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# THE PESTICIDE IN BROWN HARE ADIPOSE TISSUE AS CONSEQUENCE OF ANTHROPOGENIC FACTORS

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*Abstract:* The impact of pesticides on brown hare population in agro biotope under intensive conditions of agricultural production was analysed in this review paper. The use of pesticides represents one of anthropogenic impacts which if not applied in an adequate way may have drastic negative consequences when it reaches animal food chain. The most often visible examples of inadequate application of pesticides can be seen in mass poisoning when both herbivore and carnivore species fed on their residues perish. In the same way, another significant problem which is not easily visible are low doses of pesticides which can be found in brown hare tissue and which can, in the long run, lead to decrease in brown hare density but without visible mass deaths what most often causes a decrease in reproductive potential in conjunction with other natural and anthropogenic factors.

*Keywords:* brown hare, pesticide, anthropogenic factors, agro biotope

## Introduction

As a consequence of intensive agricultural production in a form of anthropogenic effect, Lazić et al. 2013. report about accumulating atrazine residues and its degradation products in the environment what is particularly dangerous for underground waters. During the application of pesticides, their largest part falls on the ground which afterwards by washing off penetrates into a deeper soil layers and eventually into underground waters (Pucarević et al., 2003). Further fate of pesticides in agro biotope, depends primarily on the time both of semi-decay and decay and of physical and chemical characteristics of the traits of soil and waters with which they come into contact. A negative effect of pesticides on environment is particularly expressed in the example of underground waters and soils (Fenol et al., 2014; Sharma et al., 2014; Kolpin et al., 1995). The connection of underground waters with large river flows also represents one of the essential factors in circulation of contaminants in agro biotope. Đinović-Stojanović et al., 2013. reported that a presence of organochlorine pesticides and polychlorinated biphenyl in the fish from the river Danube (Batajnica, Serbia) pointed to the need of continuous monitoring of organochlorine and some other pollutants as well. Organochlorine pesticides and polychlorinated biphenyls got into environment as a consequence of their use in intensive agriculture (Nie et al., 2012; Meng et al., 2013), but although they were removed from the use in early eighties of the last century their residues can still be found in different parts of environment such as water, air and soil (Loganathan and Kannan, 1994; Castro-Jimenez et

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al., 2011; Barakat et al., 2013). The example of glyphosate clearly illustrates their persistency and mobility what can have a significant impact on agro biotope although its use is forbidden. Sojanović et al. (2017) report following quantities of pesticides in localities of Subotica (0.0834 mg /kg), Sremski Karlovci (0.1486 mg /kg) and Erdut (0.1956 mg /kg) (Sojanović et al., 2017). Even in protected zones such as the Nature Park “*Stara Tisa*”, from where water resource is used for irrigation of arable land, the water analysis determined the presence of following pesticides residues although the levels were below critical values: terbuthylazinedesethyl, terbuthylazine, clothianidin, clomazone (Bursić et al., 2017c). The presence of pesticides in arable crops is in direct relationship with anthropogenic impact which is a main cause of further contamination of animal species. The most frequently detected pesticides in cabbage samples were clothianidin, pyrimethanil, metalaxyl, azoxistrobin and thiamethoxam. In onion samples, the most abundant pesticides were metalaxyl-M, dimetomorph, spinosad and spirotetramat. The detections were below the MRLs. These results indicate that the producers have started to apply GAP, but not in all the segments since the detection of pesticides which are not registered for use in the Republic of Serbia were applied (Bursić et al., 2017a).

### **Mass poisoning of different game species as a direct anthropogenic effect**

By analysing the anthropogenic effects which are reflected through a large spectrum of effects one of the most visible and most dangerous seems to be a mass death of game species. Numerous studies over the previous period have researched mass poisoning of fauna and game species testifying about the danger of anthropogenic impact of man on wild animal species (Antoniou et al. 2005; Berny, 2007; Martínez-Haro et al., 2008). The most common causes leading to mass deaths of wild game due to application of pesticides are first of all, the use of forbidden (banned) pesticides, then overdosing and overuse as well as an inadequate way of use. The most frequent active substances of pesticides which caused mass deaths were insecticides of the order: organophosphorus compounds (forat) and methylcarbamate compounds (carbofuran), but also the importance of rodenticides should be pointed out (zinc-phosphide and bromadiolone) (Beuković et al., 2015). Mass deaths occur not only in wild game which directly consume treated vegetable food in food chain, but animals also often get killed due to secondary poisoning of mammalian predator species (Berny et al. 1997; Antoniou et al. 1996) and birds (Elliott et al. 1996; Soler Rodríguez et al. 2006; Berny et al. 2008).

Berny and Gaillet, (2008) point out the importance of inadequate placement of bait containing insecticides (aldicarb, mevinphos, and partly carbofuran) which caused 33% of secondary poisoning of red kites (*Milvus Milvus*) in France. On the example of imidacloprid more cases of negative effects can be perceived. It is an insecticide which reacts on contact and gastrointestinally and primarily has an effect on: leaf louse, thrips tabaci, scutiform moth, leaves miners of citrus fruits, potato beetle and pests in the soil. It can be applied by means of irrigation system and it remains in soil for a long time. Its negative action and mortality rate in partridges were reported by Berny et al. (1999). By analysing a mass poisoning of wild birds in Spain, Martínez-Haro et al. (2008) reported that poisoning in the period from 1990 to 2005 caused many deaths of predatory bird species the causes identified as aldicarb and carbofuran (27.59% each) to methomyl (8.62%) and strychnine (6.9%) what is in compliance with the research (Soler Rodríguez et al. 2006). Nevertheless, taking all into consideration, the mammals, especially carnivore species, are also, to a great degree, endangered in secondary contamination, therefore, according to Lamarque et al. (1999) in France the poisoning of

carnivore accounts for 39% in which fox alone accounts for 23.6% in all recorded deaths caused by poisoning. When ungulates are in question it is thought that the per cent of their poisoning is about 25% although it has been confirmed in only 2.1 % cases (Edwards et al. 2000).

### **Anthropogenic effect on brown hare population due to contamination by pesticides from agro-biotope**

A brown hare is highly adaptive species which successfully accommodated to the conditions of intensive agricultural production. When leverets are in question, they are on the second place per frequency of poisoning among mammals. Edwards et al. 2000. report that in hares poisoning accounts for 26.2 cases and in rabbit 9.2%. The loss of biodiversity in hare population is another example of anthropogenic impact (Mezei et al., 2018.). The authors in mentioned paper point out that in different localities there exists statistically significant difference in presence of pesticides in brown hare adipose tissue. The authors point out the locality of Bačka Palanka with high presence of pesticides in relation to other localities what may be one of the causes of biodiversity loss (Mezei et al., 2018; Bursić et al., 2018.). By analysing the presence of pesticides in kidneys, out of 30 pesticides the 8 were detected in which in all samples of hares a low contamination was recorded except for two samples where residues of oxamil, carbendazim and cymoxanil (Bursić et al., 2017b) were determined in concentrations higher than allowed by EU Regulation (EC 2005). By analysing the results in one hunting ground in the territory of Bačka, an intensive agricultural production is pointed out as one of the causes of the occurrence of pesticides residues wherein a significant correlation of age and level of pesticides in brown hare adipose tissue has been found (Beuković et al., 2017). Observing the results in previously mentioned hunting ground the most frequent were residues of following pesticides: cyprodinil, difenconazo, metaxil M, tebuconazol and thiamethoxam (Beuković et al., 2017). According to the research of Šovljanski et al. 2006. it is thought that insecticides used in sugar beet treatment are extremely toxic while fungicides and herbicides are of lower toxicity what is again a significant example of anthropogenic impact on hare population which use sugar beet in their nutrition. It should be pointed out that intensification of agriculture dramatically reduced diversity of wild plant species in agricultural areas what is by many authors considered to be very important for decreasing the density of hare population in Europe. The problem of food deficiency in summer after gathering winter crops is particularly pointed out (Beuković et al., 2011) in conjunction with treating the stubble fields by total herbicides. Because of mentioned anthropogenic effects the weeds which are at that time essential green food for large monocultures are destroyed while pesticides are introduced into food chain. A solution to these problems may be development of “green corridors” between the fields under monocultures and the organic vegetable production (Beuković et al., 2011)

### **Conclusion**

On the basis of this review it can be clearly seen that in many studies it has been found out that previously mentioned groups of pesticides are to a significant degree present in the tissue of brown hare and other animal species, particularly in regions under intensive agricultural production. Yet this issue is given special attention to only in situations when poisoning is massive and huge, i.e. when protected predatory species get killed. A comparatively disturbing can, first of all, be a latent

presence of pesticides in food chain which in conjunction with other factors may have serious consequences on reproductive status of hare in agro biotope. What should certainly alleviate current situation regarding the use of pesticides in intensive agricultural production may be better control of forbidden pesticides and pesticides used in a prohibited and irregular way.

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