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Full Length Research Article

Eco-friendly Insect Repellent: Preparation and Effect on Plant Health

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Abstract

The long-term use of chemical pesticides results in contaminated water, soil and destruction of important useful soil biota as well as have very adverse effect on human health and ecosystems. Keeping in view the use of chemical pesticides, there is an urgent need to train the farmers for the production and use of an eco-friendly insect repellent to avoid the vegetables and crop toxicity. An eco-friendly and less expensive "Insect repellent" has been prepared using leaves of certain medicinal plants viz., *Azadirachta indicia* (Neem), *Datura stramonium* (Datura), *Cascabela thevetia* (Kaner), *Calotropis gigantean* (Madar), *Cannabis indica* (Bhang) and *Allium sativum* (Garlic bulbils) together with cow-urine and its impact has also been studied on plant health.

***Key words*:** Chemical pesticides, Soil biota, Eco-friendly insect repellent, Medicinal plants

Chemical pesticides have very adverse effect on human health and ecosystems. For the developing countries like India, Nepal and Bhutan etc., growing population and good health are the major concerns in the present scenario, under such situation there is an apt need to develop healthy and chemical free production of vegetables and crops with high yield. Earlier chemical control studies on insects and pests using synthetic class of pesticides like organo-chlorine (DDT), Organo-phosphorous pesticides and carbamate pesticides have indicated a negative impact on human health like, endocrine disrupting potential [1-2], reproductive disorders [3], increased risk of dementia [4]. Human beings and other grazing animals have been found to be affected by these pesticides through their diet, dermal contact and inhalation of contaminated air particularly by the farmers during their agricultural activity [5]. It has been found that, the long-term use of such pesticides results in contaminated water, soil and destruction of important useful soil biota [6]. Keeping in view the use of chemical pesticides, there is an urgent need to train the farmers for the production and use of an eco-friendly insect repellent to avoid the vegetables and crop toxicity. The present work has been focused on the production of eco-friendly and less expensive "Insect repellent" using leaves of certain medicinal plants viz., *Azadirachta indicia* (Neem), *Datura stramonium* (Datura), *Cascabela thevetia* (Kaner), *Calotropis gigantean* (Madar), *Cannabis indica* (Bhang) and *Allium sativum* (Garlic bulbils) together with cow-urine and its impact has also been studied on plant health.

MATERIALS AND METHODS

Preparation of "Insect repellent"

The insect repellent has been prepared by using the leaves of selected easily available medicinal plants viz., *Azadirachta indicia* (Neem), *Datura stramonium* (Datura), *Cascabela thevetia* (Kaner), *Calotropis gigantea* (Madar), *Cannabis indica* (Bhang) and *Allium sativum* (Garlic bulbils) together with cow urine (Table 1).

Table 1 Composition of the eco-friendly insect repellent

Ingredients	Amount
Azadirachta indica leaves	400 gm
Datura stramonium leaves	250 gm
Cascabela thevetia leaves	400 gm
Calotropis gigantea leaves	400 gm
Cannabis indica leaves	300 gm
Allium sativum bulbs	200 gm
Cow urine	8.00 L
Water	2.00L

The earthen pitcher of 12 litre capacity has been filled with the desired amount of cow urine and water. The leaves are

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dipped into the liquid medium and then covered the mouth of the pitcher with a double layered cotton cloth and incubated it for 22 days under shade. The final product is filtered through double layered muslin cloth and store for future use.

Control studies of the insect repellent

The prepared insect-repellent has been directly tested in the field in 1:10 (1L. Pesticide: 10L. Water) ratio and sprayed on selected 100 plants (Table 2) separately together with control viz., *Lagenaria siceraria* (Lauki), *Abelmoschus esculentus* (Bhindi), *Solanum melongena* (Baigan), *Brassica campestris* (Sarso) and *Oryza sativa* (Dhan) in evening after 07 to 15 days interval against the insects viz., *Leucinodes orbonalis* (Shoot borer), *Leucinodes* sp. (Fruit borer), *Drosophila melanogaster* (Fruit fly), *Aphidoiea (*Aphids), *Caelifera* (Grasshopper), Gondi bug Maize worm, and Army worms. It has been found that almost all the insects could not visit on the plant body surface.

Table 2 Treatment using the prepared insect repellent on 100 plants

Treatment	Units	Shoot borer	Fruit borer	Fruit fly	Aphids	Grass hoppers	Gondi bug
Before application	100	20	08	11	50	10	25
7 days after application	100	15	06	08	22	07	13
14 days after application	100	10	03	05	18	03	03
Control (%)	-	50	63	54	64	70	88

Quality assessment

For quality assessment of prepared insect-repellent and its impact on plant health two important Biochemical assay "Chlorophyll contents and Nitrate Reductase (NR) enzyme activity assay" have been done in the laboratory on selected two main vegetable crop viz., *Lagenaria siceraria* (Bottle gourd) and *Solanum melongena* (Brinjal) after 10 and 20 days treatment.

Chlorophyll content in leaves: Chlorophyll is an important biomolecule, critical in photosynthesis, which allows plants to obtain energy from light. The estimation of chlorophyll has been done as per the method suggested by [7-8].

Assay of nitrate reductase activity: Nitrogen is one of the important requirements of the plants which are usually taken as nitrates by soils; majority of this nitrate is added to the biosynthesis of proteins and nucleotides. The Nitrate Reductase (NR) enzyme estimation was done in fresh leaves. According to the protocol suggested by [9-10].

Antifungal activity: The prepared liquid insect-repellent also showed antifungal activity and exhibited 100% fungicidal action under *in vitro* test against the pathogen viz., *Alternaria* sp., *Fusarium* sp. and *Pytheium* sp. at 900 µl/10 ml concentration, using food poison method. Under in vivo field test condition no pathogen has been observed on the test plants.

RESULTS AND DISCUSSION

When the prepared insect-repellent are directly tested in the field on selected plant crops of 50 and 100 units (Table 2-3) after 07 to 14 days interval against the insects viz., *Leucinodes orbonalis* (Shoot borer), *Leucinodes* sp. (Fruit borer), *Drosophila melanogaster* (Fruit fly), *Aphidoiea* (Aphids), *Caelifera* (Grasshopper), gondi bug maize ear worm, and army worms, each separate plants viz., *Lagenaria siceraria* (Bottle gourd), *Abelmoschus esculentus* (Ladies 'finger), *Solanum melongena* (Brinjal), *Brassica campestris* (Mustard) and *Oryza sativa* (pady). In 50 units of experimental setup *Leucinodes orbonalis* (Shoot borer) 67%, *Drosophila melanogaster* (Fruit fly) 83%, Beetless damage of leaves 100%, Maize ear worm 80%, *Caelifera* (Grasshopper) 100% and Army worms 70% were controlled. Similarly in 100 units of the experimental plants *Leucinodes orbonalis* (Shoot borer) 50%, *Leucinodes* sp. (Fruit borer) 63%, *Drosophila melanogaster* (Fruit fly)54%, *Aphidoiea (*Aphids) 64%, *Caelifera* (Grasshopper) 70% and Gondi bug 88 % were controlled.

Chlorophyll estimation in control and experimental plants of *Lagenaria siceraria* (Bottle gourd) and *Solanum melongena* (Brinjal) showed a significant difference which were recorded after 10 and 20 days treatment. The amount of chlorophyll a, chlorophyll b, carotenoid and total chlorophyll in comparison to control plants were high (Fig 1-2) and found that there was no any pest or insect's attraction and infectious agents on the treated plant body surface.

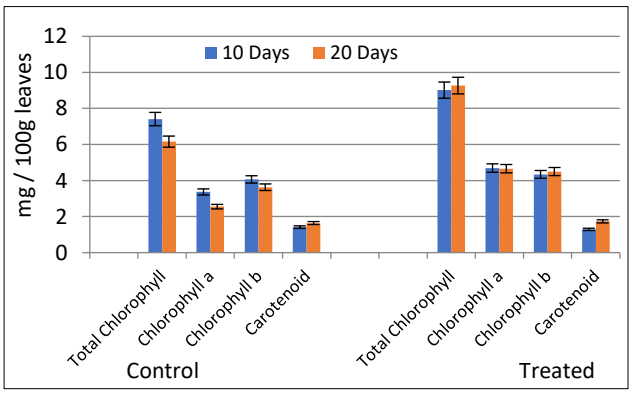

Fig 1 *Solanum melongena* (Brinjal)

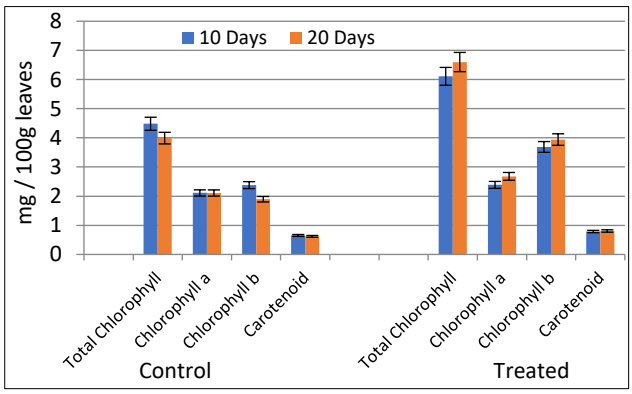

Fig 2 *Lagenaria siceraria* (Bottle gourd)

Nitrate reductase activity was also assayed in leaves harvested after 10 and 20 days. The assay of Nitrate Reductase activity, in control and experimental plants of *Lagenaria siceraria* (Bottle gourd) and *Solanum melongena* (Brinjal), exhibited an enormous change (Fig 3-4). Nitrogen is one of the important requirements of the plants which are usually taken by soils as nitrates. Following reduction by Nitrate Reductase (NR) enzyme the fate of most of this nitrate is to be incorporated into proteins and nucleotides. The development of control and treated plants were carefully observed during the entire study

and found that there was a clear different in control and experimental plants. In the plants treated with prepared repellent there was no any invader insects or pests and showed good health.

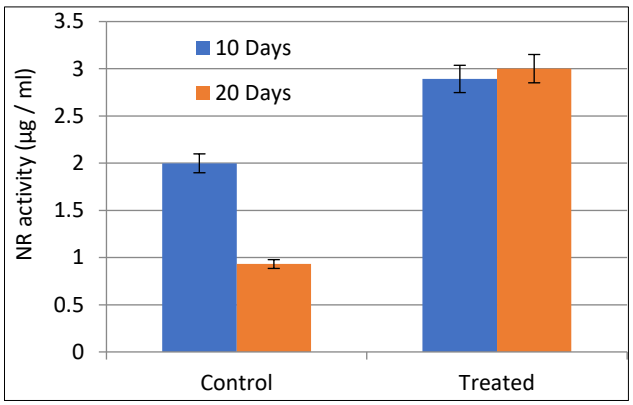

Fig 3 NR activity

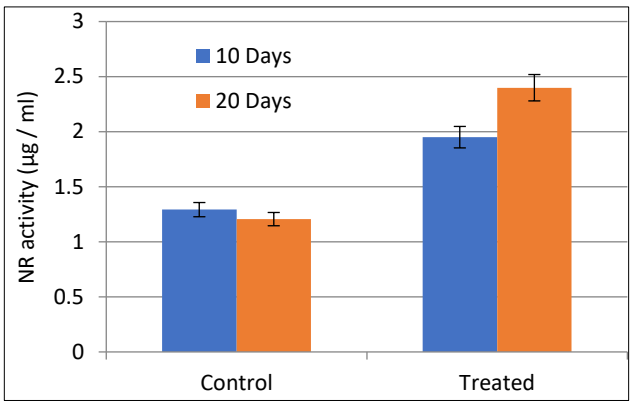

Fig 4 NR activity - *Lagenaria siceraria* (Bottle gourd)

Results indicate that the experimental plants which treated with prepared earthen pitcher insect repellent using leaves of certain medicinal plants viz., *Azadirachta indicia* (Neem), *Datura stramonium* (Datura), *Cascabela thevetia* (Kaner), *Calotropis gigantean* (Madar), *Cannabis indicia* (Bhang) and *Allium sativum* (Garlic bulbils) with cow-urine excelled on all parameters tested (chlorophyll contents in leaves and nitrate reductase activity) without any toxic effect on plant health and soil organism rather than use of a synthetic pesticide or repellent. It has been also observed that, the prepared repellent has antimicrobial activity under i*n vitro* experimental condition against the soil born pathogen viz., *Alternaria* sp., *Fusarium* sp. and *Pytheium*, and can also make the plants disease free. However further detailed study is required its effect on soil organism and harmful pathogens.

CONCLUSION

The prepared "Eco-friendly insect repellent" is an effective Bio remedial product which can be widely used for a variety of crop and vegetables against harmful insects and pests. Chemical pesticides and fertilizers have very adverse effect on human health and ecosystem. Prepared eco-friendly and less expensive "Insect repellent" using leaves of medicinal plants viz., *Azadirachta indicia* (Neem), *Datura stramonium* (Datura), *Cascabela thevetia* (Kaner), *Calotropis gigantean* (Madar), *Cannabis indicia* (Bhang) and *Allium sativum* (Garlic bulbils) with cow-urine tested on a variety of vegetable crops viz., *Lagenaria siceraria* (Bottle gourd), *Abelmoschus esculentus* (Ladies 'finger), *Solanum melongena* (Brinjal), *Brassica campestris* (Mustard) and *Oryza sativa* (pady) against the insects viz., *Leucinodes orbonalis* (Shoot borer), *Leucinodes* sp. (Fruit borer), *Drosophila melanogaster* (Fruit fly), *Aphidoiea* (Aphids), *Caelifera* (Grasshopper), Gondi bug Maize worm, and Army worms. It has been observed that almost all the insects were controlled after treatment. The prepared insect repellent excelled all the parameters like chlorophyll estimation and Nitrate-reductase activity assay while tested for plant health and there was no any toxic effect.

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LITERATURE CITED

1. Mnif W, Hassine AIH, Bouaziz A, Bartegi A, Thomas O, Roig B. 2011. Effect of endocrine disruptor pesticides: A review. *International Journal of Environmental Research and Public Health* 8(6): 2265-2203.
2. Karami-Mohajeri S, Abdollahi M. 2011. Toxic influence of organophosphate, carbamate, and organochlorine pesticides on cellular metabolism of lipids, proteins, and carbohydrates: A systematic review. *Human and Experimental Toxicology* 30(9): 1119-1140.
3. Jamal F, Haque QS, Singh S, Rastogi S. 2015. The influence of organophosphate and carbamate on sperm chromatin and reproductive hormones among pesticide sprayers. *Toxicology and Industrial Health* 32(8): 1527-1536.
4. Lin JN, Lin CL, Lin MC, Lai CH, Lin HH, Yang CH, Kao CH. 2015, Increased risk of dementia in patients with acute organophosphate and carbamate poisoning: A nationwide population-based cohort study. *Medicine (Baltimore*) 94(29): e1187.
5. Yusa V, Coscolla C, Millet M. 2014.New screening approach for risk assessment of pesticides in ambient air. *Atmospheric Environment* 96(2014): 322-330.
6. Sarfraz M, Dosdall LM, Keddie BM. 2009. Fitness of the parasitoid *Diadegma insulare* is affected by its host's food plants. *Basic and Applied Ecology* 10(6): 563-572.
7. MacLachlan S, Zalik S. 1963. Plastid structure chlorophyll concentration and free amino acid composition of a chlorophyll mutant of barley. *Canadian Journal of Botany* 41: 1053-1062.
8. Richa, Tiwari RK, Wajih SA, Prabhuji SK. 2016. Bio-fertilizer from household wastes. *Climate Change and Environmental Sustainability* 4(2): 224-228.
9. Streeter JG, Bosler ME. 1972. Comparison of *in vitro* and *in vivo* assays for nitrate reductase in soybeans leaves. *Plant Physiology* 49: 448-450.
10. Srivastava HS. 1990. Regulation of nitrate reductase activity in higher plants. *Phytochemistry* 19: 725-733.