Pak. J. Bot., 37(1): 149-153, 2005.

SCREENING OF PLANT LEAVES AS GRAIN PROTECTANTS AGAINST *TRIBOLIUM CASTANEUM* DURING STORAGE

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Abstract

Many species of plants have potential to be utilized as medicinal and therapeutic agents, not only for the treatment of various diseases of man and animals but can also be used as insect control agents for various stored grains. Present work has been focussed to assess the repellency and toxicity of some medicinal plants immune to insect attack. Response varied with plant materials, insect species and exposure time. The potential of leaves of five plants viz., *Eucalyptus, Bougainvillea glabra, Azadirachta indica, Saraca indica* and *Ricinus communis*, were selected as grain protectants against insect infestation.

Forty five days storage of wheat grain samples were tested with 5% (by weight) of above mentioned selected test leaves which showed 78% to 76% of repellency against *Tribolium castaneum* insect as compared to the control samples of wheat grain without test leaves.

Introduction

The storage of grains and other food products in respect to insect infestation is a serious problem throughout the world. In 1989, 9% post harvest losses, due to insect and mite infestation, were reported worldwide suggesting a need to make an all out effort to combat these post harvest losses. In Pakistan, it has been estimated that 5–7% loss of food grain occurs due to poor storage conditions (Jilani & Ahmad, 1982). Wheat among all the cereals grains, constituting 80% of the staple food of Pakistan, is highly sensitive to the attack by insects. Besides insects, rodents and molds are also the main biological factors involved in stored food grain losses. The most important and premier requirement of the country, therefore, is to check insect and microbial growth so as to control and reduce grain losses during storage in the season (Tadashi, 1989; Pree *et al*., 1989).

Modern methods of food grain treatment using insecticides and fumigants to check post harvest losses during storage are highly expensive (White & Leesch, 1995). These treatments, due to their residual effects are toxic and continuous applications of such chemicals leads to environmental pollution and health hazards, besides developing resistance in organism (Champ 1981; Subramayam & Hagstrum, 1995). Presently worldwide attention is focussed on screening and development of less hazardous and cheap material as Methyl bromide and phosphine and mostly the natural products such as powdered vegetable/fruit peels are recommended as grain protectants (Singh *et al*., 1978)

Traditionally, different parts of neem tree and other plant leaves have also been used as food grains protectants at farm level (Jilani & Ahmad 1982). The search for deriving effective insecticides from natural material became highly imperative. Hence present study was undertaken to screen the leaves of medicinal plants, growing under regional environmental conditions and also investigate their potential in controlling insect infestation.

Material and Methods

Samples of wheat grains: Local variety of wheat grain *Triticum aestium* cultivated in the region was collected from different Govt. go downs with 12% to 20% moisture content.

Insect tested

Culture: The species of stored grain insect *Tribolium castaneum* (HBST) was maintained in laboratory without exposure to any insecticide. Ten days old adults were reared on broken wheat grains at a temperature of 30 to 35° C with relative humidity of 55% under low crowding conditions.

Doses: Sixteen insects (per 100 gms) weighing 266 gms per 100 gms of samples were used for carrying out the studies (Collins, 1998).

Sample preparation

Healthy mature plant leaves each of *Azadirachta indica*, *Saraca indica*, *Bougainvillea glabra*, *Eucalyptus* and *Ricinus communis*, were selected for their insecticidal activity and also tested as grain protectants under lab scale experimental studies. Freshly procured green leaves of plants were cut into small pieces and dried separately at room temperature under shed for 10–12 days, to avoid vaporization of their volatile compounds. Dried leaves in 5% ratio (w/w) were manually grounded and mixed with ½ kg wheat grain (i.e. 475 grams of wheat grain + 25 grams of Test leaves). Each set of grain with crushed leaves was stored in perforated polyethylene bags in triplicate. Control containing ½ kg wheat grains without any test plant leaves were simultaneously stored in triplicate under conditions as for test batches. Each set, marked as i to vi, was stored for three months under identical conditions (35–37°C). On completion of the incubation period of storage, grains from each set of experiment were separated from test leaves and weighed to determine weight loss in 100 grains. Percentage of grain damage, and the insect count per batch was also recorded.

Results from all set of treatments were evaluated separately and weight loss calculated (Adams & Schulten, 1978; Champ, 1981).

$$\% \text{ wt. loss counted} = \frac{(UNd) - (DN)}{4(Nd) + (N_4)} \times 100$$

$$\text{or} \quad \% \text{ Mortality} = 100 \frac{\text{No. of Insects alive in Test}}{\text{No. of Insects alive in control}} \times 100$$

Results

Wheat grain sample No. 1 stored for three months without any treatment under normal laboratory conditions (35 to 37^0 C) showed 9% weight loss in 100 grains i.e., initial weight of 3.77 gms per 100 grains was reduced to 3.4 gms. Total number of insects present in initial material i.e. 16 per 100 gms to 85 per 100 gms material, thus increasing infestation from 6 to 43% (Table 1).

Table 1. Effects of storage on wheat grain losses and propagation/development of insect.

Wheat grains	100 grain weight in gms	Total number of insects/100 grains	Infestation %
Initial	3.77	16	6
After 3 months storage (without any protectants)	3.44	85	43
Change	0.33	69	37

Table 2. Grains count/100 gms sample and percent loss in wheat samples stored for 3 months with 5% leaves of different plants.

Name of plant leaves	Weight loss on storage	Infestation controlled (%)
Control (without leaves)	9.0	—
Ricinus communis	2.2	76
Azadirachta indica	2.6	71
Saraca indica	3.8	59
Bougainvillea glabra	4.5	50
Eucalyptus	6.4	29

Loss in grain weight

Encouraging results were obtained on wheat grain samples stored for three months with 5% dried grounded leaves. Grains treated with *R. communis* leaves showed only 2.2% weight loss, whereas grains stored with other crushed test leaves of *A. indica*, *Saraca indica*, *B. glabra* and *Eucalyptus* showed 2.6, 3.8, 4.5 and 6.4% weight loss respectively with respect to control. These results showed that 76, 71, 58, 50 and 29% control in wheat grain losses respectively was achieved in storage with above-mentioned leaves, as compared to control (Table 2).

Insect count

Some tested plant derived materials are found to be highly effective against insecticide resistant pest insects (Arnason *et al*., 1989; Ahn *et al*., 1977). As reported earlier, insect count increased from 16 to 85 per 100 gms material, in wheat samples, where no crushed leaves were added prior to storage (control). However, storage of wheat grains in the presence of 5% crushed leaves of all test plants, demonstrated comparatively lower insect count than control.

Wheat grains treated with *Eucalyptus* leaves showed 80 insects *Bougainvillea glabra* 70 insects, *Saraca indica* 54 insects, *Azadirachta indica* 40 insects, and *R. communis* 38 insects per100 gms., material after completion of 3 months storage period respectively. Keeping in view presence of 16 insects in initial wheat samples, there is thus a 69% increase in insect count in control. Likewise insect count of 64% in *Eucalyptus*, 22% in *R. communis* 24% in *Azadirachta indica*, 38 % in *Saraca indica* and 54% in Bougainvillea was observed. When compared with control, 6%, 55%, 53%, 36.5% and 17.6% insect control respectively has been achieved on storage when crushed leaves were used as protectants. Thus *A. indica* and *R. communis* leaves showed more than 50% control when used in 5% ratio. Their efficiency may enhance if more than 5% crushed leaves are added.

Table 3. Effects of different plant leaves on propagation of insect and control of infestation in wheat grains after three months storage.

	Insect count per 100 gms grains	*T. castaneum* % increase with respect to initial sample	Increase with respect to control	Infestation (%)
Initial	16	—	—	6
Control	85	69	—	54
Eucalyptus	80	64	6.0	43
Bougainvillea glabra	70	54	17.6	33
Saraca indica	54	38	36.5	28
Azadirachta indica	40	24	53.0	15
Ricinus communis	38	22	55.0	13

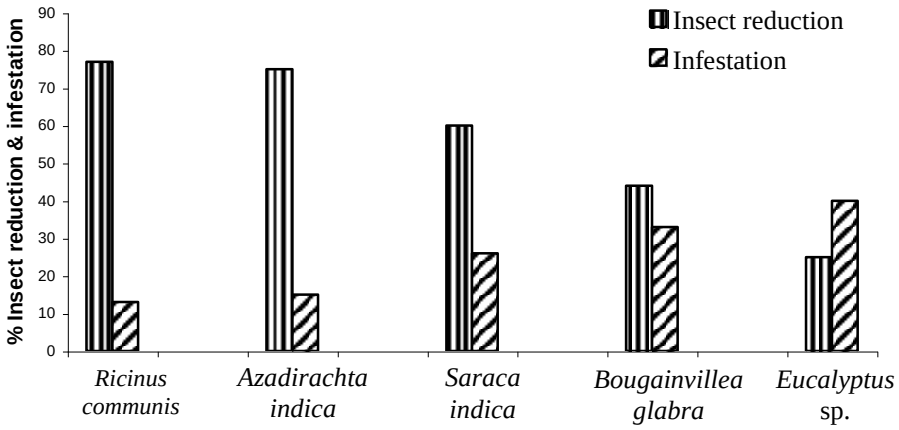

Fig. 1. Insecticidal effect of different plant leaves on *Tribolium castaneum*.

Infestation/spoilage

There was 54% spoilage in wheat grains stored without any protectants. However, leave protectants reduced spoilage to 43%, 33%, 28%, 15% and 13% in samples stored with crushed leaves of *Eucalyptus* sp., *Bougainvillea*, *Saraca indica*, *A. indicia* and *R. communis* respectively (Table 3).

The storage of wheat grains with 5% grounded leaves of *R. communis* controlled propagation of insects by 78%, and grain spoilage to 13% (Fig. 1). These results are comparable to *A. indica* which demonstrated 76% control over insects and resulted in 15% spoilage, which is known for its insecticidal properties.

On the other hand the effect of *S. indica* leaves exhibited slightly less efficiency i.e., 62% insect control and 28% grain spoilage. *Bougainville*a leaves showed insect control up-to 36% and 43% grain spoilage whereas the *Eucalyptus* leaves showed the lowest efficiency i.e. 36% insect control and 43% grain spoilage. It would therefore suggest that the use of higher dosage (5% to 8%) *R. communis* and *S. indica* (locally available) when applied as grain protectants, improve the insecticidal property as well as help to control post harvest and food grain losses during storage at farm level. Use of plant leaves as grain protectants, besides being cost effective, may also abate the environmental pollution and reduce health hazards.

Discussion

On the basis of experimental studies it was found that the mixture of plant materials with their rapid and slow action, proved to be very effective for the protection of stored grains. It has also been well recognized internationally that some plants derived insecticides can affect a limited range of pest insects, but have no harmful effect on non-targeted organisms and environment. Many of the plant derived materials possess repellant and insecticidal activities against the insects of the stored food products, and also confirms their usefulness as potent control agent. (Hill & Schoonhoven, 1981; Desmarchelier, 1994)

The plants used in this study possess the property to safeguard the stored grain materials against the insect which invade the storage bins and godowns due to the slow release of active components of selected plant leaves. Efforts are being made to develop a formulation of plant derived materials which are potentially useful and non-toxic and can be utilized in the stored grain products for long shelf life.

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(Received for publication 17 April 2004)