2012 International Conference on Biological and Life Sciences
IPCBEE vol.40 (2012) © (2012) IACSIT Press, Singapore

An Exotic Invasive Liana, *Wisteria* in Korea

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Abstract. *Wisteria floribunda* is a tendril which is distributed on Korea and Japan. This species has been widely used as a horticultural species making shade in garden, school, park and so on in Korea. *Wisteria floribunda* is introduced to Korea and naturalized. But, this species aggressively invade into forests or forest edge because of adaptability to both shade and sunlight, gorgeous sprouting from underground stems, going upward characteristics of the tendril with avoiding improper environment. I measured the ecological status of *Wisteria floribunda* for. *floribunda* which invaded forest ecosystem, Sutaribong near Gangnae Myeon, CheongwonGun, Chung Cheong Province. I checked and compared aboveground biomass, individual number and seed number of *Wisteria floribunda* for *floribunda* and species number of other species per unit area in highly, intermediately and lowly invaded areas. And physical and chemical contents of the soils invaded by *Wisteria floribunda* were analyzed. My future study plan includes the investigation of its invasion mechanism and management of this species. On the other hand, this species has been used as restoring species for artificial cut-slopes on highway and car roads. I need to monitor this species used for preventing soil erosion to block side-effect such as biological diversity loss and degraded forests, following its invasion into nearby forests.

Keywords: *Wisteria*, Exotic, Invasive, Liana, Vine, Korea

1. Introduction

Exotic species is defined as all species which are invaded from foreign countries or other habitats of domestic areas(Goh et al 1995). It is reported that these exotic species are transported into other habitats deliberately or indeliberately and destruct ecosystem balances in new habitats. The negative influences from competition with native species are very popular to us. Specially, the exotic species have great impacts on entry into the level of endangered states of native species. The treatment costs to manage exotic invasives in USA have reached to 125 billion per year and loss of crops by introduced species amount to 23.4 billion every year(Pimentel et al. 2000). The exotic species become pest species from introduction through 5 procedures. The 5 procedures have the selection of original habitat, movement into new habitats, dispersal and survival in new habitats, establishment in new habitats and naturalization. Ecological filters function at every 5 procedure to be selected. The studies of Korea and foreign countries have been limited to recording the appearance in new habitats of the 5 procedures. It is necessary to do autecological study at each procedure for managing ecological management of exotic species. Specially, no mechanism study has been done for exotic invasive plants. This condition is similar to that of foreign countries such as USA Northwest. Thus, scientific exotic plant management based on invasion model of exotic invasive plants generated from ecological study is urgently needed. Vines is specific plants which grow as dendrils from soils, wind up other plants and cover up ecological niche not taken. Two types of plants can live in shade of forests if sunlignt available. Lianas, the first type, have roots in the soils but their stem creeps to go up the crown layer. Epiphyte, the second type, is attached to the stem of other plants. Lianas grow up over other plant and supports and have the specific locations. So, they have special ecological niche and have a little species number. In this biodiversity perspective, lianas should be protected. The lianas in Korea are 30 family, 62

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genus, 106 species and 12 variatas(Lee 2006). The lianas as exotic invasives are Black Blindweed (*Polygonum convolvulus*), Copse Buckwheat(*Polygonum dumetorum)*, Small Blindweed (*Convolvulus arvensis)*, Ivy-leaved Morning-glory(*Ipomoea hederacea)*, Small-flowered White Morning-glory(*Ipomoea lacunosa)*, Morning-glory(*Ipomoea purpurea)*, Morning-glory, smallflower(*Jacquemontia taminifolia)*, Threelobe Morning-glory(*Ipomoea triloba)*, Small Red Morning-glory(*Quamoclit coccinea),* Bur-Cucumber(*Sicyos angulatus)*, Japanese Wisteria(*Wisteria floribunda)*, and Woolly-pod Vetch(*Vicia dasycarpa)* with 4 family 7 genera 12 species(Park 1995; Park 2001). Of these, Japanese Wisteria as perennial vine are distributed in China and Japan. Japanese Wisteria as well as Mile-a-minute (*Persicaria perfoliata*) have been introduced into East USA. Japanese Wisteria in Korea is distributed in forest interior and edge whereas that in USA is reported to be widespread in disturbed area(Martin 2002). If forest ecosystem is destructed and sensitive, vines have a higher possibility to invade into that ecosystem. The climate change has degraded ecosystems in other forms and becomes one of causes to be invaded by vine plants. Kenoyer(1929), a plant physiologist, compared and analysed the flora of Kalamazoo, Michigan, USA in temperate region and Barrow Colorado Island, Panama in tropical region. His study showed that lianas such as western ivy and grapes covered 1% in Kalamazoo but 10-15% in Barrow Colorado. We anticipated the widespread distribution of lianas as warming proceeds. Table 1 represented the 7 hypotheses which describe exotic species invasion including exotic invasive vines.

Table 1: The main hypotheses related with the success of exotic plants in sink community

Hypotheses	Definitions
(1) Natural enemies	Exotic species are free from the enemies controlling their population growth.
(2) Evolution of invasiveness	Exotic species experience fast genetic changes related with new selection pressure in new environment.
(3) Empty niche	Exotic species consume resources unused on site.
(4) Novel weapons	Exotic species take new method of biochemical interaction with recipient community.
(5) Disturbance	Exotic species are adapted with different degrees than original habitat in terms of disturbance type.
(6) Species richness	Species rich community is more resistant to invasion than species poor community.
(7) Propagule pressure	Variations depend on the number differences of exotics which invade into community.

2. Study of Status of Korea and Other Countries

2.1. Study of Status in Korea

The domestic study on the vine plants is deficient. Shim et al(1985) investigated into photosynthesis and respiration characteristics at different light intensity and temperature to decipher cultivation use and growth environment adaptable to five *Lonicera* species in western countries including native vines such as *Actinidia arguta, Celastrus orbiculatus,* and *Lonicera japonica*. Jeong et al(2000) suggested revegetation model on 10 species vines useful for plant materials of expressway soundproofing walls. The Jeong et al's study demonstrated that *Paederia scandens, Celastrus orbiculatus, Lonicera japonica, Wisteria japonica, Parthenocissus tricuspidata,* and *Parthenocissus quinquefolia* grow well and could be revegetated in 3 years completely. Park et al(2004) studied the growth environment of vines which dominated at little tree layer because of declined *Pinus thunbergii* forests. The study of Park et al(2004) concluded that vines of tropical

origin dominated at light condition produced from degraded tree layer affected by close chemical factories. Park(2006) tested endurance and growth characteristics by changes of soil moisture content for *Wisteria japonica* used for revegetation at rocky slopes. Moon et al(2007) showed that seeds of Bur-Cucumber (*Sicyos angulatus*) at first year have higher dormancy and increased growth after June from experiments of changes and early growth. And Moon et al(2008) reported that dominance of other plants at Bur-Cucumber communty and Bur-Cucumber appears at riparian zone. Lee et al(2007) showed herbicide can be used to control Bur-Cucumber at cultivated and noncultivated areas. In conclusion, the domestic study on vines is scarce from autecological study to functional study including native and exotic species.

2.2. Study of Status in Other Countries

Vines has been unnoticed at temperate region in terms of study. According to Ladwig and Meiners(2009), it is reported that vines appeared a little at trees of host of temperate forests, USA but *Celastrus orbiculatus* showed the increasing trend and threatened forest growth. Herbivory by herbivores has been used to control invasive vines as eco-friendly options. Raghu et al(2006) demonstrated that herbivores, specialist predating over 50% of leaf tissues, are effective in eradication of *Macfadyena unguiscati*, invasive vine.

3. Results and Discussion

3.1. Field Study Results of an Exotic Invasive Vine, *Wisteria*

Wisteria floribunda is a native vine and presumed to be introduced into Korea. This *Wisteria* has been used for shade plants in garden, school and park, Korea. But, it is difficult to estimate introduction time historically. It is estimated that *Wisteria* is naturalized after introduction. Presently, *Wisteria* is recorded in forest ecosystems to the south of Chungbuk. *Wisteria* invades into forest and forest edge and established because this species has wide tolerance range to light (sunny and shady places), vigorous vegetative growth by rhizome and growth to evade unsuitable environments. I surveyed the ecological status at forested areas where Wisteria invades. Light intensity above and below *Wisteria* and soil moisture contents within invaded and un-invaded areas were compared. The quadrats were established with 10×10 m in invaded forest ecosystem and the cover of Wisteria and species number were counted and litter depth was recorded. The result of this pilot study is as follows.

Table 2: Photosynthetic photon flux density ($\mu molm^{-2}s^{-1}$) above and below *Wisteria* canopy

	Above *Wisteria* canopy	Below *Wisteria* canopy
Photosynthetic photon flux density ($\mu molm^{-2}s^{-1}$) (%±SE, n=30)	95.5±21.3	18.0±2.7

Table 3: Soil condition between sites dominated by *Wisteria* and control sites

	Site invaded by *Wisteria*	Control site
Soil moisture content (%±SD, n=10)	42.4±3.4	38.9±1.5

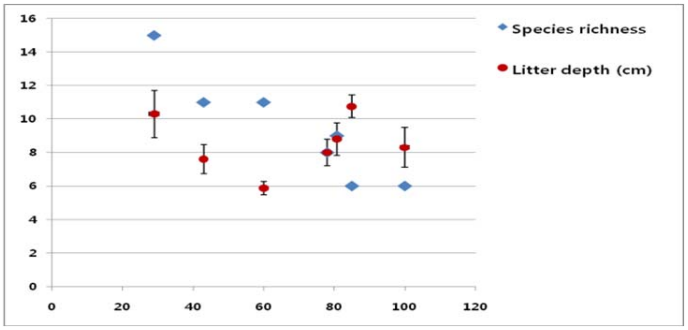

Fig. 1: Relationship between *Wisteria* cover (%), species richness and litter depth (cm).

Forests invaded by *Wisteria*

Quercus acutissima twisted to death by *Wisteria*

Photo 1: Impacts on forest ecosystem by exotic invasive vine plant, *Wisteria*

3.2. Implications of *Wisteria* Management

Wisteria floribunda is a tendril which is distributed on Korea and Japan. This species has been widely used as a horticultural species making shade in garden, school, park and so on in Korea. *Wisteria floribunda* is introduced to Korea and naturalized. But, this species aggressively invade into forests or forest edge because of adaptability to both shade and sunlight, gorgeous sprouting from underground stems, going upward characteristics of the tendril with avoiding improper environment. I measured the ecological status of *Wisteria floribunda* for. *floribunda* which invaded forest ecosystem, Sutaribong near Gangnae Myeon, CheongwonGun, Chung Cheong Province. I checked and compared aboveground biomass, individual number and seed number of *Wisteria floribunda* for *floribunda* and species number of other species per unit area in highly, intermediately and lowly invaded areas. And physical and chemical contents of the soils invaded by *Wisteria floribunda* were analyzed. My future study plan includes the investigation of its invasion mechanism and management of this species. On the other hand, this species has been used as restoring species for artificial cut-slopes on highway and car roads. I need to monitor this species used for preventing soil erosion to block side-effect such as biological diversity loss and degraded forests, following its invasion into nearby forests.

4. Acknowledgements

I would appreciate field works of graduate and undergraduate students.

5. References

[1] B.C. Moon, S.M. Oh, I.Y. Lee, C.S. Kim, J.R. Cho, S.C. Kim. Change of weed species in Bur cucumber(*Sicyos angulatus* L.) community and domestic distribution aspect. *Kor. J. Weed Sci.* 2008, **28**(2):117-125.

[2] B.C. Moon, T.S. Park, J.R. Cho, S.M. Oh, I.Y. Lee, C.K. Kang, Y.I. Kuk. 2007. Characteristics on emergence and early growth of Bur cucumber(*Sicyos angulatus*). *Kor. J. Weed Sci.* 2007, **27**(1):36-40.

[3] C.-M. Park. Effects of water conditions and *Rhizobium* inoculation on the growth of *Wisteria floribunda* seedling in slope soils. *Kor. J. Env. Eco.* 2006, **20**(4):425-435.

[4] E. Park, J. Kim, J. Lee, H. Cho, J. Min. Vegetation of liana dominating in the vicinity of Onsan industrial complex. *Korean J. Ecol*. 2004, **27**(6):335-345.

[5] I.Y. Lee, S.M. Oh, B.C. Moon, C.S. Kim, J.S. So, J.E. Park, N.I. Park, J.B. Oh, O. Kwon, Y.K. Lee. Weeding effect of troublesome exotic weeds, *Sicyos angulatus* and *Amaranthus spinosus*, by several herbicides. *Kor. J. Weed Sci.* 2007, **27**(3):195-201.

[6] K. Go, M. Suh, J. Kim, K.D. Kim, G. Gil. *Survey for Ecological Impact by Naturalized Organisms (Ⅰ). Report No. 95-02-446*. NIER, 1995.

[7] L.A. Kenoyer. General and successional ecology of the lower tropical rain-forest at Barro Colorado Island, Panama. *Ecol.* 1929. 10:201-222.

[8] L.M. Ladwig, S.J. Meiners. Impacts of temperate lianas on tree growth in young deciduous forests. *For. Ecol. Manage.* 2009. 259:195-200.

[9] D. Pimentel, L. Lash, R. Zuniga, D. Morrison. Environmental and economic costs of nonindigenous species in the United States. *BioScience*. 2000. 50:53-65.

[10] S. Asano. *Seeds/Fruits and Seedlings of Plants in Japan*. Shinshichi Hirota, 2005.

[11] S.H. Park. *Colored Illustrations of Naturalized Plants of Korea*. Ilchokak, 1995.

[12] S.H. Park. *Colored Illustrations of Naturalized Plants of Korea Appendix*. Ilchokak, 2001.

[13] K.K. Shim, Y.H. Ahn, M.S. Yoo. Studies on photosynthesis of perennial vines (*Actinidia arguta*, *Celastrus orbiculatus*, *Lonicera japonica*, *Lonicera japonica* var. *aureoreticulata*, *Lonicera sempervirens*). *J. Kor. Soc. Hort. Sci.* 1985, **26**(1):44-50.

[14] S. Raghu, K. Dhileepan, M. Trevino. Response of an invasive liana to simulated herbivory: implications for its biological control. *Acta Oecol*. 2006. 29:335-345.

[15] T.B Lee. *Colored Flora of Korea*. Hyangmunsa, 2006.

[16] T.G. Jeong, J.C. Park, J.H. So, K.O. Choi. Simulation model development of vines by computer for green covering of the traffic noise barrier. - Centered on vines for green covering of highway traffic noise barrier - *J. Korean Env. Res & Reveg. Tech.* 2000, **3** (3): 37-44.

[17] T. Martin. Weed Notes *Wisteria sinensis* (Chinese wisteria) *Wisteria floribunda* (Japanese wisteria). The Nature Conservancy, 2002.