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Effectiveness Of Specific Indian Spices In Controlling Rice Weevils (*Sitophilus Oryzae*) (Coleoptera, Curculionidae) In Stored Rice (*Oryza Sativa*)

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ABSTRACT:

Today, the rice sector heavily relies on synthetic pesticides to prevent loses. Nonetheless, these chemicals carry toxicity risks and can have harmful impacts on humans, animals and ecosystem. Thus, this study aims to observe the effectiveness of common Indian spices. The mortality and repllency rate were determined using a random arrangement with five different treatments. In this study, we have demonstrated the effectiveness of various Indian spices, viz, *Myristica fragrans* (mace), *Piper nigrum* (black pepper), *Cinnamomum zeylanicum* (cinnamon), *Carom copticum* (ajwain), *Laurus nobilis* (bay leaves) in protecting stored rice from *Sitophilus oryzae* infestation. The data was subsequently subjected to statistical analysis, with the significance level set at $P< 0.05$. Mace and Black pepper exhibited the highest effectiveness causing 90% and 85% of mortality respectively. In terms of repellency, the assessment of various reveals that Mace shows a significant repellent effect, demonstrating a notably high repellency rate within 12 hours. Therefore, the results indicate this trend (Mortality- Mace> Black pepper> Cinnamon> Ajwain> Bay leaves) (Repellency- Mace> Black pepper> Cinnamon> Ajwain> Bay leaves). This was an attempt to explore an alternative approach to pest management demonstrating that these spices contain elements with natural insecticidal and repellent properties. Experiment was performed to check the effecient of spices and repllency behaviour on Rice Weevil.

KEYWORDS: Mortality Rate, Indian spices, *Sitophilus oryzae*, Repellency Rate, Natural insecticides.

INTRODUCTION:

Rice, also known as *Oryza sativa,* serves as crucial crop and staple food for approximately half of earth's inhabitants cultivated across over 100 nations, its production is predominately driven by Asia, accounting for about 90% of global output (Akhtar and Raza,2015).

Rice faces persistent pest infestations during the period after harvest when it is stored. Among these pests, one of significant ones that adversely affect both the quality and quantity of stored rice *S. oryzae*, commonly referred to as Rice Weevils (Prastowo,2022).

The consumption of endosperm by rice weevils lead to reduction in carbohydrates content and depletion of significant amount of protein and vitamins, resulting in weight of stored grains (Dal Bello et al.,2000). Rice weevils are known to actively

reproduce in whole grains like wheat, barley, oats and rice and they also infest on various legumes and split pulses (Rajasara et al., 2019).

Both the larval and the adult stages contribute to the deterioration of stored products (Dhaniya & Dayanandan, 2016). In addition to direct losses, the reduced seed viability caused by *S.oryzae*, diminishes both the nutritional and market worth of grains (Ashamo,2006). Pest, particularly *S.oryzae* cause a decrease in stored rice in warehouses, typically ranging from 5% to 10% (Bond et al., 2013).

The extent of damage in each country varies based on factors such as climate, temperature, and humidity. In India, this damage typically falls within the range of 20% to 25%, emphasizing the critical need for measures to control these pests (Phillips & Throne, 2010). Traditional methods of protecting grains involve using common salt in red gram and adding ash to sorghum and rice to repel insects (Trivedi et al., 2018).

However, agricultural chemicals contribute significantly to both immediate and long-lasting risks, including pollution of soil, water, and air. The long- term risks posed by agricultural chemicals, such as cancer, genomic damage, oxidative stress, respiratory issues, thyroid disorders, and metabolic effects, cannot be ignored (Hajam & Kumar, 2022). Additionally, these chemicals contribute to a wide range of hazards, including resistance and resurgence.

Consequently, contemporary researchers are prioritizing the implementation of bio insecticide substitutes to mitigate adverse impacts on food safety. Naturally, plants, herbs, and spices serve as powerful reservoirs of pest deterrents due to their inclusion of specific bioactive compounds that both repel pests and serve as targeted toxins against them (Ravi et al., 2019; Tlak Gajger & Dar 2021).

Spices, sourced from nature, can efficiently manage pests in stored grains like wheat (Meena and Lal 2019). Spices offer an environmentally friendly alternative to synthetic pesticides, as they pose no harm to non- targeted organisms or the ecosystem. Unlike synthetic pesticides, spices do not leave behind the toxic residues that could pollute soil, water, or air (Farhana, Islam, Islam 2006). Excessive use of synthetic pesticides can result in the emergence of resistance within pest communities. Employing spices as a substitute can aid in averting or postponing the emergence of resistance. Generally regarded as safe for human consumption, spices carry minimal health risks if unintentionally consumed (Padin et al, 2013). Spices and their derivatives are biodegradable and can efficiently combat pests while preserving beneficial insects unharmed (Ushasri et al.2022).

MATERIALS AND METHODS

The study was conducted at 22ºC ± 5ºC and 85 ± 5% humidity. The experiment was a completely randomised design with 5 treatments and 10 replications of each; a control without any treatment was also included. This methodology is from (Saxena, 2016) through some changes are made.

Rearing of test insect

Sitophilus oryzae were raised using a procedure involving placing 50 individuals (approx. 25 males and 25 females) in a plastic jar filled with rice as both food and habitat. After leaving the jar undisturbed for several days, the adult insects were removed following 7 days of infestation, and then waited for over 35 days for new *Sitophilus oryzae* to emerge from the rice. The emerging insects were subsequently sorted to create a balanced population of males and females. Male and female insects could be distinguished by their body size and the length of their snout region, as females tend to be larger with longer snouts than males.

Preparation of spice powders

Five spices were used viz, Flower of *Myristica fragrans* (**Mace**), fruit of *Piper nigrum* (**Black pepper**), bark of *Cinnamomum zeylanicum (***Cinnamon**), the seed of opticum *Carum copticum*(**Ajowan**), and leaf of *Laurus nobilis* (**Bay leaves**).

These spices were sun dried for 7 days and then powdered in a grinder to their possible finest proportion. The powdered substance was placed in a dry plastic polybag labelled with a name of the spice to be utilised later in their experiment.

100 grams of rice with 10 gram of spice powder was taken for each treatment.

TABLE 1: LIST OF SPICES USED

SI.NO.	SPICE	BOTANICAL NAME	FAMILY NAME	PART USED	GRAMS
1.	MACE	*Myristica fragrans*	Myristicaceae	FLOWER	10gm
2.	BLACK PEPPER	*Piper nigrum*	Piperaceae	FRUIT	10gm
3.	CINNAMON	*Cinnamomum zeylanicum*	Lauraceae	BARK	10gm
4.	AJWAIN	*Carom copticum*	Apiaceae	SEED	10gm
5.	BAY LEAVES	*Laurus nobilis*	Lauraceae	LEAF	10gm

Fig1: TYPES OF SPICES USED IN AN EXPERIMENT

Fig2: WEIGHT OF PER SPICE – 10gm

Bioassay 1:

Study of the toxicological impact of spice powder on *Sitophilus oryzae*

spice powder and 100 grams of rice in individual plastic glasses. Then introduce 20 adult rice weevils into each glass, and cove clot the rice weevils from crawling the sides, petroleum jelly was spread inside each plastic glass just above the rice layer. Each

container was also labelled with specific spice used to easily identify the mixture. The experiment involved monitoring the mortality rate by counting the number of dead rice weevils after 12 hours, 24 hours, 36 hours, 48 hours, 62 hours, 72 hours of exposure. To ensure accurate outcomes and provide varied data for analysis, each combination of spice and rice was replicated in 10 distinct sets. Furthermore, a control group comprising 20 untreated Sitophilus oryzae in 100 grams of rice was also replicated in 10 sets to create a comparative benchmark, conducted simultaneously.

$$\text{Mortality \%} = \frac{Number\ of\ Dead\ insects}{Total\ number\ of\ insect} \times 100$$

Bioassay 2:

Study of repellent action of different spice powders on *Sitophilus oryzae*

The Repellency test involved using a transparent bowl inside a small cup with treated spice powder while transparent bowl remained untreated. 20 adult rice weevils were placed on each small cup and covered with muslin cloth to prevent their escape. After approximately 12 hours, the number of insects in the treated and untreated areas was counted separately. This process was repeated three times for each spice. For the calculation of the repellence percentage the following formula is used-

$$\text{Repellency \%} = \frac{(NC - NT)}{(NC + NT)} \times 100$$

Where, **NC - Number of insects in control (untreated area)**

NT - Number of insects on the treated area

Fig3:SET-UP FOR AN EXPERIMENT

Fig4:CULTURING OF *Sitophilus oryzae*

The data collected were analysed in a completely randomised design to find significant differences between the Mace, Black pepper, Cinnamon, Ajowan, Bay leaves treatment.

The analysis of variance (ANOVA) was applied. The test significance value is. The calculation was performed by using graphs are plotted using the Graph pad Prism 10.0 software for Microsoft. The Test of Significance is P <0.01.

OBSERVATION

MORTALITY EFFECT

TABLE 2: SHOWING MEAN MOTALITY EFFECT OF DIFFERENT KINDS OF SPICES ON *Sitophilus oryzae*

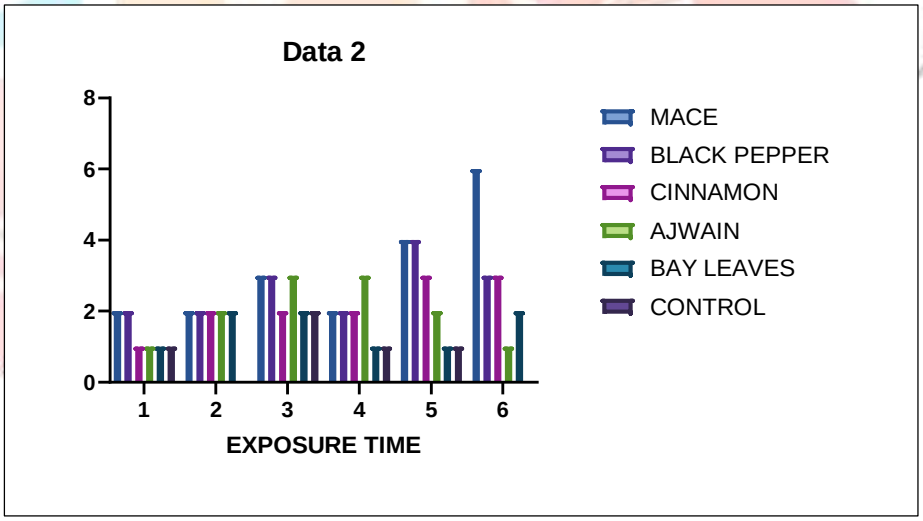
MORTALITY (MEAN±S.E)

SI.NO	TREATMENT	NO. OF BEETELES	12hr	24hr	36hr	48hr	60hr	72hr
1.	CONTROL	20	0.33±0.47	0.33±0.47	0.66±0.47	0.33±0.47	0.66±0.47	1.00±0.81
2.	MACE	20	2.33±0.47	2.66±0.77	3.33±0.47	2.33±0.47	4.33±0.47	5.66±0.47
3.	BLACK PEPPER	20	2.33±0.47	2.33±0.47	3.35±0.47	1.66±0.47	3.55±0.47	4.66±0.47
4.	CINNAMON	20	2.66±0.47	1.33±0.47	2.00±0.81	2.00±0.81	2.66±0.47	3.00±1.63
5.	AJWAIN	20	1.33±0.47	1.66±0.47	1.66±0.47	2.00±0.82	2..66±0.47	1.33±0.47
6.	BAY LEAVES	20	1.33±0.47	1.00±0.81	1.33±0.47	0.66±0.47	1.33±0.94	1.33±0.94

*THREE OT OF TEN REPLCATIONS ARE CONSIDERED

*TEST SIGNIFICANCE LEVEL IS < 0.01

GRAPH 1 : SHOWING MEAN MORTALITY OF DIFFERENT SPICES ON *Sitophilus oryzae* AGAINST TIME



12hr 24hr 36hr 48hr 60hr 72hr

2. **REPELLE**

TABLE 3: SHOWING REPLLENCY DATA OF SPICE AGAINST *Sitophilus oryzae*

SI.NO.	TREATMENT	A 1	B 1	C1	A2	B2	C2	MEAN±STANDARD ERROR	NUMBER OF BEETLES
1.	MACE	7	6	6	3	4	4	5.00±1.41	10
2.	BLACK PEPPER	6	6	5	4	4	5	5.00±0.81	10
3.	CINNAMON	6	6	5	4	4	5	5.00±0.81	10
4.	AJWAIN	3	3	4	7	7	6	5.00±1.73	10
5.	BAY LEAVES	2	2	3	8	8	7	5.00±2.70	10

A1, B1, C1 = UNTREATED AREA

A2, B2, C2 = TREATED AREA

GRAPH 2: SHOWING MEAN REPLLENCY OF SPICE AGAINST *Sitophilus oryzae*

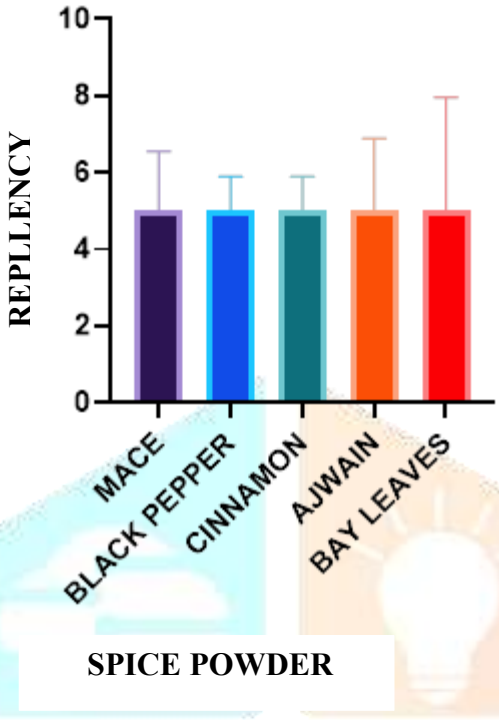


Fig5: REPLLENCY BEHAVIOUR OF- *Sitophilus oryzae*

RESULT

The study investigated the effectiveness of particular Indian spices against Sitophilus oryzae in stored rice. The research examines the mortality rates and repellent effects of five different spices. Based on observations and results Mace demonstrate the strongest insecticidal properties and were most effective against Sitophilus oryzae with black pepper and cinnamon following closely behind. Ajowan exhibited Lower potency compared to cinnamon. Bay leaves showed the least effectiveness.

Repellence behaviour of spices against rice weevil is high for MACE with high insecticidal properties among other spices.

As per the ANOVA variant analysis, mace demonstrated the highest repellent efficacy, registering a significant mean value is $P<0.01$.

Table 2 and Graph 1 illustrated that the highest mortality rate, reaching 90% occurred within 72 hours of applying Mace powder in replicates, with Black pepper and cinnamon, showing 85% and 75% of mortality rates. The remaining treatment exhibited relatively lower levels of mortality, with Ajwain 65% and Bay leaves 55%. The results of the ANOVA indicate that the $P < 0.01$.

Fig6: RICE WEEVIL UNDER EFFECT OF SPICE

DISCUSSION

Sitophilus oryzae is widely recognized as one of the most damaging primary pests of stored grains such as barley, maize, rice, and wheat (Atwal and Dhaliwal, 2002). The annual loss of grain in storage caused by these insects is estimated to be around 15% (Joshi et al., 1991). It is approximated that insect pest attacks lead to the loss of about 20% of the total maize harvest each year (Upadhyay et al., 2001).

In an experiment total five different spices were taken to test the mortality and repellence behaviour of rice weevil. In

For other spices which include BLACK PEPPER, CINNAMON, AJWAIN, BAY LEAVES for black pepper and cinnamon the mortality resides between 80%-70%. After Mace both show significant results in mortality rate and their repellence behaviour against rice weevil.

MACE>BLACKPEPPER>CINNAMON >AJWAIN>BAY LEAVES.

Others Scientist findings include different types of ingredients against rice weevil as:

These findings suggest that such active compounds may contribute to the repellent activity against S. zeamais and exhibit their potency even at lower concentrations. While chili and lemongrass are recognized

In a particular study, the highest recorded grain loss in wheat due to a single weevil was 19%, while in rice, it reached nearly 57% (Banerjee and Nazimuddin, 1985). Additionally, the preference of S. oryzae for host crops was investigated in a study involving five types—polished rice, rough rice, wheat, maize, and barley—under conditions of both free choice and no choice.

spice 1 as MACE the mortality rate came 90%. Upon being sprayed on rice immediate effects were seen.

Extracts from black pepper and turmeric exhibited moderate levels of repellence. Piperine, a compound found in black pepper, likely contributed to this effect The pungent substance in black pepper and cinnamaldehyde, a key component of cinnamon Flavors, have been reported to possess insecticidal activities (Huang & Ho, 1998; de Paula et al., 2000). These findings suggest that such active compounds could contribute to the repellent activity against S. zeamais.

for their insect repellent effects (Oyedele et al., 2002; Chomchalow, 2003; Parugrug & Roxas, 2008), the repellent activity of chili and lemongrass against S. zeamais adults was not confirmed in our experiment.

Extracts of lemongrass and dry chili showed weak repellency activity.

CONCLUSION

In Conclusion, experiment was conducted on *Sitophilus oryzae* against five different spices that can easily found on any Indian house. As spices posses insecticidal properties provide repellancy against rice weevil. The relative safety of botanical insecticides for humans is a significant factor in sustaining their ongoing use. The current studies represent just the initial phase in investigating the potential utility of selected spices for future commercial applications as a source of third-generation organic insecticides against *Sitophilus oryzae.*

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