

Effect of Neem leaf and Orange peels on granary weevil, *Sitophilus granaries* (L.) (Coleoptera: Curculionidae) growing on wheat grain

*Archana Kumari & Amrendra Kumar Jha

University Department of botany, Jai Prakash University, Chapra, Bihar, India

ABSTRACT

An experiment was conducted at the laboratory of P.G Dept. of Botany J. P. University Chapra Saran. Two plant powder namely Neem leaves and Orange peels (known Insecticide) are tested to determine the growth of *Sitophilus granaries*, (Coleoptera: Curculionidae) on wheat grains. Considering the percentage of mortality, the toxicity of powder's increased gradually with increasing concentration. The treatments were arranged in CRD (Complex Randomized Design) with three replications. The dead adult weevils were counted within 8 weeks after the wheat was treated by Neem leaf powder and Orange peels powder. Three sets of testing were set including treatment of seeds with two different plant powder extracts such as Orange peels powder and Neem leaf powder, and a control where no plant powder were applied to the grains. The dosage of powder, 5g, 10g, 15g, 20g, 25g, and 30g were applied to 500 grains included weevil mortality, weevil survival and grain damage. The results from the study showed that the highest percentage weevil mortality was recorded for Neem followed by Citrus. The lowest and highest mortality rate have been seen of 5g & 30g for Neem extract of 27 & 30 respectively, where of these value was noticed of 1 & 5 at 30g & 5g respectively for Citrus extracts. The percentage alteration calculated 10 & 0 of 5 & 30g of Neem extract whereas 16.6 & 3.3 for Citrus extract respectively.

Key Words - Neem Leaf, Orange Peel, *Sitophilus granaries*, Wheat grain.

*Corresponding author : archana.sumanpriya@gmail.com

INTRODUCTION

Wheat, *Triticum aestivum* L, Gramineae (Poaceae) is an annual cereal grain and is one of three most significant crops worldwide. Wheat is the most important cereal crop of the temperate regions of the earth. It is a staple food of about half the population of the world. South-west Asia is possibly its centre of source. Wheat is an important food crop of the world and it is broadly cultivated in main parts of world. Wheat grain has many uses and is the fore most component in many processed foods. Wheat is the important source of vegetable protein in human food, having a higher protein content than other major cereals, maize or rice (USDA, 2014). In terms of total production tonnages used for food, it is presently second to rice as the main

human food crop and ahead of maize, after allowing for maize's more extensive use in animal feeds. It is the most important staple food crop for more than one third of the world residents and contributes more calories and proteins the world diet than any other cereal crops (Adams, 2002; Shewry, 2009). Post harvest losses by stored insect pests are 9% in developed countries and 20% or more in developing countries (Phillips and Throne, 2010). Losses of wheat due to inadequate storage and other post-harvest factors at the farm, village and commercial levels of up 4% have been observed (Mc Farlane, 1989; Abdulahi and Haile, 1991), though losses in excess of 40% for other cereals are not uncommon (NRC, 1996). Wheat has

only few insect-pests under field situation, but it is vulnerable to insect attack after harvest. The granary weevil, *S. granaries* (L.) is one of the most prevalent and unhelpful primary pests of stored cereals in Egypt. This pest is an internal feeder and causes significant loss to cereals affecting the quantity, as well as quality of stored cereal grains through storage (Phillips and Throne, 2010). In addition, all life stages of *Sitophilus* infested granaries include many protein fractions with allergenic potential risk factors for exposed persons (Jakubas-Zawalska *et al.*, 2016). The control of stored-grain insect pests by chemical insecticides and fumigants are tools for preventing or minimizing insect damage to stored grain. However, the regular use of synthetic pesticides as stored grain protects ants resulted in environmental contamination, potential toxicity to living organisms and dramatic increase of pest fight to pesticides (Prakash and Rao, 1986 & 1987). As a result, there is a growing need for the development of alternative strategies aiming at lessening the use of insecticides.

Natural products are an option to synthetic pesticides for control of stored grain pests since they have small negative impacts to health and environment. Among the most capable botanicals are scented plants and their powders. They are non-persistent in the in the environment and comparatively safe to natural enemies, non-target organisms and humans (Koul *et al.*, 2008). Plant materials with insecticidal properties are one of the most significant locally possible, biological control of pests.

Many studies reported its effective use in administration insect pest. Plant based necessary oils like Citrus and Neem have stepped in market place and is best suited for organic food invention in developing and industrial countries. Azadirachtin, extracted from Neem leaf, act on target organism as antifeedant growth regulator. Akhtar *et al.* reported that plant species of the family Meliaceae such as *Azadirachta indica*, and sweet orange peel are rich sources of active botanical insecticides. Moreover, essential oils

together with those obtained from Citrus fruit peel of Rutaceae family have potential to be employed in pest management program next to stored grains. Plant powders have been confirmed to possess potent insecticidal activity against many stored-product insects. For example, plant powders from Neem and Citrus had strong insecticidal activity on *Sitophilus oryzae* and *S. granaries* (Ebadollahi, 2011). The study proves the insecticidal activity of plant powder of Neem leaf and Orange peels against *S. granaries* in addition; the current study was designed to investigate the suitability of these plant powders to protect stored wheat grains.

MATERIAL AND METHODS

Experimental site:- The research was carried out in the Department of Botany laboratory of Jai Prakash University, Chapra. Which is located between latitude 180o (90o at the North and 90° South) and 360° of longitude (+180° eastward and -180° westward). The distance between each degree of latitude is about 69 miles (110 kilometers).

Insect culture:- The adult *S. granaries* used for the experiment were cultured in a plastic container under ambient laboratory temperature of 36.5°C. The fresh wheat grains were purchased from Mashrak Saran.

Experimental conditions:- Adult *S. granaries* used for the experiments were obtained from already infected private warehouses, Mashrak Saran. Plant protection orange peels were collected from an orange juice seller in Chapra. Neem leaves were obtained from the B.S.M. Degree College Campus in Mashrak.

Two plant powder extract were applied for three weeks to see the efficacy of the powders. Different amount of the powder, thus 5g, 10g, 15g, 20g, 25g, and 30g were measured using an electronic balance scale and were separately kept in small plastic containers. The containers were covered with a fine mesh muslin cloth held in place with rubber bands for exposure to air. Thirty (30) adult *S. granary* were introduced into each container and shaken well, so that the powder gets mixed over the weevils.

Bioassay:- A quantity of five hundred (500) of wheat grains per treatment was mixed independently with tested powders. 500 (five hundred) grain of wheat were placed in small plastic container. The different amount of each plant powder extract (5g, 10g.....30g) were applied to each container. Thirty (30) adult weevils were introduced into each container.

After mixing it is covered with muslin cloth and tied with rubber bands. The grains in the controls contain no plant powder. The setup was kept for 8 weeks and the observations were made weekly.

RESULTS

The plant powder showed various levels of

bioactivity against adult *S. granaries* during the 8 week experimental periods (Table 1). The toxicity of powder improved slowly with increasing amount of extract.

Neem leaf powder resulted in weevil mortality up to lowest and highest mortality rate been seen in 5 & 30g for Neem extract of 27 & 30 in numbers respectively. Where these value was noticed of 25 & 29 at 30g & 5g respectively for Citrus extracts. The percentage alteration has also been calculated for neem and citrus extracts. The maximum percentage alteration has been calculated is 10 & 0 of 5g & 30g for neem extract whereas 16.6 & 3.3 for citrus extract respectively.

Table: - 1. Percentage weevil mortality of wheat grain treated with different dose of plant powder extracts, during summer season

Total no. of grain taken	Control		Doses (gram)	Experimental					
	Total no. of insect taken	Mortality		Neem extract			Citrus extract		
				Mortality	Differences	% Alteration	Mortality	Differences	% Alteration
500	30	7	5g	27	3	10	25	5	16.6
500	30	7	10g	28	2	6.6	26	4	13.3
500	30	6	15g	28	2	6.6	26	4	13.3
500	30	6	20g	29	1	3.3	27	3	10
500	30	5	25g	30	0	0	28	2	6.6
500	30	5	30g	30	0	0	29	1	3.3

In present study: - The percentage of weevil of wheat grain treated with different dose of plant powder extract during Summer season have been described in table- 1& percentage by fig- 1. Dose of Neem and Citrus extract (5g, 10g, 15g, 20g, 25g and 30g) have been applied on 500 wheat grain, inoculated e- 30 insects. The lowest and highest mortality rate been seen of 5 & 30g for neem

extract of 27 & 30 respectively. Where these value was noticed of 1 & 5 at 30g & 5g respectively for Citrus extracts. The percentage alteration has after calculated for Neem and Citrus extracts.

The maximum percentage alteration has been calculated is 10 & 0 of 5 & 30g for Neem extract whereas 16.6 & 3.3 for Citrus extract respectively.

Table: - 2. Percentage weevil survival of wheat grain treated with six doses of plant powder extracts during Summer season.

Total no. of grain taken	Control		Doses (gram)	Experimental					
	Total no. of insect taken	Survival		Neem extract			Citrus extract		
				Survival	Differences	% Alteration	Survival	Differences	% Alteration
500	30	23	5g	3	27	90	5	25	83.3
500	30	23	10g	2	28	93.3	4	26	86.6
500	30	24	15g	2	28	93.3	4	26	86.6
500	30	24	20g	2	28	93.3	3	27	90
500	30	25	25g	0	30	100	2	28	93.3
500	30	26	30g	0	30	100	1	29	96.6

In current study: - The percentage of weevil Survival of wheat grain treated with six doses of plant powder extract during Summer season have been described in table- 2 & percentage by fig- 2. Dose of Neem and Citrus extract (5g,10g, 15g, 20g, 25g, and 30g) have been applied on 500 wheat grain, inoculated e⁻ 30 insects. The lowest and highest Survival rate is seen in 5 & 30g for Neem

extract and 3 & 0 respectively. Where of these values were noticed in 29 & 25 at 30 & 5g respectively for Citrus extracts. The percentage alteration has also been calculated for Neem and Citrus extracts. The maximum percentage alteration has been calculated is 90 & 100 of 5 & 30g for Neem extract where as 83.3 & 96.6 for Citrus extract respectively.

Table: -3. Showing damage of wheat grain after application of plant extract (N+C) during Summer season.

Total no. of grain taken	Control		Doses (gram)	Experimental					
	Total no. of insect taken	Damage		Neem extract			Citrus extract		
				Damage	Differences	% Alteration	Damage	Differences	% Alteration
500	30	20	5g	5	495	99	5	495	99
500	30	18	10g	3	497	99.4	4	496	99.2
500	30	16	15g	2	498	99.6	4	496	99.2
500	30	15	20g	1	499	99.8	2	498	99.6
500	30	14	25g	1	499	99.8	1	499	99.8
500	30	12	30g	0	500	100	1	499	99.8

In this survey: - The Percentage Damage of wheat grain treated with different doses of plant powder extract during Summer season have been described in table- 3 & percentage by fig- 3. Doses of Neem and Citrus extract (5g,10g, 15g, 20g, 25, and 30g) have been applied on 500 wheat grain, inoculated e⁻ 30 insects. The lowest and highest Damage rate has been seen at 5 and 30g Neem extract of 5 & 0 respectively. Whereas value was noticed of 499 & 495 at 30 & 5g respectively for Citrus of extract. The percentage alteration has also been calculated for Neem and Citrus extract. The maximum percentage alteration has been calculated at 99 and 100 of 5 & 30g for neem extract while 99 and 99.8 for Citrus extract respectively.

DISCUSSION

Weevil Mortality: - Results from the current study shows that the uses of the said botanical powders have the great potential in protection of the wheat grains against *S. granaries*. Weevil mortality was high in grains treated with the plant extract compared to the control. Wheat grains treated with Neem leaf powder recorded high weevil mortality than grain treated by Citrus peel powders. The control treatment had more weevils surviving than

dead as was expected. Higher plant dosage on the other hand were effective and controlling the weevils than lower dosage (5g). It was observed from the experiment that high dosages of the plant extract resulted in high weevil mortality. Trends seen in weevil mortality were inversely correlated with weevil survival as high weevil mortality resulted from low weevil survival and vice versa. It was also observed that increasing the dosage of Neem leaf powder from 20g and 30g completely killed the weevils. Citrus peel powder was effective at 20g and above of the powder applied. Hence it can be said that the higher dosage applied, the more effective it becomes, thus the higher mortality seen in the weevil population.

Weevil survival:- The study showed that the wheat grains treated with the plant extracted powder recorded low weevil survival. Out of the two plant extract used, wheat grain treated with Neem leaf powder had less weevils surviving compared to that leaf treated with Citrus peel powders. The control treatment as was expected had almost all the weevils surviving since there was no application of the plant powder extract.

Grain Damage:- In terms of grain damage, minimal damage from weevils was recorded in the grains treated with the two plant powder extracts. Grain damage was very low in seeds treated Neem leaves powder. The low values recorded can be attributed to the high mortality of the weevils to the plant extract application since low numbers of weevils are ineffective in causing substantial damage in storage. The lowest and highest Damage rate has been seen at 5 and 30g Neem extract of 5 & 0 respectively. Whereas value was noticed of 499 & 495 at 30 & 5g respectively for Citrus of extract. The percentage alteration has after calculated for Neem and Citrus extract. The maximum percentage alteration has been calculated at 99 and 100 of 5 & 30g for neem extract while 99 and 99.8 for Citrus extract respectively.

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