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Editorial
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Insecticidal Seed Treatments in Rice

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Editorial

Rice is the staple food for the majority of the world's population. Globally, rice is cultivated on an estimated 160 m ha annually [1]. Although the U.S contributes only 2% of world rice production from less than 1% of world's acreage, the U.S is one of top five global exporters of rice [2]. Insect pests pose a major biotic threat to rice production throughout the world. In the U.S, the rice water weevil (RWW), Lissorhoptrus oryzophilus Kuschel (Coleoptera: Curculionidae), is the most destructive insect pest of rice [3]. In addition to the RWW, a number of other pests can attack rice during the seedling, vegetative and early reproductive phases of rice development. The importance of these pests varies regionally. In Arkansas, for example, Colaspis sp. can be important pests of young rice and can severely reduce early season stands [4]. In Louisiana and Texas, several Lepidopterans are important, including the fall armyworm, Spodoptera frugiperda (Lepidoptera: Noctuidae), and the sugarcane borer, Diatraea saccharalis (Lepidoptera: Crambidae). While these pests are not consistently important constraints on yield, they can occasionally cause heavy losses. In contrast, losses from the RWW would probably average 5% or more if fields were not treated and this insect is a key driver of early season pest management decisions [5]. Application of foliar pyrethroid insecticides for weevil management, a practice used since the late 1990's, has been problematic due to high toxicity of this group of insecticides to aquatic invertebrates, primarily to red swamp crawfish, the major aquaculture commodity co-cultivated with rice in rotation systems in Louisiana [6-8]. As alternatives to pyrethroids, two groups of insecticides have been labeled since the mid-2000s as seed treatments in rice- the anthranilic diamide group (active ingredient: chlorantraniliprole; Dermacor X-100®) and the neonicotinoid group (active ingredietns: thiamethoxam; Cruiser Maxx®; clothianidin; Nipsit INSIDE®). These seed treatment insecticides have longer residual activity on RWWs than pyrethroids and are two to three orders of magnitude less acutely toxic to crawfish than pyrethroids [6,7]. The two groups of seed treatment insecticides differ in their activities on their sporadic insect pest complex [9] and in their potency against weevils [10]. The growers' choice of treatment with neonicotinoid or anthranilic diamide is influenced by the threat of sporadic pests, the relative safety of these insecticide classes on crawfish, and the cost of treatment.

A corner stone of IPM is the holistic use of compatible tactics that minimize the selection pressure imposed by any single tactic, thus enhancing the long term sustainability of management programs. To this end, chlorantraniliprole seed treatments have been found to be compatible with the water management strategy of shallow flooding and with the use of resistant cultivars [11]. The high potency and efficacy of chlorantraniliprole compared with neonicotinoid seed treatments suggest the potential to reduce the use rates of chlorantraniliprole [11], although there is debate about whether reducing insecticide rates is compatible with insecticide resistance management [12,13]. Notwithstanding this debate, reducing insecticide use can help alleviate insecticide presence and persistence in the environment. The exceptional selectivity of anthranilic diamides for insect ryanodine receptors as opposed to mammalian receptors, combined with the high potency of these insecticides against Lepidoptera and Coleoptera, has attracted considerable attention in the crop protection industry for deployment of this group of insecticides for pest management in field, fruit crops and turf grasses [14].

There are, however, several issues and questions related to the use of seed treatment insecticides that urgently require attention from researchers. High levels of the anthranilic diamides in crops and soils [15] - for instance, rice treated as seeds with chlorantraniliprole residues persist in root even at mid tillering - raise questions on environmental persistence of anthranilic diamides [9]. Neonicotinoids are highly soluble and residues disappear quickly in rice plants [9] but active ingredients in surface runoff, tail water from irrigated fields and contamination of ground water could be problematic in crops such as potato, corn and soybeans [16-20]. The growing evidence for the negative impacts of neonicotinoid use on pollinators may favor for the use of more selective anthranilic diamides as alternatives. The effects of seed treatments on soil dwelling arthropods and aquatic insects in rice and other crops are unknown. The ecosystem services provided by soil and aquatic arthropods through their detritivorous and predatory habits signify the need for evaluating the impact of seed treatments on these non-target organisms. Although both modes of action of insecticides are less likely to cause acute toxicity to crawfish in rice pond ecosystem and seem to be more compatible with rice-crawfish crop rotations than pyrethroids, as evidenced from crawfish survival in simulated field paddy experiments in small plots [[21], SKL and MJS unpublished], studies on the effects of prolonged exposure on this crustacean in field exposure settings are lacking. Finally, seed treatments could have direct effects on plants by way of altering plant defenses [22], plant responses to abiotic stresses [23] and plant growth. Research in these areas is required to understand the overall economic and environmental impacts of seed treatments in rice.

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