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Efficacy of 10 dusts on life cycle of *Tribolium castaneum*

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Silica dusts have a long history of use in agriculture for insect control. But the product has several problems that limit its overall use and effectiveness. The present study is investigating a form of silica that has not been used in agriculture to date. The study has been comparing both hydrophilic and hydrophobic forms of the silica against traditional silica products such as Dryacide. The study

has focused on the key grain pest the red flour beetle (*Tribolium castaneum*) and explored the ability of the new form of silica to control the various beetle life stages. The results show that the efficacy of the new silica against larvae was nearly two-to threefold higher than that of adults. The results also show a clear difference in performance between hydrophilic and hydrophobic forms of the silica with hydrophobic forms outperforming the hydrophilic forms for the control of the red flour beetle.

Susceptibility of Stored Grain Insects to the Insect Growth Regulator Methoprene

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Abstract

The insect growth regulator (IGR) methoprene is labeled in the United States (US) for direct application to stored grain commodities, and as a residual surface treatment to empty grain bins and flooring surfaces inside indoor structures. Methoprene is also labeled in the US as an aerosol for use in indoor areas. One of the challenges in research with methoprene and stored product insects is through design of experiments that mimic how methoprene would be used in practical applications. Recent research with methoprene will be used to describe experimental designs to examine efficacy of methoprene when used as a grain protectant.

Keywords: stored products, IGRs, management, efficacy

1. Introduction

Insect pests can cause economic damage to stored grain commodities, especially in warm temperature areas and in the tropics. One of the components of integrated pest management (IPM) for stored grains is the use of protectant insecticides, which are applied as raw commodities are loaded into grain bins or elevator silos. Historically organophosphate insecticides were the primary protectants used by grain managers, but due to concerns with insecticide resistance, along with new regulations, some products in developed countries have been removed from the market (Daglish, 2008; Arthur, 2012). Today there is more emphasis today on using reduced-risk insecticides, including but not limited to pyrethrins, pyrethroids, insect growth regulators (IGRs) (Arthur, 2012), and biological insecticides such as spinosad (Hertlein et al, 2011, Nayak and Daglish, 2017).

Other components of IPM programs for stored grains include the use of aeration, which involves using low airflow rates to cool and modify a grain bin, thus limiting the growth of insect pests Arthur and Casada, 2016). It is not to be confused with grain drying, which utilizes much higher airflow rates to remove excess moisture from grains before they are stored (Navarro et al., 2012). Pre-binning cleaning and sanitation is also important, as the environment in and around grain storage sites can contain residual pockets of grain residues and spillages that will support insect pest development (see references in Arthur, 2018). Finally, the primary component for controlling stored grain insects is the fumigant phosphine. Concerns regarding the development of phosphine resistance (Lorini et al., 2007, Nayak et al., 2015, 2017, Afful et al., 2018) could lead to more extensive use of grain protectants. Thus, when designing experiments to evaluate efficacy of grain protectants, including reduced-risk adulticides and IGRs, there are multiple factors that must be considered

One IGR that is being used in the US as a grain protectant is methoprene, which is also labeled as a residual surface treatment and as an aerosol inside structures to control stored product insects. As an IGR, it does not kill adults, and it has limited efficacy against *Sitophilus species* (Lui et al, 2016). Methoprene can be used alone, or combined with other strategies, including the use of aeration (Arthur, 2016; Lui et al., 2016) and with the pyrethroid deltamethrin (Kavallieratos et al., 2015). Multiple factors should be considered when planning experiments utilizing methoprene as a grain protectant. This paper presents a review and discussion of some of those factors as they relate to