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Biology and Ecofriendly Management of Rice Weevil *Sitophilus oryzae* (LIN.) in *Stored Sorghum*

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Abstract

Sorghum (Sorghum bicolor (L.) moench) is a premier crop of the semi arid tropics. It is a dry land crop grown in kharif and rabi seasons. In India sorghum growing areas are situated in Andhra Pradesh, Gujarat, Haryana, U.P, Karnataka, Maharashtra and Tamil Nadu. Sorghum grains are eaten in different forms in India. Stored sorghum suffers heavy damage by rice weevil, Sitophilus oryzae L. necessitating detailed studies on its biology and eco-friendly management on sorghum.

Keywords: *Sorghum, Kharif, Rabi, Sitophilus oryzae, Eco-friendly.*

Introduction

In India, sorghum or jawar, *Sorghum bicolor* (L.) moench, is the third important cereal crop after wheat and rice. It is a premier crop of the semi-arid tropics and used as a major staple food in several parts of the world. Major sorghum growing areas in India are Andhra Pradesh, Gujarat, Uttar Pradesh, Madhya Pradesh, Rajasthan, Karnataka and Tamil Nadu. About two third of total area of sorghum is under *Kharif* crop and remaining area is under *rabi* crop for food, feed forage and industrial raw material. (Anonymous 2015)

Sorghum grains are consumed in different forms in India namely boiled rice like products, poultry feed, source for alcohol production and unleavened bread. Popped sorghum is a popular snack food in central and south India. Popping improves quality by reducing anti-nutrients, increasing grain protein, soluble dietary fibre and carbohydrate digestibility (Subramanian 1956)

During green revolution era concerted efforts in sorghum were made to increase its productivity. The principal aim of green revolution was feed our ever increasing human population which is growing at the rate of 2.1% per year (Gahukar, 1992; Prem Kishore and Gahukar, 1992). It is well established fact that lot of efforts are be put for the production of grain but there is no use if the produced seeds are not saved. Several insects attack the stored grains, among them *Sitophilus oryzae*L. is very common.

For controlling this dangerous pest on sorefum several protective methods have been developed , like use of different insecticides, pesticides but these methods are not good for grains, therefore,sevral many eco-friendly methods have been developed.

Importance of Rice Weevil, *Sitophilus oryzae* L

Sitohilus oryzae L. is the most destructive insect pest of the stored cereals, mainly wheat, rice and maize(Champ and Dyte, 1976). This species has relatively short developmental period and high populations can easily be built up. It has been found that rice weevil infestation alone resulted in sorghum grain losses of 61.3% over a period of 5months (Venkatrao et al. 1958). The weight loss in stored sorghum is caused by both larval and adult feeding. Besides causing grain loss, weevil infestation reduces the quality and viability of seed as well as seedling vigour. The presence of storage pest in grain also reduces the commercial value of sorghum (Borikar and Tayde, 1984)

In the countries, where storage facilities are inadequate, stored grain resistance might be used either alone or along with other protective methods. Apart from this different plant products and inert materials have been used as surface barrier against storage pests to prevent cross infestation.

Biology of Rice Weevil, *Sitophilus oryzae* L.

Sitophilus oryzae is a tiny weevil (1.6in.long) with its head produced into a snout like projection. It is generally reddish brown in colour. The two sexes look superficially alike but when carefully examined, the males can be distinguished from the females by the form of the rostrum which is shorter and broader in the male than in the females. Life cycle of *S.oryzae* contains eggs, larva, pupa and adults. Both adults and larvae attack the grain upon which they feed voraciously so muches that the grain is rendered unfit for human consumption.

Wille (1923) observed that *S.oryzae* takes 45 days in summer, 5 months in cool weather of autumn and winter for completion of one generation where as Okuni(1924) reported eight generations of *S.oryzae* in a year. According to Lopez, and Cristobal (1953) the adult survived for 15 to 30 days with food. Bheemanna (1986) observed adult longevity ranging from 14 to 165 and 7 to 11days with and without food, respectively. Yevoor (2003) observed that female lived for 115.76 days; male lived for 97.42 days with food. Female lived for 9.50 days, male lived for 7. 32 days without food.

Controlling of Rice Weevil by Various Methods

By Screening of Sorghum varieties/ Hybrids against rice weevil

Recently many efforts are being made to develop varieties less susceptible to stored grain pests. Samuel and Chatterji (1953) reported that among the 24 varieties screened against *S.oryzae* the variety JS- 20 proved to be highly resistant. Whereas the variety imperial Saomer was highly susceptible to the pest: Kishore et al (1975) reported that percentage of damaged grains due to rice weevil after 45 days varied from 6.50(CSH-5) to 21.17(CSV-4) Borikar and Tayde (1979) carried out screening studies against rice weevil and reported that hybrids CSH-8R, CSH-1 and CSH-5 and the varieties 168 and 370 were less susceptible to attack to *S.oryzae* than the local varieties. Reddy et al (2002) evaluated thirty five grain genotypes representing 6 variable groups for orientation, colonization and ovipositional response of the rice weevil, *Sitophilus oryzae* (L.) Greater levels of oviposition were noticed in 2077B, DJ-6514 and IS 11758 in free choice tests and 22198, M148-138, P-721 and Nizamabad (M) in no choice tests. Significantly less damage to seed observed on 2219A/B, 116B, IS9487, CSV8R (M) and local yellow (Anonymous, 2014).

Eco-friendly methods for the Management of Rice weevil in stored Sorghum ---

Recently, interest in has been shown plant- derived compounds as alternatives to the synthetic insecticides. They are biodegradable and are relatively safe to natural enemies and higher organisms.

There are many examples of plant derived compounds:

Sweet flag rhizome*(Acorus calamus*) powder

Jilani (1984) and Panesu et.al (1983) reported that sweet flag rhizome reduced the seed infestation upto 5.4 percent compared to untreated control.

Biradar (2000) studied the mortality of *S.oryzae* consequent to the impregnation of gunny bags with botanicals.

Yevoo (2003) studied that sweet flag powder at 2 percent caused zero percent grain damage and weight loss.

Turmeric*(Curcuma longa)*

Panikar and Vijayalakshmi(1998) reported use of turmeric powder against *S. oryzae*

Neem leaf powder*(Azadirachta indica*)

Neem leaf powder has repellent activity (Jilani and Su (1983)). This repellent activity of neem leaf powder was also supported by Banrjee and Nigam(1985) Sunilkumar(2003) studied that neem leaf powder at 1 percent dosage was not effective in protecting the sorghum grains after 30days after storage against *S.oryzae.*

Custard apple seed powder *(Anona squamosal* L.)

The custard apple seed extract possess more olfactory repellency against normal susceptible strain of *S.oryzae* (Quadri, 1973).

Mishra et al (1992) found that wheat grains can be protected from the attack of *S.oryzae* by mixing custard apple seed powder at 5percent for 75days.

Sunil Kumar (2003) reported that custard seed powder at 1percent was effective in controlling *S.oryaze* on sorghum grains upto 90days after storage.

Tulsi Leaf Dust (Ocimum Sasi Licum)

Banrjee and Nigam (1985) reported that tulsi leaves has repellent property against stored grain pests.

Lohra and Singhavi(1998) reported the repellency power of tulsi at the rate of 1.0,2.5 and 5.0 ml/100mg sorghum seeds against *S.oryzae*.

Lakke leaf powder *(Vitex negundo)*

Mishra et al. (1992) reported that Lakke leaf powder at 5 percent in wheat grains caused 80 percent mortality of *S.oryzae* in 30days after treatment.

Sunil Kumar (2003) showed that there was 7to 18 percent seed damage in sorghum seeds treated with *vitex negundo* at 1percent from 3 to 90 days after treatments.

Inert materials to be used for Evaluation Against *S.oryzae*

Many Inert materials were also tried to protect grains against storage pests like:

Kaolinite clay

Alexander et al. (1944) was the first to report that inert dusts remove the insect epicuticular lipid layer by absorption depending on physical nature of the dust particles.

Swamiappan et al. (1976) observed that acid activated clay treatment caused cent per cent adult mortality of many of the stored grain pests within 24 hours after treatment.

Yevoor (2003) reported that Ka olinite at 10percent caused up to 90percent mortality of adult at 28days after treatment.

Neem Seed Kernel Powder-(NSKP)

Mishra et al. (1992) reported that neem seed Kevel powder at 0.5 percent (w/w) retained its effect for longer duration causing 100, 96.70, 83.30 percent adult weevil mortality at 30, 60 and 75 days after treatment.

Rama Rao and Sarangi (1998) reported neem seed powder (5%) as an effective grain protectant against *S.oryzae.*

Sunil Kumar (2003) observed that neem seed powder at 1percent showed less percent of seed damage of 5 to 10 percent after 30 to 60 days of storage.

Sand

Application of sand in India is an age old practice to protect stored grains from insect attack (Pruthi and Singh, 1950). Sand at 30 percent effectively prevented the infestation by*S.zeamais* in maize (Golob et. al. 1982)

Saw dust

Chahal and Judge (1988) studied saw dust as physical barrier against Khabra beetle in wheat grains. An 8cm. layer of saw dust over wheat grains prevented the attack of beetle.

Yevoor (2003) reported that saw dust at 10 percent was not effective in controlling rice weevil damage to maize grains.

Cow dung Ash

Pawar (1980) observed that 1.25 cm layer of cow dung ash at the top was effective in protecting seeds from *C. chinensis activities in redgram seeds.*

Yevoor(2003) reported that ash was not effective to maize grains which showed less than 50 percent adult mortality.

Conclusion

Investigations on rice weevil, *S.oryzae* with respect to biology, reaction of genotypes, efficacy of grain protectants carried out under laboratory condition. Different plant products and inert materials were evaluated to test their bioefficacy against *S.oryzae*. Bio efficacy was measured based on adult mortality, population build up, weight loss and percent seed damage. With respect to percent grain damage, the treatment of sweet flag powder was found superior followed by kaolinite and neem seed kernel powder.

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