Ecotoxicology and Environmental Safety 154 (2018) 92–99

Contents lists available at ScienceDirect

Ecotoxicology and Environmental Safety

journal homepage: www.elsevier.com/locate/ecoenv

Toxicological effect of underutilized plant, *Cleistanthus collinus* leaf extracts against two major stored grain pests, the rice weevil, *Sitophilus oryzae* and red flour beetle, *Tribolium castaneum*

Govindharaj Guru-Pirasanna-Pandi*, Totan Adak, Basana Gowda, Naveenkumar Patil, Mahendiran Annamalai, Mayabini Jena

Division of Crop Protection, ICAR-National Rice Research Institute, Cuttack 753006, India

ARTICLE INFO

Keywords:
Botanicals
Biopesticide
Coleoptera
Phyllanthaceae
Repellence

ABSTRACT

Toxicity and repellency activity of *Cleistanthus collinus* (Roxb.) (CC) leaf extracts were evaluated against rice weevil, *Sitophilus oryzae* (L.) and red flour beetle, *Tribolium castaneum* (Herbst) under laboratory condition. Five concentration(s) (1%, 1.5%, 2%, 2.5% and 4%) with two controls (acetone and water) treatments along with deltamethrin were used for direct and contact residual toxicity. The insect that survived after CC exposure were transferred to an untreated feeding substrate and the population buildup of subsequent two generation were recorded after 30 (F_1) and 60 days (F_2). In the contact residual toxicity, highest CC concentration (4%) produced 75% mortality in *S. oryzae* and 62.5% mortality in *T. castaneum* during 7 days of exposure, whereas in direct toxicity the mortality were 81% and 58% respectively, for *S. oryzae* and *T. castaneum*. The long term effect of CC was apparent in both the insect species, where F_2 populations were significantly decreased in the CC treatments. CC treatment at 4% produced similar adult mortality in comparison to deltamethrin at 1%. In addition, repellent activity of CC extracts was observed against both *S. oryzae* and *T. castaneum*. This is the first step towards assessing the scientific basis for the understanding the effectiveness of CC extracts against stored grain pests and it could be a viable eco-friendly option for stored grain insect pest management.

1. Introduction

Rice holds the record of being staple food for more than 1.6 billion people around the world, particularly in Asia, Latin America, and some parts of Africa. It is invariably infested by insect pests at all stages starting from their growth until they are being processed and consumed. Tropical and sub-tropical regions of the world facing difficulty to increase their food grain production; however they are more quantity of produce lost between harvest and consumption by storage insect pest (Kumar and Kalita, 2017). Storage is the one of the important post-harvest practices that when properly executed, helps in reducing food shortage problems. Among the different losses in post-harvest operation, storage holds a major share (7.5%). According to food and agricultural organization (FAO), approximately 70% of the farm produce is stockpiled by farmers for various purposes. In India, farmers generally use locally designed storage structures for bulk storage of their commodities which in most cases are not insect or moisture proof (Grover and Singh, 2013).

Storage insect pests inflict both qualitative and quantitative loss to cereals, making them unfit for sowing (loss viability) or for food or feed. Further, it also creates serious problems for food industries and export commodities via., food contamination (Rajendran, 2002). United Nation (UN) reports suggest that, *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) and *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae), are the two foremost storage insect pest of rice throughout the world (Sallam, 2014). These are most devastating stored insect pests that causes about 30–40% weight losses thereby have greater economic importance. Moreover, pest infestation may have upto 90% damage potential within 5–6 months after infection.

It is extremely difficult to eradicate any species of insect pest as they are coevolved with plants, so it can only be managed by bringing down the population to below economic injury level (EIL). In storage also different management options like physical, bio-control agents, sex pheromones, botanicals, fumigants and synthetic insecticides *etc* (Golob, 1997; Shaaya et al., 1997; Rosell et al., 2008; Islam et al., 2010; Isman, 2017) have been evaluated and recommended to farmers.

* Corresponding author.
E-mail addresses: guru.g@icar.gov.in (G. Guru-Pirasanna-Pandi), totanadak@gmail.com (T. Adak), basanagowda4099@gmail.com (B. Gowda), patil2850@gmail.com (N. Patil), annamalaiagriento@gmail.com (M. Annamalai), mayabini.jena@gmail.com (M. Jena).

https://doi.org/10.1016/j.ecoenv.2018.02.024
Received 28 August 2017; Received in revised form 3 February 2018; Accepted 5 February 2018