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Management of rice weevil *(Sitophilus oryzae*) by using botanical pesticides in stored grain Sorghum for a sustainable environment

Puja Singh[1], Sangeeta Avasthi[2]
[1] Assistant Professor, Department of Zoology, A.N.D.N.N.M. Mahavidyalaya, Harshnagar, Kanpur, Uttar Pradesh, India
[2] Professor, Department of Zoology, A.N.D.N.N.M. Mahavidyalaya, Harshnagar, Kanpur, Uttar Pradesh, India

Abstract
The investigations on management of the Sitophilus oryzae linked with stored millets were taken away to understand the efficacy of Ecofriendly botanicals pesticides on the mortality of the pesticides. The efficiency of five environmentally friendly insecticides against Sitophilus oryzae infestations in sorghum is assessed. This experiment was conducted under a Complete Randomized Block Design (CRD). The effect of Phyto extracts and reasons on adult Sitophilus oryzae mortality at 30, 60, 90, and 120 days of exposure was investigated in this investigation. After 30 DAS days of storage, grain remained undamaged in treatments employing 5% concentrations of sweet flag powder, custard apple seed powder, and neem leaf powder, coriander seed powder. The highest level of grain damage was recorded by tulsi powder. At 60 days after sowing (DAS), the treatments using 5% sweet flag powder, 5% custard apple seed powder, and 5% neem leaf powder showed no grain damage. After 90 days after sowing, no grain damage was observed with the application of 5% sweet flag powder, 5% custard apple seed powder, and 5% neem leaf powder. The treatments using 5% sweet flag powder, 5% custard apple seed powder, and 5% neem leaf powder showed no signs of grain damage after 120 days. Therefore, it can be said that these compounds are both economically and environmentally feasible and can be easily obtained and used to control Sitophilus oryzae in stored grains like sorghum.

Keywords: Ecofriendly, Sitophilus oryzae, Sorghum, Sustainable environment, Botanical extract

Introduction

Sorghum is the fifth most significant cereal in the world after rice, wheat, corn, and barley. With 10.68 million tonnes produced overall, it ranks third in importance among India's cereal crops, behind rice and wheat (Anonymous 1983). More than 500 million people in 30 Asian and African nations depend on it as a staple crop (ICRISAT 2015), Although its economic needs and uses may alter over time, Africa's native crop is sorghum [Sorghum bicolor (L.) Moench]. In regions of Asia and Africa, Sorghum is a staple crop and is used for food to the tune of over 90%. Sorghum is mostly utilized in the US to produce ethanol and feed cattle. India produces 8.9 million metric tons of Sorghum and 3.0 million metric tonnes of millet annually (Anon 2001 a, Table 1).

Sorghum is produced in India, which is the second-largest producer in the world. The principal States of India are Rajasthan, Maharashtra, Madhya Pradesh, Andhra Pradesh, Uttar Pradesh, and Karnataka for the production of Sorghum grain. Grains of Sorghum are mostly utilized as human food and stems and leaves are for use as animal food. The grains are used for food, beverage preparation, and biofuel. Rural regions will continue to be a staple diet for many rural communities. Sorghum is mostly grown in arid regions, particularly on thick clay soil that is shallow. It is a very versatile crop that can grow in a variety of conditions, including drought, different soil fertility levels, and different temperatures. Sorghum is grown in both season rainy season (kharif) and Rubi (post-rainy season crop). The months of November through December are ideal for production, and rain or high relative humidity should not coincide with flowering. Due to its many climatic adaptations to tropical regions, sorghum is frequently restricted to low-input management and poor soils. It is extensively grown under rainfed conditions for grain and forage production. Applying enough water and nutrients, particularly during crucial phases of crop growth, might result in high production. Certain hybrids have even been demonstrated to grow more when exposed to periods of drought stress. Depending on the cultivator, harvesting can occur five to seven months after planting, however, early varieties mature in less than 100 days. Sorghum has lots of nutrients like carbohydrates, proteins, fats, and calcium and a small amount of iron and vitamins. It has a comparatively high iron, zinc, phosphorus, and vitamin B-complex content. It is also a good source of fiber (86.2 5%). Red-grained tannins in particular have antioxidant properties that guard against cell damage, a significant cause of disease and aging. Sorghum is used by patients who are suffering from diabetes, and hypertension.

Drought-tolerant and high-energy crops include Sorghum due to its versatility and many applications, "Sorghum is one of the truly indispensable crops" needed for the survival of humankind.

The introduction of hybrids and high-yielding improved varieties greatly expanded grain production and a concomitant intensification of pest problems. Damage due to insect pests is one of the major concerns. Consequently, it's critical to prevent insect pest damage to grains like Sorghum and millet (Hall and Yoganand 2000). In India, nearly 32.1% of the produce is lost due to insect pests (Borad and Mital, 1983). The harvested Sorghum grains are attacked by pests during storage.

According to Pradhan (1973), the "green revolution" accomplished in India the implementation of high yielding was the virtue of the absence of any serious pests in this crop. Similar initiatives with other crops, such as Sorghum, have not succeeded because of several significant insect

pests. Pest Sitophilus oryzae causes considerable and significant damage during storage affecting the quality and quantity of protein, fiber, and carbohydrates and damaging the nutritional value and organoleptic properties by feeding inside the kernel.

Rice weevil is the most commercially important of them, with 61.3% seed loss (Venkat Rao *et al*., 1958). For the management of insect pests former use chemical pesticides which are very hazardous to human health as well as the environment. This situation highlights the need for natural insecticides that are safe but effective for pest control in storage and have no harmful side effects on non-target organisms. Eco-friendly pesticides which are extracted from plant product these pesticides are Neem, Tulsi, Custard apple, sweet flag and Coriander.

Material and Method

Study area – The research was conducted at A.N.D.N.N.M. Mahavidyalaya affiliated with C.S.J.M.U. Kanpur.

Source of insects

The adult and larval form of Sitophilus oryzae were collected from infested grain of Sorghum and then reared in laboratory.

Biopesticides used and their preparation for plant powder

Leaves, Rhizomes, and Seeds are collected from several plants and then dried at room temperature making them fine powder in a grinder and then packed in a plastic container.

Table 1: List of Ecofriendly botanicals that have been used

Sr. No.	Common Name	Scientific name	Part	Dosage (%)
1.	Custard apple	*Annona squamosa L.*	Seed	5
2.	Sweet flag	*Acorus calamus L.*	Rhizome	5
3.	Neem	*Azadirachta indica A. Juss*	Leaves	5
4.	Tulsi	*Ocimum basilicum L.*	Leaves	5
5.	Coriander	*Coriandrum sativum*	Seeds	5

Culture of test insect

50 adults Sitophilus oryzae were introduced into 500g of disinfested Sorghum in kliner jars respectively in three replications in the laboratory. For the oviposition insect was left for 7 days and after that, it took an adult and transferred it into the next culture.

Experimental design

In this experiment, we use C.R.D (complete randomized design) with 3 sets of replications. 100 gm of treated seed (5gm/100gm seed) were put into a test tube in 3 sets of each treatment and see the percentage of losses brought on by insect pests and the percentage of damage and weight loss that were noted at 30-day intervals up to 180 days.

Grain damage by insect

Observe monthly grain damaged by Sitophilus insect and compare with control which is untreated by biopesticides

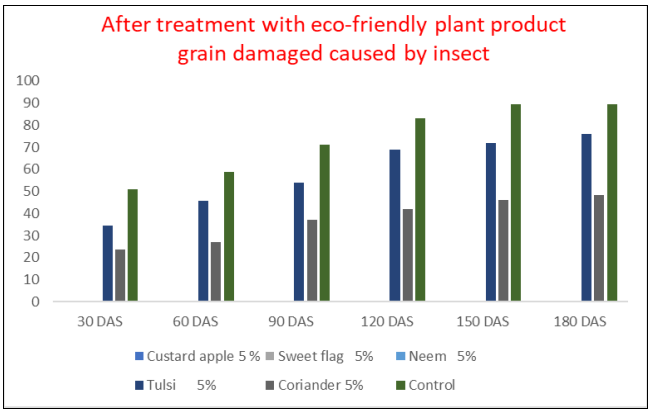
$$\% \text{ weight loss} = \frac{O-P}{Q} \times 100$$

P = weight of 100 damaged grains
Q= Weight of 100 undamaged grains
O = weight of equal no of undamaged grains

Experimental observation

Table 2: After treatment with an Eco-friendly botanical product grain damage caused by insect

Treatments	Duration					
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS
Custard apple 5 %	0.45	0.45	0.45	0.45	0.4	0.45
Sweet flag 5%	0.42	**0**.42	0.42	0.42	0.42	0.42
Neem 5%	0.41	0.41	0.41	0.41	0.41	0.41
Tulsi5%	34.43	45.75	54.01	68.84	72.02	76.00
Coriander 5%	23.82	26.906	36.950	41.830	46.03	48.529
Control	51.14	58.90	71.07	83.03	89.56	89.56



Result and discussion

From the above data, we can analyze that, after how many days which is the most effective Ecofriendly pesticides in which, grain loss is the least and which is the least effective in which grain loss is most.

30 DAS

The highest percentage of grain damage in untreated grain was found to be 51.14 percent 30 days after storage, followed by Tulsi (34.43) and Coriander (23.82), However, the treatments of 5% sweet flag powder (0.42), 5% custard apple seed powder (0.45), and 5% neem leaf powder (0.41) showed the least amount of grain damage. The maximum grain damage was observed in tulsi and coriander which is least effective in 30 DAS.

60 DAS

The most grain damage was noted in Tulsi leaf powder 5% (45.75) and coriander seed powder 5% (26.906) 60 days after storage. Least or no grain damage was recorded in neem 5% (0.41), custard apple 5% (0.45), and maximum damage was recorded in Tulsi leaves.

90 DAS

Neem leaf powder 5% (0.41), sweet flag powder 5% (0.42), and custard apple seed powder 5% (0.45) caused the least amount of grain damage, if any, while Tulsi leaf powder 5% (54.0) and coriander seed powder 5% (36.05) caused the most grain damage, making them less suitable for grain storage.

120 DAS

Following 120 DAS, the treatments of sweet flag powder 5% (0.45), custard apple seed powder 5% (0.42), and neem leaf powder 5% (0.41) showed little to no grain damage,

while Tulsi 5% (87.00) and coriander 5% (41.83) showed the most grain damage.

150 DAS

The treatments with the least amount of grain damage after 150 DAS were sweet flag powder 5% (0.45), custard apple seed powder 5% (0.42), and neem leaves powder 5% (0.41). The treatments with the most grain damage were Tulsi 5% (72.02) and coriander 5% (46.03), which are the least effective at storing grain.

180 DAS

The treatments with the least amount of grain damage after 180 DAS were sweet flag powder 5% (0.45), custard apple seed powder 5% (0.42), and neem leaf powder 5% (0.41). The treatments with the most damage were Tulsi 5% (76.0) and coriander 5% (48.589), which are the least effective at storing grain.

Overall, the findings showed that the most effective botanical pesticides for controlling S. oryzae infestation were sweet flag powder, custard apple seed powder, and neem leaf powder. Therefore, these plant products work well for storing sorghum grain.

Conclusion

Accordingly, the plant products—sweet flag powder, custard apple seed powder, and neem leaf powder—were the most successful in reducing the S. oryzae infection, according to the overall results. Table 2 shows the percentage of weight reduction following grain treatment with different plant products. There was no weight loss in the treatments of 5% sweet flag powder, 5% custard apple seed powder, and 5% neem leaves powder after 30 DAS. Results after 60 and 90 DAS were comparable.

Sweet flag powder 5%, custard apple seed powder 5%, and neem leaf powder 5% did not result in weight loss after 120 DAS. Tulsi powder 5% resulted in the greatest weight loss (56.00%). The outcomes following 150 and 180 DAS were comparable.

Thus, sweet flag powder, custard apple seed powder, and neem leaf powder were the most effective in controlling of *S. oryzae* infestation. The treatment of tulsi leaf powder and coriander seed powder was found to be the least effective.

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