. (Feb-2002; Jun-2002).
15. CAS: herbarium of the California Academy of Sciences, San Francisco, USA (Sep-2008).
16. CHAPA: Herbario-hortorio of the Colegio de Postgraduados, Montecillo, México (Jul-2004; Sep-2005).
17. CICY: herbarium of the Centro de Investigaciones Científicas de Yucatán, Mérida, México (Apr-2005; Jan-2011).
18. COL: Herbario Nacional Colombiano, Instituto de Ciencias Naturales, Bogotá, Colombia (May-1985; Jul-1990; Jul-2002; Feb-2009; Jun-2010).
19. CORD: Museo Botánico, Universidad Nacional de Córdoba, Córdoba, Argentina (Oct-2009).
20. CPUN: herbarium of the Universidad Nacional de Cajamarca, Cajamarca, Perú (Jun-1985; Jul-1986).
21. CR: herbarium of the Museo Nacional, San José, Costa Rica (Jan-1987, Jun-2004, Aug-2005).
22. CS: herbarium of Colorado State University, Fort Collins, USA. (Aug-2008).
23. CUZ: herbarium of the Universidad San Antonio Abad, Cuzco, Perú (Feb-2001).
24. DAV: herbarium of the University of California-Davis, Davis, USA. (Sep-2008; Nov-2010).
25. DES: herbarium of the Desert Botanical Garden, Phoenix, Arizona, USA. (Feb-1979).
26. DS: Dudley herbarium of Stanford University, USA. (now in CAS) (Sep-2008).
27. DUKE: herbarium of Duke University, Durham, USA. (Aug-2011).
28. EBUM: herbarium of the Escuela de Biología, Universidad Michoacana de San Nicolás de Hidalgo, Morelia, México (Feb-2003).
29. ECON: Oak Ames herbarium, Harvard University, Cambridge, USA. (Jul-2006).
30. ENCB: herbarium of the Escuela Nacional de Ciencias Biológicas, Ciudad de México, México (Jul/Aug-1978; Sep-2004; Apr-2005).
31. F: Field Museum of Natural History, Chicago, USA. (Jul/Aug-2004).
32. FI: herbarium of the Museo di Storia Naturale dell’Università, Firenze, Italy (Jul-2008).
33. FHO: herbarium of the School of Forestry of the University of Oxford, Oxford, England (Feb-2007).
34. G: herbarium of the Conservatoire et Jardin Botaniques, Geneva, Switzerland (Feb-2002).
35. GH: Gray Herbarium; it is together with the A and ECON herbaria at Harvard University, Cambridge, Massachusetts, USA. (Jul-2006).

36. HAO: herbarium of the Universidad Antenor Orrego, Trujillo, Perú (Oct-2000).
37. HNMN: national herbarium of Nicaragua, Universidad Centroamericana, Managua, Nicaragua (Apr-2006).
38. HUT: Herbario Truxillense, Universidad Nacional de Trujillo, Perú (Oct-2000).
39. IA: herbarium of the University of Iowa, Ames, USA (Apr-2010).
40. IBUG: herbarium of the Instituto de Botánica de la Universidad de Guadalajara, Guadalajara, México (Oct-2003; May-2008; Jan-2011).
41. IEB: herbarium of the Instituto Ecológico del Bajío, Patzcuaro, México (May-2008).
42. INB: herbarium of the Instituto Nacional de Biodiversidad, Santo Domingo, Costa Rica (Aug-2003; Jul-2004; Aug-2005; Sep-2010; March 2013).
43. ISC: herbarium of Iowa State University (formerly Iowa State College), Ames, USA (Apr-2010).
44. ITIC: herbarium of the university of El Salvador, Escuela de Biología, San Salvador, C.A. (Apr-2011).
45. K: herbarium of Royal Botanic Gardens, Kew, England (Aug-1985; Mar-1986; Mar-2005; Oct-2005; Jun-2006; Jun-2011).
46. L: herbarium of the University of Leiden, Netherlands (Oct-2007).
47. LAGU: herbarium of the botanic garden 'La Laguna', Antiguo Cuscatlán, El Salvador, C.A. (Nov-2012).
48. LL: Lundell herbarium; it is together with TEX at the university of Texas, Austin, USA (Sep-2008).
49. LIL: Miguel Lillo herbarium, Tucumán, Argentina (March-1985).
50. LPB: Herbario Nacional de Bolivia, La Paz, Bolivia (April-1988).
51. M: herbarium of the Botanische Staatssammlung, München, Germany (Oct-2005).
52. MA: herbarium of Jardín Botánico Real, Madrid, Spain (Sep-2000; June-2006).
53. MEXU: Herbario Nacional de México, Instituto de Biología, UNAM, Mexico (July-1978; Aug-1994; Nov-2007; Jan-2011; March-2012; April-2013).
54. MICH: herbarium of the University of Michigan, Ann Arbor, USA (June-1988; Sep-2007).
55. MIN: herbarium of the University of Minnesota, St. Paul, USA (Apr-2010).
56. MO: herbarium of the Missouri Botanical Garden, St. Louis, USA (May/June 2002; June 2013).
57. MOL: herbarium of the Universidad Nacional Agraria, La Molina, Peru (March-1985; Oct-2000).
58. MSC: herbarium of Michigan State University, East Lansing, USA (June-1988).
59. NA: herbarium of the National Arboretum, Washington D.C., USA (July-2006).
60. NCU: herbarium of the University of North Carolina at Chapel Hill, USA (Aug-2011).
61. NEBC: herbarium of the New England Botanical Club, Harvard University, Cambridge, USA (July-2006).
62. NY: herbarium of the New York Botanical Garden, New York, USA (June 1993; June 2003; Feb-2014).
63. O: herbarium of the University of Oslo, Norway (Feb-2008).
64. OXF: herbarium of the University of Oxford, Oxford, England (Jan-2007).
65. P: herbarium of the Musée National d'Histoire Naturelle, Paris, France (Feb-2004).
66. PH: herbarium of the Academy of Natural Sciences, Philadelphia, USA (Sep-2007).
67. POM: herbarium of the Pomona College, CA; it had been received by the Rancho Santa Ana Botanic Garden, Claremont, CA, USA (Nov-2010).
68. PRG: herbarium of the national university Pedro Ruíz Gallo of Lambayeque, Peru (Oct-2000).
69. QCA: herbarium of the Pontificia Universidad Católica del Ecuador, Quito, Ecuador (July-2003).
70. RB: herbarium of the Jardín Botánico de Rio de Janeiro, Rio de Janeiro, Brazil (Oct-2011).
71. RSA: herbarium of Rancho Santa Ana Botanic Garden, Claremont, CA, USA (Nov-2010).
72. SGO: herbarium of the Museo Nacional de Historia Natural, Santiago, Chile (March-1999).
73. SI: herbarium of the Instituto Darwinion, San Isidro, Argentina (March-1985; Oct-1985; April-1988; Nov-2005).
74. TCD: herbarium of the Trinity College, Dublin, Ireland (June-2011).
75. TEX: herbarium of the University of Texas, Austin, USA (Sep-2008).
76. UC: Herbarium of the University of California, Berkeley, USA (Oct-2003).
77. UCR: Herbarium of the University of California, Riverside, USA (Aug-2014).

78. UFG: herbarium of the Universidade Federal de Goiás, Goiânia, Goiás, Brazil (Oct-2011).
79. US: National Herbarium, Smithsonian Institute, Washington, D.C., USA (Aug-1994; May-1997; Aug-2003; Sep-2009).
80. USJ: herbarium of the university of Costa Rica, San José, Costa Rica (Jan-1987; June 1991; Aug-2005).
81. USM: herbarium of the Universidad Nacional Mayor de San Marcos, Lima, Peru (March-1985; Oct-1997; Oct-2000).
82. UVAL: herbarium of the Universidad del Valle de Guatemala, Guatemala, C.A. (April-2011).
83. WIS: Herbarium of the university of Wisconsin, Madison, USA (Nov-2007).

Annex 2 – Materials found in December 2015.

Table 3 - Materials found by collection number, species, date of collection and GPS coordinates.

No.	Species	Province	date	altitude m	latitude N	longitude W
3253	<i>xanthotrichus</i>	San José	07/XII/2015	1,588	9° 40' 41.5"	84° 01' 07.1"
3254	<i>lunatus</i>	San José	07/XII/2015	1,645	9° 40' 32.8"	84° 01' 04.4"
3255	<i>leptostachyus</i>	San José	07/XII/2015	1,303	9° 38' 34.5"	84° 04' 44.1"
3256	<i>vulgaris</i>	San José	08/XII/2015	1,748	9° 37' 29.0"	84° 04' 48.7"
3257	<i>vulgaris</i>	San José	08/XII/2015	1,461	9° 38' 05.5"	84° 05' 08.4"
3258	<i>vulgaris</i>	San José	08/XII/2015	1,447	9° 40' 10.2"	84° 05' 45.2"
3259	<i>costaricensis</i>	San José	08/XII/2015	1,825	9° 41' 14.2"	84° 07' 14.5"
3242	<i>albicarminus</i>	San José	08/XII/2015	1,837	9° 41' 12.9"	84° 07' 12.4"
3260	<i>lunatus</i>	Puntarenas	09/XII/2015	147	9° 54' 47.2"	84° 41' 45.6"
3261	<i>leptostachyus</i>	Guanacaste	10/XII/2015	382	10° 09' 46.1"	85° 35' 02.9"
3262	<i>lunatus</i>	Guanacaste	10/XII/2015	435	10° 11' 42.0"	85° 36' 39.5"
3263	<i>microcarpus</i>	Guanacaste	10/XII/2015	511	10° 10' 33.0"	85° 37' 22.8"
3264	<i>lunatus</i>	Guanacaste	10/XII/2015	766	10° 09' 32.2"	85° 37' 32.2"
3265	<i>lunatus</i>	Guanacaste	11/XII/2015	655	9° 57' 47.1"	85° 16' 08.7"
3266	<i>lunatus</i>	Guanacaste	11/XII/2015	941	9° 57' 05.04"	85° 16' 36.2"
3267	<i>lunatus</i>	Guanacaste	11/XII/2015	306	9° 54' 43.3"	85° 20' 34.7"
3268	<i>costaricensis</i>	Alajuela	12/XII/2015	1,694	10° 10' 13.4"	84° 22' 35.2"
3269	<i>lunatus</i>	Alajuela	12/XII/2015	1,662	10° 09' 39.9"	84° 21' 43.7"
3270	<i>lunatus</i>	Alajuela	12/XII/2015	1,638	10° 09' 02.1"	84° 17' 48.5"

Table 4: Materials found by species, and then collection number, location and status.

No.	Species	Province	District, County	altitude m	date	status
3259	<i>costaricensis</i>	San José	Tarrazú, San Lorenzo	1,825	8/XII/2015	new
3268	<i>costaricensis</i>	Alajuela	Alfaro Ruíz, Zarcero	1,694	12/XII/2015	new?
3255	<i>leptostachyus</i>	San José	Tarrazú, San Lorenzo	1,303	7/XII/2015	new
3261	<i>leptostachyus</i>	Guanacaste	Santa Cruz, Arado	382	10/XII/2015	new
3254	<i>lunatus</i>	San José	Tarrazú, San Marcos	1,645	7/XII/2015	new
3260	<i>lunatus</i>	Puntarenas	Espiritu Santo, Caldera	147	9/XII/2015	new
3262	<i>lunatus</i>	Guanacaste	Santa Cruz, Arado	435	10/XII/2015	new
3264	<i>lunatus</i>	Guanacaste	Santa Cruz, Arado	766	10/XII/2015	new
3265	<i>lunatus</i>	Guanacaste	Nandayure, Carmona	655	11/XII/2015	new
3266	<i>lunatus</i>	Guanacaste	Nandayure, Carmona	931	11/XII/2015	new
3267	<i>lunatus</i>	Guanacaste	Nandayure, Carmoma	306	11/XII/2015	new
3269	<i>lunatus</i>	Alajuela	Alfaro Ruíz, Zarcero	1,662	12/XII/2015	new
3270	<i>lunatus</i>	Alajuela	Grecia, Grecia	1,638	12/XII/2015	new
3263	<i>microcarpus</i>	Guanacaste	Santa Cruz, Arado	511	10/XII/2015	new
3256	<i>vulgaris</i>	San José	Tarrazú, San Carlos	1,748	8/XII/2015	new
3257	<i>vulgaris</i>	San José	Tarrazú, San Carlos	1,461	8/XII/2015	new
3258	<i>vulgaris</i>	San José	León Cortés, San Pablo	1,447	8/XII/2015	new
3253	<i>xanthotrichus</i>	San José	Tarrazú, San Marcos	1,588	7/XII/2015	new

Annex 3 - Data for each individual collection (as indicated on the labels of the herbarium voucher specimens left at the National Herbarium of Costa Rica [Herbario CR]).

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental ‘Fabio Baudrit Moreno’ de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus xanthotrichus* Piper, det: D.G. Debouck. Fecha: 7/ XII/ 2015. Nv. desconocido. COSTA RICA, **San José**, Tarrazú, San Marcos, 1 km W de Cooperativa y de la sede de la Universidad Estatal a Distancia (UNED), en poblado de San Cayetano. GPS: Lat. 09° 40’ 41.5”N. Long. 84° 01’ 07.1”W. Alt. 1,588 msnm. Fecha de recolección: 7/ XII/ 2015. Observ: en bordes de cafetales. Suelo rojizo detrítico orgánico fresco en pendiente. Con roble, *Erythrina*, *Crotalaria*, *Mellinis minutiflora*. Exposición: semi soleado a sombra. Abundancia localizada, donde no usan herbicidas. En grupos pequeños de 1-5 plantas c/u. En vainas verdes. Tallos volubles de 1-2 m de largo. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3253**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental ‘Fabio Baudrit Moreno’ de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 7/XII/2015. Nv. desconocido. COSTA RICA, **San José**, Tarrazú, San Marcos, 0.2 km W de Cooperativa y de la sede de la Universidad Estatal a Distancia (UNED), en poblado de San Cayetano. GPS: Lat. 09° 40’ 32.8”N. Long. 84° 01’ 04.4”W. Alt. 1,645 msnm. Fecha de recolección: 7/ XII/ 2015. Observ: en borde de cultivos de maíz, con otras ruderales *Ricinus*, *Ipomoea*, *Ageratum*. Ambiente soleado abierto. Suelo rojizo orgánico profundo. Pequeño grupo de plantas entrando en floración (flor con alas de color lila). Tallos volubles, de 2-4 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3254**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental ‘Fabio Baudrit Moreno’ de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus leptostachyus* Bentham, det. D.G. Debouck, 7/XII/ 2015. Nv. desconocido. COSTA RICA, **San José**, Tarrazú, a 7 km del distrito de San Lorenzo. GPS: Lat. 09° 38’ 34.5”N. Long. 84° 04’ 44.1”W. Alt. 1,303 msnm. Fecha de recolección: 7/ XII/ 2015. Observ: en bosque ya tumbado para ser remplazado por cafetales con sombra de *Erythrina*. En barranco soleado, con Gramineas, Compuestas, Solanaceas. Suelo pardo orgánico pedregoso en pendiente fuerte, derivado de esquistos metamórficos. Grupo pequeño en floración (flor rosado claro), formación vainas verdes. Tallos rastreros. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3255**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental ‘Fabio Baudrit Moreno’ de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus vulgaris* L. forma silvestre, det. D.G. Debouck, 8/XII/2015. COSTA RICA, **San José**, Tarrazú, distrito San Carlos, a 2 km de Matecaña. GPS: Lat. 09° 37’ 29.0”N. Long. 84° 04’ 48.7”W. Alt. 1,748 msnm. Fecha de recolección: 8/XII/2015. Observ.: en matorral con *Cecropia*, Compuestas, *Dahlia imperialis*, Gramineas, *Mellinis minutiflora*, helechos, *Vigna*. Antiguo bosque de roble tumbado para cafetales con bananos. Soleado, abierto. Suelo pardo detrítico orgánico en pendiente fuerte. Pequeño grupo de plantas en floración (flor lila intenso) en transición a vainas verdes, con tallos volubles de 2-4 m de alto. Foliolos con manchas de *Uromyces*. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3256**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental ‘Fabio Baudrit Moreno’ de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus vulgaris* L. forma silvestre, det. D.G. Debouck, 8/XII/2015. COSTA RICA, **San José**, Tarrazú, distrito San Carlos, 2 km del poblado de Bajo San José. GPS: Lat. 09° 38’ 05.5”N. Long. 84° 05’ 08.4”W. Alt. 1,461 msnm. Fecha de recolección: 8/XII/2015. Observ.: en un barranco en camino a Alto Sapotal; flora de barranco con cedro, *Heliocarpus*,

Passiflora, *Heliconia*, *Compuetas*, *Dahlia imperialis*, *Rubus*, *Desmodium*, *Begonia*, Melastomataceae. Semi soleado, abierto. Suelo pardo orgánico fresco derivado de dioritas, en pendiente casi vertical. Pequeño grupo de plantas en floración (flor con alas de color lila) en transición a vainas verdes, con tallos volubles de 2-4 m de alto. Foliolos con manchas de *Uromyces*. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3257**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus vulgaris* L. forma silvestre, det. D.G. Debouck, 8/XII/2015. COSTA RICA, **San José**, León Cortés, San Pablo, a, 5 km W de San Isidro, en Quebrada Garro. GPS: Lat. 09° 40' 10.2"N. Long. 84° 05' 45.2"W. Alt. 1,447 msnm. Fecha de recolección: 8/XII/2015. Observ.: en matorral alto de barranco con *Cecropia*, *Poinsettia*, *Compuestas*, *Dahlia imperialis*, Gramineas altas, *Rubus*, *Desmodium*, *Begonia*, *Phaseolus lunatus* (vegetativo). Suelo pardo orgánico fresco derivado de tobas volcánicas, en pendiente muy fuerte. Soleado abierto. Pequeño grupo en vainas verdes, con tallos volubles 2-4 m alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3258**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus costaricensis* Freytag & Debouck, det. D.G. Debouck, 8/XII/2015. COSTA RICA, **San José**, Tarrazú, distrito de San Lorenzo, a, 2 km SW de San Francisco, 0.5 km SW de la Y de Llano Bonito y Bijagual. GPS: Lat. 09° 41' 14.2"N. Long. 84° 07' 14.5"W. Alt. 1,825 msnm. Fecha de recolección: 8/XII/2015. Observ.: en matorral de barranco con Meliaceae, *Compuestas*, *Dahlia imperialis*, *Ipomoea*, Gramineas altas (*Phaseolus albicarminus* #3242 a 0.25 km). Suelo pardo orgánico en pendiente fuerte. Soleado, abierto. Pequeño grupo de 5-10 plantas en floración (flor de color fucsia). Tallos volubles de 2-5 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3259**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus albicarminus* Debouck, det. D.G. Debouck, 08/ XII/ 2015. COSTA RICA, **San José**, Tarrazú, distrito de San Lorenzo, 2 km SW de San Francisco, 3 km NE de Paritilla. GPS: lat. 09° 41' 12.9"N. Long. 84° 07' 12.4"W. Alt. 1,837 msnm. Fecha de recolección: 8/ XII/ 2015. Observ.: en remanentes de bosque latifolio montano bajo, convirtiéndose en matorral con *Dahlia imperialis*, otras *Compuestas*, *Solanaceae*, *Ipomoea*, *Gramineae*, helechos. Amb: abierto, mi soleado, con neblinas frecuentes. Suelo franco arcilloso pardo con mucha materia orgánica húmedo en pendiente. Mater: población localizada de 15-20 plantas, en fin de floración (alas blancas, estandarte con tinte violáceo), formación de vainas verdes. Hojas trifolioladas sin variegación a lo largo de la nervadura central. Tallos volubles de 2-5 m de largo. [encontrado por primera vez el 10/XII/2012]. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes. No. **3242**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 9/XII/2015. COSTA RICA, **Puntarenas**, Espiritu Santo, poblado Caldera, 1 km SSE de la entrada a Puerto Caldera, en la colina arriba de Punta Coralillo. GPS: Lat. 09° 54' 47.2"N. Long. 84° 41' 45.6"W. Alt. 147 msnm. Fecha de recolección: 9/XII/2015. Observ.: en bosque tropical mixto con algunas Palmas, Cactáceas, y sin epifitas, algunos árboles microfilos, con *Rhynchosia minima*, *Galactia*, *Centrosema* (2 especies). En conversión a pasturas y urbanizaciones. Suelo pardo franco orgánico derivado de tobas, plano a pendiente suave. Soleado abrigado. Pequeño grupo de aproxim. 10 plantas en floración

(flor lila muy claro), y formación de vainas verdes, con tallos volubles de 2-4 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3260**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus leptostachyus* Benthams, det. D.G. Debouck, 10/XII/2015. COSTA RICA, **Guanacaste**, Santa Cruz, 9 km S del poblado Arado, en el Bosque Nacional Diriá. GPS: Lat. 10° 09' 46.1"N. Long. 85° 35' 02.9"W. Alt. 382 msnm. Fecha de recolección: 10/XII/2015. Observ.: en bosque de transición de árboles microfilos a mesofilos de 15-20 m de altura, con *Cecropia*, *Pachyrhizus panamensis*, varias Compuestas, Iridaceae, *Selaginella*. Talud de suelo pardo franco profundo. Ambiente mi soleado abrigado. Pequeño grupo de plantas en vainas verdes en transición a maduras, con tallos rasteros de 60-100 cm de largo. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3261**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 10/XII/2015. COSTA RICA, **Guanacaste**, Santa Cruz, poblado Arado, ladera norte del Cerro Vista al Mar, cerca de Guindos Norte, en terracería a Cerro Brujo. GPS: Lat. 10° 11' 42.0"N. Long. 85° 36' 39.5"W. Alt. 435 msnm. Fecha de recolección: 10/XII/2015. Observ.: en bosque tropical de transición de árboles microfilos a mesofilos, con algunas Cactaceas, *Mimosa*, *Cecropia*, *Ipomoea*, y varios otros bejucos, Compuestas, *Dodonea*. Suelo pardo orgánico franco profundo. Ambiente soleado abierto. Pequeño grupo de aproxim. 10 plantas en floración (flor con alas lila) en transición a vainas verdes, con tallos volubles de 3-4 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3262**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus microcarpus* Mart., det. D.G. Debouck, 10/XII/2015. COSTA RICA, **Guanacaste**, Santa Cruz, poblado Arado, ladera norte del Cerro Brujo. GPS: Lat. 10° 10' 33.0"N. Long. 85° 37' 22.8"W. Alt. 511 msnm. Fecha de recolección: 10/XII/2015. Observ.: en barranco de Bosque tropical de transición a bosque seco con árboles microfilos, *Cecropia*, *Ipomoea*, *Cleome*, *Begonia*, Compuestas, *Phaseolus lunatus* en estado vegetativo. Suelo pardo orgánico, sobre esquistos metamórficos, en pendiente fuerte. Ambiente soleado abierto. Pequeño grupo de aproxim. 20 plantas, ya en madurez seca, con tallos volubles de 2-3 m de alto ya defoliados. Una planta aún en floración, con flor rosado claro. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3263**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 10/XII/2015. COSTA RICA, **Guanacaste**, Santa Cruz, poblado Arado, ladera norte del Cerro Brujo, 2 km al norte del cerro con las antenas y el radar de apoyo a navegación aérea. GPS: Lat. 10° 09' 32.2"N. Long. 85° 37' 32.2"W. Alt. 766 msnm. Fecha de recolección: 10/XII/2015. Observ.: en barranco en borde de terracería; matorral intervenido con Mimosoideae, Gramineas, *Hyparhenia rufa* (quemadas en el pasado!), *Melinis minutiflora*, *Ipomoea*, *Dodonea*. Suelo pardo profundo derivado de tobas, en pendiente fuerte. Ambiente soleado abierto. Pequeño grupo de aproxim. 15 plantas en vainas verdes, con tallos volubles de 2-4 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3264**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 11/XII/2015. COSTA RICA, **Guanacaste**, Nandayure, distrito Carmona, 2 km S de San Rafael

de Carmona. GPS: Lat. 09° 57' 47.1"N. Long. 85° 16' 08.7"W. Alt. 655 msnm. Fecha de recolección: 11/XII/2015. Observ.: en antiguo bosque tropical subhúmedo tumbado para pasturas, en borde de pasturas sobre cercos, con *Annona*, *Cecropia*, *Meliaceae*, *Caprifoliaceae*, *Galactia*, *Centrosema*. Suelo franco arcilloso húmedo pardo rojizo profundo. Ambiente abierto semi soleado. Grupo de 10-15 plantas localizado, en floración y transición a vainas verdes, con tallos volubles de 3-4 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3265**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 11/XII/2015. COSTA RICA, **Guanacaste**, Nandayure, distrito Carmona, 1 km W de Bellavista, 0.2 km antes de las antenas y del radar de apoyo a navegación aérea. GPS: Lat. 09° 57' 05.04"N. Long. 85° 16' 36.2"W. Alt. 941 msnm. Fecha de recolección: 11/XII/2015. Observ.: en pequeño relicto de bosque tropical subhúmedo, con *Pinus* (de siembra), *Heliconia*, *Solanum*, *Ipomoea*, Compuestas, Gramineas, *Hyparhenia rufa*, *Melinis minutiflora*. Suelo franco rojizo plano. Ambiente soleado abierto, en orilla del relicto. Pequeño grupo de aproxim. 10 plantas en floración (flores con alas rosado intenso), transición a vainas verdes, con tallos volubles de 2-4 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3266**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 11/XII/2015. COSTA RICA, **Guanacaste**, Nandayure, distrito Carmona, Nandayure, 5 km NE de San Ramón (Río de Ora). GPS: Lat. 09° 54' 43.3"N. Long. 85° 20' 34.7"W. Alt. 306 msnm. Fecha de recolección: 11/XII/2015. Observ.: en flora de barranco con *Meliaceae*, *Cecropia*, Compuestas, *Ipomoea*. Suelo pardo gris derivado de gabbro, en pendiente fuerte. Ambiente soleado abierto. Grupo de aproxim. 20 plantas en floración (flor con alas de color lila), en transición a vainas verdes, con tallos volubles de 2-5 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3267**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus costaricensis* Freytag & Debouck, det. D.G. Debouck, 12/XII/2015. COSTA RICA, **Alajuela**, Alfaro Ruiz, distrito Zarcero, 1 km NW de La Palmita. GPS: Lat. 10° 10' 13.4"N. Long. 84° 22' 35.2"W. Alt. 1,694 msnm. Fecha de recolección: 12/XII/2015. Observ.: en antiguo bosque montano bajo subhúmedo con numerosos bejucos, Gramineas altas, *Gynerium sagittatum*, *Ipomoea*. Suelo pardo franco profundo derivado de cenizas volcánicas, en pendiente. Ambiente soleado abierto. Pequeño grupo de aproxim. 10 plantas en floración (flor de color fucsia intenso) y formación de vainas verdes. Pedicelos rojos. Tallos volubles de 6-8 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3268**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 12/XII/2015. COSTA RICA, **Alajuela**, Alfaro Ruiz, distrito Zarcero, 1 km SE de Llano Bonito. GPS: Lat. 10° 09' 39.9"N. Long. 84° 21' 43.7"W. Alt. 1,662 msnm. Fecha de recolección: 12/XII/2015. Observ.: en antiguo bosque subhúmedo talado para cafetales, con Ciprés, Compuestas, Gramineas altas. Suelo pardo franco profundo derivado de cenizas volcánicas. Ambiente soleado abierto. Pequeño grupo de aproxim. 10 plantas en floración (flor con alas de color lila) y formación de vainas verdes, con tallos volubles de 2-4 m de alto. Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3269**.

Trabajo de Recolección de Germoplasma de *Phaseolus*. Misión colaborativa entre el Centro Internacional de Agricultura Tropical, y la Estación Experimental 'Fabio Baudrit Moreno' de la Universidad de Costa Rica, con el apoyo del Global Crop Diversity Trust. Nc. *Phaseolus lunatus* L. forma silvestre, det. D.G. Debouck, 12/XII/2015. COSTA RICA, **Alajuela**, Grecia, distrito Grecia, 4 km NNE de San Luís de Grecia. GPS: Lat. 10° 09' 02.1"N. Long. 84° 17' 48.5"W. Alt. 1,638 msnm. Fecha de recolección: 12/XII/2015. Observ.: en restos de bosque subhúmedo, con Ciprés, Roble, Gesneriaceae, Gramineas, *Melinis minutiflora*, *Ipomoea*, *Vigna*, *Desmodium*, helechos. Suelo pardo franco profundo derivado de cenizas volcánicas. Ambiente soleado abierto. Unas pocas plantas en cercas de cafetales y bordes de terracería. Entrando en floración, con tallos volubles de 1-2 m de alto. Población de mayor altura! Col. DG Debouck, R Araya Villalobos & N Chaves Barrantes No. **3270**.