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Potency of Some Spices Against *Callosobruchus chinensis* Linnaeus

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Abstract: The experiment was conducted to investigate the insecticidal potency of some spices against pulse beetle (*Callosobruchus chinensis*) on stored chickpea with six treatments. The data were recorded on days to 100% mortality, days to adult emerged, number of adults emerged and chickpea weight loss (%). Minimum number of days to 100% mortality was observed in cloves and black pepper treated pulse beetles, while maximum number was recorded in control treatments. Equal number of days to adult emerged was counted in all the treatments including control. Minimum number of adults emerged was counted in cloves and black peppers treated pulse beetles. However, maximum number was counted in control treatments. Lower weight loss percent was also calculated in cloves and black peppers treated pulse beetles as compared to other treatments. However, higher weight loss percent was calculated in control treatment.

Key words: Mortality, weight loss, potency, pulse beetle, stored chickpea

Introduction

Pulses have a prominent place in daily diet and they are rich source of vegetable protein, mineral matter and vitamin-B. They are of special significance of the people in developing countries like Pakistan, who can hardly afford animal protein in adequate quantities. Among the pulses, chickpea (*Cicer arietinum*) belonging to the family leguminosae is the fifth most important legume crop in the world. It ranks third among the world's pulse crops after dry bean and dry pea.

The pulse seeds suffer a greater damage during storage due to insect attack (Sherma, 1989). Among the insect pests attacking stored products, pulse beetle (*Callosobruchus chinensis* Linnaeus Coleoptera: Bruchidae) is a serious one. (Alam, 1971). This insect has been reported from the Philippines, Japan, Indonesia, SriLanka, Burma and India. It is a notorious pest of chickpea, mung, moth, peas, cowpeas, lentil and arhar respectively.

The extent of damage to pulse seeds is very high both qualitatively and quantitatively (Atwal, 1976). There was 55-69% loss in seed weight and 45.6 –66.3% loss in protein content by pulse beetle on chickpea (Gugar and Yadav, 1978). About 100% loss of pulse seeds was found due to infestation by pulse beetle (Borikar and Puri, 1985).

Amonkar and Banerji (1971) have observed the antagonistic properties of diallyl disulfied and diallyl trisulfied against several pests of economic importance such as the potato tuber moth, the red cotton bug, the red palm weevil, house flies and mosquitoes. They have isolated, identified and even duplicated synthetically the active ingredients with in garlic oil that are responsible for killing the wormlike larvae of certain mosquitoes and agricultural pests.

Jilani and Hassan (1984) tested powders of five plant species rhizomes of *Acorus calamus* (C), *Allium sativum*, seeds of *Azadirachta indica (A. juss)*, *Carum copticum* and leaves of *Xanthoxylum armatum* (Dc), for their effectiveness as grain protectents against *Rhizopertha dominica* (F), *Sitophilus oryzae* (L.) and *Sitotroga cerealella* (Oliv). *Acorus calamus* proved to be the best for completely checking development of insect in wheat grain. *Azadirachta indica* and *Allium sativum* also have good results.

Sighamony *et al.* (1984) tested oil of clove, cedarwood (*Juniperus virginiana*), karanja (*Pongamia glabra*) and an acetone extract of black pepper (*Piper nigrum*) in India by a choice method to determine their repellent effects on adults of *Tribolium castaneum*. The cedarwood, karanja and pepper products were found to be more potent than the standard repellent dimethylphthalate. Karanja oil and pepper extract were rated as the most repellent at the highest concentration tested (10.38mg/cm^3) but were less repellent at the lowest concentration tested (2.59mg/cm^3). Karanja oil appeared to retain its repellent effect strongly over the 8 weeks of the experimental period.

Don- Pedro (1985) studied the toxicity of powdered sun-dried orange and grapefruit peels to *Callosobruchus maculatus* and *Dermestes maculatus* in the laboratory. LD50s of orange and grapefruit peels admixed with cowpea grains on adults of *C. maculatus* were 4.00g (peel)/100g (cowpea) and 5.62g (peel)/100g (cowpea) respectively. LD 50s of the ground peels on adults of *D. maculatus* were much higher at 14.13g (orange peel)/100g (fish pieces) and 14.29g (grapefruit peel)/100g (fish pieces). Orange and grapefruit peels deterred adult test insects from admixed cowpea and dried fish pieces respectively. Orange peel at high dosages was also shown to depress progeny development of *D. maculatus*. The possible use of ground orange peel as a protectant for at least cowpea grains from *C. maculatus* infestation in small scale storage in Nigeria is discussed.

Jilani *et al.* (1988) tested twenty one local plant materials known for their activity against insect pest in the form of powder mixed with mung beans, *Vigna radiata* (L.), against the pulse weevil, *Callosobruchus analis* (F). Out of these, rhizomes of sweetflag, *Acorus calamus* (L.) and seeds of soya, *Peucedanum graveolens* Benth. were found to be of same insecticdal value. Sweetflag rhizome powder was further studied by mixing it with grain @ 1.0, 0.5 or 0.25% as a dispenser made of the same quantities of powder or 0.05, 0.025 or 0.0125% of its petroleum ether extract. All the test forms of sweet flag showed high insecticidal activity and checked progeny emergence in the weevil. An unidentified fraction obtained from petroleum ether extract of sweet flag rhizomes was highly insecticidal.

Saxena *et al.* (1992) tested aerial parts of *Lantana camara* for their insecticidal, antiovipositional and antifeedant activity against *Callosobruchus chinensis*. Petroleum ether and methanol extracts of the plant showed 10-43% mortality at 1-5% concentrations. The extracts also showed complete feeding deterrent action at 5% concentrations. Loss of fecundity was also noticed in both the extracts at higher doses. The antiovipositional values were 30 mg/100 gm for petroleum ether extract and 40 mg/100gm of seed for methanol extract.

Khaire (1992) studied efficacy of ten vegetable oils; viz, sunflower, castor, mustard, safflower, palm, ground nut, sesame, neam, karanj and maize each applied at rates of 5, 7.5 and 10 ml/kg of grain (0.5, 0.75 and 1% v/w concentration) as grain protectants of pigeon pea against pulse beetle (*Callosobruchus chinensis* L). Effects on progeny emergence, loss in grain weight and germination upto 100 days after treatment were measured. Adult emergence was completely prevented by karanj oil at 0.75 and 1%

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and neem oil at all levels up to 100 days. No emergence of adults occurred upto 66 days with castor oil at 0.75 and 1% levels. Minimum grain loss was noted with castor, mustard and ground nut oils at the 1% level up to 100 days after treatment. There was no adverse effect of the various oils on seed germination. Neem, palm and karanj oils are cheaper when compared with others.

Miah *et al*. (1993) reported that when several local (Bangladesh) plant materials were tested against *Callosobruchus chinesis* Linn. on chickpea seeds, Nishinda (*Vitex engundo*) leaf poweder was the most effective in reducing numbers of eggs laid, adult emergence and seed weight losses.

Iqbal and Poswal (1995) tested powdered spices (flowers of clove, rhizome of ginger and turmeric, fruits of black and chilli pepper (*Piper nigrum*, *Capsicum frutescens*) and bulb of garlic), malathion (1.5%) and powdered stem of the tree C*ombretum imberbe* mixed with cow peas in 0.5 liter jar at 1g/jar, against C. maculatus. Oviposition and seed weight loss were recorded 10 and 70 days later, respectively. Cloves and black pepper gave results which were not significantly different from those produced by malathion.

The use of plants and minerals as traditional protectants of stored products is an old practice used all over the world (Golob and Webley, 1980). These traditions have been largely neglected by farmers, after the second world war, with the advent of synthetic or petroleum-based inseticides. However, the potential hazards for mammals from synthetic insecticides, the ecological consequences and the increase of insect resistance to pesticides has led to a search for new classes of insecticides with lower mammalian toxicity and a lower persistence in the environment (Roger and Hamraoui, 1993).

Pulse beetle being an internal feeder can not be controlled with insecticides. It is also not advisable to mix insecticides with food grains. Fumigation being the most effective method cannot be practiced in our villages because the storage structures are not airtight and are mostly built inside the residential areas. Plant materials which are being traditionally used by some farmers are quite safe and appear to be the most promising as grain protectants. Similarly, the use of spices are also less costly, easily available, safer and don't do any hazard using in the stores.

Keeping these views, the present experiment was designed to investigate the insecticidal potency of some spices against pulse beetle on chickpea seeds.

Materials and Methods

Five different spices clove (*Syzygium aromaticum*), black pepper (*Piper nigrum*), cinnamon (*Cinnamomum zeylanicum*), red pepper, (*Capsicum annum*), (*Amomum subulatum*) and a control treatment were used against pulse beetle on chick pea seeds. The experiment was carried out in the laboratory, Department of Entomology, University of Arid Agriculture, Rawalpindi during 2001. The experiment was conducted in randomized complete block design. Different spices and chickpea seed were obtained from departmental store whereas the pairs of pulse beetle were obtained from NARC, where these were reared scientifically.

The spices were ground in an electric grinder to a fine powder and 1g fine powder of each spices was put in each petridish. Then chickpea seeds were weighed on electric balance and 40g weighed seeds were put in each petridish. Newly emerged five pairs of adult pulse beetles were released in each petridish and the petri dishes were covered with the lids, so that the beetles may not go away from petridishes. The petri dishes were kept on the laboratory table.

The data were recorded on days to 100% mortality, days to adults emerged, No. of adults emerged and % wight loss of chickpea. The released beetles were checked daily for recording the data on number of days to 100% mortality. The died beetles were removed from petridishes and were counted. The final number of days were counted where the 100% mortality was occurred. The petridishes were observed daily after the release of beetles for determining the total number of days to adults amerged. The number of adults emerged were counted daily and later on added to determine the total number of adults emerged and then the average was determined. Weight loss was checked at the end of the experiment. The weight loss caused by the pulse beetles was assessed by subtracting the weight of the infested seeds in the petridishes from the weight of non-infested seeds recorded before releasing the beetles and then percent weight loss was determined be the formula given below.

$$\text{Wieght loss(\%)} = \frac{\text{Initial weight - Final weight}}{\text{Initial weight}} \times 100$$

Results and Discussion

Days to 100% mortality: It is obvious from the data that highly significant differences ($P<0.01$) were found among all the treatments. Minimum number of 3.75days to 100% mortality was observed in the cloves and black pepper treated chick pea followed by red pepper treated chickpea having 5.00days to 100% mortality (Fig. 1). The data recorded in greater cardamom treated chickpea remained statistically at par with red pepper treated chickpea having 6days to 100% mortality. In cinnamon treated chickpea 8.25days to 100% mortality was observed. However, maximum of 9.50days to 100% mortality was observed in control treatment.

Days to adults emerged: The data indicate that all the treatments remained statistically non-significant ($P>0.05$). However the total number of days to adults emerged varied from 21.00 to 21.50 among all the treatments (Table 1).

Number of adults emerged: It is clear from the result that different treatments showed highly significant differences ($P<0.01$) (Fig. 2). All the treatments produced less number of adults as compared to the control treatment where 29.00 adults were emerged. However, minimum number of 10.50 adults emerged were counted in cloves treated chickpea which remained statistically at par with the black peppers treated chickpea having 10.75 adults emerged followed by red peppers, greater cardamom and cimmamon having 16.00, 21.00 and 25.75 number of adults emerged respectively.

Table 1: No. of days to adult emerged of pulse beetle as affected by different insecticidal potency of spices

Treatments spices (40g/dish)	No. of days to adult emerged
T_1 = Control	21.50
T_2 = Cloves	21.25
T_3 = Black pepper	21.00
T_4 = Red pepper	21.25
T_5 = Greater cardamom	21.50
T_6 = Cinnamon	21.50
LSD value at 5%	NS

Weight loss of chickpea: Weight loss was determined in mean percent. It is obvious from the results that highly significant ($P<0.01$) differences were found among all the treatments (Fig.3). Minimum weight loss percent of chickpea was 8.09 and 8.34% and was calculated in cloves and black peppers treated pulse beetles respectively and remained statistically at par. While red peppers and greater cardamom treated pulse beetle produced 12.45 and 15.44% weight loss of chickpea followed by 20.36% weight loss of chickpea calculated in Cinnamon treated pulse beetles. However, maximum of 22.34% weight loss of chickpea was recorded in control treatments.

The data pertaining to the number of days to 100% mortality (Fig.1) showed highly significant differences. The treatment where cloves and black peppers were applied against the pulse beetle took less number of days to 100% mortality and remained

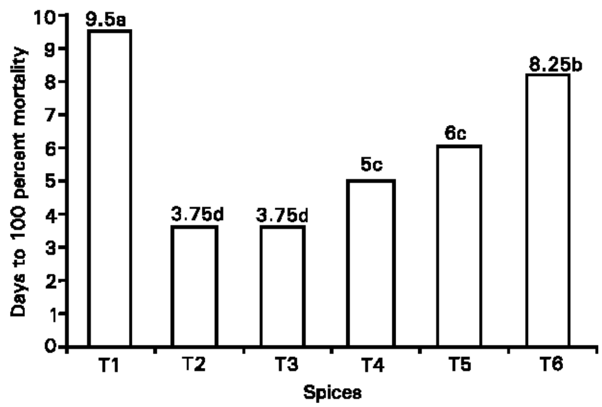

Fig. 1: Days in which 100% mortality of pulse beetle was achieved as effected by different insecticidal potency of spices

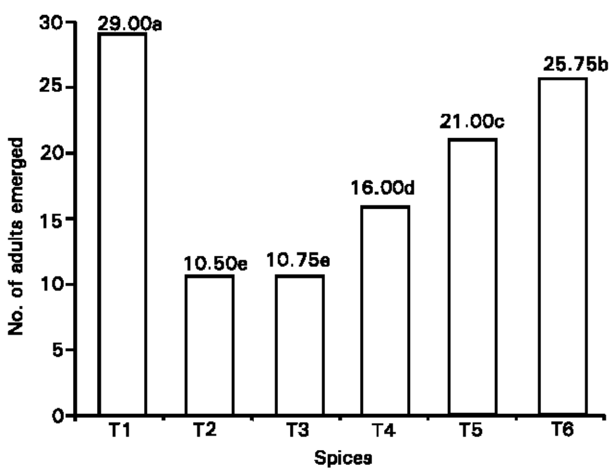

Fig. 2: Graphical presentation for No. of pulse beetle adults emerged as effected by different insecticidal potency of spices.

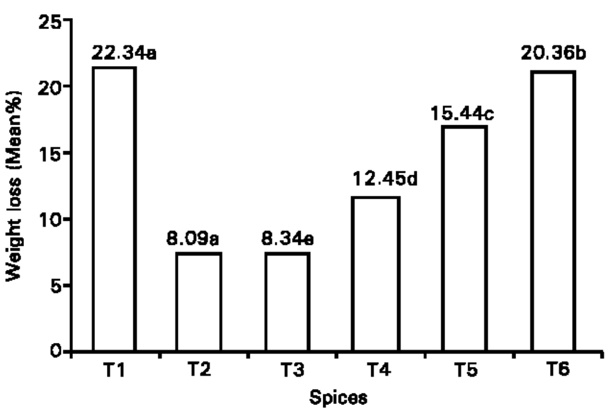

Fig. 3: Weight loss of chickpea (%) as effected by different insecticidal potency of spices

T_1	= Control	T_2	= Cloves
T_3	= Black peppers	T_4	= Red peppers
T_5	= Greater cardamom	T_6	= Cinnamon

statistically at par. The reason could be that the pungent smell of cloves which was due to its active ingredient eugenol, which might have killed the pulse beetle earlier. Similarly the sharp flavour of black peppers which was due to its active component piperine killed the pulse beetles earlier. These findings are confirmed by Jilani and Hassan (1984), who stated that different plant materials with different percentage caused 100% mortality in coleoptera in 9 to 43 days as against 45 days in control. These results are also supported by Iqbal and Poswal (1995), who reported that cloves and black peppers gave equal results for controlling *Callosobruchus maculatus*. However, maximum number of days to 100% mortality was counted in control treatments.

Concluding the above mentioned results, it could be said that number of days to adults emerged (Table 1) indicated that none of the treatments under study reached the level of significance, showing equal number of days to adults emerged. It was observed that the different active components of different spices did not effect number of days to the emergence of pulse beetle adults. The reason could be that as the larva of pulse beetle is an internal feeder and remained safer from the outer environment.

The data related to the total number of adults emerged (Fig. 2) showed highly significant differences among the treatments. The cloves and black peppers treated pulse beetles on chick pea produced less number of adults. The possible reason could be that the active components of both the spices may effect the physiological behaviour of pulse beetles, such as ovipositional activity, growth inhibition and adults mortality. These results are in conformity with Miah *et al.* (1993) who observed that different plant materials tested against *Callosobruches chinensis* on chickpea seeds remained effective in reducing adults emergence. However, maximum number of adults emerged were counted in control treatments.

The data recorded on weight loss of chickpea (Fig. 3) indicated that cloves and black peppers treated pulse beetles showed highly significant differences among all the treatments. It was observed that cloves and black pepper treated pulse beetles on chickpea caused minimum weight loss percent. The possible reason is that due to early mortality the pulse beetles layed less number of eggs on less number of chickpea grains. So, the number of infested grains were less as compared to other treatments. Where as the maximum weight loss percent of chickpea was calculated in control treatments. These results are supported by Miah *et al.* (1993) who stated that different plant materials remained effective in reducing chickpea weight losses.

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