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SOLANACEAE DIVERSITY IN VIETNAM: A PRELIMINARY TAXONOMIC INVENTORY FOR CONSERVATION AND UTILIZATION

SUMMARY

Solanaceae plays an important role in providing food, vegetables, spices, medicine, and ornamentals in Vietnam. However, solanaceous genetic resources are facing serious threats of erosion and eradication. Our objective is to give a survey on the diversity as well as an evaluation of the role of solanaceous indigenous plants in the local communities to identify the current status and its importance for conservation and sustainable utilization in the future. The data comes from a survey and a collection in central Vietnam as well as herbarium specimens from the collections of Solanaceae in Vietnam. An analysis of these specimens and the result from the survey show that Solanaceae in Vietnam includes 15 genera with 63 species. Besides, there are 6 species belonging to 5 genera being in question regarding the taxonomy. Three genera, *Solanum* (31 species), *Lycianthes* (7 species) and *Physalis* (5 species) represent 68% of the total number of species. Among the 63 recorded species, there are 29 wild species, 22 cultivated species and 12 species being wild and cultivated. 6 species are used as fruits, 41 species as medicine, 16 species as ornamentals, 4 species as spices and 22 species as vegetables. The indigenous solanaceous plants include 24 species belonging to three genera: *Lycianthes* (7 species), *Solanum* (13 species) and *Tubocapsicum* (1 species). The indigenous solanaceous species in Vietnam are mostly wild species, among them there are three endemic species as *Lycianthes baviensis* V. V. Hop, *Solanum robinsonii* Bonati and *Solanum thorelii* Bonati.

Keywords: Solanaceae, diversity, genetic resource, species richness, Vietnam

INTRODUCTION

Solanaceae is one of the most important families of flowering plants to human beings with considerable value in economical, agricultural, and medicinal respects (Bennett, 2010; Knapp et al., 2004; Wiart, 2006), especially valuable they are as vegetable crops (Hawkes, 1999; Mueller et al., 2005; Samuels, 2015).

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Paper presented at the 7th International Scientific Agricultural Symposium "AGROSYM 2016".

Notes: The authors declare that they have no conflicts of interest. Authorship Form signed online.

In Vietnam, solanaceous plants play an important role in providing food, vegetables, spices, medicine and ornamentals as well as improving income for the local people (Chi, 1997; Ho, 1999; Hop and Phuong, 2003). In recent years, the solanaceous genetic resources in Vietnam are still facing serious threats of erosion and eradication. The main reasons are the fast replacement by new, high-yielding crop varieties and the intensive farming process, human activities as destruction and non-rational exploitation of forests and lands, urbanization and modernization, the pressure of population with growing food demands, natural disasters along with negligence and insufficient management of humans (Sen and Trinh, 2010; Trinh, 1996).

The Solanaceae are ranked the eighth of 37 families in valuable and rare species that are needed to conserve in Vietnam including 107 rare genetic resources belonging to 26 species and 3 genera (MARD, 2005a), however, conservation of these species received very little attention so far (Tuong *et al.*, 2010; Tuong *et al.*, 2013). One of the biggest obstacles for the conservation of indigenous species including solanaceous species are incomplete statistics, classification and evaluation of them. This would be necessary especially for wild species having close relationships with crops in different ecological regions in Vietnam to provide information for ex-situ or in-situ conservation (Catacutan *et al.*, 2014; Hue *et al.*, 2012). Besides, determining and selection of important indigenous solanaceous genetic resources for conservation have not been done. Therefore, the utilization of germplasm collections, particularly in the wild species, is still very limited (PGRV, 2012; PGRV, 2014; Tuong, 2014; Tuong *et al.*, 2010). The objective of this study is to give a survey on the diversity as well as the evaluation of the role of solanaceous indigenous plants in the local communities to identify the status as well as importance of them for conservation and sustainable utilization in the future.

MATERIALS AND METHODS

The study was designed as an investigation based on the results of a survey and collection in 5 provinces in central Vietnam (Figure 1) from September 2013 to February 2014 and the data come from 308 herbarium specimens from the collections of Solanaceae in Plant Genetic Resource in Vietnam.

The provinces were selected for the survey based on eco-geographic data (Guarino *et al.*, 2005). Identification of Solanaceous species used the method of comparing morphological characteristics with using the identification keys by Ho (1999), Hop (2006) and Zhang (1994). Useful solanaceous plants were determined by surveys and interviews with 155 randomly-selected households base on questionnaire. Additionally, special collecting trips were organized with indigenous experts: traditional doctors, village elders and other local people who knew about useful plants. The information was also checked and compared with documents on medicinal plants by Loi (1995), Chi (1997), Ho (1999) and Batugal (Batugal *et al.*, 2004).

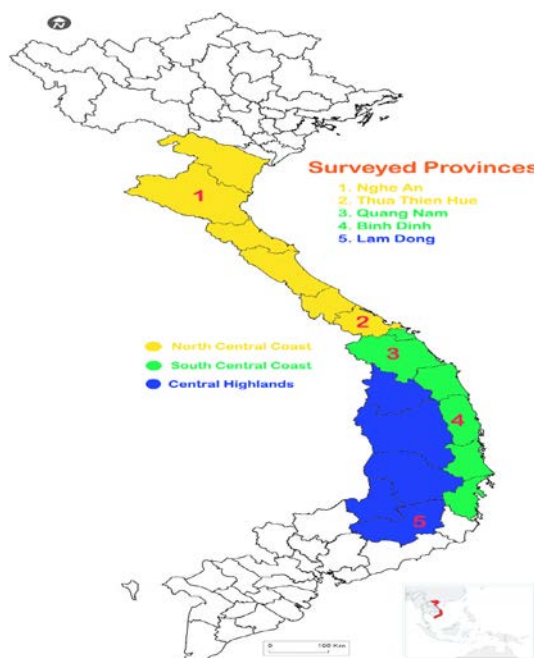


Figure 1. Surveyed provinces in central Vietnam

Classification is based on system by Hunziker (2001). Solanaceous species are re-identified base on detail descriptions and they also updated scientific name according to The Plant List (2016) (version 1.1).

RESULTS AND DISCUSSION

According to solanaceous system by Hunziker (2001), Solanaceae in Vietnam can be classified into 2 subfamilies (*Cestroideae*, *Solanoideae*) with 7 tribes (*Cestreae*, *Nicotianeae*, *Francisceae*, *Browallieae*, *Datureae*, *Lycieae*, *Solaneae*) and 5 subtribes (*Nicotianinae*, *Physalinae*, *Iochrominae*, *Capsicinae*, *Solaninae*) with 15 genera (*Cestrum*, *Nicotiana*, *Petunia*, *Brunfelsia*, *Browallia*, *Datura*, *Brugmansia*, *Lycium*, *Physalis*, *Tubocapsicum*, *Capsicum*, *Solanum*, *Cyphomandra*, *Lycopersicon*, *Lycianthes*). In addition, there is one genus (*Atrichodendron*) thats affinity with Solanaceae is debated.

The table 1 shows that the Solanaceae in Vietnam are represented by 15 genera with 63 species. Besides, there are 6 species belonging to 5 genera being doubtful (Table 2). *Solanum* and *Lycianthes* are the most diverse genera. Three genera, *Solanum* (31 species), *Lycianthes* (7 species) and *Physalis* (5 species) represent 68% of the total number of species. *Capsicum* (3), *Cestrum* (2), *Datura* (3), *Lycium* (3) and *Nicotiana* (2) group only few species. *Browallia*, *Brugmansia*, *Brunfelsia*, *Cyphomandra*, *Lycopersicon*, *Petunia* and *Tubocapsicum* are represented by only 1 species each (Table 1 and Figure 2).

Comparing with some countries in Asia the number of genera and species of solanaceous plants in Vietnam is diversity of species (Figure 3). Some genera belonging to Solanaceae are not found in Vietnam as *Anisodus*, *Atropa*, *Atropanthe*, *Hyoscyamus*, *Mandragora*, *Nicandra*, *Nierembergia*, *Przewalskia*, *Physaliastrum*, *Physochlaina*, *Salpiglossis*, *Schizanthus*, *Scopolia*, *Solandra* and *Withania*. However, the number of species in *Solanum* is quite large with 31 species (only smaller than China and Taiwan).

Table 1. Genera and species of Solanaceae in Vietnam

Sub-family	Tribe	Subtribe	Genus ^a	The number of species ^b
<i>Cestroideae</i>	<i>Cestreae</i>		<i>Cestrum</i>	2
	<i>Nicotianeae</i>	<i>Nicotianinae</i>	<i>Nicotiana</i>	2
			<i>Petunia</i>	1
	<i>Francisceae</i>		<i>Brunfelsia</i>	1
	<i>Browallieae</i>		<i>Browallia</i>	1
<i>Solanoideae</i>	<i>Datureae</i>		<i>Datura</i>	3
			<i>Brugmansia</i>	1
	<i>Lycieae</i>		<i>Lycium</i>	3
	<i>Solaneae</i>	<i>Physalinae</i>	<i>Physalis</i>	5
		<i>Ichrominae</i>	<i>Tubocapsicum</i>	1
		<i>Capsicinae</i>	<i>Capsicum</i>	3
		<i>Solaninae</i>	<i>Solanum</i>	31
			<i>Cyphomandra</i>	1
			<i>Lycopersicon</i>	1
			<i>Lycianthes</i>	7

^a Genus *Atrichodendron* is not mention in this table.

^b Not including the species which being doubtful

Table 2. List of doubtful taxon belong to Solanaceae in Vietnam

Genus	Scientific name	Reasons
<i>Atrichodendron</i>	<i>Atrichodendron tonkinense</i> Gagnep.	no herbarium specimen, can belong to Boraginaceae (Ho, 1993)
<i>Cyphomandra</i>	<i>Cyphomandra godefroyi</i> Bonati	leaves and interpetiolar stipules characteristic of Rubiaceae (Bohs, 1994)
<i>Lycianthes</i>	<i>Lycianthes denticulata</i> (Blume) Bitter.	no herbarium specimen, unknown distribution
<i>Lycium</i>	<i>Lycium cochinchinensis</i> Lour.	no herbarium specimen, excluded from this genus (Zhang et al., 1994)
<i>Solanum</i>	<i>Solanum mauritianum</i> Scop.	no herbarium specimen, unknown distribution
	<i>Solanum virginianum</i> L.	doubt about existence

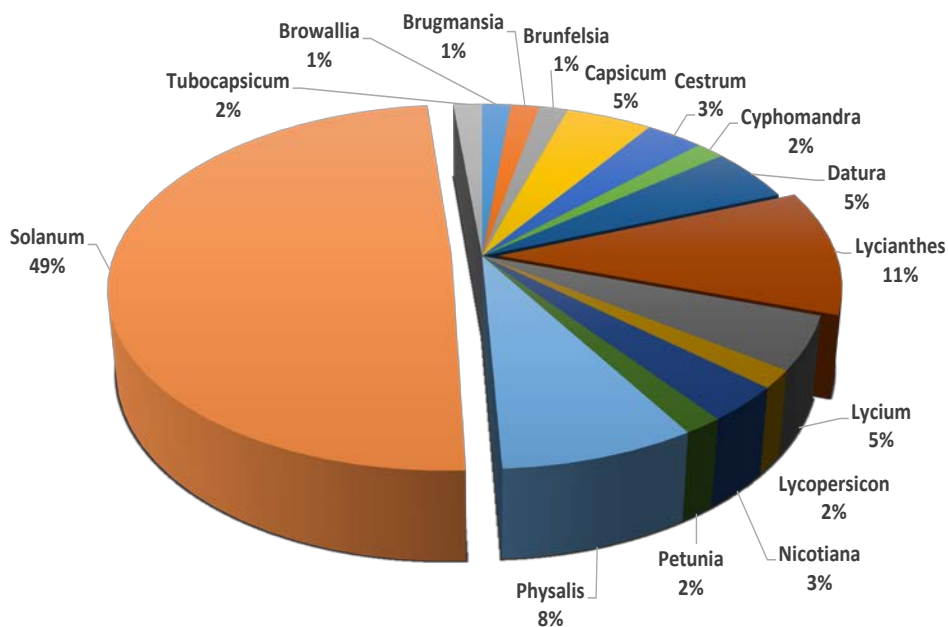


Figure 2. Percentages of genera of Solanaceae family in Vietnam

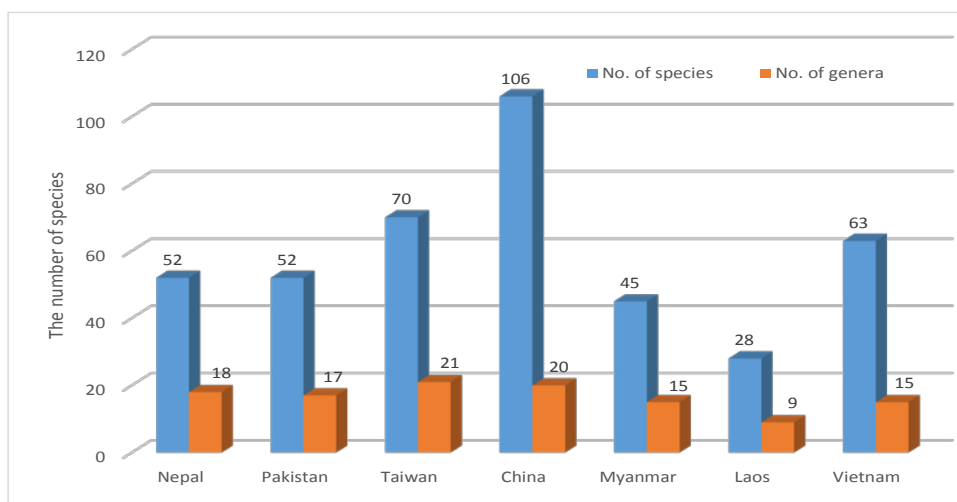


Figure 3. Number of genera and species of Solanaceae family in some countries in Asia

There are 29 wild species, 22 cultivated species and 12 species being wild and cultivated (Table 3 and Figure 4). Genus *Solanum* is highly diverse regarding morphological characteristics as well as its distribution in nature and species of *Solanum* are found everywhere from mountains areas to delta areas. Some wild species are distributed everywhere as *Solanum nigrum* L. and *Solanum torvum*

Sw. while some species are only distributed in the mountains areas as *Solanum erianthum* D. Don.

This genus has many species, which are very similar so it is easy to have confusion as *Solanum capsicoides* or *Solanum viarum* (Hop, 2006). Genus *Lycianthes* has 20 native species in South East Asia (Hunziker, 2001) in which 7 wild species in North Vietnam. This shows that Vietnam is also one of the central areas of this genus in Asia (Hop, 2006; Zhang et al., 1994).

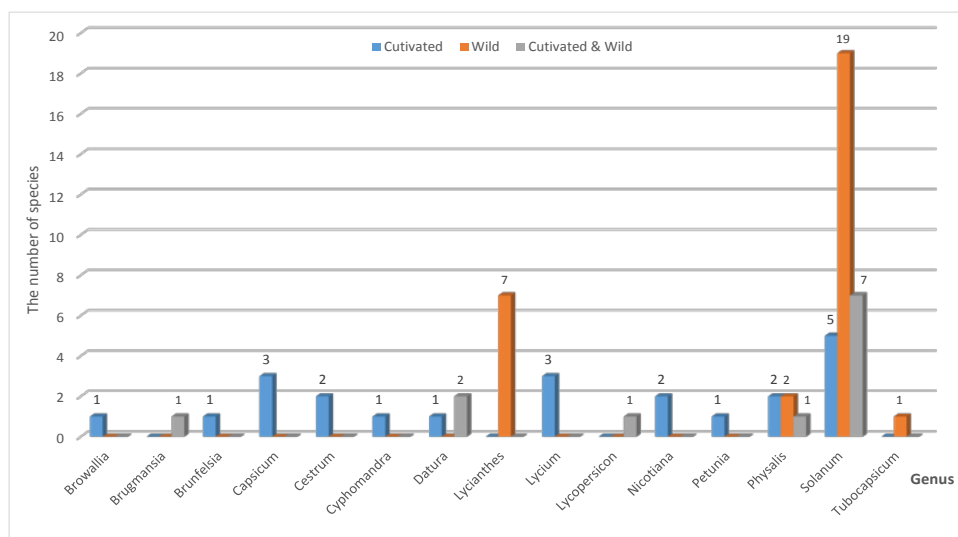


Figure 4. Status of solanaceous species in Vietnam

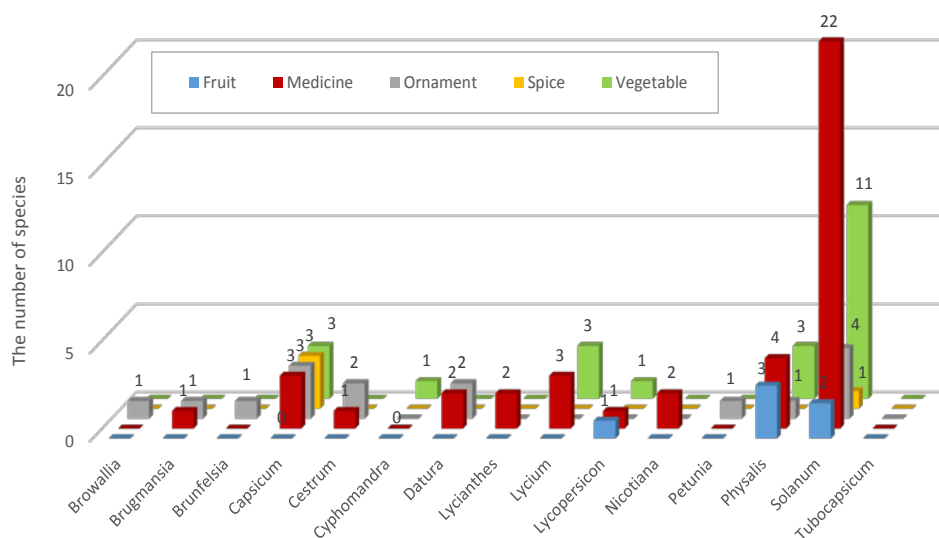


Figure 5. Value of solanaceous plants in Vietnam

Table 3. Species of Solanaceae in Vietnam

Species	Voucher collection	Bio. status ^a	Type ^b	Used ^c
<i>Browallia americana</i> L.	Lâm Đồng, V. V. Hợp 19 (HN)	C	I	O
<i>Brugmansia suaveolens</i> (Humb. & Bonpl. ex Willd.) Bercht. & J.Presl	Lâm Đồng, N. Đ. Khôi 20 (HN)	C, W	I	M, O
<i>Brunfelsia pauciflora</i> (Cham. & Schlecht) Benth.	Phú Thọ, V. X. Phương 7861 (HN)	C	I	O
<i>Capsicum annuum</i> L.	Nghệ An, N. N. Thìn 550 (HNU)	C	I	M, O, S, V
<i>C. baccatum</i>	None, recorded in this study	C	I	M, O, S, V
<i>C. frutescens</i> L.	V. X. Phương 3705 (HN)	C	I	M, O, S, V
<i>Cestrum elegans</i> (Brongn.) Schlechter	None, recorded by Ho (1993) and Nhan (1996)	C	I	O
<i>C. nocturnum</i> L.	Hà Nội, T. Đ. Lý 1 (HN)	C	I	O, M
<i>Cyphomandra betacea</i> (Cav.) Sendtn.	None, recorded by G. Bonati (1927) and Nhan (1996)	C	I	V
<i>Datura innoxia</i> Mill.	Hà Nội, N. Tập 2610A-B-C (HNPM)	C, W	I	M, O
<i>D. metel</i> L.	Tuyên Quang, V. X. Phương 6991 (HN)	C, W	I	M, O
<i>D. stramonium</i> L.	Hòa Bình, V. X. Phương 1938 (HN)	C	I	M, O
<i>Lycianthes baviensis</i> V. V. Hop	Hà Tây, Lý-Nhan-Vệ 237 (HN)	W	E	
<i>Lycianthes biflora</i> (Lour.) Bitter	Sơn La, V. X. Phương 16150 (HN)	W	N	M
<i>Lycianthes bigeminata</i> (Nees) Bitter	Hà Giang, sine nom. coll. (HN)	W	N	M
<i>Lycianthes laevis</i> (Dunal) Bitter	Sơn La, V. X. Phương 16142 (HN)	W	N	
<i>Lycianthes lysimachioides</i>	Hà Tây, Đoàn Trung Quốc 3802 (HN)	W	N	
<i>Lycianthes macrodon</i> (Wal. ex Nees) Bitter	Cao Bằng, sine nom. coll. 8295 (HN)	W	N	
<i>Lycianthes neesiana</i> (Wall. Ex Nees) D'Acry & Z. Y. Zhang	Hà Tây, Dur-Croat 77996 (HN)	W	N	
<i>Lycium barbarum</i>	None, recorded by Ho (1993)	C	I	M, V
<i>Lycium chinense</i> Mill.	Hà Giang, N. K. Đào 73 (HN)	C	I	M, V
<i>Lycium ruthenicum</i> Murray	Hà Nội, sin nom. coll. & sine num. (HNIP)	C	I	M, V
<i>Lycopersicon esculentum</i> Mill.	Hà Nội, 72HN Bách-Tâm 283 (HN)	C, W	I	F, M, V
<i>Nicotiana rustica</i> L.	Thanh Hoa, V. X. Phương 10902 (HN)	C	I	M
<i>Nicotiana tabacum</i> L.	Lạng Sơn, N. Đ. Khôi 333 (HN)	C	I	M
<i>Petunia hybrida</i> Vilm.	Lâm Đồng, V. V. Hợp 20 (HN)	C	I	O
<i>Physalis alkekengi</i> L.	Hà nội, 72 HN4 sine nom. coll. 233 (HN)	C	I	M, V
<i>Physalis angulata</i> L.	Lạng Sơn, N. Đ. Khôi 327 (HN)	W	I	F, M, V
<i>Physalis minima</i> L.	Kon Tum, N. H. Hiến 275 (HN)	W	I	M, V
<i>Physalis peruviana</i> L.	Lâm Đồng, N. H. Hiến 676 (HN)	C, W	I	F, M
<i>Physalis pubescens</i>	None, recorded by Ho (1993)	C	I	F, O
<i>Solanum album</i> Lour.	Kon Tum, V. V. Hợp 06 (HN)	C	N	M, V
<i>Solanum aethiopicum</i>	None, recorded in this study	C	I	M, V
<i>Solanum americanum</i>	None, recorded by Ho (1993)	W	I	F, M, V

<i>Solanum capsicoides</i> All.	Lạng Sơn, N. V. Phú 7266 (HN)	C, W	I	M
<i>Solanum cyanocarphum</i> Blume	Kon Tum, N. V. Hiến 240 (HN)	W	N	
<i>Solanum diphyllum</i> L.	None, recorded in this study	W	I	M
<i>Solanum dulcamara</i> L.	Ninh Bình, Đoàn KSVT 4805 (HN)	W	I	M
<i>Solanum erianthum</i> D. Don	Hà Giang, DKH 6208 (HN)	C, W	I	M
<i>Solanum ferox</i> L.	Khánh Hòa, Poilane 3245 (HM)	W	N	M
<i>Solanum incanum</i> L.	Lạng Sơn, Hoàng Vệ 15538 (HN)	W	I	M
<i>Solanum involucratum</i>	None, recorded by Ho (1993)	W	N	M, V
<i>Solanum laciniatum</i> Ait.	Hà Nội, N. V. Phú 16300 (HN)	C	I	M
<i>Solanum lasiocarpum</i> Dunal	Nghệ An, Đoàn KSVT 4201 (HN)	W	N	M, V
<i>Solanum lyratum</i> Thunb.	Lạng Sơn, V. X. Phương 3692 (HN)	W	N	M
<i>Solanum mammosum</i> L.	Lào Cai, N. V. Phú 7651 & 7652 (HN)	C, W	I	M, O
<i>Solanum melongena</i> L.	Lạng Sơn, N. V. Phú 16306 & 16307 (HN)	C	N	M, V
<i>Solanum nienkui</i> Merr. & Chun	Đắk Lắk, N. T. Nhan 695 (HN)	W	N	
<i>Solanum nigrum</i> L.	Lào Cai, Đội KS Việt Trung 2565 (HN)	W	I	F, M, V
<i>Solanum pittosporifolium</i> Hemsl.	Cao Bằng, CBL 552 (HN)	W	N	
<i>Solanum praetermissum</i> Kerr ex Barnett	Hà Tây, HPP 20 (HN)	W	N	
<i>Solanum procumbens</i> Lour.	Phú Thọ, N. V. Phú 7658 (HN)	C, W	N	M
<i>Solanum pseudocapsicum</i> L.	Hà nội, V. V. Hợp 05 (HN)	C, W	I	O
<i>Solanum robinsonii</i> Bonati	Khánh Hòa, N. V. Phú sine num. (HN)	W	E	
<i>Solanum seaforthianum</i> Andr.	Hải Phòng, LX-VN 3229 (HN)	C, W	I	O
<i>Solanum spirale</i> Roxb.	Yên Bái, VN 934 (HN)	W	N	M, V
<i>Solanum thorelii</i> Bonati	Lào Cai, Đoàn KSVT 3344 (HN)	W	E	
<i>Solanum torvum</i> Sw.	Điện Biên, DKH 5875 (HN)	W	I	M, V
<i>Solanum trilobatum</i> L.	None, recorded by G. Bonati (1927), Ho (1993), and Nhan (1996)	W	N	M
<i>Solanum tuberosum</i> L.	Hà nội, sine nom. coll. 7220 (HN)	C	I	M, V
<i>Solanum viarum</i> Dunal	Phú Thọ, V. X. Phương 8047 (HN)	W	I	
<i>Solanum violaceum</i> Ortega	Hà Giang, V. X. Phương 305 (HN)	C, W	N	M, V
<i>Tubocapsicum anomalum</i> (Franch. & Sav.) Makino	Lai Châu, DKH 5915 (HN)	W	N	

^a Biological status: W = Wild; C = Cultivated

^b Type: ecological state of a species in Vietnam: N = Native/Indigenous; I = Introduced; E = Endemism;

^c Used: F = Fruit; M = Medicine; O = Ornament/decoration; S = Spice ; V = Vegetable

Abbreviations: HN = Institute of Ecology and Biological Resources, HNU = College of Natural Sciences - Vietnam National University in Hanoi, HNIP = Hanoi University of Pharmacy, HNPM = National Institute of Medicinal Materials.

The wild species belonging to Solanaceae in Vietnam have common features that grow near forests, wastelands, roadsides and thickets so it is quite convenient for humans to exploit and use them, but also easy to be negatively affected by human activities. The valuable species of solanaceous plants include

51 species (80,95 percentage of total species), in which 6 species for fruits, 41 species for medicine, 16 species for ornamentals, 4 species for spices and 22 species for vegetables (Table 3 and Figure 5). The important solanaceous species in Vietnam are *Capsicum annuum* L., *Lycopersicon esculentum* Mill., *Nicotiana rustica* L., *Solanum tuberosum* L. and *Solanum melongena* L.. The most important medicinal species is *Solanum procumbens* Lour.

Table 4 List of indigenous solanaceous species in Vietnam

Botanical name	Common name	Biological status ^a	Distribution ^b	Type ^c	Used ^d
<i>Lycianthes baviensis</i>	Cà ngũ ba vì	W	N	E	
<i>Lycianthes biflora</i>	Cà hai hoa	W	N/M/S	N	M
<i>Lycianthes bigeminata</i>	Cà ngũ cặp đôi	W	N	N	M
<i>Lycianthes laevis</i>	Cà ngũ nhãn	W	N	N	
<i>Lycianthes lysimachioides</i>	Cà ngũ dạng trần châu	W	N	N	
<i>Lycianthes macrodon</i>	Cà ngũ cuống to	W	N/M/S	N	
<i>Lycianthes neesiana</i>	Cà ngũ ness	W	N	N	
<i>Solanum album</i>	Cà pháo	C, W	N/M/S	N	M, V
<i>Solanum cyanocarphum</i> *	Cà trái lam	W	M/S	N	
<i>Solanum ferox</i> *	Cà lông	W	M/S	N	M
<i>Solanum involucratum</i> *	Cà tổng bao	W	N	N	M, V
<i>Solanum lasiocarpum</i> *	Cà trái lông	W	N/M/S	N	M, V
<i>Solanum lyratum</i> *	Cà đòn	W	N	N	M
<i>Solanum melongena</i> *	Cà	C	N/M/S	N	M, V
<i>Solanum nienkui</i>	Cà cụm hoa dài	W	M	N	
<i>Solanum pittosporifolium</i> *	Cà lá cườm thảo	W	N	N	
<i>Solanum praetermissum</i>	Cà dài bao quả	W	N	N	
<i>Solanum procumbens</i> *	Cà gai leo	C, W	N/M	N	M
<i>Solanum robinsonii</i> *	Cà robinson	W	M	E	
<i>Solanum spirale</i> *	Cà xoắn	W	N/M	N	M, V
<i>Solanum thorelii</i> *	Cà thorel	W	N/M/S	E	
<i>Solanum trilobatum</i> *	Cà ba thù	W	M/S	N	M
<i>Solanum violaceum</i> *	Cà đại hoa tím	C, W	N/M/S	N	M, V
<i>Tubocapsicum anomalum</i>	Ớt ống	W	N/M	N	

^a Biological status: W = Wild; C = Cultivated

^b Distribution: Abbreviations: letters for three areas (N = North, M = Middle, S = South) in Vietnam

^c Type: ecological state of a species: N = Native; E = Endemism

^d Used: M = Medicine; V = Vegetable;

* Belong to rare genetic resources exchange international in case special (MARD, 2005b)

The indigenous solanaceous plants include 24 species belonging to three genera: *Lycianthes* (7 species), *Solanum* (13 species) and *Tubocapsicum* (1 species) (Table 4).

The indigenous solanaceous species in Vietnam are mostly wild species, in which there are three endemic species including *Lycianthes baviensis* V. V. Hop, *Solanum robinsonii* Bonati and *Solanum thorelii* Bonati.

CONCLUSIONS

The results of this analysis show that the Solanaceae flora of Vietnam is very diverse with 15 genera and 63 species. *Solanum* and *Lycianthes* are the most diverse species in Vietnam. Solanaceous species are mostly wild species, but the most cultivated species are introduced to Vietnam and there are 51 valuable species including 6 species for fruit, 41 species for medicine, 16 species for ornament, 4 species for spice and 22 species for vegetable. Economic value is mainly in vegetables and medicines. The indigenous solanaceous plants include 24 species belonging to three genera with three endemic species. *Solanum album*, *Solanum melongena* and *Solanum procumbens* are indigenous species with high value.

ACKNOWLEDGEMENT

We would like to thank to the Vietnamese government (VIED) and German Academic Exchange Service (DAAD) for financial support in this study

REFERENCES

- Batugal P.A., Kanniah J., Sy L., Oliver J.T. (2004) Medicinal Plants Research in Asia- Volume I: The Framework and Project Workplans Bioversity International.
- Bennett B. (2010) Twenty-five economically important plant families. Economic botany.
- Bohs L. (1994) *Cyphomandra* (Solanaceae). *Flora Neotropica*:1-175.
- Bohs L., Olmstead R. G. (1997) Phylogenetic relationships in *Solanum* (Solanaceae) based on *ndhF* sequences. *Syst. Bot.* 22: 5-17.
- Bonati G. (1927) Solanaceae, Paris.
- Catacutan D., Hai P.H., Phuong V.T., Bac D.V., Muchugi A., Lua H.T. (2014) Call for a tree domestication strategy in Vietnam, World Agroforestry Centre (ICRAF) Vietnam., Hanoi. pp. 4.
- Chi V.V. (1997) Dictionary of Medicinal Plants in Vietnam. Ho Chi Minh City: Y Hoc Publisher 435.
- Guarino L., Maxted N., Chawona E. (2005) A methodological model for ecogeographic surveys of crops International Plant Genetic Resources Institute (IPGRI).
- Hawkes J. (1999) The economic importance of the family Solanaceae. *Solanaceae IV. Advances in botany and utilization*. Kew: Royal Botanic Gardens, Kew:01-8.
- Ho P.H. (1993) Solanaceae Montreal.
- Ho P.H. (1999) Solanaceae Young Publishing House, Ho Chi Minh.
- Hop V.V. (2006) Study on classification of Solanaceae family (Solanaceae Juss.) in Vietnam, Institute of ecology and biological resources, Ministry of Education and Training in Vietnam, Hanoi. pp. 136.
- Hop V.V., Phuong V.X. (2003) Alkaloid species belong to Solanaceae family in Vietnam. *Journal of Biology in Vietnam* 25:27-31.

- Hue N.T.N., Nghia L.T., Phi H.D. (2012) Conservation and use of indigenous vegetables in Vietnam: status, challenges and recommendations, Hanoi. pp. 6.
- Hunziker A.T. (2001) Genera Solanacearum: the genera of Solanaceae illustrated, arranged according to a new system A.R.G. Gantner.
- Knapp S., Bohs L., Nee M., Spooner D.M. (2004) Solanaceae—a model for linking genomics with biodiversity. *Comparative and Functional Genomics* 5:285-291.
- Loi D.T. (1995) Medicinal trees and medicaments of Vietnam Science and Technology Publishing House, Hanoi.
- MARD. (2005a) List of valuable and rare genetic resources need to conserve, in: M. o. A. a. R. D. i. Vietnam (Ed.), Ministry of Agriculture and Rural Development in Vietnam, Hanoi. pp. 66.
- MARD. (2005b) Rare genetic resources exchange international in case special in: M. o. A. a. R. Development (Ed.), Hanoi.
- Mueller L.A., Solow T.H., Taylor N., Skwarecki B., Buels R., Binns J., Lin C., Wright M.H., Ahrens R., Wang Y. (2005) The SOL Genomics Network. A comparative resource for Solanaceae biology and beyond. *Plant physiology* 138:1310-1317.
- Nhan N.T. (1996) Solanaceae Juss. PGRV.
- PGRV. (2012) The results of conservation and sustainable utilization of national plant genetic resources from 2006 to 2010, Plant Genetic Resources of Vietnam, Hanoi.
- PGRV. (2014) The results of conservation of plant genetic resources from 2010 to 2014, Plant genetic resources of Vietnam, Hanoi.
- Samuels J. (2015) Biodiversity of Food Species of the Solanaceae Family: A Preliminary Taxonomic Inventory of Subfamily Solanoideae. *Resources* 4:277-322.
- Sen P.T., Trinh L.N. (2010) Vietnam second country report on the state of the nation's plant genetic resources for food and agriculture, The second report on the state of the world's plant genetic resources for food and agriculture. pp. 33.
- TPL. (2016) Version 1.1, The Plant List
- Trinh L.N. (1996) Vietnam: Country report to the FAO international technical conference on Plant genetic resources. pp. 9 - 11.
- Tuong L.K. (2014) Outstanding achievements in research and development of agricultural plant genetic resources from 2008 to 2013, Plant genetic resources of Vietnam, Hanoi.
- Tuong L.K., Mai D.T.H., Hai N.H., Thu D.M. (2010) The results of collection of genetic resources of agricultural plants from some provinces in the Northeast, the South Central Coast and Central Highlands in 2009, Plant genetic resources of Vietnam, Hanoi. pp. 11.
- Tuong L.K., Nghia L.T., Suu T.D., Tung V.V., Truong V.X., Toan V.D., Hue H.T., Huy L.Q. (2013) Conservation and development of plant genetic resources at the National gene bank in 2012, Plant genetic resources of Vietnam, Hanoi. pp. 10.
- Wiat C. (2006) Medicinal Plants of Asia and the Pacific CRC Press.
- Zhang Z.-y., Lu A.-m., D'Arcy W.G. (1994) Solanaceae. *Flora of China* 17:300-332.