

Two Unrecorded Alien Plants of Genus *Melilotus* in Korea: *M. officinalis* and *M. indicus* (Leguminosae)

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Abstract - Two unrecorded alien plants, *Melilotus officinalis* (L.) Lam. and *M. indicus* (L.) All. (Leguminosae) were found in Korea. *M. officinalis* is native to Eurasia and widely distributed in agricultural regions throughout the world. *M. indicus* is native to Mediterranean and Southwestern Europe, and naturalized in temperate regions all over the world. These species are morphologically similar to *M. suaveolens* (Jeon-dong-ssa-ri). However, *M. officinalis* is distinguished from *M. suaveolens* by transverse nerved legumes, definite ovary stalks, and five to eight number of ovules in ovary. *M. indicus* is also distinguished from *M. suaveolens* by smaller size of flowers, broadly triangular calyx teeth, globose legumes, and minutely papillose seeds. The local name of *M. officinalis* and *M. indicus* were given as “Ju-reum-jeon-dong-ssa-ri” and “Jom-jeon-dong-ssa-ri” based on transverse nerved legumes and overall smaller size than *M. suaveolens*, respectively. The descriptions on morphological characters and photographs at the habitat of *M. officinalis* and *M. indicus* are provided.

Key words – Alien plant, Leguminosae, *Melilotus indicus*, *Melilotus officinalis*, *Melilotus suaveolens*

Introduction

The genus *Melilotus* (L.) Mill. (Leguminosae) is comprised about 20 species in temperate and subtropical regions of Eurasia, and North Africa (Isely, 1954; Kita, 1965; Choi, 2007). Several species of the genus *Melilotus* are widely cultivated for soil improvement and naturalized throughout the world (Kita, 1965; Di *et al.*, 2015). In Korea, two taxa of *Melilotus* have been reported: *M. albus* Medik. (Huin-jeon-dong-ssa-ri) and *M. suaveolens* Ledeb. (Jeon-dong-ssa-ri) (Lee, 2006; Choi, 2007; Park, 2009; Kim *et al.*, 2017). Both taxa are native to Eurasia and have been introduced to Korea as naturalized plants (Jung *et al.*, 2017).

Recently, *M. officinalis* (L.) Lam. and *M. indicus* (L.) All. were observed in Jeju island, Korea. They are native to Eurasia and Mediterranean-Southwestern Europe, respectively.

The local name of *M. officinalis* and *M. indicus* were given as “Ju-reum-jeon-dong-ssa-ri” and “Jom-jeon-dong-ssa-ri” based on transverse nerved legumes and its overall smaller size than *M. suaveolens*, respectively.

Materials and Methods

In this study, we reported two unrecorded alien plants, *M. officinalis* and *M. indicus* which observed in Jeju island as naturalized plants in Korea. The descriptions on morphological characters, photographs at the habitat, and a key to allied taxa in Korea of *M. officinalis* and *M. indicus* were provided (Fig. 1-3). The morphological comparison among *M. albus*, *M. suaveolens*, *M. officinalis*, and *M. indicus* was also provided (Table 1). The examined specimens were listed in Appendix 1.

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Results and Discussion

Taxonomic treatment

Melilotus officinalis (L.) Lam., Fl. Franc. 2: 594, 1779

Trifolium officinale L., Sp. Pl. 2: 765. 1753 [*T. "M. officinalis"*]

Plants biennial herbs, 40-100(-150) cm tall, slightly pubescent to glabrescent. Stems erect, branched. Stipules

linear-filiform, 8-12 mm long, entire or with 1 tooth at base. Leaves alternate, pinnately 3-foliolate, leaflet broadly oval to oblong-lanceolate, 15-25 mm long, glabrous adaxial, sparsely pubescent abaxial, lateral veins 10-13 pairs, running into teeth. Racemes axillary, 4-15(-20) cm long, elongate after anthesis, 30-80 flowers; bracts filiform, 1.5-2 mm long; pedicels equal to bracts. Flowers yellow, 4-7 mm long; standard larger



Fig. 1. Photographs of *Melilotus officinalis* (L.) Lam. A. Habitat; B. Raceme; C. Flowers; D. Ovary; E. Stipule; F. Leaves; G. Legumes; H. Seeds; I. Voucher specimen.

than wings and keel; calyx 2-3 mm long, teeth lanceolate; ovary narrowly ovate, definite stalk; ovules (4-)5-8. stamens 10(9 filaments fused, 1 free); pistil 1. Legumes yellowish brown at maturity, indehiscent, ovoid-elliptic, apex acute, style persist, 3-4 mm long, glabrous, transverse nerved surface. Seeds 1-2, yellowish-brown, elliptic to ovate, about 2.5 mm long, smooth. Flowering May to Sep. Chromosome numbers

$2n = 16$ (Ferrarella *et al.*, 1981; Schlarbaum *et al.*, 1984).

Korean name: Ju-reum-jeon-dong-ssa-ri (주름전동싸리)

Distribution: Native to Eurasia; Introduced to North America and widely distributed in agricultural regions throughout the world (Isely, 1954); Habitat grasslands, hillsides, ravine shores, margins of mixed woodlands (Vincent and Wei, 2010); KOREA: Gangwon-do, Gyeonggi-

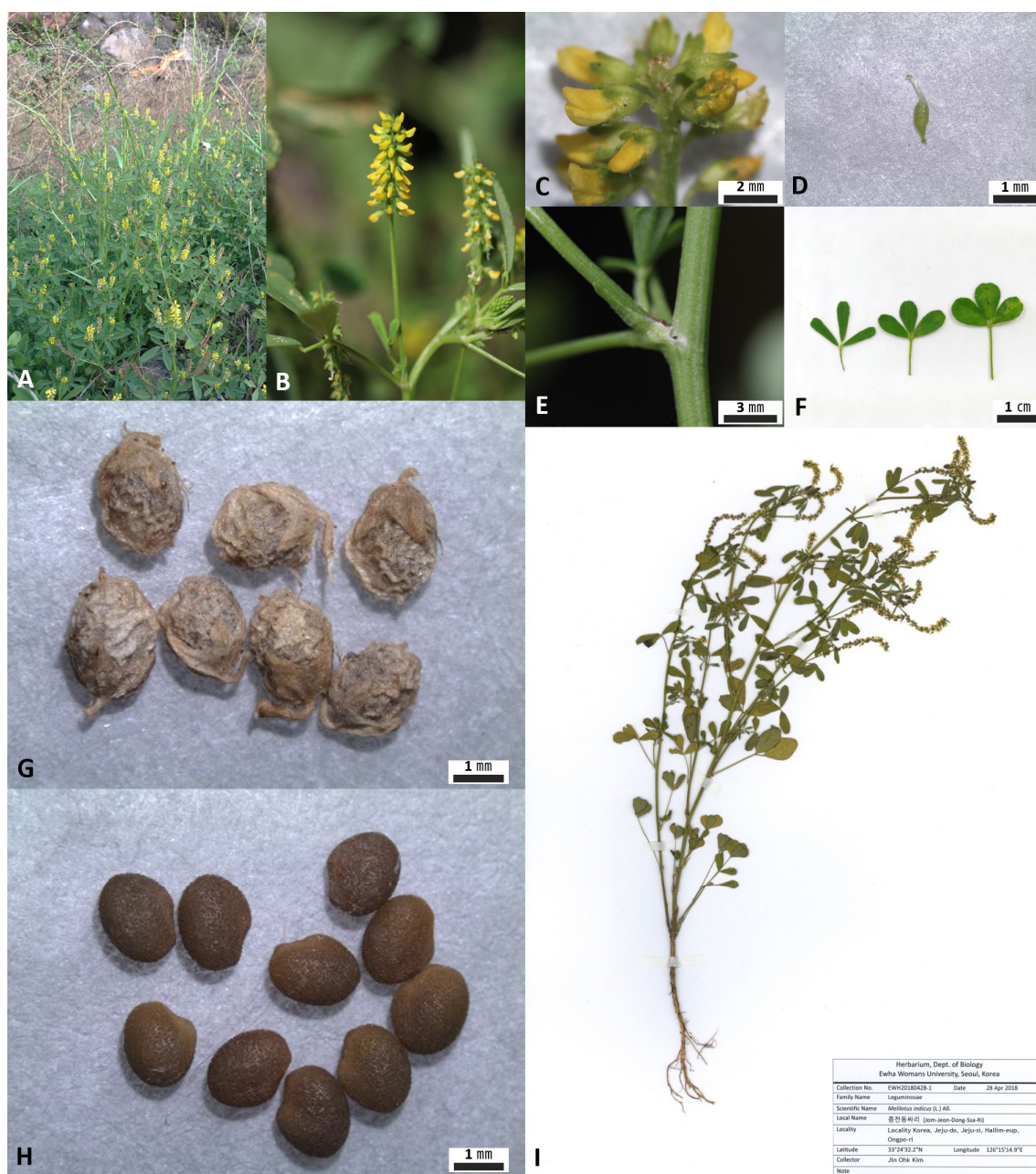


Fig. 2. Photographs of *Melilotus indicus* (L.) All. A. Habitat; B. Raceme; C. Flowers; D. Ovary; E. Stipule; F. Leaves; G. Legumes; H. Seeds; I. Voucher specimen.

do, Gyeongsangbuk-do, Jeju-do, and Seoul based on localities of the examined specimens (Appendix 1); Observed in open places and roadsides of coastlines with *Raphanus sativus* var. *hortensis* f. *raphanistroides*, *Vitis ficifolia* var. *sinuata*, *Rumex crispus*, *Vitex rotundifolia*, *Chenopodium album* var. *centrorubrum*, *Sagina japonica* in Jocheon-up, Jeju-si, Jeju-do, Korea.

Voucher specimens: Korea. Jeju-do, Jeju-si, Jocheon-eup, Jocheon-ri, 24 May 2017, EWH20170524 (Fig. 1, 11 sheets).

Notes: Since *M. officinalis* is similar in morphology to *M. suaveolens*, it has been mistaken for *M. suaveolens*. As a result of examining the specimens of the National Korea Arboretum, Ewha Womans University, and Ewha Womans University Natural History Museum (Appendix 1), *M. officinalis*



Fig. 3. Photographs of (1) *Melilotus albus* Medik. and (2) *M. suaveolens* Ledeb. A. Raceme; B. Flowers; C. Ovary; D. Legumes; E. Seeds.

was misidentified as *M. suaveolens*. In fact, it is difficult to distinguish between *M. officinalis* and *M. suaveolens*. Because they are very closely related and had been separated by trivial characters (Ohashi *et al.*, 1984). Therefore Vincent and Wei (2010) and Ohashi *et al.* (1984) treated *M. suaveolens* as synonym of *M. officinalis* and *M. officinalis* for. *suaveolens*, respectively. However, *M. officinalis* has transverse nerved legumes (Fig. 1. G) and ovary with 5 or 6(-8) ovules (Table 1) while *M. suaveolens* has reticulate nerved legumes (Fig. 3. 2-D) and ovary with 2-4 ovules (Schulz, 1901; Polozhij and Malyshev, 2006). Komarov (1945) also classified them as separate species based on the number of ovules in ovary; *M. officinalis* and *M. suaveolens* have 4-8 and 2-3(-4) ovules in ovary, respectively. In addition, *M. officinalis* has definite ovary stalks (Fig. 1. D) while *M. suaveolens* has sessile one (Fig. 3. 2-C) (Isely, 1954; Stevenson, 1969). Therefore, *M. officinalis* is distinguished from *M. suaveolens* by transverse nerved of legume surface, definite ovary stalks, and 5-8 numbers of ovules in ovary. In the recent study of Zhang *et al.*

(2018), *M. officinalis* and *M. suaveolens* were also treated as each separate species based on 5 DNA sequences. The introduction time of *M. officinalis* is uncertain, but according to the examined specimens, *M. officinalis* has been naturalized in South Korea at least since 2003.

***Melilotus indicus* (L.) All.**, Fl. Pedem. 1: 308, 1785.

Trifolium indicum L., Sp. 2: 765. 1753 [*T. "M. indica"*]

Plants annual, slightly pubescent to glabrescent. Stems erect or ascending, 20-50 cm tall, branched base. Stipules lanceolate, dilated at base, 4-6 mm long, base auriculate, with 1-2 tiny teeth, margin membranous. Leaves alternate, pinnately 3-foliolate, leaflet obovate-cuneate to narrowly oblong, 1-2 cm long, glabrous adaxial, sparsely pubescent abaxial, lateral veins 7-9 pairs, running into teeth, margins serrate toward apex, apex obtuse or truncate, sometimes retuse, base cuneate. Racemes axillary, slender, dense, 1-5 cm long, elongate after anthesis, 10-40 (-50) flowers; bracts filiform; pedicels 0.5-1 mm long. Flowers yellow, 2-3 mm long; standard ovate, retuse,

Table 1. The morphological comparison among *Melilotus albus*, *M. suaveolens*, *M. officinalis*, and *M. indicus*

Characters	Taxa			
	<i>M. albus</i> (흰전동싸리)	<i>M. suaveolens</i> (전동싸리)	<i>M. officinalis</i> (주름전동싸리)	<i>M. indicus</i> (좁전동싸리)
Height	50-150(-200) cm	40-80 cm	40-100(-150) cm	20-50 cm
Stipule shape	filiform-subulate	linear-filiform	linear-filiform	lanceolate, dilated at base
Leaflet shape	oval to oblong-lanceolate	obovate to oblong-lanceolate	broadly oval to oblong-lanceolate	ovate-cuneate to narrowly oblong
Raceme length	8-15(-20) cm	4-10 cm	4-15(-20) cm	1-5 cm
Number of flowers	40-80(-105)	30-40	30-80	10-40(-50)
Pedicel length	1.5-2 mm	1-1.5 mm	1.5-2 mm	0.5-1 mm
Flower color	white	yellow	yellow	yellow
Flower length	4-6 mm	3.5-4.5 mm	4-7 mm	2-3 mm
Petal length	standard>wing=keel	Standard=wing=keel	standard>wing>keel	standard=wing=keel
Calyx length	2-2.5 mm	1-1.5 mm	2-3 mm	1-1.3 mm
Calyx teeth shape	lanceolate	triangular lanceolate	lanceolate	broadly triangular
Ovary stalk	sessile	sessile	definite stalk	subsessile
Number of ovules	3-4	2-3(-4)	(4-)5-8	2
Legume shape	obliquely ovate	ovoid-elliptic	ovoid-elliptic	ovoid-globose
Legume apex	acute	acute	acute	rather acute
Legume surface	reticulate nerved	reticulate nerved	transverse nerved	reticulate nerved
Legume length	3-4 mm	3-4 mm	3-4 mm	2 mm
Seed surface	smooth	smooth	smooth	minutely papillose
Flowering period	Jun. to Sep.	May to Sep.	May to Sep.	Mar. to May

equal to wings and keel; calyx teeth broadly triangular, 1-1.3 mm long; ovary narrowly ovate, subsessile; ovules 2; diadelphous stamens 10(9 filaments fused, 1 free); pistil 1. Legumes light brown at maturity, indehiscent, ovoid to globose, about 2 mm long, glabrous, reticulate nerved surface. Seeds 1-2, yellowish-brown, elliptic to ovate, minutely papillose, about 1.5 mm long. Flowering March to May. Chromosome numbers $2n = 16$ (Ferrarella *et al.*, 1981; Schlarbaum *et al.*, 1984).

Korean name: Jom-jeon-dong-ssa-ri (좁전동싸리)

Distribution: Native to Mediterranean and Southwestern Europe (Shimizu, 2003); Naturalized in temperate regions all over the world (Shimizu, 2003); Habitat open places, roadsides, coastlines, meadows, wastelands (Schulz, 1901; Vincent and Wei, 2010). KOREA: Jeju-do and Seoul based on localities of the examined specimens (Appendix 1); Observed in open places and roadsides of coastlines with *Vitis ficifolia* var. *sinuata*, *Rumex crispus*, *Vitex rotundifolia*, *Chenopodium album* var. *centrorubrum*, *Sagina japonica*, *Setaria vridis*, *Eremochloa ophiuroides*, *Artemisia capillaris* in Hallim-eup, Jeju-si, Jeju-do, Korea.

Voucher specimens: Korea, Jeju-do, Jeju-si, Hallim-eup, Ongpo-ri, 28 Apr. 2018, EWH20180428 (Fig. 2, 6 sheets).

Notes: As in the case of *M. officinalis*, *M. indicus* also has been mistaken for *M. suaveolens*. However, it is distinguished from *M. suaveolens* (Fig. 3) by smaller size of flowers, broadly triangular calyx teeth, globose legumes, and minutely papillose seeds (Fig. 2). In addition, the flowering period of *M. indicus* is March to May, while that of *M. suaveolens* is May to September (Table 1). The introduction time of *M. indicus* is uncertain, but according to the examined specimens, *M. indicus* has been naturalized in South Korea at least since 1957.

Key to taxa of genus *Melilotus* in Korea.

1. Flower 2-3 mm long; calyx teeth broadly triangular; seeds papillose *M. indicus* 좁전동싸리
1. Flower longer than 3.5 mm; calyx teeth lanceolate; seeds smooth.
 2. Flower white *M. albus* 흰전동싸리
 2. Flower yellow.
 3. Flowers 4-7 mm long; ovule number 5-8; legume surface transverse nerved

- *M. officinalis* 주름전동싸리
3. Flowers 3.5-4.5 mm long; ovule number 2-4; legume surface reticulate nerved
- *M. suaveolens* 전동싸리

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Appendix 1. A list of specimens examined in this study.

***Melilotus albus* Medik. (흰전동싸리)**

KOREA. Gangwon-do: Gangneung-si, Okgye-myeon, Mt. Seokbyeong-san, 04 Jun. 2006 (KHB1127636); Samcheok-si, 21 Jun. 2017 (EWH20170621-1~EWH20170621-4)

***M. indicus* (L.) All. (좁전동싸리)**

KOREA. Jeju-do: 10 Jun. 1983 (ENHA200508012094); 11 Sep. 2001 (KHB1106828); Jeju-si, Gujwa-eup, Gimnyeong-ri, Gimnyeong Coast, 12 May 2012 (KHB1363133); Jeju-si, Hallim-eup, Geumneung-ri, Jeongwoloreum, 13 May 2009 (KHB1310831, KHB1310839); Jeju-si, Hallim-eup, Ongpo-ri, 05 Jul. 2017 (EWH20170705-1~EWH20170705-4); Jeju-si, Hallim-eup, Ongpo-ri, 28 Apr. 2018 (EWH20180427-1~EWH20180427-6); Jeju-si, Hangeong-myeon, Dumo-ri, 20 Jun. 2014 (KHB1469065). Seoul: Seodaemun-gu, Daehyeon-dong, Ewha Womans University, 18 May 1957 (EWUA200009061024); Seodaemun-gu, Daehyeon-dong, Ewha Womans University, 12 Jun. 1957 (EWUA200009061025, EWUA200009061026); Seodaemun-gu, Daehyeon-dong, Ewha Womans University, 15 Jun. 1957 (EWUA200009061029); Seodaemun-gu, Yeonhui-dong, 15 Jun. 1957 (EWUA200009061028)

***M. officinalis* (L.) Lam. (주름전동싸리)**

KOREA. Gangwon-do: Pyeongchang-gun, Bongpyeong-myeon, Mt. Cheongtae-san, 29 Jun. 2008 (KHB1322848); Yangyang-gun, Hyeonnam-myeon, Sangwoncheon-ri, Mt. Manwol-san, 24 Jun. 2008 (KHB1499187). Gyeonggi-do: Ansan-si, Danwon-gu, Isl. Seongam-do, 22 Jun. 2011 (KHB1338105); Paju-si, Gyoha-eup, Sannam-ri, Sannam Wetland, 14 Jun. 2011 (KHB1323924); Yeosu-si, 04 Jun. 2017 (EWH20170604-1~EWH20170604-5). Gyeongsangbuk-do, Ulleung-gun, Seo-myeon, Namseo-ri, 25 Jun. 2009 (KHB1332454). Jeju-do: Jeju-si, Jocheon-eup, Jocheon-ri, 24 May 2017 (EWH20170524-1~EWH20170524-11). Seoul: Mapo-gu, Sangam-dong, Worldcup Park, Haneul Park, 19 May. 2004 (KHB1074375); Mapo-gu, Sangam-dong, Worldcup Park, Haneul Park, 07 May 2005 (KHB1088824); Mapo-gu, Sangam-dong, Worldcup Park, Haneul Park, 30 May 2009 (KHB1236737); Mapo-gu, Sangam-dong, Worldcup Park, Haneul Park, 02 Jun. 2010 (KHB1297505); Mapo-gu, Sangam-dong, Worldcup Park, Top of the Noneul Park, 23 May 2003 (KHB1082779); Mapo-gu, Sangam-dong, Worldcup Park, Noneul Park, 06 Jun. 2008 (KHB1214876)

***M. suaveolens* Ledeb. (전동싸리)**

KOREA. Busan: Saha-gu, Hadan-dong, Isl. Eulsuk-do, 22 Aug. 2008 (KHB1214721). Chungcheongbuk-do: Jecheon-si, Deoksan-myeon, Mt. Worak-san, 05 Aug. 2005 (KHB1539983); Danyang-gun, Yeongchun-myeon, Mt. Sobaek-san, 03 Jul. 2005 (KHB1539922). Chungcheongnam-do: Boryeong-si, Jusan-myeon, Jeungsan-ri, 21 Jun. 2013 (KHB1427818); Seocheon-gun, Biin-myeon, 20 Jul. 1971 (EWUA200009061030~EWUA200009061033); Taean-gun, Wonbuk-myeon, Banggal-ri, 07 Sep. 2005 (KHB1093166). Daegu: Suseong-gu, Pa-dong, 27 May 2011 (KHB1324840). Gangwon-do: Gangneung-si, Okgye-myeon, Mt. Seokbyeong-san, 09 Sep. 2006 (KHB1136369, KHB1136370); Goseong-gun, Hyeongne-myeon, Sacheon-ri, 03 Jul. 2008 (KHB1542357); Hoengseong-gun, Anheung-myeon, Jigu-ri, Mt. Obong-san, 17 Jun. 2008 (KHB1322296); Hwacheon-gun, Mt. Il-san, 16 Oct. 2008 (KHB1311651); Jeongseon-gun, Gohan-eup, Geumdaebong 24 Jul. 2008 (KHB1499197, KHB1499198); Jeongseon-gun, Sabuk-eup, Mt. Nomok, 23 Jul. 2008 (KHB1499195); Jeongseon-gun, Yeoryang-myeon, Mt. Ballon-san, 27 Jul. 2010 (KHB1307267, KHB1308923); Jeongseon-gun, Yimgye-myeon, Goyang-ri, Mt. Munrae-san, 05 May 1977 (EWUA200009061037~EWUA200009061045); Pyeongchang-gun, Mitam-myeon, Mt. Cheongok, 04 Sep 2008 (KHB1323117); Samcheok-si, Gagok-myeon, Punggok-ri, Mt. Eungbong-san, 17 Jul. 2008 (KHB1320606); Taebaek-si, Mt. Hambaek, 29 Aug. 2008 (KHB1499194); Taebaek-si, Mt. Taebaek, 30 Jul. 2002 (KHB1060180); Yeongwol-gun, Jungdong-myeon,

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