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Damage Report on a Newly Recorded Coleopteran Pest, *Aphanisticus congener* (Coleoptera: Buprestidae) from Turfgrass in Korea

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ABSTRACT. *Aphanisticus congener* is a newly recorded buprestid (Coleoptera) insect pest of turfgrass in Korea. This buprestid pest was initially found from turfgrass conservation site in a greenhouse in Jinju, Gyeongnam province, Korea in July, 2014. The *Aphanisticus* in the family Buprestidae is a leaf miner. *A. congener* is the close species of *A. aeneus* which was firstly reported as sugarcane leaf sucker in India. *A. congener* was active from early July to late August in the greenhouse. Damage by the insect led to drying out and browning of turfgrass leaf because larva fed on cell sap of leaves and adult fed on leaf surface. *A. congener* damaged *Zoysia japonica*, *Z. sinica*, *Conodon dactylon,* and *Poa pratensis* when adults were artificially released into potted turfgrasses in the laboratory. In green house, *A. congener* damaged *Z. japonica*, *Z. macrostachya, Z. matrella, Z. sinica*, *Conodon dactylon,* and hybrid zoysiagrass. However, no damage symptoms were observed from the same turfgrass accessions in the nearby field of the greenhouse. Thus, the new coleopteran pest may be a warm-adapted pest for turfgrass, damaging turfgrass leaf only in warmer conditions.

Key words: Aphanisticus, Buprestid, Turfgrass insect, Zoysiagrass

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Humans have used turfgrass to enhance their environment for more than 1000 years (Beard and Green, 1994). Turfgrass provide substantial environmental, recreational, and aesthetic benefits (Potter, 1998). Potter (1998) enumerated the following benefits provided by lush and healthy turf; 1) capturing and cleaning of runoff water from urban areas, 2) providing soil improvement and restoration, 3) moderating temperature and improving air quality, 4) reducing noise and glare, 5) reducing pests, pollen, and human disease exposure, 6) properly designing urban green areas such as golf courses, parks, and backyards create good wildlife habitat, and 7) improving the physical and mental health of the urban population.

Thus, turfgrass have been grown in a large area and become one of the important agricultural businesses in many countries. In the United State of America, turfgrass industry generated revenue yields exceeding $62 billion in 2005 while sustaining about 825,000 jobs (Haydu et al., 2005). The size of Korean turfgrass business is 1/30-1/40 of USA (Lee et al., 2001). The golf courses are the biggest market and followed by road side, cemetery and playground in turn in Korea (Lee et al., 2001). Farmers producing sods and area of sod cultivation have increased from 2001 and total size of sod cultivation was 3,056 ha in Korea in 2011 (Choi and Yang, 2006; Korea Forest Service, 2012; Bae et al., 2013).

Although turfgrass are important cash crops, several kinds of pests including insect pests are obstacles to maintain and run turf fields. Main insect pests are coleopteran and lepidopteran insects in turfgrass (Brandenburg and Freeman, 2012; Hatsukade, 1995; Potter, 1998; Watschke et al., 2013). In Korea, thirteen species in 8 families of 6 orders and 28 species in 10 families of 6 orders were listed as turfgrass insect pests in sod cultivation areas and golf courses, respectively (Choo et al., 2000; Lee et al., 2014).

Species and density of turfgrass insect pests were different depending on locality and season and sometimes some insect pests have been newly described from turfgrasses (Choo et al., 2000; Kim et al., 2011; Billeisen and Brandenburg, 2014).

In the course of surveying on insect pests from turfgrasses, coleopteran leaf feeding pest was found. The larva bores inside of leaf and adult feeds on outer surface of leaf. Because leaf miners have not been recorded from turfgrasses, this unique insect is firstly recorded leaf miner pest from turfgrass. The insect pest was identified as *Aphanisticus congener* included family Buprestidae in Coleoptera (Choi et al., 2016). Thus, some information including damage status on newly recorded leaf miner pest collected from field and pot tests is presented for the further study on this new important insect pest.

Insect pests were investigated from potted turfgrasses in greenhouse located in Southern Forest Resource Research Center, Korea Forest Research Institute, Jinju, Gyeongnam province, Korea from March 2014. In this greenhouse, 338 genetic conservation turfgrasses which were collected from various sites in Korea from 2010 have been transplanted and maintained in pots (Fig. 1A). In addition, turfgrasses collected from the same greenhouse were transplanted and maintained in the field near greenhouse (Fig. 1B). Collected beetles (*A. congener*) were put in a 10 ml glass vial, brought to laboratory and observed under the microscope (SMZ 800, Nicon, Kanagawa, Japan) in laboratory.

In first year, *A. congener* was collected from the green house and identified as a turf pest by following different published references (Saunders, 1873; Kurosawa et al., 1985). Next year, the damage percentage of the turfgrass caused by *A. congener* was counted in same green house. Total 131 turfgrass isolates which were already grown in the greenhouse pot (20×20×15 cm) were investigated. All the investigations were made by random hand picking method and identified the damaged leaf (damage caused by feeding habit of the beetle). Single turfgrass isolate which have more than 30 leaves were selected. 10 leaves out of each turfgrass isolate were counted as a single replication and damage rate were recorded in each replication (i.e. single turfgrass isolate have three replications).

Z. japonica was bought from local market, planted in the pot (10×16×5 cm) and kept in laboratory. The Kentucky blue grass (*Poa pratensis*) was grown by seeding in the same pot and kept in laboratory. One month later (19 July) beetles were collected from the greenhouse of Jinju (where, *A. congener* was first identified) and brought to laboratory with turfgrass as food to keep alive. In each pot 10 beetles were released and every pot was covered with protected turf case (30×25×20 cm) not to escape from the case. Damage was checked daily with the same way made in greenhouse.

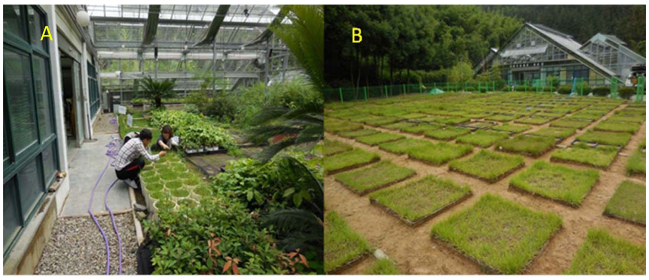

Fig. 1. Surveyed greenhouse (A) and field (B) in Southern Forest Resource Research Center, Korea Forest Research Institute, Jinju, Gyeongsangnamdo, Korea.

The damaged number of leaf of turfgrass caused by *A. congener* that has already been counted was then converted into percentages by arcsine transformation and analyzed by analysis of variance (ANOVA) (SAS Institute, 2011). The percentages (mean ± SD) are shown in the table. Significant differences between means were separated by Tukey's test ($P<0.05$).

The adult beetles damaging surface of upside part of leaf by feeding the cell sap were observed and damaged leaf finally turned to have white stripes by insect feeding (Fig. 2A). However, the larvae damaged inside of leaf by remaining under the cortex layer of the leaf (Fig. 2B). Similar damage symptoms were observed from larval and adult's damage.

Damage caused by the *A. congener* was observed in *Cynodon dactylon* (Fig. 2C), *Zoysia japonica* (Fig. 2D), *Z. sinica* (Fig. 2E), and hybrid zoysia (Fig. 2F). Damage was observed only from turfgrasses in greenhouse, but not from turfgrasses in outside field near greenhouse.

Detailed damage symptom of *A. congener* was investigated using potted turfgrass. 10 individuals of *A. congener* were released into potted zoysiagrass (*Z. japonica*) and Kentucky bluegrass (*P. pratensis*) to investigate the damage symptom.

Fig. 2. Damage symptom of turfgrass caused by adult (A) and larva (B) of *Aphanisticus congener* and damage in *Cynodon dactylon* (C); *Zoysia japonica* (D); *Z. sinica* (E) and hybrid zoysia (F) in greenhouse.

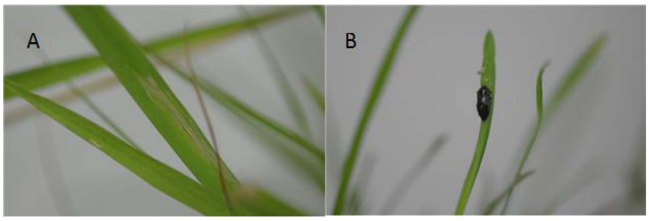

Fig. 3. Damage caused by *Aphanisticus congener* in zoysiagrass, *Zoysia japonica* (A) and Kentucky bluegrass, *Poa pratensis* (B) in laboratory. *Aphanisticus congener* was artificially released in each turfgrass pot.

The damage symptom caused by *A. congener* from artificially released potted turfgrass showed similar pattern as observed in greenhouse turfgrass (Fig. 3).

A. congener injured and made damage symptom on 5 species of zoysiagrasses (*Z. japonica*, *Z. macrostachya*, *Z. matrella*, *Z. sinica* and hybrid zoysiagrass) and bermudagrass, *Cynodon dactylon,* in greenhouse (Table 1). Damage rate was different among turfgrass isolates (df=130, 262, F=5.79, P < 0.0001). Only 2 isolates (SN001-*Paspalum vaginatum* and Koraishiba-*Z. matrella*) were not damaged by *A. congener* out

Table 1. Percent damage rate of turfgrass lines by *A. congener.*

Turf species	Isolated code	% leaf damage with SD[y]	Turf species	Isolated code	% Stem damage with SD
Cynodon dactylon	BN004	34.3±1.7 A-M[z]	Hybrid zoysiagrass	S13	25.0±5.0 A-O
	BN005	35.7±4.6 A-M		S18	12.7±6.3 G-P
	BN011	43.9±14.6 A-J		Senoc	30.2±3.0 A-O
	BN7003	33.6±2.6 A-M		Z6004	12.7±4.7 F-P
	BN7013	57.7±3.5 A-E		Z6005	6.7±11.5 M-P
	BN7014	48.1±29.2 A-J		Z6006	30.0±10.0 A-O
	BN7021	50.2±3.6 A-H		Z6009	19.1±8.7 A-P
	BN7030	62.5±4.9 AB		Z6013	13.0±6.1 F-P
	BN7036	51.7±8.0 A-G		Z6014	16.7±5.8 B-P
	BN7044	45.4±24.3 A-J		Z6018	21.3±5.4 A-P
	BN7048	64.6±6.4 A		Z6028	22.7±3.9 A-P
	BN7066	46.1±3.6 A-I		Z6030	25.8±5.2 A-O
	BN7068	4.9 ±4.3 L-P		Z6053	37.4±19.6 A-L
	BN7070	45.8±7.9 A-I		Z6061	19.4±10.1 A-P
	S-30	44.7±4.7 A-J		Z6073	32.3±4.6 A-N
Hybrid zoysiagrass	Anyang	13.3±5.8 E-P		Z6077	22.7±6.4 A-P
	CF6034	13.3±5.8 E-P		Z6081	34.4±5.1 A-M
	CF6035	18.3±1.7 A-P		Z6088	18.3±16.1 E-P
	CF6036	44.2±22.7 A-J		Z6090	38.8±10.2 A-L
	CJ1007	44.5±17.3 A-J		Z6096	20.0±20.0 D-P
	CJ1018	23.3±15.3 A-P		Z6101	47.0±2.6 A-I
	CJ1019	38.5±7.8 A-L		Z6112	22.7±6.4 A-P
	CJ1025	51.8±7.4 A-G		Z6113	35.5±15.0 A-M
	CJ4016	5.3±4.6 L-P		Z6116	5.8±5.0 L-P
	CJ6003	42.1±7.1 A-J		Z6118	28.2±9.2 A-O
	CJ6004	28.8±8.2 A-O		Z6132	19.4±10.1 A-P

Table 1. Percent damage rate of turfgrass lines by *A. congener* (continued).

Turf species	Isolated code	% leaf damage with SD[y]	Turf species	Isolated code	% Stem damage with SD
	CJ6005	41.8±10.5 A-K		CS6002	35.5±7.8 A-M
	CJ6006	31.8±27.6 A-O		CS6038	45.6±10.7 A-J
	CJ6008	39.3±2.7 A-M		CS6039	13.3±5.8 E-P
	CJ6009	16.1±5.3 C-P		CS6040	24.2±5.2 A-O
	CJ6010	26.7±8.8 A-O		CS6041	51.8±7.4 A-G
	CJ6011	15.8±5.8 C-P		Genhee	8.8±9.1 J-P
	CJ6012	36.6±3.3 A-M		Milnok	69.8±3.0 A-G
	CJ6013	24.1±3.7 A-O		Z6136	16.7±11.5 C-P
	CJ6014	42.4±2.8 A-M		Z6142	50.0±10.0 A-H
	CJ6020	47.8±13.5 A-H		ZN6023	23.0±15.7 A-P
	CJ6023	49.7±19.6 A-H		ZN6024	37.0±17.3 A-M
	CJ6024	29.6±11.0 A-O		ZN6031	12.5±6.5 G-P
	CJ6030	51.8±7.4 A-G		ZN6082	16.1±12.7 C-P
	CK1028	43.3±20.8 A-J		ZN6085	19.1±8.7 A-P
	CK6029	16.7±15.3 G-P		ZN6087	27.1±8.8 A-O
Paspalum vaginatum	SN001	0.0±0.0 P	*Z. matrella*	S-20	33.9±6.7 A-O
Zoysia japonica	Jenics	41.1±1.0 A-O		Z4010-1	25.1±11.2 A-O
	S22	23.3±15.3 A-P		Z4052	8.3±1.5 H-P
	S-6	16.7±5.8 B-P		Z4058	29.8±6.6 A-O
	S7	3.3±5.8 NOP		Z4082	24.4±15.0 A-O
	Z1008	11.9±5.5 G-P		Z4095-3	41.8±10.5 A-K
	Z1014	21.7±2.9 A-P		Z4099	42.1±7.1 A-J
	Z1050	43.3±12.4 A-J		Z4100	11.9±4.1 G-P
	Z1056	40.0±17.3 A-L		ZN4025	2.6±4.4 OP
	Z1067	26.0±3.6 A-O		ZN4049	16.1±5.3 C-P
	Z1094	16.7±1.4 B-P		ZN4054	27.2±2.5 A-O
	Z1102	24.8±10.0 A-O		ZN4065	6.1±5.4 K-P
	Z1122	26.7±15.3 A-O		ZN4067	12.8±6.3 F-P
	Z1134	35.0±6.0 A-O	*Z. sinica*	S2	53.3±15.3 A-G
	Z1136	31.2±4.7 A-N		S-4	58.6±22.7 A-D
	ZN008	32.1±3.7 A-N		Z2002	31.9±14.3 A-N
	ZN1045	31.2±4.7 A-N		Z2017	21.8±4.8 A-P
	ZN1046	15.5±6.3 C-P		Z2043	35.2±8.9 A-M
	ZN1053	19.1±8.7 A-P		Z2049	23.4±3.7 A-O

Table 1. Percent damage rate of turfgrass lines by *A. congener* (continued).

Turf species	Isolated code	% leaf damage with SD[y]	Turf species	Isolated code	% Stem damage with SD
	ZN1055	60.0±10.0 ABC		Z2097	22.7±6.4 A-P
	ZN1063	24.1±3.7 A-O		ZN2022	10.0±10.0 I-P
	ZN1080	57.1±8.6 A-F		ZN2034	26.7±5.8 A-O
Z. macrostachya	S-23	12.4±5.0 G-P		ZN2061	25.2±6.2 A-O
	S-3	24.4±5.9 A-O		ZN2062	26.1±21.1 A-O
Z. matrella	Koraisiba	0.0±0.0 P			

[y]SD: standard deviation.
[z]The same uppercase letter in row indicated that there is no significant difference among means (Tukey's test, $P < 0.05$).

of 131 surveyed turfgrass isolates. Mean stem damage rates were 44.6±14.3% in *C. dactylon*, 28.3±13.8% in hybrid zoysiagrass, 28.6±14.1% in *Z. japonica*, 18.4±8.5% in *Z. macrostachya*, 20.1±13.9% in *Z. matrella* and 30.4±14.1% in *Z. sinica* respectively. Based on stem damage rate, burmudagrass was more susceptible than zoysiagrass by *A. congener*. Damage rate of *Cynodon dactylon* showed the most damage caused by *A. congener*. This may be caused by the different leaf structures than other species (Potter, 1998).

A. congener Saunders is recorded as a new insect pest of turfgrass (*Zoysia japonica*) in Korea. The new buprestid pest was found only from genetic conservation turfgrasses in greenhouse in Jinju, Gyeongnam province, Korea in 2014. Taxonomical report of this species in Korea was published at 2016 (Choi et al., 2016).

The genus *Aphanisticus* is distributed throughout the continents and habitats of the Old World (Bellamy, 2007). *Aphanisticus congener* has very close similarities to *A. aeneus* which was firstly reported in India as sugarcane leaf sucker (Mukunthan and Nirmala, 2002). Some other species of *Aphanisticus* were also recorded as insect pests of sugarcane in Southeast Asia and USA (Mahesh et al., 2013; Wellso and Jackman, 1995).

A. congener was first described by Saunders (1873) from specimens collected in Japan. Adults are about 3 mm long, black, and described as follows: "Head very small, channeled between the eyes. Thorax largely and irregularly punctured; front margin scarcely more than half the length of the base; sides rounded, chiefly posteriorly and depressed, especially near the hind angles; the margin itself is slightly elevated; base straight. Elytra transversely rugose and largely punctate-striate, sides sinuated above the middle; apex rounded.unded.re abside and legs are punctured, the second antennal segment is large and round, the terminal four segments forming a decided club (Saunders, 1873; Kurosawa et al., 1985). It is unclear if *A. congener* is indigenous to Korea, Japan or elsewhere because very little is known about the species.

Although this buprestid pest was found only from greenhouse condition this time, new pest was thought to be distributed more places in Korea because the occurrence places of this pest was warmer climatic areas. Korea is being influenced by global warming and being largely changed in recent. In addition, there are some subtropical and warmer areas in Korea. Thus, it is possible that new buprestid pest will be distributed more places in Korea. *A. aeneus* firstly reported from sugarcane crop field in India (Mukunthan and Nirmala, 2002) is also a warmer geographical area species. Further research on ecology and physiology of this insect is needed to eradicate effectively before dispersed widely in Korea. Those study will also lead to get interesting and important information on *A. congener* for science.

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