



Bio-control of *Sitophilus granarius* (grain weevil) using plant extracts and cow urine

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Abstract: *Sitophilus granarius* also known as grain weevil is a common pest of many grains such as rice, wheat, barley. It causes huge damage of grains. In present investigation, powder prepared from *Azadirachta indica*, *Justicia adhatoda*, *Murraya koenigii*, *Ocimum sanctum*, *Zingiber officinale*, *Acacia nilotica* and fresh cow urine were used. The effects of this powder were observed on mortality rate, adult productivity of grain weevil and grain damage. The highest mortality was observed after treatment of mixture of all selected plant powder mixed with dried cow urine followed by dried cow urine, *Justicia adhatoda*, *Azadirachta indica*, *Acacia nilotica*, *Murraya koenigii*, *Ocimum sanctum*, *Zingiber officinale*.

The study was extended to prepare tablets from the selected plant extracts and cow urine. The tablets were prepared by using latex of *Acacia nilotica*. The results of present study showed that the tablets prepared from mixture of plant extracts and dried cow urine also found to be effective in reduction of adult emergence, increase in mean mortality (74%) and reduced grain damage.

Key Words: Cow urine, plant extracts, *Sitophilus granarius*, mortality rate, tablet preparation.

1. INTRODUCTION :

In human diet cereals, pulses and grains have great nutritional value and it is concurred that the grains can stored for long duration. These stored grains are attacked by number of pests which can damage grains. These storage enemies not only consume or spoil the edible and inedible parts of the stored grains but also lead to post-harvest deterioration causing economic losses due to obvious decay and adverse changes in the odor, taste, appearance and nutritive value (1);(2);(3). During production and storage it is important to maintain the quality of grains and control the pests which can damages the stored grains.

Sitophilus granarius is one the most widespread and destructive pest of stored grains all over the world. Especially such types of insects are very active in warm and humid area. It is well known that both the adults and grubs are serious pests of stored grains namely rice, wheat, maize and barley (4).

Control of this insect population around the world is primarily dependent upon fumigants and insecticides which resulted in undesirable effects on non-target organisms, environment and human health (5). Fumigation is the most widely adopted method and has been in practice. None of these methods and products can be declared as safe to the precious lives of human beings, birds, beneficial insects, animals and to the environment (6). The insecticides, pesticides are also used to control the pests which are chemically synthesized. They may cause toxic effects on the stored grain which leads to reduce the quality of grains. It shows health related problems on consumer as well as environmental pollution.



In India, medicinal plants have many therapeutic applications. Neem, aduśa, curry leaves, basil, ginger, babul, parsley, dill, thyme, eucalyptus, chinaberry are the example of plant species which possess medicinal, insecticidal, repellent property. Cow urine is also used in control of number of insects' problems. So instead of chemicals, bioinsecticidal plants and cow urine can be used as they are safe and cheap. Use of plant extracts as powder to protect stored grains for longer duration, there are chances to convert it into toxicants and it may affect on human health. So in this experiment, tablets were prepared from plant powder (7),(8).

In present investigation, plant powder prepared from Neem (*Azadirachta indica*), aduśa (*Justicia adhatoda*), curry leaves (*Murraya koenigii*), basil (*Ocimum sanctum*), ginger (*Zingiber officinale*), babul (*Acacia nilotica*) and cow urine were used against grain weevils. From the selected plants plant extracts were prepared. The plant extracts and dried cow urine showed highest mortality rate on grain weevil were used to prepare tablets.

2. Materials and methods :

Insect culture

Stock of grain weevil was collected from wheat grains available in the local market of Solapur city, MH, India. Grain weevils were identified as *Sitophilus granarius* from Department of Zoology, Walchand College of Arts and Science, Solapur, MH, India. 50 pairs of *S. granarius* were introduced in the plastic beaker containing 20gm wheat grains. These beakers then covered by muslin cloth to prevent escape of weevils and also for ventilation. The culture maintained at room temperature throughout the experiment (9).

Collection of medicinal plant parts and cow urine

The fresh, disease free leaves of plants viz. *Azadirachta indica* (neem), *Justicia adhatoda* (aduśa), *Murraya koenigii* (curry leaves), *Ocimum sanctum* (basil), *Acacia nilotica* (babul) and rhizome of *Zingiber officinale* (ginger) were collected from botanical garden of Walchand College of Arts and Science, Solapur, Maharashtra, India. The plants parts were identified from Department of Botany of same college. Fresh cow urine of healthy desi cow were collected in sterile screw capped glass container (10).

Preparation of plant powder and dried cow urine

The collected plant parts were washed with running tap water. The washed plant parts were shade dried and then powdered by using grinder (11). Cow urine kept for natural drying upto 15 days.

Effect of plant powder and dried cow urine on grain weevils

For the experiment, 50 pairs of grain weevils were introduced in beakers containing 20 gm of wheat grains. Then, 5 gm of each plant powder and dried cow urine were added in separate beaker. One beaker containing mixture of all plant powder along with dried cow urine was used. In control beaker only grain weevils and wheat grains were added. These beakers were covered by using muslin cloth with rubber band and incubated at room temperature to observe the effects of plant powder on grain weevils. Mortality was recorded after 6 days of interval of time for 30 days. To calculate the mortality, the number of dead grain weevils in each beaker was counted. Grain weevil mortality was assessed as

$$\text{Number of dead grain weevils} / \text{Total number of grain weevil} \times 100$$

Effect of plant powder on adult emergence was calculated by using Abbott's formula

$$\text{Percentage of corrected mortality} = \frac{(\text{observed mortality} - \text{control mortality}) \times 100}{100 - \text{Control mortality}}$$

Percentage of weight loss was determined to estimate the difference between initial and final weight by following equation:

$$\% \text{ Weight loss} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100 \quad (4).$$



Preparation of plant extracts and tablets

All selected plant powder was subjected for preparation of plant extracts by cold extraction method. In this method, 10 gm of mixture of all plant powder mixed with 50 ml of sterile distilled water and maintained at refrigerator for 48 hrs. Then filtration was carried out by using muslin cloth and the filtrate kept for natural drying for 48 hrs to obtain semi-solid extract. This semi-solid extract mixed with mixture of all plant powder and dried cow urine to prepare tablets by adding latex of *Acacia nilotica* as a binder (12). Tablets were prepared, each having 500 mg of weight.

Effect of tablets on grain weevils

For the experiment, 50 pairs of grain weevils were introduced in beakers containing 20gm wheat grains. Then 5 tablets were added to observe the effects on weevils. For control beaker, no tablets were added and these beakers were covered by using muslin cloth with rubber band and incubated at room temperature. Mortality, adult emergence and weight of grain were recorded at 6 days interval in one month. The experiment was performed in triplicate for confirmation of results (7).

3. Results and Discussion :

Effect of plant powder and dried cow urine on *S. granarius*

Mortality

After 30 days of treatment, effect of plant powder on mortality of *S. granarius* was observed. It was found that highest mortality was observed after treatment of mixture of all plant powder along with dried cow urine (76%) followed by dried cow urine (72%), *Justicia adhatoda* (65%), *Azadirachta indica* (58%), *Acacia nilotica* (55%), *Murraya koenigii* (53%). The least effect showed by *Ocimum sanctum* (39%), *Zingiber officinale* (37%) (Table 1).

These results were compared with previous findings of Researchers. (13) They reported the use of neem powder and ashes from various sources were effective against different stored grain pests. Previous studies demonstrated that plant extracts isolated from *Melia azadarach* (80.54%) and *Zanthoxylum acanthopodium* (70.74%) have effective in increased mortality rate of *S. granarius*. (4)

Insecticidal activities of different doses of plant extracts obtained from *Piper nigrum*, *Carumcarvi* and *Sesamum indicum* were reported against rice weevil *Sitophilus oryzae* L previously. Researcher also reported that extract of *P. nigrum* was found to be the most efficient in increased mortality rate.(14)

Adult emergence and grain weight loss

The effect of plant powder and dried cow urine on adult emergence of *S. granarius* and weight loss of grains was observed. In control beaker, number of weevils emerged were found to be highest i.e. 34%.

Among the all plant powder, *Zingiber officinale* showed highest adult emergence followed by *Ocimum sanctum* with 18% and 15% respectively. The least emergence showed by *Murraya koenigii*, *Acacia nilotica*, *Azadirachta indica*, *Justicia adhatoda*, dried cow urine and plant powder mixed with dried cow urine were 10%, 10%, 10%, 8%, 5%, 3% respectively (Table 2).

The highest grain weight loss was showed by *Zingiber officinale* and *Ocimum sanctum* with 11.69% and 11.17% respectively. The least grain weight loss showed by plant powder mixture with dried cow urine, dried cow urine, *Justicia adhatoda*, *Azadirachta indica*, *Acacia nilotica*, *Murraya koenigii* with 1.22%, 2.91%, 3.01%, 8.63%, 9.23%, 10.07% respectively (Table 2).

Many investigators working with use of different plant materials as an insecticides concluded that the percent of grain weight loss decreased with increase in concentration of plant materials. (15);(16);(17);(18);(19).

Table 1: Effect of plant powder and dried cow urine on mortality rate of *S. granarius*

Sr. No.	Treatments	Mean mortality % (6 - 30 days)				
		6	12	18	24	30
1	Plant powder mixture + dried cow urine	24.21	43.20	51.28	69.08	76



2	Dried cow urine	30.28	38.17	48.69	60.23	72
3	<i>Justicia adhatoda</i>	19.17	29.18	41.82	52.39	65
4	<i>Azadirachta indica</i>	21.34	28.89	33.16	47.80	58
5	<i>Acacia nilotica</i>	17.45	26.19	36.40	42.39	55
6	<i>Murraya koenigii</i>	16.32	20.29	32.20	41.87	53
7	<i>Ocimum sanctum</i>	13.28	19.64	28.02	30.28	39
8	<i>Zingiber officinale</i>	13.07	21.09	23.69	27.06	37
9	Control	1.21	1.90	1.90	1.90	7

Table 2: Effect of plant powder and dried cow urine on adult emergence of *S. granarius* and grain weight loss

Sr. No.	Treatments	Adult emergence (mean±SD)	Grain weight loss % (mean±SD)
1	Plant powder mixture + dried cow urine	3± 1.00	1.22±0.37
2	Dried cow urine	5±0.83	2.91±0.47
3	<i>Justicia adhatoda</i>	8±0.47	3.01±0.47
4	<i>Azadirachta indica</i>	10±0.40	8.63±3.29
5	<i>Acacia nilotica</i>	10±0.52	9.23±4.0
6	<i>Murraya koenigii</i>	10±0.58	10.07±3.80
7	<i>Ocimum sanctum</i>	15±1.12	11.17±2.30
8	<i>Zingiber officinale</i>	18±1.00	11.69±2.90
9	Control	34±3.22	24.78±6.20

Effect of tablets on *S. granarius*

The effect of tablets on mortality rate of grain weevils 74%, adult emergence 4% and loss in grain weight is 1.39% (Table 3).

The present investigation is agreed with the previous findings of Rongsriyam *et al* (7). They concluded that commercial formulations of products containing neem (*Azadirachta indica*) are a good example of insecticide with 80% cumulative mortality (larvae, pupae and adults) of *Aedes aegypti* and *Culex quinquefasciatus*.

Table 3: Effect of tablets on mortality, adult emergence of grain weevils and weight loss of grains

Sr. No.	Treatment	Treatment (no. of tablets)	Mean mortality % (6-30) days					Adult emergence (mean±SD)	Grain weight loss % (mean±SD)
			6	12	18	24	30		
1	Tablets of plant extracts + cow urine	5	6	12	18	24	30	4±0.64	1.39±0.32
			20.53	39.69	48.12	61.48	74.00		

4. Conclusion :

The mixture of plant powder prepared from *Azadirachta indica*, *Justicia adhatoda*, *Murraya koenigii*, *Ocimum sanctum*, *Zingiber officinale*, *Acacia nilotica* and dried cow urine were found to be effective in increased mortality rate, prohibiting adult emergence of *S. granarius* and decreased grain weight loss percentage.

Similarly, tablets prepared from mixture of selected plants extracts and dried cow urine was also significantly effective in controlling *Sitophilus granarius*.



Hence, mixture of plant powder and dried cow urine and tablets prepared from plant extracts with cow urine can be used to control the pest of various grains which is eco-friendly and safe.

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