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Efficacy of botanical extracts and a chemical pesticide against *Helicoverpa armigera* infesting oats

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Abstract
An experiment was carried out in the field at the Faculty of Agriculture, Wadura, North Kashmir during 2015-16 under free choice conditions to evaluate the efficacy of Green leaf extracts against *Helicoverpa armigera* on oats crop. The results revealed that dichlorvos showed significant results in an increase in pest mortality 28.52, 40.00, 51.33 and 61.71 per cent after 1, 3, 5 and 7 days after treatment (DAT), respectively with 92.53 per cent increase in the mortality over control. This was followed by NSKE 22.34, 35.20, 40.43 and 33.65 per cent after 1, 3, 5 and 7 DAS, respectively with 89.69 per cent increase in the mortality over control. Among the botanicals NSKE was found to be most effective followed by *Artemisia annua* however, it was found least in case of green leaf extract of walnut.

Keywords: oats, *Helicoverpa armigera*, mortality, green leaf extract

1. Introduction
Oats rank sixth in the world cereal production statistics following wheat, maize, rice, barley and sorghum. It is an important livestock feed and is a good source of protein, fiber and minerals. This crop is considered to be a rich source of protein, equal to meat, milk, and egg protein. As food oats are mostly preferred in breakfast, moreover it is viewed by consumers as one of the wholesome, healthiest, natural food with the result there is rising global food demand for oats. Out of cereals, the highest amounts of β-glycan are found in barley and oats grains [2]. It is cultivated in Punjab, Haryana, West Bengal, Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan and Maharashtra. The total area covered under oats cultivation in the country is about 5 lakh ha. The crop occupies maximum area in Uttar Pradesh (34 per cent), followed by Punjab (20 per cent), Bihar (16 per cent), Haryana (9 per cent) and Madhya Pradesh (6 per cent) [15]. Various arthropods and nematodes cause damage to oats (*Avena sativa* L. and *A. byzantino* K.) plants throughout their life and no stage of the crop is free from damage. Crops can be affected from the seedling stage until the grain is harvested. Pests of oats are either polyphagous (damaging a wide range of plants) or oligophagous (feeding on only a few plant species) and it is very rare, any insect found to be monophagous to oats crop. Hundreds of arthropod species feed on oats cultivated in the USA and other countries. Low infestations of certain pests in cereals may stimulate growth and tillers, and actually increase yields [19]. Damage to oats in 1954 was estimated to be over $5 million (USA); an estimated $12 million (USA) loss was prevented with insecticides [21]. Examples of such pests are the green bug, *Schizaphis graminum* Rondani; the chinch bug, *Blissus leucopterus* Say; and the cereal cyst nematode, *Heterodera avenae* Wollenweber; most oats pests are only occasional pests and cause economic damage sporadically when climatic conditions are favorable for outbreaks. Examples of occasional pests in the USA are the armyworm, *Pseudaletia unipuncta* Haworth; cutworms, *Agrotis* or *Thogonia* Morrison; *Apamea amputatrix* Fitch; *Chorizogrotis auxiliaries* Grote; *Crymodes devoststor* Brace; *Euxoa ochrogaster* Guenee; *Peridroma margoritosa* Haw; cereal leaf beetle, *Oulema melanopus* L. and grasshopper's *viz. Melanoplus* spp and *Schistocerca americana* Drury [22].
Adverse effects of synthetic pesticides on humans are caused by pesticides residues left on crops when they are eaten. These residues can negatively affect human health through chronic illnesses such as cancer and sterility [4]. Adverse effects of the application of pesticides on the environment can be summarized as: biodiversity loss, water contamination, disruption of food chains and soil degradation. Bioactive plant extracts as an alternative to synthetic pesticides,

although botanicals pesticides have been used for thousands of years against insect pests. These provide a valuable source of active chemicals such as alkaloids, terpenoids, cucurbitacin, glycosides, flavonoids and other compound that have been used as toxins against several insect pests which affect commercial crops [13]. The use of these biologically active mixtures are usually safer to humans and the environment than conventional pesticides, with minimal residual effects and also with least development of resistance against pests. Therefore the use of plant pesticides has been recommended ever more as a suitable alternative of plant protection with minimum negative risks. Keeping in view the above facts it becomes imperative to study the efficacy of botanical extracts and a chemical pesticide against *Helicoverpa armigera* on Oats.

2. Materials and Methods

An experiment was carried out to assess the efficacy of Green leaf extracts *viz*. Artemisia (*Artemisia annua* L.), *Anthemis cautella*, Datura (*Datura stramonium* L.), Walnut (*Juglans regia*), NSKE, and Rhizome extract of Ginger (*Zingiber officinale*) @ 5% were evaluated against the *H. armigera* on oats crop at the Faculty of Agriculture, Wadura, SKUAST-Kashmir during 2015-16. Dichlorvos 76 EC @ 0.076% and sterile water were kept as positive and negative control respectively.Variety Sabzar was sown on 1st November 2015 for this purpose. The experiment was laid out in a Randomized Complete Block Design with eight treatments and three replications, in a field measuring about plot size was 3x4m² (Total=24 plot) and spacing 22.5cm**.**

2.1 Preparation of plant extracts

Plant parts from different test plants were collected, washed with water to remove dirt and chopped into small pieces, then grinded using clean water in the ratio of 50 gm. plant material in one liter of water to get 5% solution and filtered through double folded muslin cloth to prevent fiber particles from blocking the spray nozzle. Small quantity of starch and soap solution was also added to improve their rain fastness and better distribution on crop. The treatments were imposed using a Knapsack sprayer. The death of larvae population per cm^2 was recorded after spray at 1, 3, 5 and 7 days after treatment. Per cent mortality of larvae over negative control was calculated. Data collected from the experimental site was subjected to standard statistical procedure using standard statistical procedures [8]. Botanicals and insecticide was applied in the evening to escape the effect of sunlight on chemicals. Per cent mortality was calculated as:

$$\text{Per cent mortality} = \frac{\text{Pre count} - \text{Post count}}{\text{Pre count}} \times 100$$

Where,

Pre count =Number of live larvae before treatments

Post count=Number of live larvae after treatment

Similarly, increase mortality over control was calculated as:

$$\% \text{ Increase over control} = \frac{\text{Treated - control}}{\text{Treated}} \times 100$$

3. Results and Discussion

Field efficacy of different plant extracts was evaluated against *H.armigera* infesting oats under field conditions (Table-1). Data obtained on this aspect revealed that at the time of initiation of experiment, the population of *H. armigera* varied from plant to plant. Observations recorded on 1, 3, 5 and 7 days after treatment (DAT) revealed among the tested botanical insecticide @ 5% level of concentration, and DDVP 76 EC @ 0.076%were evaluated against *H.armigera*. Present studies revealed that among different plant extracts evaluated, highest control was recorded in case of NSKE @5% against *H. armigera* with highest mean percent mortality of 32.90%, followed by *A. annua* with 27.03% after 7 days of treatments. The remaining extracts with decreasing order of efficacy were *A. cautella* (85.64) > Datura (84.45) > Ginger (81.67) > Walnut (70.07). (Table-1&Fig-1). Among the botanicals NSKE was found to be most effective followed by *Artemisia annua* however, it was found least in case of green leaf extract of walnut. The better results of NSKE may be due to antifeedant or repellent property and this is in line with the observation of Gilani (2001) [7] who has reported that neem plant extracts deter insects from feeding. The results of the present study were in conformity with the findings of Redferen *et al*., 1980 [17] also reported that neem compound *azadirachtin* has antifeedant effect on insects. In addition to NSKE, also showed about 80% reduction in the mean number of *H. armigera*. This is in accordance with the findings of Zewain *et al*., 2005 [23] they have reported that cis-dehydrocrotonin extracted from *Croton cajucar* bark inhibits the growth of *Heliothis virescens*. The results are partially in agreement with those of Thakur *et al*., 1988 [20] also stated that the neem seed kernel extract can be used against *H. armigera* instead of highly toxic synthetic insecticides. Jaglan *et al*., 1997 [11] proved that the neem seed kernel extract in chloroform: methanol (9:1) was the most promising in causing adverse effects on *H. armigera*. Bhushan *et al*., 2011 [5] also reported that Neem seed kernel extract (NSKE 5%) was found most effective in reducing the larval population and pod damage in chickpea. Weekly spray application of the extract of neem seed kernel has also been reported effective against borers Reddy *et al*., 1996 [16] attacking vegetable crops due to the presence of azadirachtin. It was demonstrated that azadirachtin was effective systemically and where insects ingest azadirachtin it had a toxic effect, interrupting growth and development. In subsequent work, azadirachtin and triterpenoids having antifeedant effects were isolated in smaller amounts from the neem seeds (Kraus, 2002) [14]. *Artemisia annua* proved also effective in management of *H. armigera* and ranked 2nd among the botanicals. Several studies have reported insecticidal effects of *A. annua* extract containing growth retardation, antifeedant, and larvicidal effects (Haghighian *et al*., 2008; Shekari *et al*., 2008; Hasheminia *et al*., 2011) [10, 18, 9]. Khosravi *et al*., 2010 [12] observed that *A. annua* extract affected the nutritional indices and also showed antifeedant activities on *Glyphodes pyloalis* Walker. Anshul *et al*., 2015 [3] Showed that methanolic extract of powdered *A. annua* leaves adversely affect *H. armigera*. The extract affected toxicity, inhibition and disruption of the growth, development and histopathological and biological parameters of *H. armigera*. The essential oil of *Artemisia judaica* L. has been demonstrated to possess insecticidal activity and repellence against several insects, such as *Callosobruchus maculatus* (Fab.) and *Sitophilus oryzae* L. (Aggarwal *et al*., 2001; Elhady ABD, 2012) [16, 1]. *Anthemous cautella* and Datura treatments remained at par. However minimum mortality per cent was recorded in GLE of walnut among the treatments. Least mortality was found in control

due to HaNPV/natural death. Data of mortality per cent increase over control depicted the trend dichlorvos (92.53) > NSKE (89.69) > *Artemesia* (87.45) > *Anthemous cautella* (85.64) > Datura (84.45) > Ginger (81.67) > Walnut (70.07).

4. Conclusion

The use of plant extracts with insecticidal properties has the potential of reducing the effects of insect pests of agricultural crops. These can be of importance to the resource-poor farmers in many areas of the developing world. The significant reduction in pest's numbers on the treated plants was an indication that they can be used as alternatives to chemical insecticides. Even though various pest species attacked the oats crop, *H.armigera* caused the most serious damage. It was the main cause of reduction of loss of fodder as well as grain.

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Table 1: Efficacy of various botanicals and DDVP against *H. armigera*

Days / Treatments	Per cent mortality					Increase over control %
	1 DAT	3 DAT	5 DAT	7 DAT	Mean	
GLE *Artemisia* 5%	18.95(25.74)	32.50(34.68)	31.36(34.03)	25.53(30.33)	27.03(31.19)	87.45
GLE of *Anthemous cautella* 5%	12.77(20.83)	28.75(32.33)	30.75(33.66)	22.21(28.10)	23.62(28.73)	85.64
GLE Datura 5%	12.09(20.29)	26.25(30.77)	28.56(32.29)	20.34(26.79)	21.81(27.54)	84.45
GLE Walnut 5%	9.18(17.47)	13.75(21.71)	11.50(19.80)	10.90(19.27)	11.33(19.56)	70.07
NSKE @ 5%	22.34(28.15)	35.20(36.37)	40.43(39.46)	33.65(35.44)	32.90(34.85)	89.69
Ginger Extract 5%	11.96(20.17)	22.50(28.25)	20.64(27.00)	18.91(25.76)	18.50(25.30)	81.67
Dichlorvos 76 EC @ 0.076%	28.52(32.26)	40.00(39.20)	51.33(45.74)	61.71(51.75)	45.39(42.24)	92.53
Untreated (water)	3.09(10.12)	5.00(12.73)	3.01(9.98)	2.49(9.04)	3.39(10.47)	-
Mean	14.86(21.88)	25.49(29.51)	27.19(30.24)	24.46(28.31)	-	-
CD $_{(P\leq0.05)}$	3.81	6.42	1.23	0.84		
Treatment	1.32					
Days	0.93					
Treatment× Days	2.65					

DAT= days after treatment
GLE=Green leaf extract

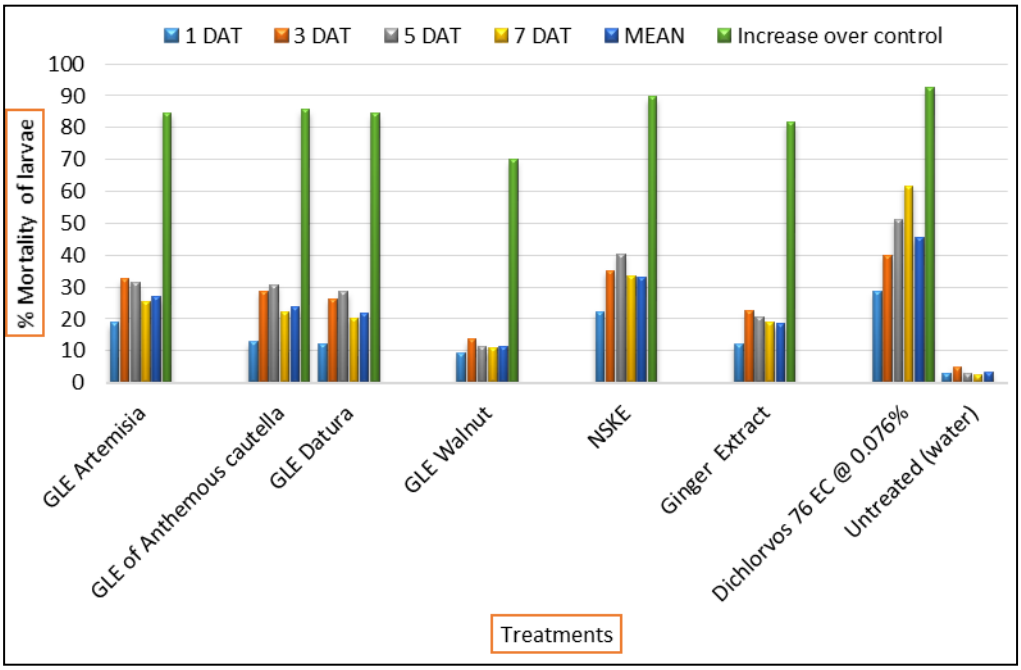

Fig 1: Efficacy of various botanicals and DDVP against *Helicoverpa armigera*

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