

## EFFICACY OF *AZADIRACHTA INDICA* L. OIL ON BAGGING MATERIAL AGAINST SOME INSECT PESTS OF WHEAT STORED IN WAREHOUSES AT FAISALABAD

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### ABSTRACT

Neem oil, a known insect repellent, was tried with 5%, 10%, 15% & 20% concentrations at intervals of 30, 60 & 90 days on packaging materials of two different density used for storage of wheat in warehouse under natural conditions. The warehouse had *Rhizopertha dominica*, *Sitophilus granarius*, *Tribolium castaneum* and *Trogoderma granarium* in abundance. As per statistical analysis, 10% oil treatment reduced the insect penetration more than those of 5% significantly but it was non significantly different from that of 15% and 20%. Moreover deterrence to penetration decreased with the passage of time. Percent mortality could be achieved only upto 62.21 to 82.99 % for different insects. With all concentrations, percent mortality was more at first interval than at second and third interval. Mortality was directly proportional to the concentration of the spray material. Population build up in the packages and mortality showed non significant relation to the changing temperature and relative humidity in the warehouse but it showed significant change due to type of packaging materials. No concentration of oil imparted any taint to the wheat stored or alter its viability. Unleavened bread made from the flour of wheat stored in treated bags was equally acceptable as the control to the consumers.

### INTRODUCTION

In Indo-Pak subcontinent, mostly unleavened bread made from whole wheat flour is the staple food of the people and the wheat is stored in jute bags stacked in the warehouses both in private & public sectors and is protected from insect pests by the application of synthetic insecticides along with phosphine fumigation ( Ahmad, *et al.* 1986 ). Consequent to the development of resistance against phosphine gas, insect pests of stored wheat could be controlled with three times higher doses of it in public sector storages in Punjab ( Anonymous, 2000 ). Resistant strains of stored grains insect pests were also controlled through prolonged exposure to phosphine gas under polyethylene cover in warehouses ( Anwar, *et al.* 2003 ). For safe and natural control of insect pests of stored products, neem (*Azadirachta indica* L.) oil has been used successfully by several scientists and found its significant antifeedant potential (Seck, 1994). Ahmed *et al.* reported that neem oil has a considerable modifying effect on mating behaviour of *Callosobruchus chinensis* L. Bloszyk, *et al.* (1990) reported that hundreds of materials had been investigated for use in insect-resistant packaging such as synthetic pyrethroids, natural botanical antifeedants and silica gel. According to Saxena, *et al.* (1989), *Azadirachta indica* has antifeedant effects for different insect pests of stored products. Fields, *et al.* (2001) found that Neem was repellent to many stored product-insects when tested by exposure on filter paper or in preference chambers. Hou, *et al.* (2004) compared Deet, Neem and protein rich Pea flour for their resistance

to penetration into wheat filled packaging and reported that Deet and Neem prevented the insects piercing and entering into it but the protein rich Pea flour did not. Moreover neem was repellent enough to reduce insect immigration into packages but further work is needed to determine if it has commercial potential. Wong, *et al.* (2005), compared Citronella, Garlic oil, Neem extract, pine oil & pyrethrum for their insect repellence and found positive results. Growth inhibition effect of neem seed oil upon *Tribolium castaneum* in laboratory conditions was established by Jilani, *et al.* (2003). Extracts of neem, turmeric and sweet flag were evaluated as repellents against *Sitotroga cerealella* in vitro and found that the acetone extract of neem was the most effective botanical insecticide (Zaidi, *et al.* 2003). Deterrent effects of powders made from leaves, seeds and bark of *Azadirachta indica* and *Nerium oleander* were tested against *Rhizopertha dominica* and got its repellency upto 96 % from neem leaves and seeds by Khan, *et al.* 2003. In laboratory studies, neem seed oil obtained from different localities was appraised against Red Flour Beetle for its repellence and achieved it upto 52.25% from oil obtained from Hyderabad (Nazli, *et al.* 2003 ). In USA, pyrethrins synergized with piperonyl butoxide were approved for use as a treatment for insect-resistant packaging on the outer layer of packages or with adhesives (Highland, 1991). Some adult insects of stored products can pass through holes less than 1 mm in diameter and their larvae can enter through even smaller holes (Cline and Highland, 1981). All the above investigations were conducted under laboratory and

controlled conditions but no technology or procedure was developed to be adopted by the farmers or warehouse managers. According to Peterson, *et al.* (2001), safety of many of natural insect repellents still needs to be evaluated and field efficacy trials are also required to make these as a part of integrated pest management program. These can be used in packaging to prevent infestation of stored products but this aspect is under exploited at the current time.

Present studies were conducted to develop an IPM protocol which might be an alternate to the practices being adopted presently for the control of insect pests of stored grains at farm level but are safe, economical, easy to apply and nature friendly. For the purpose, cleanliness of grains, quality of packing material and efficacy of neem oil as a repellent & antibiotic agent were appraised by applying on jute bags stored in warehouses under natural conditions.

## MATERIALS AND METHODS

Neem seeds were collected from the naturally grown plants at Faisalabad and dried in sunshine for about ten days. After de-hulling, oil extraction from dried kernels was made by hydraulic press and soxhlet's apparatus using n-hexane as solvent. Different dilutions i.e. 5%, 10%, 15% and 20% of the oil were prepared in ethanol for their evaluation.

Infestation free (sun dried, fumigated and entoleted), new crop wheat having moisture content  $9\pm 0.5\%$  was packed in treated 5 Kg jute bags measuring 9x12 inches (mesh size 1x1 mm) made from new cloth considering as experimental units. Each treatment was applied on nine jute bags put in three groups and kept for a period of 30, 60 and 90 days separately to check their effectiveness as grain protectants / repellants against coleopterous insect pests of stored grains. The treated bags filled with wheat were placed in the openly ventilated warehouse of a flour mill under the favorable conditions for the multiplication of insects. Experiment was repeated with jute bags made of cloth having mesh size 0.5x 1 mm also to determine the impact of packing material on the entrance and growth of insect pests in the packages.

Absolute data for adult population build up inside the bags and percent mortality of *Trogoderma granarium*

(Everts), *Rhizopertha dominica* F. , *Sitophilus granarius* L. and *Tribolium castaneum* (Hbst) were collected after sieving the grains of each experimental unit at specific intervals. Its correlation with the meteorological conditions was determined. Impact of treatments on the viability of grains, farinographic and organolaptic properties of flour and chapatti made from wheat stored in the treated bags were also determined so that the treatments could be made acceptable in all respects to the consumers. To get the precise results and distributional properties of the data, recommended statistical tools were applied.

## RESULTS AND DISCUSSIONS

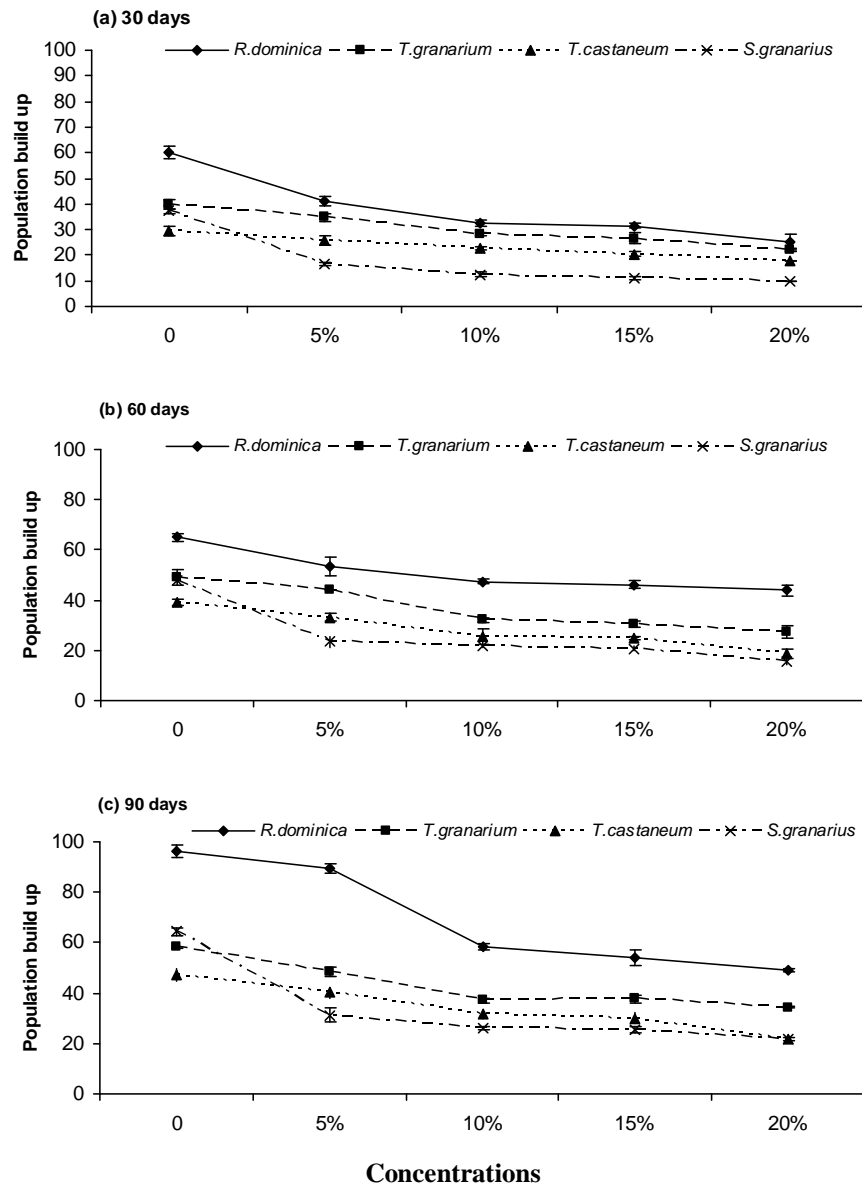
All three independent factors i.e. oil concentrations, storage time and packing material showed statistically significant effects on the entrance and modification of growth pattern of *Rhizopertha dominica*, *Trogoderma granarium*, *Tribolium castaneum* and *Sitophilus granarius* in the experimental units. Thus the Azadirachtin, active ingredient of neem seed oil, proved growth inhibiting and repellent properties.

Data given in Table (1) shows the population build up of different coleopterous stored grain insects at different storage Periods against various concentrations of Neem Seed Oil. Number of total target insects entered and multiplied into the bags increased with the passage of time which indicates that repellence and antibiotic effects of the oil decreased gradually from first to third storage interval. Recorded insect count (live +dead) under different treatments showed that significant reduction was found in 10% oil treatment and it differed insignificantly from 15% and 20%. Fig.1 demonstrates the trend of population build up.

Percent mortality in treated packages was significantly high as compared to the control. It showed declining trend with the passage of time and was optimum in 10% oil treatment even after 90 days but it did not vary significantly from 15% and 20% at each level which depicts that antifeedant or growth inhibiting effect of the oil decreased with the increase of storage time due to transpiration of essential oil or its degradation. The trend is illustrated in Table 2.

**Table 1: Population build-up of different insects at various storage periods against different concentrations of Neem seed Oil.**

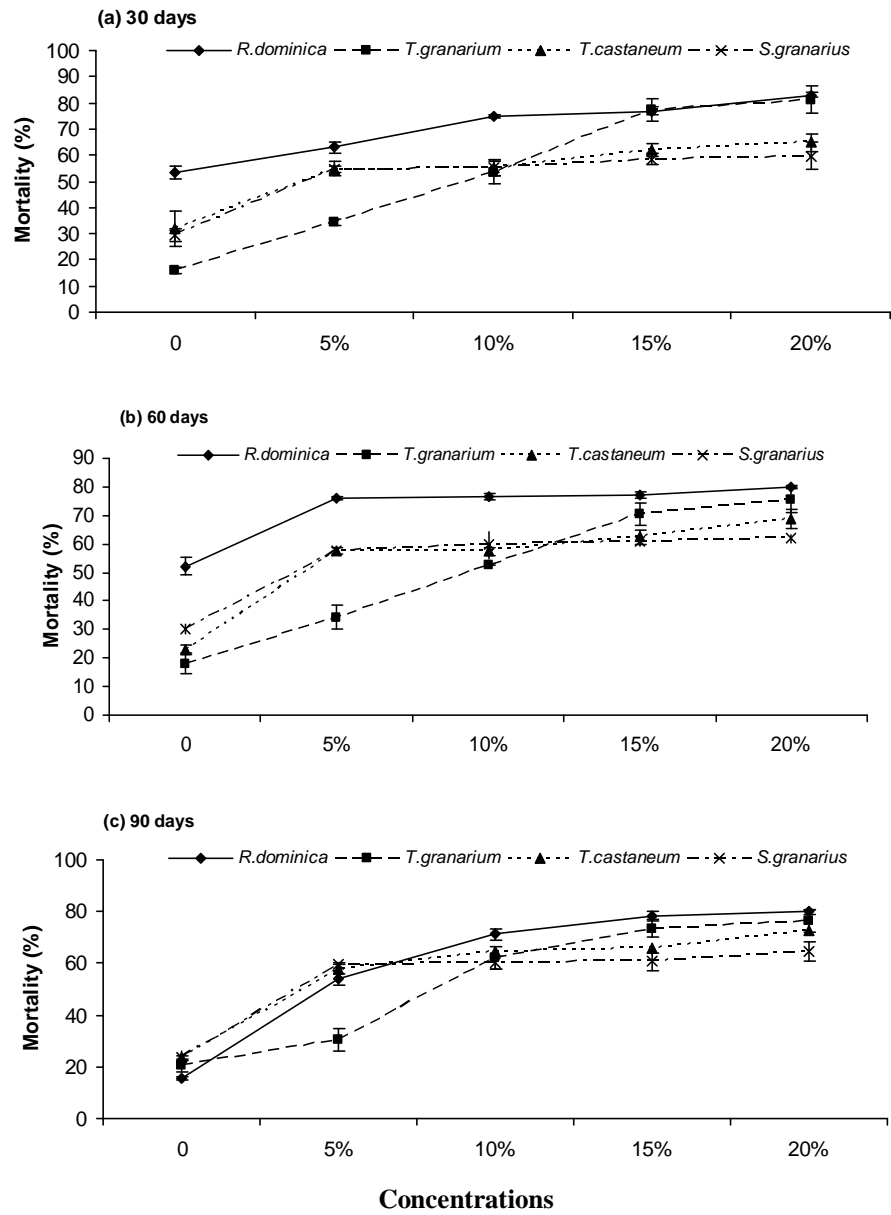
Insect Species	Storage Period	Concentrations of <i>Neem Seed Oil</i>				
		0 %	5 %	10 %	15 %	20 %
<i>Rhizopertha Dominca</i>	30 Days	60.000 ± 2.517	41.000 ± 2.000	32.667 ± 1.333	31.333 ± 0.882	25.000 ± 3.055
	60 Days	65.000 ± 1.732	53.667 ± 3.756	47.333 ± 0.882	46.000 ± 1.528	44.000 ± 2.082
	90 Days	96.000 ± 2.517	89.333 ± 1.667	58.333 ± 1.202	54.000 ± 3.215	49.333 ± 0.667
<i>Trogoderma granarium</i>	30 Days	40.000 ± 1.732	34.667 ± 1.764	28.000 ± 0.577	26.667 ± 2.333	22.000 ± 0.577
	60 Days	49.000 ± 3.215	44.000 ± 0.000	32.000 ± 1.000	30.333 ± 1.202	27.333 ± 2.186
	90 Days	58.333 ± 0.333	48.333 ± 1.764	37.000 ± 1.000	37.667 ± 1.333	34.333 ± 0.333
<i>Tribolium castaneum</i>	30 Days	29.333 ± 1.764	25.667 ± 1.856	22.667 ± 0.667	20.333 ± 0.882	18.000 ± 0.000
	60 Days	39.000 ± 1.155	33.000 ± 1.528	25.333 ± 3.283	25.000 ± 0.577	18.667 ± 1.856
	90 Days	47.333 ± 2.603	40.333 ± 2.186	31.667 ± 1.667	30.000 ± 2.309	22.000 ± 0.577
<i>Sitophilus granarius</i>	30 Days	37.333 ± 0.882	16.667 ± 0.667	12.333 ± 0.882	11.000 ± 0.577	10.000 ± 0.000
	60 Days	48.000 ± 0.577	23.333 ± 2.028	22.000 ± 0.577	20.667 ± 0.882	15.667 ± 1.202



**Fig.1: Effect of different oil treatments on population build up of insects at various storage intervals**

**Table-2: Effect of concentrations and storage periods on insect mortality.**

Insect Species	Storage Period	Concentrations of <i>Neem Seed Oil</i>				
		0 %	5 %	10 %	15 %	20 %
<i>Rhizopertha dominica</i>	30 Days	48.887 ± 1.262	69.117 ± 1.482	71.503 ± 1.928	77.660 ± 1.770	82.990 ± 1.473
	60 Days	48.737 ± 2.579	85.007 ± 1.172	77.483 ± 1.721	65.977 ± 1.130	71.460 ± 3.188
	90 Days	11.480 ± 1.307	49.550 ± 2.454	65.120 ± 3.044	78.503 ± 0.922	71.057 ± 4.411
<i>Trogoderma granarium</i>	30 Days	29.087 ± 1.030	86.543 ± 0.655	60.723 ± 1.793	63.963 ± 1.337	62.213 ± 4.711
	90 Days	15.920 ± 3.093	71.210 ± 3.301	60.370 ± 1.163	62.777 ± 4.020	56.203 ± 4.588
<i>Tribolium castaneum</i>	30 Days	20.850 ± 3.287	72.763 ± 9.235	64.520 ± 3.418	47.693 ± 2.472	66.557 ± 4.279
	60 Days	19.603 ± 1.981	61.670 ± 1.431	64.790 ± 3.020	48.203 ± 2.215	64.817 ± 1.853
	90 Days	17.510 ± 0.886	61.140 ± 0.944	64.287 ± 1.199	51.110 ± 1.110	64.447 ± 2.223
<i>Sitophilus granarius</i>	30 Days	25.087 ± 2.769	71.990 ± 1.808	42.450 ± 3.165	64.950 ± 1.080	66.667 ± 3.333
	60 Days	29.190 ± 3.247	73.093 ± 1.398	42.553 ± 2.585	61.217 ± 2.749	48.890 ± 1.110
	90 Days	23.830 ± 1.171	68.410 ± 1.778	35.133 ± 0.921	36.563 ± 1.928	53.030 ± 5.305



**Fig. 2: Effect of different concentrations of Neem oil on percent mortality of insects at various storage intervals**

Average temperature of the warehouse varied from 24°C to 39°C and relative humidity from 26% to 51% during the experimental period. Extremities of temperature and relative humidity were not lethal for insects. Moreover internal conditions of the experimental units might be favorable for multiplication of insects. However fluctuation in weather conditions did not affect the insect population or their mortality, perhaps due to its non persistent trend. Fig.3 shows the trend of meteorological conditions.

Unleavened bread (chapatti) was prepared from the whole wheat flour of the wheat stored in treated bags was got tested for its taste, flavour and overall acceptability. No significant change was noted amongst all treatments as compared to the control. It means that package application of neem oil has no adverse effect upon the dietary profile of the commodity stored.

Our results indicate that neem oil has a strong insecticidal effect on stored grain beetles when used in proportions ranging from 5 to 20 percent applied on packing bags, thus confirming the conclusion reached by Rajapakse & van Emden (1997) and Das, (1986). In the instant experiment, neem seed oil efficiency relates to its application rate, i.e. concentration of oil is directly proportional to the percent mortality and inversely proportional to the population build up at a specific time interval. Mode of action of neem oil is mechanical as it covers the cuticles of insects with a fatty acid film which deprives them of oxygen (Schoonhoven, 1978). Along with the asphyxiating effect, there are numerous insecticidal compounds which are synthesized by *A. indica* and are present in the oil extracted from its kernels, the most important of which is azadirachtin which has growth inhibiting effect (Koul *et al.*, 1990). Through the present investigations, we could succeed only upto 57.7% mortality in 90 days storage, 60.0 % in 60 days storage and 69.5 % in 30 days storage which was improved upto 15 % with the help of improved bags density. However we remained quite successful for keeping the stored commodity free of any taint/ foul flavor by restricting the insecticide upto only packing material.

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