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4TH INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SCIENCE AND TECHNOLOGY

SEPTEMBER 19-23 2018

BOOK OF PROCEEDINGS

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ORAL PRESENTATIONS - 20 SEPTEMBER 2018

	SESSION A
TIME	**A-1. Session - Chairman: Ayşegül Pala**
11:00	761 - Determination of the microbial composition of 1-year shelf-life lyophilized bacteria with DGGE method - Didem Aksu, Güven Özdemir
11:10	831 - Determination of Optimum Operational Conditions for the Removal of 2-Methylisoborneol and Geosmin from Drinking Water by Peroxone Process - Hazal Gülhan, Malhun Fakıoğlu, Mustafa Evren Erşahin, Hale Özgün, Izzet Ozturk
11:20	801 - Use of Alginate – Clinoptilolite Beads for the Removal of Mixed Heavy Metals: Effect of Clinoptilolite Size and Alginate – Clinoptilolite Ratio - MERVE YILDIZ, ÇİĞDEM MORAL
11:30	841 - Multi-Response Optimization of Nanofiltration Process for Carbamazepine Removal - ALI OGUZHAN NARCI, Ugur Ulukoylu, Berna Kiril Mert, Esra Can Dogan
11:40	835 - Removal of Diclofenac from Aqueous Solution by Microwave Enchanced Persulfate Oxidation: Optimization Using Taguchi Design - Nevim GENÇ, ELİF DURNA
11:50	827 - Investigation of the Use of Adsorbents Derived from Waste Shells with Addition of PAn/K2S2O8 in Laundry Wastewater Treatment by Adsorption Methods - Eylem TOPKAYA, Sevil Veli, Ayla Arslan, Çisil Gülümser, Hatice Kurtkulak, Şehriban Zeybek, Anatoli Dimoglo
12:00	830 - Adsorption of methylene blue by using activated carbon prepared by olive seed - Ayşegül Pala, Ceren Melis Karakıvrak, Gunes Kursun
12:10	814 - Kinetic Study of Dye Adsorption on Activated Carbon Produced from Bitter Orange Peels - Ayse Gunay, Kemal Aktas, Merve Ozkaleli, Meltem Asiltürk, Ayca Erdem
12:20	828 - Investigation of Bisphenol A Solutions Treatability by Using Ozone Based Oxidation Processes - Eylem TOPKAYA, Ayla Arslan
12:30-13:30	*LUNCH IN THE HOTEL RESTAURANT (Only for BLUE - GREEN - ORANGE PACKAGE ID HOLDERS)*
	A-2. Session - Chairman: Nuri Azbar
13:30	739 - A CASE STUDY FOR WASTE TO ENERGY CONVERSION: MCw PLASMA GASIFIER - MELDA CARPINLIOGLU
13:40	876 - QUANTIFICATION OF MICROORGANISM COMPOSITION OF BIOHYDROGEN PRODUCTION FROM THE DRY FERMENTATION SYSTEM BY REAL-TIME Q-PCR - Cansu Vural, Didem Aksu, Tuğba Keskin, Haris Nalakath Abubackarc, Güven Özdemir, Nuri AZBAR
13:50	792 - A useful Way to Dispose of Phenolic-rich Agricultural Wastes: Mushroom Cultivation - Funda ATİLA
14:00	803 - THE MICROWAVE OVEN CURING OF FLY ASH-BASED GEOPOLYMER MORTARS - GÖKHAN KÜRKLÜ, GÖKHAN GÖRHAN
14:10	837 - Microwave Assisted Sludge Disintegration: Optimization of Operating Parameters - Elif DURNA, Nevim GENÇ
14:20	769 - Thermophilic digestion of organic fraction of solid wastes and some agro based organic wastes - Nuri Azbar, DUYGU KARAALP, Tugba Keskin
14:30	740 - MICROWAVE PLASMA GASIFICATION PROCESS OF POLYETHYLENE - MELDA CARPINLIOGLU, AYTAC SANLISOY
14:40	794 - Multiple Criteria Analysis of Waste-to-Energy (WtE) Technologies for the Treatment of Municipal Solid Waste : PROMETHEE/GAIA - Birol Elevli, Hakan Öztürk
14:50	813 - Activated Carbon Production from Local Agricultural Residue - Ayse Gunay, Kemal Aktas, Merve Ozkaleli, Meltem Asiltürk, Ayca Erdem
15:00	884 - Determination of the effect of mixed organism culture obtained from the petrochemical industry wastewater on the biodegradation of PTA in CSTR ..... - Tayyibe ALPAY, Hürsel Çay, Didem Aksu, Burçin Karabey, Bike Pashayeva Öğünlü, Caner Vural, Güven Özdemir
15:10-15:30	*BREAK COFFEE / TEA*
	A-3. Session - Chairman: Bahtiyar OZTURK
15:30	857 - AN ENVIRONMENTALLY FRIENDLY PLANT IN TERMS OF OXYGEN SUPPLY: HEMP - Selim AYTAÇ
15:40	800 - The importance of Indoor Air Pollution for School Children - Bahtiyar OZTURK, HULYA AYKAC OZEN, Hamdi Obekcan
15:50	763 - ASSESSMENT OF SOME PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOIL IN SAMSUN TEKKEKÖY REGION WITH CBS - Ayşe Kuleyin, Özcan Coluk, Aziz Sisman
16:00	829 - Petaloid Monocotyledonous Flora of Bingol Province (Turkey) - Süleyman Mesut Pinar, Mehmet Fidan, HÜSEYİN EROĞLU
16:10	804 - THE IMPORTANCE OF VENTILATION FOR INDOOR AIR QUALITY - Bahtiyar OZTURK, HULYA AYKAC OZEN, Hamdi Obekcan
16:20	821 - The effects of environmental pollutants on honeybees (Apis mellifera L.) - Cengiz ERKAN, Ayhan Gosterit
16:30	795 - Tannase Production and Enzyme Characterization from Bacillus coagulans - Sadik Dinçer, Esra Sunduz Yigittekin
16:40	758 - Environmental Risks of Bumblebee Commercialization and Suggestions for Prevention - Ayhan Gosterit, Fehmi Gurel, Cengiz Erkan
16:50	752 - Unique Efficacy of Sulfoxaflor pesticide on Culex Pipiens L. (Diptera: Culicidae) Mosquitoes - Mohamed Ahmed Ibrahim Ahmed
17:00	899 - Recent advances in membrane fouling control in wastewater treatment processes - Amar Cemanovic, Abdullah Kizilet, Neslihan Manav Demir, Özer ÇINAR
17:10-17:30	*BREAK COFFEE / TEA*
	A-4. Session - Chairman: Olga Kiuila
17:30	878 - Economic dynamic modeling of climate policy in Poland - Olga Kiuila
17:40	865 - Experiences on sustainable tourism development in Turkey - Saniye Gül Güneş
17:50	808 - Legislations of Ministry of Environment and Urbanization in Turkey for Sustainable Construction - Şerife Gökçe, Osman Aytekin, Hakan Kuşan, İsmail Zorluer
18:00	809 - Temporal Coastal Change Analysis in Kızılırmak Delta and Yeşilırmak Delta - Aziz SISMAN, Elif Aldanmaz
18:10	891 - Production of Functional Catechin Extracts from Waste Green Tea - Murat Yilmazlekin, Başak Bilcanoğlu, Sevinç Tay
18:20	900 - Overview of Studies on Innovations in Fire Resistance of Timber Structures from the Perspective of Sustainability - Hamdi Tekin, İsmail Cengiz Yilmaz
18:30	*854 - Social and Economic Effects of Hydroelectric Power Plants: Keban HEPP Sample - Alp Buğra AYDIN*
18:40	*840 - IMPROVING WATER QUALITY PARAMETERS BY USING HYDRAULIC STRUCTURES - Alp Buğra, Fahri Özkan*
18:50	
19:30	*DINNER IN THE HOTEL RESTAURANT (Only for BLUE and GREEN PACKAGE ID HOLDERS)*

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Environmental Risks of Bumblebee Commercialization and Suggestions for Prevention

Ayhan Gosterit[1], Fehmi Gurel[2], Cengiz Erkan[3]

Abstract

Bumblebees are an important pollinator of wild flora as well as agricultural crops and are increasingly used as an effective commercial pollinator in greenhouses crops mainly in tomatoes all over the world. Eurasian Bombus terrestris L. is the most reared subspecies for commercial pollination and has been used outside its natural distribution area. Very early after commercial introduction, it was recognized that this species is invasive and may disturb local ecosystems. There are many invasive characteristics of B. terrestris such as high migration ability, early seasonal emergence, high adaptability under adverse climatic conditions in various habitat, polylectic foraging strategies and regulation of life cycle in a year in newly colonized area. A single commercially produced B. terrestris colony may produce more than a hundred of new queens which may escape from greenhouses and found nest in native flora. The invasion and the increase in population of introduced B. terrestris in the new areas have caused some problems, such as competition with native pollinators for floral resources and nest sites, the introduction of parasites and pathogens, and hybridization with native species. Therefore their potentially effects on the environment are also being observed carefully. The aim of this report is to raise awareness about the environmental risks of bumblebee commercialization and make suggestions for prevention of this possible ecological damage.

Keywords: *Bumblebee, Bombus terrestris, Commercialization, Invasion, Ecology*

1. INTRODUCTION

Contributions of bees which commonly known as beneficial insects to pollination of flowering plants cannot be ignored. Bees which include about twenty thousand species are most important insect group and have 8 or 9 families according to morphological characters [1]. Honeybees (*Apis mellifera* L.) are most effective pollinator insects of native flora due to their extensive rearing all over the world. Bumblebees, of which about 250 species have been determined, are in second place for pollination of many flowering plants. This bee genus is used for the pollination of many cultivated plants in many countries [2, 3]. Because of their rearing is easier and their colony population is larger than the others, *Bombus terrestris* is the most year round reared species, in comparison to other bumblebee species. This species which includes nine subspecies is used mainly for greenhouse tomato pollination. They reduces pollination labor costs and improves the quality and quantity of crops. Commercially reared *B. terrestris* colonies are used in many countries, including some outside of its native range [4, 5].

Bumblebees are indispensable pollinator. However, *B. terrestris* has an invasion potential into new locations where they are non-native. Early seasonal emergence, high adaptability under adverse climatic conditions in a range of habitats, generalist or polylectic foraging strategies, and great phenological flexibility are most important invasive characteristics of *B. terestris.* Soon after its commercial introduction, it was recognized that this species is invasive, can spread into new locations, and may disturb local ecosystems [6, 7]. Competition with native pollinators for floral resources and nest sites, the introduction of parasites and pathogens,

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hybridization with native species and alteration of natural pollination systems are major problems that caused by invasion and the increase in population of introduced *B. terrestris* in the new areas. A single commercial *B. terrestris* colony is capable of producing more than a hundred new queens, which potentially could escape from greenhouses and form nests among the native vegetation [8, 9].Therefore, these environmental risks should be taken seriously.

2. ECOLOGICAL FLEXIBILITY OF *B. TERRESTRIS*

B. terrestris has a broad spread area in the world. The natural distribution range of *B. terrestris* is the Palaearctic region between latitudes 60°N and 30°N and longitudes 10°W and 105°E. About ten geographically separated subspecies have been recognized in this distribution range. It is known that this species adapts better to hot and dry climate [4, 10, 11]. Commercial rearing of *B. terrestris* started to about thirty five years ago and this industry has developed rapidly. Colonies are produced by more than 30 suppliers and marketed to all over the world. We estimated that total number of colonies that use for pollination is to be around two millions per year.

B. terrestris has also speed and broad invasive potential related to other bumblebee species. Invasion speed of this species differs to their population density and ecological conditions. Researches displayed that *B. terrestris* has spread at 90 km in New Zealand, at 30 km in Israel, and at 25 km in Tasmania [12, 13]. It is also proved that *B. terrestris* can visit the flowers of many plants for pollen and nectar resources from sea level to 1500 m in altitude, containing all of the major native vegetation types [2, 13, 14].

B. terrestris shows great ecological flexibility, particularly in terms of diapause responses [12, 15]. Bivoltinism has been reported for some Mediterranean *B. terrestris* populations [15]. New Zealand *B. terrestris* populations are largely bivoltine and that nest founding by *B. terrestris* is possible any time of the year in some parts of New Zealand due to the variety of plants which provide some pollen and nectar throughout winter [1]. Similarly, two distinct generations have been found in Tasmania in the same season [16]. Our previous study that conducted in Mediterranean Coastal Region of Turkey showed that, native *B. terrestris* populations forage on 47 flowering plant species from 20 families. Two of the plant species (*Arbutus unedo* L. and *Vitex agnus-castus* L.) have long flowering periods and play a crucial role in the life cycle of native *B. terrestris* populations. The emergence of queens at the aestivation site was synchronized with the flowering of *Arbutus unedo* L., while the emergence of sexuals coincided with the flowering of *Vitex agnus-castus* L. [14].

3. RISKS OF BUMBLEBEE COMMERCIALIZATION

As a result of the contribution of humans, the potential of crossing geographical obstacles of living organisms has reached a level that cannot be predicted. Although a part of introduced species are beneficial for human health and that they cause little environmental damage, the other part of them quickly spread to new areas and have done great ecological harm [13]. The best example in this regard is the European honeybee, *Apis mellifera* L., which taken afterwards to America. Numerous studies have demonstrated that *A. mellifera* displaces native anthophiles and contributes to the pollination of weeds [17, 18]. The potential of *B. terrestris* to invade many habitat around the world raises concerns because of this species have similar harmful environmental impacts like honeybees. Possible negative effects of *B. terrestris* invasion are competition with native pollinators for floral resources, competition for nest sites, introduction of parasites and pathogens that may infect native organisms, disruption of pollination of native plants, and the hybridization with native species [6, 11].

Different organisms such a birds, insects and mammals that living in a specific region are fed by pollen and nectar gathered from flowers. One of the most important group of insects is bees. Foods of all bee species include pollen and nectar collected from flowers. Therefore, introduction of new species to a specific region or extreme increase of exotic species in this region make competition inevitable with host bee species in terms of the use of plant sources [11].

B. terrestris has the potential to compete for floral resources with host bee species, as a consequence of its polylectic foraging behavior. Many of these plants constitute the significant portion of food resource of other many native bee species. Life cycle and ecology of *B. terrestris* overlap with the foraging profiles of all other bee subgenera. Foraging period of bumblebees that forage during the spring and summer is longer than other pollinators. They have also capable of more use the pollen and nectar resource according to other pollinators [19]. Furthermore, *B. terrestris* that the most reared species for commercial pollination may has an advantage for competition of floral resource using because of its crowded colony population [11]. *B. terrestris* has comparatively larger and more hairy body than many other bee species. Bees that have a large body also take an advantage in cold weather because of their high ability to protect temperatures. *B. terrestris* can work very long hours, forage from dawn to dusk even on cold, rainy or foggy days. Overlap in floral resources is shows

that there is a competition between the *B. terrestris* and other bee species. However, if the nectar and pollen resources are not scarce, competition may not appear [20].

Other critical resource for bees in native fauna is nest site. There may be competition between the introduced *B. terrestris* and native organisms for nest sites. Sexuals (young queens and males) are produced in bumblebee colonies towards the end of the colony cycle in late summer. After mating, the young queens go into diapause while the founding queen. The following spring, the queens that survived hibernation seek the nest site for found their colonies. *B. terrestris* generally found their colonies in existing cavities below ground, often using abandoned rodent holes and spaces beneath man-made structures such as garden sheds [6]. The time of diapause termination varies according to region where native populations live. For example, in Mediterranean Region of Turkey, while queens of a native populations emerge from diapause in autumn at the Phassalis site (coastal region), queens of other native populations emerge from diapause in in spring at the Termessos site (500 – 700 m altitude) [14]. Founding nest site takes place in an ecological balance in native fauna. However, queens produced in commercial colonies potentially could escape from greenhouses and form nests among the native vegetation where using of commercial colonies for pollination agent is common. This case may increase the competition for nest site by disrupting the ecological balance.

Invasions and increased populations of introduced *B. terrestris* into new areas have also caused the transmission of parasites and pathogens. *Locustacarus buchneri, Nosema bombi, Crithidia bombi* and *Apicystis bombi* are some important pest and diseases which are determined in commercially reared colonies. In japan, determination of endoparasitic mite, *L. buchneri*, in introduced colonies of *B. terrestris* clearly reveals the risk that the transfer of parasites and diseases [21]. Transfer of parasite and diseases may affect the not only native bumblebee species but also other insect species.

Another negative effect of bumblebee invasion is disturbing the pollination of native flora [6]. There must be a harmony between the morphology of the flower and pollinator for effective pollination. Flower of plant are visited by many pollinator and pollination quality of these pollinators is different. *B. terrestris* visits the different species of plant and sometimes provide the poor quality pollination. *B. terrestris* that as known also nectar robing obtain the nectar of flowers with long corolla by making perforations at the base of the corolla tube. This behavior inhibits the visiting the flower by other pollinator and finally seed set [22]. Very few of plants that visited by bumblebees are host plants of the region where they live. Therefore, they may cause to increasing of pollination of exotic plant. It is inevitable that increasing of exotic plants causes to ecological and economic harm [23].

Interspecific hybridization between non-indigenous *B. terrestris* and indigenous bumblebee species was demonstrated [24]. Negative effects of inter-subspecific hybridization on native ecosystems have also been evaluated [25]. Our previous study revealed that hybridization between commercial and native genotypes generally resulted in intermediate expression of the colony traits. Maternal genotype primarily determines the colony traits. Our results imply that hybridization with the commercial genotype affected some colony traits of native *B. terrestris* colonies [9]. However, information about consequences of nearly 30-year history of commercialization of bumblebee respect to their hybridization level is not sufficient.

4. CONCLUSION AND SUGGESTIONS

Bumblebees have become an indispensable pollinator, especially for greenhouse tomato production, because of its pollination efficiency, which reduces pollination labor costs and improves the quality and quantity of crops. Currently, about 250 species of true bumblebees have been identified. *B. terrestris* is the most commonly commercially reared species. This species is also one of the most abundant and widespread bumblebees throughout continental Europe and many Mediterranean and Atlantic island. It easily adapts to cloudy weather and to small enclosed areas, such as greenhouses. Commercially reared *B. terrestris* colonies are excellent pollinators and have been used in many countries for pollination agency. However, their negative effects on native ecological systems have been intensely discussed. Especially, negative effects of their commercialization such as competition with native pollinators for floral resources and nest sites, introduction of parasites and pathogens, disruption of pollination of native plants, and the hybridization with native species must be taken into attention for ecological sensitivity. Industry of bumblebee rearing and pollination service has an economic and sociological importance. Therefore, it is clear that prevention or restriction of use of commercially reared bumblebee colonies not rational and possible. However improve structural conditions of greenhouses, using covering nets, killing colonies and then burning the hive after use, using queen excluder and using colonies with health certificate can be can be suggested as a solution to decrease the negative ecological impacts of bumblebee commercialization.

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