Potential for the Development of Insecticide Resistance to White Grubs

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In general, the probability of development of resistance depends on the frequency of the resistance gene in any given population. The higher the resistance gene frequency, the more easily the resistance develops. The basic philosophy of management is that one can prevent the resistance gene frequency by not selecting so rigorously with insecticides.

This being said, there have been relatively few documented cases of insecticide resistance in the turf and landscape settings. This phenomenon is likely due to the life cycle of insects associated with the turf and ornamental landscape. Many turf and ornamental insects have one to two generations per year, especially white grubs. Consequently, the frequency of exposure of an insecticide to turf or ornamental insects is relatively low.

However, where widespread, repeated applications of the same insecticide are made over an extended period of time, insecticide resistance is possible. For example, most turfgrass managers typically rely on annual applications of nicotinoid insecticides (e.g., clothianidin [Arena], imidacloprid [Merit], or thiamethoxam [Meridian]) to manage white grubs. As a result, turf managers may be predisposing themselves to a greater potential or likelihood of resistance since nicotinoid insecticides have fairly long residual activity (> 100 days) and they are frequently applied to relatively large areas of turf on an annual basis.

There are several insecticide resistance management practices that can be employed to reduce the likelihood of developing insecticide resistance, including: 1) alternating among classes of insecticides; 2) making target treatments rather than blanket or prophylactic sprays; 3) using shorter residual insecticides; and 4) selecting non-chemical methods of insect control (i.e., cultural or biological). To this end, the most practical approach to reducing the likelihood of insecticide resistance is to rotate or select alternative classes of insecticide chemistry or to make target treatment applications of an insecticide to areas where the target insect has historically been problematic rather than making blanket or cover sprays.

For various reasons, including: 1) performance; 2) effectiveness; 3) reliability and 4) cost, the nicotinoid class of insecticides dominate the white grub market as the insecticide of choice for preventative control. From an insecticide resistance management perspective, this situation raises concerns as the potential for insecticide resistance is heightened. For this reason, the development and registration of effective, alternative insecticide classes are needed to reduce the potential for the development of insecticide resistance to white grubs.

Fortunately, a new insecticide class has been discovered. DuPont has reported a novel insecticide class named the anthranilic diamides. Anthranilic diamides have a truly novel mode of action–they are not nerve poisons. Rather, the mode of action is the activation of ryanodine receptors in muscle cells that have selectivity for insect receptors. Specifically, the active ingredient (chlorantraniliprole) causes calcium ions to leak out of insect muscle cells, which ultimately results in insect death. Because of this selectivity, anthranilic diamides are extremely safe to mammals (a mammalian toxicity LD_{50} of 5,000 mg/kg). Chlorantraniliprole promises to be a very low toxicity insecticide that is a highly effective preventive grub control material. Chlorantraniliprole is expected to be registered with the EPA and commercially available sometime in the spring of 2008 under the brand name of Acelepryn™.