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## Neurological and Behavioral Effects that may be Caused by Pesticides

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NEUROLOGICAL OR BEHAVIORAL EFFECTS	PESTICIDES	SUMMARY OF STUDIES
Neurocognitive Effects	Organophosphates, N-methyl carbamates	Pesticides can penetrate the blood brain barrier or affect the brain by disrupting oxygen supply, nutrients, hormones, or neurotransmitters. <sup>1</sup> Acute or chronic exposure to organophosphates and N-methyl carbamate pesticides may cause neuropsychological deficits. Exposure to organophosphates may also cause visuospatial deficits. Cognitive symptoms include impairment of memory and psychomotor speed, anxiety, irritability, and depression. <sup>2</sup>
Parkinson's Disease (PD)	Paraquat, organophosphates, dieldrin, fungicides maneb and mancozeb,	The cause of Parkinson's Disease is unknown, but studies have found associations with herbicide and insecticide exposure—one study found that patients with PD were three-four times more likely to have past exposure to insecticides. <sup>3,4</sup> One animal study found a correlation between the combined use of paraquat and maneb and the incidence of PD. <sup>5</sup>
Peripheral Neurotoxicity	Organophosphates and N-methyl carbamates	These pesticides can interfere with impulse transmission in the peripheral nervous system. <sup>6</sup> High dose exposures to organophosphates can result in chronic effects such as sensory, motor, and autonomic neuropathies. <sup>7</sup> Acute organophosphate poisoning may cause muscle weakness, profound weakness of the neck flexors, and weakness or paralysis of the muscles involved in respiration. <sup>8</sup>
Delayed Neurotoxicity	Organophosphates	Organophosphate-induced delayed neuropathy (OPIDN) may cause weakness, paralysis, or parasthesias, mainly of lower extremities. <sup>9</sup>
Sensorimotor deficits	DEET, permethrin	Recent research in laboratory rats suggest that exposure to DEET, which is the main ingredient in most mosquito repellents, and permethrin, which is used in MD for mosquito control, may cause significant sensorimotor deficits and disruption of the blood-brain barrier. <sup>10</sup>

Source: Solomon, Gina (2000). "Pesticides and Human Health: A Resource for Health Care Professionals." Published by Physicians for Social Responsibility and Californians for Pesticide Reform. Available online at <http://www.sfbaypsr.org/publications.html>. Also see endnotes.

1 Keifer, M.C. and R.K. Mahurin (1997). "Chronic Neurologic Effects of Pesticide Overexposure." *Occupational Medicine (Philadelphia)* 12, p. 291-304.

2 Jamal, G.A. (1997). "Neurological symptoms of Organophosphorus Compounds." *Adverse Drug Reactions Toxicol Review* 16, p.133-70.

3 Gorell, J.M., C.C. Johnson, B.A. Rybicki, et al. (1998). "The Risk of Parkinson's Disease with Exposure to Pesticides, Farming, Wellwater, and Rural Living." *Neurology* 50: 1346-50.

4 Veldman, B.A.J., A.M. Wign, N. Koers, et al. (1998). "Genetic and Environmental Risk Factors in Parkinson's Disease." *Clin Neurol Neurosurg*, 100: 15-26.

5 Thiruchelvam, M., E. Richfield, R. Baggs, A. Tank, and D. Cory-Slechta (2000). "The Nigrostriatal Dopaminergic System as a Preferential Target of Repeated Exposures to Combined Paraquat and Maneb: Implications for Parkinson's Disease." *J. Neuroscience*, 20: 9207-9214.

6 See note 1 above.

7 See note 1 above.

8 Stephens, R., A. Spurgeon, and H. Berry (1996). "Organophosphates: The relationship between chronic and acute exposure effects." *Neurotoxicol Teratol*, 18: p. 449-53.

9 National Environmental Education and Training Foundation (2003). "Competency Guidelines for Medical and Nursing Education." A Project of the National Strategies for Health Care Providers: Pesticides Initiatives. Available online at <http://www.neetf.org/health/PestEd.pdf>.

10 Abou-Donia M., et. al, (2001). "Subchronic Dermal Applications of DEET and Permethrin to Adult Rats, Causes Diffuse Neuronal Cell Death and Cytoskeletal Abnormalities in the Cerebral Cortex and the Hippocampus and Purkinje Neuron Loss in the Cerebellum." *Experimental Neurology*, November.