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Research Article

EFFECT OF MEDICINAL PLANT NEEM AND TULSI ON THE CONTROL OF HARMFUL STORED GRAIN PEST *TENEBRIO MOLITOR* (TENEBRIONIDAE)

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ABSTRACT

Tenebrio molitor commonly known as yellow mealworms are major diverse group of insects. Both adults as well as larvae of *T. molitor* are ravenous feeders on a vast range of grains. This study was undertaken for approximation of the insecticidal effect of medicinal plants neem (*Azadirachta indica*) and tulsi (*Ocimum tenuiflorom*) against major stored product insect. The different amount of methanolic leaf extract of neem and tulsi were prepared and was analyzed for their insecticidal properties in laboratory against the larva as well as adult of *T. molitor*. At the dose of 10ml/kg grain, the larval mortality of *T. molitor* fluctuated from (32 to 57%) whereas adult mortality showed range from 27 to 52% The value at 25ml/kg and 50ml/kg grains fluctuated from (56 to 70%) and (67 to 82%) respectively in case of larval mortality, On the other hand adult mortality showed a slightly lower mortality range from 51 to 65% and 62 to 78% respectively. The chi-square test showed a substantial ($p < 0.05$) insecticidal effect of both the plants leaf compared to both larval and adult pest of stored grain but the neem had strong insecticidal effect as compared to tulsi against the larva and adult of *T. molitor*. The result of both the plants leaf extracts was promising as they retard larval growth as well as adult oviposition. Therefore, this led to explore the possibilities of use of medicinal plants leaf extract for insect control with due consideration to stored grains protection along with environment protection from the harmful synthetic insecticides.

Keywords: *Tenebrio molitor*, Insecticide, Yellow mealworm, Medicinal plant extract.

INTRODUCTION

Tenebrio molitor usually known as yellow mealworm acts as a chief pest for the grain's storage, although it is used as a food (Park, 2014). Powdered larval product of yellow mealworm is used as supplement over traditional meals as it contains twice the higher content of protein, minerals and fats (Han *et al*., 2016). Yellow mealworm fed on agricultural waste product is very good alternative to obtain the nutrition from that agricultural waste for human consumption, but the accumulated pesticide during their life cycle causes health risks to the humans (Houbraken *et al*., 2016). Due to widespread use of synthetic pesticides it caused insecticide resistance, environmental pollution and even it targets beneficial insects and no doubt it is very harmful for the humans if consumed, so, now a days the attention towards the natural product is in increasingdemand (Copping, 2000; Isman, 2006). Many pests destroy the stored food products which are kept in dark and damp places. Polystyrene currently cannot be decayed by dumping in landfills or recycled because of its complex molecular structure. Annually, humans throw away over 21 million tons of polystyrene. Previous research done at universities worldwide has found that *T. molitor* (mealworms) can potentially digest polystyrene safely through a gut bacterium called *Exiguobacterium* sp. (Lomoriello, 2020). They prefer to feed on food grains and food substances nearing decaying stage. *T. molitor can* be simply controlled by fumigation with ethylene dichloride, carbon tetrachloride, methyl bromide or many other fumigants. But these procedures of fumigation are harmful for nature because they may harm human body if the infected food products are consumed by the human beings. Many insecticides are also known to cause many physiological aberrations (Brown, 1963; Gangrade & Pant, 1970), whether they are given in the form of liquid spray or

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dust. Generally, insecticides act a poison at the cellular level. Hence, when stored food grains exposed to certain insecticide as mentioned earlier may also become harmful to human beings besides killing the insect pests. DDT, BHC and Malathion which account for more than 50 percent of total pesticides are the cheapest and are most popular among small farmers. The use of different insecticide causes a serious threat (Gupta, 1990). neem powder is water soluble and can be easily washed away and it is effective on different pests and parasites such as ticks, mites, beetles (*T. molitor*), bugs, cockroaches, head lice and many more insects and pests (Schmahl *et al*., 2010). Neem stem twigs are widely used as brushing (chewing) in rural areas since immemorial time is proved to have antibacterial and anti-plaque properties (Almas & Al-Lafi, 1995). Insecticidal and pesticidal properties of tulsi leaf extract are also reported (Nanasombat & Lohasupthawee, 2005). Other methods of control like hormonal insecticide (Williams, 1967) or biological control of different insect pests are being explored. The control of Japanes beetle *Papilla japonica* (Patterson *et al*.,1991) is controlled by their alkaloids produced by *Acromonius sp*. Alkaloids from *N.lolii* and *N. perenne* are able to alter the insect behavior (Azevedo *et al*., 2000). But the uses of above methods are harmful because as it is not only damage physiology of animals but also to the human beings. Biological pesticides having least lethal effect, fast degradation and reduced environmental damaging properties make botanical pesticides as suitable for organic farming (Cosimi *et al*., 2009). The yellow mealworm is the largest insect species that attack the stored grain in India. Hence, neem (*Azadirachta indica*) and tulsi plants (*Ocimum tenuiflorom*) were undertaken to investigate its effect on *Tenebrio molitor.*

MATERIAL AND METHODS

Methanolic extracts were made using the leaves of tulsi and neem separately. 100 new emerged larvae of yellow mealworm were kept in a culture tube having 1kg of methanolic leaf extract of tulsi as well as neem treated grains separately. Likewise, adult *T. molitor* was also kept in another culture tube having 1kg of grains mixed with the methanolic leaf extracts of tulsi and neem separately. Muslin clothes were used to cover the culture tube and tied with the help of rubber bands. The mortality percentage of larva as well as adult of yellow mealworm was estimated after 3 days. Alongside controls were also retained with the species which has not been contaminated to the treated grains and the remarks were made on the same.

Data analysis

All the values obtained during observation were represented as mean. Chi-square test was applied to establish the insecticidal activity of the medicinal plant extract tested.

RESULTS AND DISCUSSION

Effect of medicinal plants leaf extract on the adult as well as larval mortality of yellow mealworm is presented in Table 1. At the dose of 10ml/kg of grain the highest larval mortality was observed in grain treated with neem (61.4%) which was followed by tulsi (36.5%). In the same way the result for adult mealworm was also perceived in which the maximum mortality was observed in grain treated with neem (56.5%) followed by tulsi (31.5%) (Table 2). At the dose of 25ml/kg grain for larval mortality, it was observed more in the case of neem (74.8%) which was followed by tulsi (61.6%) (Table 1). Parallel result was also obtained in adult mealworm with the maximum mortality in the case of neem (69.9%) followed by tulsi (56.1%) (Table 2). With the dose of 50ml/kg grains in larva also the highest mortality was observed in case of neem (86.9%), which was followed by tulsi (71.9%) (Table 1). Equivalent result in adult insects with the highest mortality was also found in case of neem (81.9%) followed by tulsi (67%) (Table 2). All the studies were better in case of control in which larval as well as adult mealworm mortality was not perceived. The insecticidal activity of neem and tulsi gradually increased with increase in the amount of extract against both larva and adult of *Tenebrio molitor.* The chi-square test presented a substantial ($p<0.05$) insecticidal effect of both the plant leaf against larval and adult pest of stored grain. The neem had strong insecticidal effect as compared to tulsi in contrast to the larva and adult of *T. molitor*.

In the present study, the leaf extract of neem and tulsi was suggestively ($p < 0.05$) insecticidal at very low amount against the larva and adult of *T. molitor.* The quantity of plant extract and comparative toxicity were designed and given in Table 1 & 2. On the basis of amount of plant extract, it is apparent (Table 1 & Table 2) that on the basis of amount of plant extract, the most effective plant source insecticide was extract of neem at highest dose followed by tulsi. The furthermost vital finding is that mortality response was directly relational to the increase in amount of different treatment with the development of substantial time. In the observation of several diverse biological effects exhibited, the neem and tulsi extract can be utilized as comparatively harmless, low-priced and new approach in integrated pest management program against the larva and adult of *T. molitor* to protect the stored grains in the comparison of former recommended predictable synthetic insecticide method. Herbal preparation used as medicinal purpose since from ancient times as mentioned in Vedas was an important integral part of 'medicinal science in ancient India' (Rastogi & Mehrotra, 2002).

Table 1. Effect of medicinal plant neem and tulsi on the mortality of larva of *Tenebrio molitor*.

S.No.	% of larval mortality at various amount of neem extract			% of larval mortality at various amount of tulsi extract			Control
	10 ml	25 ml	50 ml	10 ml	25 ml	50 ml	
1	60	70	84	30	65	75	1
2	55	67	86	40	70	74	0
3	59	74	87	35	60	73	0
4	61	75	88	30	70	75	0
5	63	76	92	35	55	77	0
6	65	77	83	40	60	73	0
7	66	81	89	40	65	70	0
8	60	79	87	35	55	69	0
9	70	75	88	40	53	67	0
10	55	74	85	40	63	66	0
∑ fx/n	61.4	74.8	86.9	36.5	61.6	71.9	0.1

Chi-square value - 1.889106 [significant] (df=2).

Table 2. Effect of medicinal plant neem and tulsi on the mortality of adult of *Tenebrio molitor*.

S.No.	% of Adult mortality at various amount of neem extract			% of adult mortality at various amount of tulsi extract			Control
	10 ml	25 ml	50 ml	10 ml	25 ml	50 ml	
1	55	65	79	25	60	70	0
2	50	62	81	35	65	69	0
3	54	69	82	30	55	68	0
4	56	70	83	25	65	71	3
5	58	71	87	30	50	72	0
6	60	72	78	35	55	68	0
7	61	76	84	35	55	65	1
8	55	74	82	30	50	64	0
9	65	71	83	35	48	62	0
10	51	69	80	35	58	61	0
∑ fx/n	56.5	69.9	81.9	31.5	56.1	67	0.4

Mean effect on adult of *Tenebrio molitor*.

CONCLUSION

In the current set of experimentation, after the application of methanolic extract of neem and tulsi at different amounts, it was perceived that substantial feeding took place by the larva in most treatment; it opens the thought for the enzymatic variance in the larva which caused the decease level due to some protein deficiency. Recent study on protein of yellow mealworm showed that precise actions of pepsin and trypsin expressively reduced with age from the first harvesting time until 50 and 45 days after harvesting, respectively (Rodjaroen *et al*., 2020). The future research should also investigate the nutrition content of the medium and effect of environmental parameters.

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