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Impact of nanoformulations on Bagrada bug, *Bagrada hilaris* (Burmeister) (Pentatomidae: Heteroptera) in Indian mustard under controlled condition

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Abstract
Laboratory experiments were conducted in order to find out the impact of nanoformulations on a painted bug, *Bagrada hilaris* at Department of Plant Protection, Aligarh Muslim University, UP during 2014-2016. The main objective was to study the effect of nanoformulations of NSKE, copper, silver and manganese in comparison with conventional chemicals like imidacloprid and Neemazal as a recommended insecticide on the mustard crop. Mustard pods and young branches were treated with six different concentrations 1:10, 1:100, 1:200, 1:500, 1:1000 and 1:2000 of the tested compounds. Fifteen individuals of painted bugs were released to each petriplate and the observations on mortality of insects were taken after 24 hrs, 48 hrs and 72 hrs of treatments in comparison with untreated control. Results showed that imidacloprid was most toxic than other tested compounds and documented the least LC_{50}values **(**0.002) and within the nano formulations silver was found to be superior LC_{50} (0.004) followed by copper, manganese, NSKE with LC_{50} of 0.011, 0.032, 0.045 respectively. Whereas neemazal was found to be least effective and showed highest LC_{50} (0.124). The highest per cent mortality was found in the population treated with imidacloprid as (97.78±0.71) % over control (2.37±1.01) % at 1:10 concentration. Among all nanochemicals, per cent mortality was recorded maximum (84.44±0.58) in the population treated with silver at 1:10 concentration on the 4th day of application followed by copper (77.78±0.58), manganese (73.33±1.00) and NSKE (68.89±1.53).

Keywords: Nanoformulations, Painted bug, Efficacy, Mortality

1. Introduction
Rapeseed-mustard group of crops is the major oilseed crop of India. A large variety of pests damage oilseeds and cause significant losses in the field as well as storage condition. Insect pests play a significant role in the economics of oilseed production. Among all the insects painted bug also known as bagrada bug is one of the important insect pests of Indian mustard, they can damage leaves and developing pods which gradually lead to wilting of the plant. Insecticidal application is inevitable for the cultivation of cruciferous crops. Besides higher cost, these insecticides cause undesirable side effects to the human health and thus, non-chemical control methods are now gaining importance day by day. Besides, in certain cases, judicious use of newer group of insecticides along with bio-control agents and other eco-friendly practices may be helpful to reduce the damage by pest [2]. Application of pesticides to crops causes serious health hazards to man, contamination in the food stuffs, soil, water, vegetation and environment. In addition to killing insects, pesticides can be toxic to a host of other organisms including birds, fish, beneficial insects, and non-target organism, apart from the decline in soil fertility.
Therefore, nanotechnology would provide green and efficient alternatives for the management of insect pests in agriculture without harming the nature. This art is focused on traditional strategies used for the management of insect pests and potential of nanomaterials in insect pest control as modern approaches to nanotechnology [11].

2. Materials and methods
Nanoformulations containing Neem Seed Kernel Extract (NSKE), copper, silver and

manganese were obtained from the center of excellence in material science, Department of applied physics, Aligarh Muslim University, Aligarh. The respective nanochemicals were measured with pipette as 1 ml and mixed with distilled water to obtain the nano formulations of 1:10, 1:100, 1:200, 1:500, 1:1000 and 1:2000 and tested in laboratory (25±2ºC), the effect of above mentioned nanoformulations were compared with traditional chemicals like Neemazal and Imidacloprid available in market along with the control. An experiment was laid out in completely randomized design with four treatments in six concentrations and each replicated thrice.

Indian mustard *Brassica juncea* was grown in a plot sized of 3m x 3 m with spacing between row to row and plant to plant kept at 45 cm x 15 cm at the experimental field of Faculty of Agricultural Sciences, Aligarh Muslim University, UP (India) during Rabi season of 2014-2016. Young branches and pods of mustard were collected from the field and carried to the laboratory, the material was washed with distilled water and. Nanoformulation Treated leaves and pods were kept in petriplates and after drying the material fifteen individuals of painted bugs were released to each petriplate. The observations on mortality of insects were taken after 24 hrs, 48 hrs and 72 hrs of treatments. The data collected on biological development of *B. hilaris* was subjected to analysis of standard deviation with the help of MS excel of office 2007 programme and the bioassay of nanochemicals was done with the statistical software SPSS version 16.

3. Results

The maximum percentage of mortality was found in population treated with imidacloprid as 97.78±0.71 over control (2.37**±**1.01) at 1:10 concentration after 72 hours of treatment. With the increased in dilution the mortality trend was reduced and the least per cent mortality (68.89±0.58) was recorded at concentration of 1:2000 (Table 2). Among all nanochemicals, per cent mortality was recorded maximum (84.44±0.58) in population treated with silver as at 1:10 concentration on 4th day of application followed by copper (77.78±0.58), manganese (73.33±1.00) and NSKE (68.89±1.53). In case of nano silver treated bugs, the per cent mortality was recorded higher (33.33±1.00) over control (1.06±0.36) at 1:200 and 1:500 concentration after 24 hours of treatment. But the maximum mortality after 48 (62.22±1.15) and 72 hours (84.44±0.58) was found at 1:10 concentrations (Table 1). It was found that dilution was not causing significant effect on insects treated with manganese nanoformulation and the mortality per cent was recorded same (28.89±0.58) at 1:10 and 1:200 concentrations after 24 hours of treatment. Population treated with manganese showed maximum (55.56±1.53) mortality over control (2.42±1.07) however; at 48 hours it was found highest at 1:100 concentrations, but at 72 hours per cent mortality (73.33±1.00) was noticed comparatively higher at 1:10 concentration. In case of nano NSKE and copper treated bugs, per cent mortality was recorded highest at 1:10 concentration after 24, 48, and 72 hours of treatment. The least mortality (60.00±2.65) was noticed over control (1.92±0.05) on population treated with neem at 1:10 concentration (Table 1).

Among all the nanochemicals (silver, copper, manganese, NSKE) and traditional insecticides tested against painted bug, imidacloprid was found most toxic, and documented the least LC_{50}values **(**0.002) with regression coefficient of 0.656 and within the nano formulations silver was found to be superior LC_{50} (0.004) with regression coefficient 0.240 followed by copper, manganese, NSKE with LC_{50} of 0.011, 0.032, 0.045 and 0.333, 0.318, 0.001, respectively as regression coefficient. Whereas neemazal was found least effective and showed the highest LC_{50} (0.124) with regression coefficient 0.134 (Table 3).

4. Discussion

For maintain the quality of produce it is necessary to prevent the attack of *B. hilaris* from feeding on cotyledons and young plants. An integrated approach including monitoring, cultural, mechanical, biological and chemical control used to manage the bug population in cole crops. Historically, insecticides such as Paris green, organochlorines, and cyclodienes were used for bagrada control [3, 4]. More recently, organophosphates, carbamates, and pyrethroids were evaluated and used against *B. hilaris*. However, only chlorpyrifos and methomyl have demonstrated significant contact toxicity against *B. hilaris* adults in laboratory and greenhouse bioassays [6, 8, 12]. Pyrethroids are commonly used to control *B. hilaris* because of their fast knockdown. Recent trials showed that pyrethroids caused rapid mortality of *B. hilaris* adults upon contact and protected plants from feeding damage [5, 6, 7, 8]. Newer insecticides such as neonicotinoids, imidacloprid and acetamiprid provided significant protection of mustard crops against *B. hilaris*[13].

In present investigation imidacloprid was found to be most toxic against *B. hilaris*. Among nano formulation silver was most effective followed by copper, manganese and neem seed kernal extract. Neemazal was found least effective chemical among the tested insecticides for controlling painted bug. The similar investigations were made by (Singh *et al*., 2011, Patidar *et al*., 2015 Ahuja *et al*., 2008 and Palumbo *et al*., 2016) [13, 10, 1, 9] on the efficacy of several chemicals against painted bug in mustard and stated that comparative higher control of painted bug and yield was obtained by the chemical treatment with imidacloprid which is in agreement with the current findings.

5. Conclusion

Among the chemicals tested against painted bug, imidacloprid was found most toxic documented the least LC_{50}values **(**0.002). Among nanoformulation silver was recorded to be highest toxic with 0.004 as LC_{50} followed by copper, manganese, NSKE with LC_{50} of 0.011, 0.032, 0.045, respectively. Whereas neemazal was found to be least effective and showed the highest LC_{50} (0.124). Among all concentrations tested against painted bug 1:10, 1:100 and 1:200 dilutions were found highly effective in causing significant mortality.

Table 1: Effect of Nanochemicals on *Bagrada hilaris*

Nanochemicals		**Silver**			**Manganese**			**Nske**			**Copper**	
		No of days after treatment			No of days after treatment			No of days after treatment			No of days after treatment	
Concentration	24 HAT	48 HAT	72THAT	24 HAT	48 HAT	72THAT	24 HAT	48 HAT	72THAT	24 HAT	48 HAT	72THAT
1:10	31.11±0.58	62.22±1.15	84.44±0.58	28.89±0.58	53.33±1.73	73.33±1.00	22.22±1.55	44.44±1.53	68.89±1.53	26.67±0.58	55.56±0.58	77.78±0.58
1:100	28.89±0.58	55.55±0.58	82.22±0.58	28.89±0.58	55.56±1.53	68.89±0.58	13.33±1.00	33.33±1.73	62.22±1.15	33.33±1.00	53.33±1.00	75.56±0.58
1:200	33.33±1.00	57.78±1.53	77.77±1.53	24.44±1.53	35.56±1.15	64.44±1.15	20.00±1.00	37.78±058	60.00±1.00	20.00±1.15	46.67±1.00	68.89±0.58
1:500	33.33±1.00	55.56±0.58	73.33±1.00	20.00±0.00	40.00±1.00	60.00±1.00	22.22±0.58	37.78±0.58	57.78±1.53	26.67±1.00	44.44±0.58	60.00±1.00
1:1000	24.44±0.58	51.11±1.53	71.11±1.53	24.44±0.58	48.89±1.53	57.78±0.58	6.67±1.00	24.44±1.53	51.11±2.08	13.33±2.52	40.00±2.00	57.78±0.57
1:2000	24.44±0.58	44.44±0.58	62.22±0.58	20.00±1.00	35.56±0.58	44.44±0.58	13.33±1.00	31.11±1.15	42.22±0.58	26.67±1.73	40.00±2.00	46.66±1.00
Control	1.06±0.36	2.34±1.89	2.53±0.09	1.34±0.47	2.03±0.89	2.42±1.07	2.12±0.01	2.41±0.89	3.12±1.91	1.19±0.07	2.23±1.00	2.75±1.10

Table 2: Effect of chemicals on *Bagrada hilaris*

Chemicals	**Imidacloprid**			**Neemazal**		
		No of days after treatment			No of days after treatment	
CONCENTRATION	24 HAT	48 HAT	72THAT	24 HAT	48 HAT	72THAT
1:10	31.11±0.58	66.67±1.00	97.78±0.71	2.96±0.57	48.89±1.53	60.00±2.65
1:100	22.22±1.15	53.33±1.00	84.44±0.58	4.44±1.00	48.89±1.53	57.78±1.53
1:200	33.33±1.73	53.33±1.73	80.00±0.00	2.96±0.58	40.00±1.73	53.33±2.00
1:500	28.89±0.58	51.11±0.58	77.78±1.15	5.9±1.15	40.00±1.73	48.89±1.15
1:1000	24.44±1.15	51.11±0.58	73.33±1.00	4.44±1.00	31.11±0.58	46.67±1.00
1:2000	22.22±1.15	42.22±1.53	68.89±0.58	4.44±1.00	28.89±0.58	37.78±0.58
control	1.01±0.11	2.33±1.18	2.37±1.01	1.71±1.02	1.83±0.32	1.92±0.05

Table 3: Bioassay of chemicals against painted bug

Nanochemicals	**Equation**	**R^2**	**LC_{50}**	**LC_{75}**	**X^2**
SILVER	y = 19.15x + 10.89	R^2 = 0.240	0.004	0.007	10.596
NSKE	y = -0.147x + 8.574	R^2 = 0.001	0.045	0.042	7.51
MANGANESE	y = 24.24x + 8.743	R^2 = 0.318	0.032	0.031	13.267
COPPER	y = 27.77x + 9.118	R^2 = 0.333	0.011	0.024	7.067
CHEMICALS					
NEEMAZAL	y = 1.400x + 7.428	R^2 = 0.134	0.124	0.131	9.77
IMIDACLOPRID	y = 33.92x + 11.38	R^2 = 0.656	0.002	0.003	6.729

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7. References

1. Ahuja R, Singh SK, Sundria MM, Dhandapani A. Integrated management strategy for painted bug, *Bagrada hilaris* (Burm.) inflicting injury at seedling stage of mustard (*Brassica juncea*) in arid western Rajasthan. Pesticide Research Journal. 2008; 20:48-51.
2. Firake DM, Behere GT, Azad NS. Eco-friendly management of mustard aphid, *lipaphis erysimi*: a most destructive pest of brassicaceous crops thakur division of crop improvement (Entomology) ICAR Research Complex for NEH region, Umiam, Meghalaya (India). Popular Kheti. 2011; 1(3):31-33.
3. Hill DS. Pests of Crops in Warmer Climates and Their Control. London: Springer Science, UK. 2008.
4. Howard CW. The Bagrada bug (*Bagrada hilaris*). Transvaal Agric. J 1907; 5:168-73.
5. Palumbo JC. Control of *Bagrada hilaris* with conventional and experimental insecticides on broccoli. Arthropod Manag. Tests. 2012; 37:E9.
6. Palumbo JC, Huang T, Perring TM, Reed DA, Prabhaker N. Evaluation of conventional insecticides for control of *Bagrada hilaris* on broccoli. Arthropod Manag. Tests. 2013; 38:E4.
7. Palumbo JC, Huang T. Control of *Bagrada hilaris* with conventional insecticides on broccoli. Arthropod Manag. Tests. 2014; 39:E40.
8. Palumbo JC, Prabhaker N, Reed DA, Perring TP, Castle SJ, Huang T. Susceptibility of *Bagrada hilaris* (Hemiptera: Pentatomidae) to insecticides in laboratory and greenhouse bioassays. J. Econ. Entomol. 2015; 108:672-82.
9. Palumbo JC, Perring TM, Millar JG, Reed DA. Biology, Ecology, and Management of an Invasive Stink Bug, *Bagrada hilaris*, in North America. Annual Review of Entomology. 2016; 61:453-73.
10. Patidar J, Patidar RK, Shakywar RC, Pathak M. Host preference and survivability of *Bagrada hilaris* (Burmeister, 1835) on off season crops. Annual Plant Protection Science. 2013; 21:273-275.
11. Ragaei Mohamed, Sabry AH. Nanotechnology for insect pest control. International Journal of Science, Environment and Technology. 2014; 3(2):528-545.
12. Reed DA, Palumbo JC, Perring TM, May C. *Bagrada hilaris* (Hemiptera: Pentatomidae), An Invasive Stink Bug Attacking Cole Crops in the Southwestern United States. J. Integ. Pest Mngmt. 2013; 4(3).
13. Singh SP, Singh YP, Kumar A. Bioefficacy evaluation of chemical insecticides against painted bug, *Bagrada hilaris* (Burm.) in mustard. Pestic. Res. J. 2011; 23(2):150-53.