Status of *Glycine* and *Vigna* in the Lao PDR

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Introduction

Leguminous crops are considered as one of the main cash crop after rice and maize for the Lao PDR economy. Because of the high local and external demand, such crops are becoming more important. Soybean is mainly used as source of protein, but it is also used for edible oil extraction.

Farmers have a good knowledge of leguminous plants; the species cultivated for food and fresh consumption include: *Vigna unguiculata* spp. *sesquipedalis*, *Cajanus cajan*, *Phaseolus vulgaris*, *Arachis hypogaea*. Some other species are used in industrial processing for the extraction of vegetable oil, for the preparation of complementary food and nutritive biscuits for children and the remaining are utilized for animal feed.

Moreover the leguminous cultivation improve soil fertility through root nodules that are result of the symbiosis between certain bacteria (*Rhizobium* spp) and the plants, by fixing natural nitrogen nitrogen (estimated rate is between 75-150 kg N/ha/season). Plant parts other than seed of the leguminous after harvesting, such as root, leaves, stem, if incorporated into the soil increase its fertility.

Grain legume can be found throughout Laos, from the North to the South; some of them are "local varieties" or others have been introduced. Due to the lack of data on such a classification, this difference will not appear in this paper.

Present situation

2.1. Grain legumes production in the Lao PDR

Soybean, mungbean and groundnut are cultivated in rural areas by small farmers throughout the country. The total area cultivated is about 15,000 ha with an average yield of 0.6-0.9 t/ha for soybean, 0.3-0.6 t/ha for mungbean and 0.7-0.8 t/ha for groundnut.

These crops are considered as complementary cash crop and used for home consumption. Traditionally most of them are grown with minimum agricultural inputs.

2.2. Cultivars and sowing's techniques

Farmers use a number of cultivars, which are introduced into the country, and statistical information on them is lacking.

- groundnut: *Arachis hypogaea* L.
- mungbean: *Vigna radiata* L. Wilezek
- soybean: *Glycine max* L. Merr. *unguiculata* spp. *sesquipedalis*
- *Vigna unguiculata* spp. *sesquipedalis*
- peageon pea: *Cajanus cajan* L. Millsp.
- kidney bean: *Phaseolus vulgaris* L.

and others.

Production system and sowing techniques utilized by farmers are different in the North and the South.

Groundnut, mungbean and soybean can be found along the riverbank or islands, generally intercropped with a cereal crop. Also in upland conditions, farmers grow these crops, but on small scale.

Grain legumes production in large areas occurs after the main crop. The sowing period extends between mid to the end of rainy season and the harvest is at the beginning of dry season. The legumes are also cultivated along the riverbank during the dry

Table 1. Lao National Agricultural Production data (2007)

Crop	Area(Ha)	Yield(T/Ha)	Production(T)
Rice	604,147	3.63	2,193,400
Upland Rice	105,696	1.77	187,450
Irrigated	71,400	4.61	329,200
Maize	154,255	4.48	690,795
Soybean	8,040	1.30	10,455
Mungbean	2,450	1.00	2,470
Groundnut	15,965	1.96	35,070
Vegetable & Bean	84,335		734,385

season, on using residual moisture for growth.

Diseases, pests and weed

- Disease do not cause significant economic damage; nevertheless some diseases exist during crop cycle: soybean mosaic virus, bacteria disease, powdery mildew and leaf rust.

- Frequently insects cause damage to grain legumes in the period 2 weeks after sowing to harvest: *Sylepta derogate*, *Malana gromyza*, and *Negara viridula* are important pests.

- In the lowlands, weeds become the main problem for grain legumes: *Eleusine indica*, *Digitaria ciliaris*, *Echinochloa colona*, *Ageratum conyzoides*.

Research objectives/Expected results

Soybean research

In the beginning research on grain legumes emphasized soybean. A soybean variety, Clark 63, was introduced in the country and further selected for extension.

Between 1977 and 1983 the collection of soybean was carried out by Hat Dok Keo station, with 13 entries including varieties Clark 63, TKS, Lincoln and Lee 74 from USA (introduced through Thailand), SJ4 and SJ5 from Thailand, HD4, COC CHUM and MUANG KHUANA from Vietnam, Hill and E.K. from USA (introduced through Vietnam) and SANTAMARIA from Brazil (introduced through Vietnam). Each variety was given a HDK entry number for experiments (CLARK 63 = HDK 002, TKS = HDK 003, SJ4 = HDK 005, SJ5 = HDK 006).

In 1983, Hat Dok Keo station received 94 soybean varieties from Japan, which were given the entry numbers as HDK 014 to HDK108. These varieties were apparently not evaluated, probably because of the lack of researchers and funds at that time, but they were kept in the cold room at the station.

At the end of 1983, the Asian Vegetable Research and Development Centre (AVRDC) gave 278 varieties and some advanced lines, which were included in Hat Dok Keo collection as entry numbers HDK 109 to 386. This new planting material was never fully evaluated due to the small quantity of seed.

In 1984, 14 varieties were introduced from Vietnam (HDK 387 to HDK 400).

In 1985, 14 varieties introduced from various origins (INSOY Program) HDK 403 to HDK 416.

Varieties through the IITA program were introduced in 1984 (HDK 418 to HDK 435). These were the TGX series of which the most popular were the HDK 420 (TGX 330-04E), HDK 425 (TGX 536-02D), HDK 429 (TGX 744-01E), *etc*.

In 1986 several other varieties were introduced including planting material from Hungary (HDK 436 and HDK 437, from Japan, Vietnam and Thailand (HDK 438 to HDK 440) and from IITA (HDK 442 to HDK 457). Other entries from IITA were HDK 459 to HDK 464 introduced in 1987 as well as HDK 471 to HDK 473.

Some planting materials were also introduced from the USSR (HDK 475 to HDK 480) in 1988 while HDK 482 to HDK 490 was introduced in 1989 from Indonesia.

Vigna research

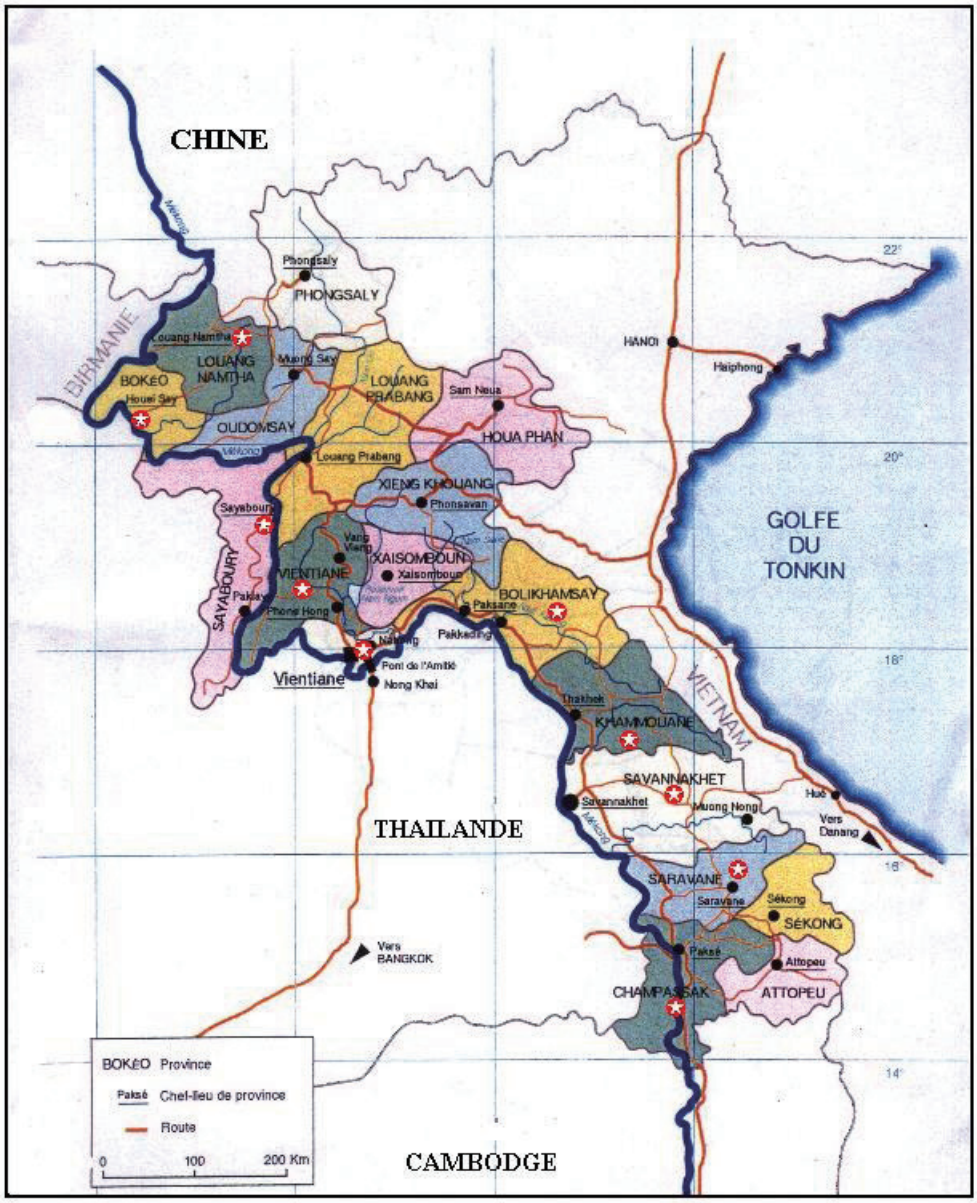
For mungbean, 150 varieties were introduced into the collection from 1977 to 1989. In 1977 several varieties were in the collection (entries HDK 001 to HDK 011) mostly from Philippines and Vietnam. More varieties, such as UTHONG 1, were introduced from Vietnam in 1983 (HDK 013 to HDK 027).

A field survey for *Vigna* sp. was conducted in Lao PDR from November 15 to 26, 2003. During the survey, Vientiane, Luang Prabang, Champassak and Saravan provinces were explored. Nineteen *Vigna* accessions consisting of five *Vigna umbellata*, one *V. unguiculata*, three *V. hirtella*, one *Vigna* (cf. *V. reflexo-pilosa*), five *V. minima* and four *Vigna* sp. (cf. *V. hirtella*) were collected. *V. umbellata* (rice bean) was found cultivated in a farmer's garden near Vientiane. Escaped *V. umbellata* was also found in Champassak and Saravan provinces. An accession of black seeded *V. unguiculata* (cowpea) was found growing as an escape around a paddy field in Luang Prabang province. Three accessions of *V. hirtella* and one accession of *Vigna* sp. (cf. *V. reflexo-pilosa*) were also found in Luang Prabang province. In the Boloven plateau of Champassak province, an unidentified *Vigna* species (cf. *V. hirtella*) was found near an upland rice field at an elevation around 1000 m. *V. minima* was found at high elevation (the Boloven plateau) and also at a low elevation area (around lowland paddy rice field) in Champassak and Saravan provinces.

AVRDC supplied 94 varieties in 1983 (HDK 028 to HDK 122) originating from different parts of the world including crosses made by AVRDC. This set of planting material included also some *V. ungiculata* (HDK 108 to HDK 110), *V. angularis* (HDK 111 to HDK 114), *V. umbellata* (HDK 115 to HDK 118) and *V. mungo* (HDK 119 to HDK 122).

From 1986 to 1989, various mungbean varieties were introduced, most of them coming from Thailand. These varieties were recorded as HDK 123 to HDK 150. The most popular of these Kham-

Map of Lao PDR



-Land locked country - Total area-236,800 Km^2
-Mountainous -80% - Flat plain -20%
-Monsoon climate - Average annual rainfall 1,000-1,500 mm
-Max.peak precipitation - 3,000mm.

phengsaen 1 (HDK 125), Khamphengsaen 2 (HDK 126) introduced in 1987, Chainat 60 (HDK 132) introduced in 1988 and Uthong 2 (HDK 147) in 1989, and Khamphengsaen 1, Khamphengsaen 2 were reintroduced in 1989 from the National Genebank of Thailand.

For groundnut (*Arachis hypogaea* L.), a total of 40 varieties have been collected by Hat Dok Keo station from 1977 to 1987. Entries HDK 01 to HDK 05 were collected from Thailand and Lao before 1983, 7 varieties were introduced from Vietnam (HDK 06 to HDK 14) and another 15 varieties were collected from various origins (HDK 13 to HDK 24). The entries HDK 28 to HDK 32 are from Laos and were collected in 1986. Some varieties were collected with the assistance of the Franco-Lao cotton and oilseeds crop project. HDK 34 to HDK 36 in 1986 from IRHO/CIRAD and also HDK 38 in 19887, HDK 39 (SJ 38 from Thailand, HDK 40 were recorded in the collection.

Regarding kidney beans (*Phaseolus vulgaris*), entries are mostly from Vietnam (HDK 10) and 2 from Japan (HDK 7, 8).

Naphok started research on grain legumes in

1984 with emphasis on soybean; activities were concentrated on varietal trials under rainfed and irrigated conditions.

Through the Integrated Agricultural Development Project UNDP/FAO/LAO/82/011, linkages were established with the INTSOY Program.

The INTSOY trials have identified the following promising varieties: IAC 6, ISRA/IRAT 44A/73 and EGSY 91-7 in 1984, SH 1274, AGS-8, UFY-1, IAC 73-5115 and Dupo crop in 1984-85, TGX 302A-27, UWANG KEUMKONG, IGH 24, TGX 5560-3D, AGS 245, IACC 8 and PR 141 in dry season 1985-86. From 1986, international soybean trials were conducted in collaboration with IITA. These trials were conducted in collaboration with Hat Dok Keo station where some of the trials were located.

Acquired knowledge

Soybean

Research on soybean has mostly been conducted under on station conditions. Varieties Clark 63 and TK 5 were released for extension.

The most recent research activities conducted both Naphok and Hat Dok Keo have led to the identification of the following promising varieties: TGX 536-02D (HDK 425), TGX 744-01E (HDK 429), TGX 330-04E (HDK 420). These varieties have shown good yield potential under on-station conditions with yields up to 1.8- 2.2 t/ha. Improved cultural practices have been developed for semi-mechanized production both in wet and dry seasons.

Mid-August is considered as the most appropriate sowing period for soybean under on-station conditions in order to enable harvesting operations after the heavy rains in September. Recommended fertilizer rates for similar soil conditions as Naphok are NPK 00-20-25 kg/ha. Insect pests are controlled by application of monocrotophos (Azodrin) as curative treatment.

Mungbean

The variety UTHONG 1 (HDK 12) has been selected as the most appropriate mungbean variety, but still with some susceptibility to powdery mildew. Yield average is 300-500 kg/ha (harvested 3 times), cultural practices have been defined for both rainfed and irrigated cultivation.

The genus *Vigna* are agronomically and economically important in Lao PDR. Among them, *V. radiata* (mungbean) and *V. unguiculata* (cowpea) are the most widely cultivated crops. *V. umbellata* (rice bean) is a traditional food crop of Lao PDR. *V. umbellata* is thought to have been domesticated in Southeast Asia and therefore is expected to have high genetic variation in Lao PDR. Beside these cultivated *Vigna*, several wild *Vigna* species are distributed in Lao PDR and these wild species are thought to have high potential for future crop improvement programmes. However, systematic survey and collecting of these *Vigna* species have not been conducted in Lao PDR.

Groundnut

Variety Tainan 9 was selected as the most adapted variety to local conditions with high yield.

Kidney bean

Variety Cove Lam Dong is considered as the most appropriate variety for green pod production.

Other grain legumes

Other grain legumes species were not sufficiently studied to enable formulation of recommendations. Preliminary trials were conducted on pigeon pea and observations were made on yard long bean.

Future perspectives:

Research Program and Varietal Improvement

Long-term research program

The long-term research program will support the development of grain legumes as cash crop for the farmers, the diversification of crop production and the improvement of the cropping system by possible introduction of grain legumes crops in the cropping sequences. Grain legumes will be used to sustain soil fertility wherever possible.

For the crop improvement we must collect and evaluate the indigenous and exotic germplasm and to identify those adapted to condition in Lao PDR.

Medium-term program (5 years)

Medium-term research activities will aim at developing a range of different varieties of grain legumes suitable for the different cropping systems of the potential regions. Improved production practices will be developed for farmers by using traditional knowledge as a base for improvement. Initial emphasis will be on soybean, mungbean, groundnut and yard long bean.

Varietal improvement

- selection criteria will be the following
• good resistance to insect pests and diseases
• good yield in medium to low input environment
• adaptability to acid soil condition
• good seed viability under simple storage condition
• appropriate qualities for use as food or animal feed
• appropriate growth cycles for growing under different climatic conditions (according to the legume species involved)

Short-term program (3Years)

Year 1:

- Introduced lines from different sources such as China, Thailand and Vietnam of soybean will be evaluated in wet season and irrigated dry season in farmer field under the participatory of farmer, in Vientiane Capital, Vientiane and Savannakhet Province.
- Pests and diseases survey in farmer field in Vientiane Capital and Vientiane Province in wet and dry season crops
- Advance to F_4-F_5 from 2 crosses made by RCCRC in year 2006 and from other countries
- Make at least 4-6 crosses a year at RCCRC

Year 2:

- Introduced lines from different sources of soybean that were evaluated in 2009-2010 will be evaluated again in wet and irrigated dry season in farmer field under the participatory of farmer, in Vientiane Capital, Vientiane and Savannakhet Province
- Pests and diseases survey in farmer field in Vientiane Capital, Vientiane and Savannakhet Province in wet and dry season crops; and other growing areas if available
- Evaluation of advance lines selected from the 2 crosses made in 2006
- Advance to F_2/or F_4-F_6 for crosses made in the previous year
- F_2-F_4 progeny selection of the crosses made by the project, at RCCRC
- Seed multiplication of very promising line/varieties selected from the evaluation plot

Year 3:

- Seed multiplication of very promising varieties
- Dissemination of new planting material to the farmers in both late wet and dry season
- Pests and diseases survey in farmers field in Vientiane Capital and Vientiane Province in wet and dry season crops; and other growing areas if available
- Advance to F_2/or F_5-F_6 of different crosses made earlier

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• **Mungbean: VC 1686 and VC 1168 from Taiwan**

◆ **Soybean : S Ch 5 and CM 60 from Thailand**

Hybridization (Soybean 300 lines)