Neonicotinoids: possibile new ED?

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The widespread alarm on the severe decrease of the bee population, reported by scientific literature as well as media, has been attributed to different factors among which the agricultural use of neonicotinoids. Neonicotinoids constitute a class of systemic insecticides of new conception which have quickly spread in the last decade; their name is due to their similarity in structure to nicotine.

The active principles are: imidacloprid (progenitor compound), thiametoxam and clothianidin. The highly hydrosoluble neonicotinoids are quickly absorbed by the plant and conveyed in all its parts, allowing protection also to the parts developing after treatment. Moreover these plant protection products are also used for seeds dressing, as antiparasitic drugs for domestic animals as well as insecticides for domestic use. Neonicotinoids act on the central nervous system of insects with a acetylcholine-mimetic mechanism, altering the nerve impulse transmission by irreversibly binding to the acetylcholine nicotinic receptors (nAChR), localized in synapses between two neurons. The differences between insects and mammals nAChR bestow to such substances a high selectivity (Tomizawa M and Casida JE, 2005). Despite, some recent data seems to suggest a neurotoxicity risk for useful insects such bees, especially subsequently to chronic exposure, triggering variations in communication and orientation ability (Ramirez-Romero R et al, 2008).

The suspect is that neonicotinoids may induce “subtle” alterations also in vertebrates and maybe such risk has not been adequately evaluated yet, particularly in the matter of neuro-endocrine effects.

Imidacloprid shows low acute toxicity in laboratory animals; administration during pregnancy results in skeletal anomalies in rat and rabbit. In dogs hepatic toxicity was observed, with an increase of cholesterol serum levels, following prolonged dietary exposure. Thyroid histological alterations, mainly evident in males, can be observed in rat following chronic exposure at \( > 300 \) mg/kg food (comparable to about 15 mg/kg pc); the mechanism of such effects has not been explicated yet (http://extoxnet.orst.edu/pips/imidaclo.htm).

It is important to point out that nAChR, the target receptor for neonicotinoids, is present in mammals in several districts involved in the endocrine network: chromaffin cells of the adrenal medulla (Sala F et al, 2008), pineal gland (Hernandez SC et al 2004) as well as in male germ cells, principally in flagellum (Palmero S et al 1999). The potential effects of neonicotinoids mediated by the interference of nAChR in mammals are not well known yet; however the activity of nAChR is modulated by endogenous hormones (estraadiol) as well as endocrine disrupters such as phthalates (Liu PS and Lin CM, 2002).

The still limited data available shows that the neuro-endocrine effects of neonicotinoids in vertebrates should deserve a more focused evaluation.

References


• Ramirez-Romero R, Desneux N, Decourtye A, Chaffiol A, Pham-Delégue MH. Does Cry1Ab protein affect learning performances of the honey bee Apis mellifera L. (Hymenoptera, Apidae)? Ecotoxicol Environ Saf. 2008 Jan 16 [Epub ahead of print]
