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Research article/Araştırma makalesi

Agricultural pesticides used on Central West Anatolian (Eskişehir/Turkey) population areas of Great Bustard (*Otis tarda*)

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Abstract

The Great Bustard (*Otis tarda*) is the biggest species in the Western Palearctic species of the Otididae and the Male Great Bustard (*Otis tarda*) is one of the heaviest flying birds. The species is Globally Threatened Species Classified as "Vulnerable" by IUCN (IUCN, 2015) and is listed in the CITES Appendix II. Habitat of this species in our country, due to the change of agricultural land to natural and secondary steppe, nowadays constitutes mostly farmland. In addition to pest control in the field of agriculture and indirectly to get more products from agricultural areas, wide variety pesticides (Herbicides, Rodenticides, Insecticides etc.) are used. This study, was supported 201319008 (2013-64) coded Project by Eskişehir Osmangazi University Scientific Search Project Commusion, carried out in Eskişehir Aliken Important Nature Area between March 2013 – May 2015. During the field survey, in habitat of great bustard used pesticides were determined and this pesticides photographs and coordinates were taken. Finally, the written articles on determined pesticide active ingredients were scanned and potential impacts on these endangered species were discussed.

Key words: Aliken, Eskişehir, *Otis tarda*, Pesticides

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İç Batı Anadolu (Eskişehir)'daki Büyük Toy Kuşu (*Otis tarda*)'nun Yaşam Alanlarında Kullanılan Tarımsal İlaçlar

Özet

Büyük Toy Kuşu (*Otis tarda*), Otididae familyasının Batı Palearktik'te bulunan türlerinden en büyük olanı ve erkeği uçabilen en ağır kuşlardan biridir. Bu tür, Küresel Tehlikedeki Kuşlar Listesi'nde (IUCN, 2015) Hassas 'Vulnerable' ve Bern Sözleşmesi'nde EK-II statüsündedir. Ülkemizde bu türün yaşam alanlarını, doğal ve ikincil bozkırların tarım alanlarına dönüştürülmesinden dolayı, günümüzde çoğunlukla tarım arazileri oluşturmaktadır. Yine günümüzde tarım alanlarındaki zararlılarla mücadele etmek ve dolaylı olarak tarım alanlarından daha fazla ürün almak için çok çeşitli tarım ilaçları (Herbisit, Rodentisit, İnsektisit vb.) kullanılmaktadır. Bu çalışma, Eskişehir Osmangazi Üniversitesi Bilimsel Araştırma Projeleri Komisyonu tarafından 201319008 (2013-64) nolu proje ile desteklenerek Mart 2013-Mayıs 2015 tarihleri arasında Eskişehir ili Aliken Önemli Doğa Alanı (ÖDA) içinde gerçekleştirilmiştir. Yapılan arazi çalışmaları sırasında Büyük Toy Kuşunun yaşam alanları içinde kullanılan tarımsal ilaçlar belirlenmiş, fotoğraflanmış ve koordinatları alınmıştır. Son olarak belirlenen bu tarımsal ilaçların etken maddeleri üzerine yapılan makaleler taranmış ve nesli tehlikede olan bu tür üzerine oluşturacağı olası etkileri tartışılmıştır.

Anahtar kelimeler: Aliken, Eskişehir, *Otis tarda*, Pestisit

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1. Introduction

In the last decades, farmland birds in Europe and North America have been suffering population declines at higher rates than birds from other habitats (EBCC, 2014; Lopez-Jamar et al., 2010). Farmland is being profoundly altered through agricultural intensification, posing a major challenge for biodiversity conservation today in many countries (Krebs et al.,1999). Recent studies have pointed out that a major cause of bird population declines is the use of pesticides, either because of indirect effects on habitat and foodsupply (Hallmann et al.,2014; Goulson, 2014; Moreby and Sourthway, 1999) or because of direct toxic effects on the health of birds (Mineau and Whiteside, 2013). A greater probability of lethality in birds occurs when the ratio between the LD50 and the estimated field exposure dose is low (EFSA, 2009). Pesticides with higher LD50 or lower risk of exposure can produce a range of sub-lethal effects such as loss of physical condition, immunosuppression, neurological impairments or endocrine disruption (Fry,1995). All these effects may ultimately affect survival or reproduction, and therefore impact on population dynamics. (Lopez-Antia et al., 2015). The Great Bustard, (*O. tarda* Linnaeus, 1758), is a large steppe bird inhabiting cereal farmland (Lemus et al., 2011; Alonso et al., 2001; Lopez-Jamar et al., 2010) and is a globally threatened species classified as 'Vulnerable' (Bravo et al., 2012; IUCN, 2015; Palacin and Alonso, 2008; Palacin et al., 2012) and is listed in the CITES Appendix II with a wide distribution area ranging from Eastern Asia Westwards to Iberia and Northern Morocco (Alonso et al., 2003; Horreo et al., 2013; Barati and Amerifar, 2008). Great Bustards are omnivorous, with the main dietary components consisting of green plant material, arthropods and seeds (Lane et al., 1999), and prey infrequently and opportunistically on small vertebrates (amphibia, lizards, chicks of ground-nesting birds and rodent such a Voles Microtus sp.) (Lane et al., 1999; Lemus et al., 2011). Rodent consumption has not been observed in Iberian great bustards, but has been reported for central European populations (Lemus et al., 2011). Thus, both treated seeds and poisoned animals may potentially form part of their diet (Lemus et al., 2011).

In this study, was supported 201319008 (2013-64) coded Project by Eskişehir Osmangazi University Scientific Research Project Commusion, First, we determine used pesticides in habitat of great bustard between March 2013 – May 2015 in Eskişehir Aliken Important Nature Area. Finally, we scan the written articles on determined pesticide active ingredients and we discuss potential impacts on these endangered species.

2. Materials and methods

1.1. Study Area

The study area (Aliken İmportant Nature Area (INA) is semi-agricultural region which located between Çifteler and Sivrihisar in Eskişehir/Turkey, with coordinates $39^0$11'-$39^0$24' N, $31^0$09'-31^0 24' E and its total area is 19.665 hectares. Altitude of the area varies between 830-880 meters. It is surrounded by Aliken stream at North, and Seydi stream at South, which are both the branches of Sakarya river system. There are uncultivated stony and marsh areas, fallow lands and cultivated areas. At the stony areas, animal breeding is performed, while, on the cultivated areas, dry farming of plants such as graminae, Chickpea (*Cicer arietinum*) and Safflower (*Carthamus tinctorius*) is performed. However, within the area, irrigated farming of Beet (*Beta vulgaris*), Potato (*Solanum tuberosum*), Pumpkin (*Cucurbita moschata*) and Opium Poppy (*Papaver somniferum*) is performed partly.

Although there isn't a recognised status for the area, it ranks as one of the important bustard breeding areas in National Bustard Action Plan.

1.2. Methods

In the study area, field surveys were carried out in March 2013 - May 2015 period as totally 72 days. The study area was divided into squares of 1x1 km and field scanning was made by walking at each square. When empty boxes were found, date, hour, geographical coordinates, habitat type, name and the number of boxes were recorded.
Also, it has been taken information about the issue that which pesticides have been sold in the area through the interviews with the officers who supply agricultural pesticides to local farmers.

3. Results

During the study period, we identified 3 different brand of insecticide (Alpac 100 EC, Dursban 4, Safban 25 WP) and 6 different brand of herbicide (Betanal Progress OF, Betachem Compass, Gothic 100 SL, Mustang, Ester, Mega Tref 48 EC). We didn't identify any brand of rodenticide, nematicide, molluscicides, fungicide and acaricide.

Total 3 different brand of insecticide have 2 different active ingredient as Cypermethrin alpha and Chlorpyrifos-ethyl. Cypermethrin alpha is a Pyrethroid compound and Chlorpyrifos-ethyl is a Organophosphorus compound.

Total 6 different brand of herbicide have 7 different active ingredient as Phenmedipham, Ethofumesate, Desmedipham, Dichloropicolinic acid, 2,4-D, Florasulam, Trifluralin and 2,4-D isooctyl ester. Phenmedipham and

Desmedipham are Bis-Carbamate, Ethofumesate is a unclassified, Trifluralin is a Dinitroaniline, 2,4-D and 2,4-D isooctyl ester are Chlorophenoxy, Florasulam is a Triazolopyrimidine compound.

4. Conclusions

Pyrethroids are widely applied as insecticides in households, cereals, vegetable, cotton, tobacco, and other crops throughout the World (Chu et al., 2007). They are also widely used for the control of ectoparasites of domestic animals (Ural and Sağlam, 2005; Enayati et al., 2010). The primary target sites for pyrethroids are the voltage-gated sodium channels (VGSCs) (Jin et al., 2010; Rinkevich et al., 2012; Rinkevich et al., 2013). Pyrethroids exert neurotoxicity by binding to and delaying the inactivation (closing) of the sodium channels, resulting in convulsions, prostration and ultimately death (Werner and Moran, 2008; Yang et al., 2014). Based on the chemical structure, pyrethroids are divided into type I and type II (US Environmental Protection Agency (US EPA), 2010). Cypermethrin (CP), a type II pyrethroid, is one of the top five pyrethroids in use (Oros and Werner, 2005). Cypermethrin, is less acutely toxic to birds (LD50 > 1000), but their broad spectrum toxicity to invertebrates may cause depletion of important avian food resources. (Boutin et al., 1999).

Chlorpyrifos has a broad spectrum activity within the groups of OP insecticides, therefore it is a major concern with agriculture, and public health. Neurotoxicity is the main manifestation of chlorpyrifos (CPF) due to long term exposure or acute intoxication (Sanchez-Santed et al., 2004). In mammals and birds, the toxic effects of OP through inhibition of cholinesterase enzyme which results in the pooling of acetylcholine at the nerve endings and neuromuscular junctions exhibit as nicotinic, muscarinic and central nervous system effects resulting from cholinergic overstimulation (Rahimi and Abdollahi, 2007; Engelman et al., 2012). The decrease in cholinesterase in the blood (RBC, serum and plasma) and other tissues like the brain are the important points for diagnosis of OP exposure and poisoning. Also Organophosphate insecticides have been shown to alter migration in adult birds, most likely by affecting memory of the migration route (Engelman et al., 2012).

Some of the experiments were conducted previously to check the toxic effect of Chlorpyrifos on different species of animals/birds, with different treatment periods and different treatment levels. The clinical signs observed during the present experiment were salivation, lacrimation, frequent defecation, gasping, tremors and convulsions. Chlorpyrifos decreases the body weight gain and is also involved in hepatic injury as revealed by increased activity of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in rats and layer chicken. Many studies have investigated the chronic toxicity of chlorpyrifos in birds and have noted adverse effect on fertility, hatchability, embryonic deformities and bodyweight (Schom et al., 1973; Gile and Eyers, 1986). İntoxication of chlorpyrifos produced hematobiochemical and histopathological alterations in broiler birds (Ahmad et al., 2015).

2,4-D (2,4-dichlorophenoxyacetic acid) is an herbicide and secondarily a plant growth regulator (Wei et al., 2013; NPİC, 2015). Formulations include esters, acids, and several salts, which vary in their chemical properties, environmental behavior, and to a lesser extent, toxicity. The salt and ester forms are derivatives of the parent acid. 2,4-D is used for broadleaf weed control (Chu et al., 2007; Willemsen and Hailey, 2001) in agricultural and nonagricultural settings, and it is registered for use in both terrestrial and aquatic environments. Major sites include pasture and rangeland, residential lawns, roadways, and cropland. Crops treated with 2,4-D include field corn, soybeans, spring wheat, hazelnuts, sugarcane, and barley. For Non-target Organisms the primary exception is that the salt and acid forms can be extreme eye irritants. 2,4-D is actively secreted by the proximal tubules of the kidney, and toxicity appears to result when renal clearance capacity is exceeded. Dose-dependent toxic effects include damage to the eye, thyroid, kidney, adrenals, and ovaries or testes. In addition, researchers have observed neurotoxicity, reproductive toxicity, and developmental toxicity. Chlorophenoxy herbicides exhibit a variety of mechanisms of toxicity, including dose-dependent cell membrane damage leading to central nervous system toxicity, interference with cellular metabolism involving acetyl-coenzyme A (CoA), and uncoupling of oxidative phosphorylation due to either the disrupted CoA activity or cellular membrane damage. (NPİC, 2015)

Phenmedipham, Ethofumesate, Desmedipham are most popular post-emergence herbicides (Deveikyte and Seibutis, 2006). Phenmedipham and Desmedipham are Bis-Carbamate and Ethofumesate is an unclassified. Most of the carbamate compounds used in orchards are toxic to most birds (Baril et al., 1994). Carbamate-induced acute and chronic intoxication of non-target wildlife species, resulting in neurophysiological and behavioral changes in thermoregulation, food consumption, and reproduction (Jiang et al., 2013; Engelman et al., 2012).

Embryotoxicity has been observed in duck eggs exposed to herbicides via immersion in aqueous emulsions in the laboratory (Hoffman and Albers, 1984) and Trifluralin was more embryotoxic than some other herbicides and insecticides (Freemark and Boutin, 1995).

Although we didn't identify any brand of rodenticide and active ingredient, rodenticides increase in parasite and pathogen burden of intoxicated individuals, and raise concern about possible effects on the health or even survival of the birds. High parasite loads have been shown to affect reproductive rates and survival of several bird species (Lemus et al. 2011).

As the result of literature comparison, when we look at the effects of the pesticides which are obtained used in the area we see that these kind of pesticides; (1) İnsecticides decreased chick survival through direct toxicity to the

insect food preferred by Great Bustard chicks (2) Herbicides eliminate plants (weeds and non-weeds) whose seeds are important for Great Bustard and reduce suitable nestling cover in an already depauperate agricultural landscape (3) By decreasing plant diversity in non-crop habitats, herbicides also reduce arthropod populations for this species which rely on large supplies of invertebrates to feed their young (4) cause the intensity of parasits and variation of the species thus it effects the life quality so longevity in a negative way, (5) cause disturbance and attention loss in the species because of the retention of some rodenticide and insecticide in tissues through the nutrition and therefore it causes species to crash electrical transmission lines and leads to be destroyed of species, (6) decrase the quality of fertility and sperm of the this species (7) caused a reduction in the diversity of nutrients such as nutritional competition may lead to adverse effects have been reported. This is why these pesticides, as the Great Bustard (*Otis tarda*) in areas inhabited by the species that are endangered on a global scale, such as restriction or total prohibition of the use is required.

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