**Assessing the Efficacy of Bio-rational Insecticides for Controlling *Lipaphiserysimi* (Kaltenbach) Infestations on Mustard Crops**


## Abstract:

Among the various treatments evaluated for their bio-rational effect against mustard aphid on Indian mustard during year- 2021-22 at C. S. Azad University of Agriculture & Technology Kanpur Uttar Pradesh, the descending order are the followed treatments are NSKE @10% > NSKE @5% >Cow Urine @ 10% >*Verticilliumlecanii*@ 1.5kg/ha.> Lantana leaf extract@ 10 % > Castor leaf extract @ 10% > Lantana leaf extract @ 5 % > Castor leaf extract @ 5% > Cow Urine @ 5%.India, the spray of NSKE 10% @ 60 lit/ha followed by NSKE 5 % @ 30 lit/ha was proved to be the best treatments with pooled mean aphid population of 5.42, 5.10, 4.96, 4.85, 5.39, 5.26, 5.42, 5.23, 5.13, and 7.29 aphid/pant in the control after 1, 3, 5 and 7 days of treatment, respectively. The treatment NSKE 10 % was proved best and significantly superior over all treatments with highest reduction of Infestation of *Lipaphiserysimi*kalt.in both the years.


## INTRODUCTION

Rapeseed-mustard is a major oilseed crop grown in India, which produces good quality oil for cooking purposes and its cake is good feed for animals. Green leaves are used for preparing '*Saag*' and the plants are good green fodder for animals. India holds first place in growing of vegetables and exporter of vegetable oils in the world. India is a third largest producer of oilseeds in the world after China and Canada. In Rajasthan, the largest producer, planting is up exceeding 37 per cent from the same period last year. However, the government's fourth advance estimates had pegged the 2020-21 crop at 101.12 lakh tonnes and 2022-23, 107.52 lakh tones. Total oilseeds production in the country during 2021-22 is estimated at record 39.83 million tonnes which is higher by 3.35 million tones than the production of 33.22 million tonnes during 2021-22. Out of 59.33 million tones of rapeseed produced over 33.74 million hectare in the world, India produce 9.1 million tons from an acreage of 6.51 million hectare with a productivity of 1279 kg/ha. In Uttar Pradesh it occupies an area of 4.35 lakh hectare land and 3.09 lakh tones production with an average productivity of 1356 kg/ha. About 38 species of insects are reported to be associated with the Brassica oilseed crops (**Bakhetia*et. al.*,1989** ). Out of which L. *erysimi*,*Athaliaproxima*, B. *cruciferanum*, *Spilarctiaobliqua* Walker, *Chrotomyiahorticola*are the pests of major importance. Among these, L. *erysimi* is one of the most destructive insect. Damage caused by insect pests is an important factor in reducing the yield of oilseed brassicas. Aphid, L. *eyrsimi*, causes 10 to 90 per cent losses in yield in India to these crops depending upon severity of damage and crop stage (**SarwarM *et. al.*, 2009**) .*Brevicorynebrassicae* and L. *eyrsimi* are severe pests of B. *napus* and B. *juncea*. Several methods are used to manage aphids

to reduce damage to oilseed brassicas (**Annonymous 2014**). Host plant resistance and biological control methods are environment friendly. Unfortunately available cultivars of B. *napus* and B. *juncea* lack sufficient plant resistance to avoid damage by aphids (**AmerM *et. al.*, 2009, Aslam M *et al*., 2009**). Natural enemies like *Chrysoperla* Spp. and lady bird beetles, C. *septempunctata* appear at the later stage of crop when most of the damage has been caused by aphids in mustard. Moreover, populations of these two natural enemies are too low to reduce numbers of aphids (**Aslam M *et al.*, 2007**). L. *eyrsimi* has been reported to prefer B. *campestris* and B. *juncea* than B. *napus*, B. *nigra,Eruca sativa* and B. *carinata* in India (**Sahito HA *et. al*., 2010**). *Sinapis alba* L. and B. *napus* are susceptible to B. *brassicae* and L. *eyrsimi* than B. *juncea* in USA. Moreover, variable losses were observed in yield and yield components and insecticides proved to be effective in reducing losses of yield in these species of Brassica (**Brown J *et. al*., 1999**).

Among the aphids, mustard aphid, *Lipaphiserysimi* (Kalt.) is predominant and is a key pest and may cause up to 90- 96% yield loss, 31% seed weight loss and 5-6% reduction in oil content (**Bakhetia and Sekhon, 1989**). Such losses may go up to 100% in certain mustard growing region (**Singh and Sachan 1999**). The loss in grain weight varies greatly within Brassica; being 35.0- 73.3% under different agro climatic regions with a mean loss of 54.2% on all India basis (**Dhaliwal *et al.*, 2004**).

## MATERIAL & METHOD

The field experiment was conducted during *Rabi* season 2021-22 at Student Instructional Farm (SIF), Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (Uttar Pradesh). It lies between 25° 26`- 28° 58` N latitude 79° 31`- 80° 34` E longitude at an altitude of 125.9 meter above mean sea level. The climate of the district is subtropical, semi arid with hot dry summers and severe cold winters. Average rainfall is about 351.6 mm through summer monsoon during July to October, there being hardly 35.8 mm rain fall in winters. The meteorological observations of temperature (maximum and minimum) (29.2 & 4.9) and relative humidity (maximum and minimum) (86.0 & 42.2) and rainfall (mm) for the crop period were obtained from the Department of Entomology, C. S. Azad University of Agriculture and Technology, Kanpur. The experiment was laid out in Randomized Block Design with three replications. (Giriraj DRMRIJ31) is a variety. The plot size was 4.5×3 m sizes and row to row and plant to plant spacing 45×15cm. The bio-rational insecticides was applied at their recommended doses when the population reached at ETL.The mean aphid infestation indices were recorded on ten randomly selected plants, on 10 cm top shoot /inflorescence of the main shoot/plant. In management of aphid through bio-insecticides, the intensity was recorded 1, 3, 5 and 7 days after each spray, in as per techniques used by **Bakhetia*et al.* (1989b).** The observations on aphid population were collected at weekly intervals on randomly selected plants on 10 cm top shoot/inflorescence of the main shoot during both the years. followed by **Bakhetia*et al.* (1989c).**Ten treatments including control were T1 CowUrine @ 5%  30 lit/ha, T2 CowUrine@10% 60 lit/ha, T3

**Comment [U1]:** were

NSKE @5 % 30 lit/ha, T4 NSKE @ 10 % 60 lit/ha, T5 *Castor*leaextract @ 5%30 lit/ha, T6*Castor*leaextract @ 10% 60 lit/ha, T7 *Lantana*leafextract @5% 30 lit/ha, T8 *Lantana*leafextract @ 10%, T9 *Verticilliumlecanii @ 1.5kg/ha*, T10: Control with no spray.

Nymph population and pod damage by L. erysimiKalt. to be observed the aphid population recorded from top 10 cm apical twigs of plants and randomly selected 10 plants from each plot one day before spray and 1, 3, 5 and 7 days after first, second, and third spray, with one day before spraying becoming pre-treatment count for the second and third spray. All the three sprays were applied at seven days interval. The formula used to calculate the per cent infestation of pods was Abott's 1925 i.e.

Comment [U2]: italize

$$\text{Podinfestation}(\%) = \frac{\text{Numberofinfested pods}}{\text{Total numberofpods}} \times 100$$

Amountofinsecticidesrequired=

$$\frac{\text{Quantity of solution required x per cent of solution desired}}{\text{Strengthof formulation available}}$$

The Botanicals and organic compound treatments were applied through foliar spray and dusting by hands. The dusting applied after treatment sprayings were done by using a pre-calibrated knapsack sprayer.

Required quantity of insecticides was calculated using the formula as given bellow.

Comment [U3]: were

$$\text{Amount of insecticide required} = \frac{\text{Quantity of solution required x percent of solution desired}}{\text{Strength of formulation available}} \times 100$$

Cow urine was collected from dairy, department of animal husbandry and dairying. C. S. Azad University of Agriculture and Technology Kanpur.

**Table 1. Treatments Details**

| S. No. | Treatments Symbol | Treatments | Dose/ha. | Sources |
|---|---|---|---|---|
| **1** | **$T_1$** | CowUrine5% | 30lit/ha | **C.S.A.Uni.DairyFarm** |
| **2** | **$T^2$** | CowUrine10% | 60lit/ha | **C.S.A.Uni.DairyFarm** |
| **3** | **$T_3$** | NSKE5% | 30lit/ha | **Preparedinlaboratory** |
| **4** | **$T_4$** | NSKE10 % | 60lit/ha | **Preparedinlaboratory** |
| **5** | **$T_5$** | *Castor*leaextract5% | 30lit/ha | **Preparedinlaboratory** |
| **6** | **$T_6$** | *Castor*leafextract10% | 60lit/ha | **Preparedinlaboratory** |

| | | | | |
|---|---|---|---|---|
| **7** | **$T_7$** | *Lantana*leafextract5% | 30lit/ha | **Preparedinlaboratory** |
| **8** | **$T_8$** | *Lantana*leafextract10% | 60lit/ha | **Preparedinlaboratory** |
| **9** | **$T_9$** | *Verticilliumlecanii* | 1.5kg/ha. | **AnandAgroCare, Nasik Maharashtra(India)** |
| **10** | **$T_{10}$** | Control | ---------- | ---------- |

Collected leaves of the specific plant after cleaning with running tap water, dried themin shaded area for few minutes then ground it into paste form. The prepared paste were soaked inequal amount of distilled water and keep it undisturbed for overnight. The suspension was filteredwith muslin cloth and filtrate is stored in a clean glass bottle for further spray as 100 % mothersolution.Fresh leaves of the *neem* plants were collected and brought to laboratory, washed thoroughly 3-4 times with tap water. After that, they were chopped into small pieces with knife. To get one liter of 5 &10% extract, 50/100 gram of the chopped material was soaked overnight in1litre pure distil water, squeezed through muslin cloth and residue was smashed in mortar and pestle, again extracted and filtered through muslin cloth and the volume was made up to one literto get 5 &10 present leaf extract for spraying.Fresh cow urine was collected from Dairy farm of this university. 50/100 ml of cow urine was taken in a measuring flask and then distilled water was added to make up the solution of 1000 ml or per litre.For the Preparationof5 & 10%NSKETake 50/100 gm powdered neem seed kernels and soak it in 1 lit of distilled water for overnight and stir the contents often. Squeeze the soaked material repeatedly for better extraction of*azadirachtin* in the aqueous suspension. Filter the contents with muslin cloth make the filtrate to 1 litre, add 1 ml teepol and spray.

**Comment [U4]:** was

**Comment [U5]:** litre

**Comment [U6]:** put full stop (.) before take

## RESULTS AND DISCUSSION

**Effect of different bio-rational insecticides against mustard aphid, *Lipa***
**(First Spray- 2021-22)**

Data presented in table-2revealed that NSKE 10 % as spray on standing crop reduced maximum percentage *i.e.* 33.41 per cent population reduction over control proved best among all treatments by reducing mean population of *Lipaphiserysimii.e.*4.01 per plant. The second effective treatment applied to the mustard crop on standing crop as spray form was NSKE 5% with 30.37 per cent population reduction over control with mean population *i.e.* 4.203 per plant**Jandial and Kumar (2007)**.

The medial treatments in term of efficacy, spraying to the crop was Cow Urine 10 %, *Verticilliumlecanii*, Lantana leaf extract 10 %, Castor leaf extract 10 %, Lantana leaf extract 5 % and Castor leaf extract 5 % with 25.97, 25.45, 23.11, 22.15, 19.84 and 19.15 per cent population reduction over control and mean population *i.e.* 4.46, 4.50, 4.64, 4.83, 4.39 and 4.88, respectively.

Treatment cow urine 5 % as splitting form on standing crop was found most inferior among all the treatments with 18.73 per cent population reduction over control with mean population *i.e.* 4.90

per plant, however, it was statistically superior in comparison to control in which 6.037 mean population of*Lipaphiserysimi*were recorded.

**Table-2Effect of different bio-rational insecticide on the population of *Lipaphiserysimi* in mustard during *Rabi* 2021-22 (Mean per cent infestation)**

**(First Spray)**

| S.N. | Treatment | Dose/ha | Papulation of *Lipaphiserysimi* on mustard | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Before spray | After spray | | | | |
| | | | DBS | 1 Day | 3 Days | 5 Days | 7 Days | Mean |
| 1 | Cow Urine 5% | 30 lit/ha | 26.24 ± 0.225 (5.219±0.022) | 25.2 ± 0.006 (5.119±0.00) | 24.9 ± 0.329 (5.089±0.032) | 23.01 ± 0.531 (4.899±0.054) | 19.41 ± 0.04 (4.518±0.004) | 23.13 (4.90) |
| 2 | Cow Urine 10% | 60 lit/ha | 26.38 ± 0.631 (5.232±0.06) | 22.6 ± 0.529 (4.857±0.055) | 20.93 ± 0.098 (4.683±0.01) | 16.73 ± 0.235 (4.211±0.028) | 16.01 ± 0.408 (4.124±0.05) | 19.06 (4.46) |
| 3 | NSKE 5 % | 30 lit/ha | 25 ± 0.013 (5.099±0.001) | 19.73 ± 0.277 (4.553±0.03) | 17.01 ± 0.195 (4.244±0.023) | 15.91 ± 0.331 (4.112±0.04) | 14.23 ± 0.074 (3.903±0.009) | 16.72 (4.20) |
| 4 | NSKE 10 % | 60 lit/ha | 25.74 ± 0.214 (5.171±0.021) | 18.5 ± 0.424 (4.415±0.048) | 15.96 ± 0.108 (4.118±0.013) | 14.42 ± 0.023 (3.927±0.003) | 12.1 ± 0.082 (3.619±0.011) | 15.24 (4.01) |
| 5 | Castor leaf extract 5% | 30 lit/ha | 25.71 ± 0.214 (5.168±0.021) | 25.1 ± 0.17 (5.109±0.017) | 24.4 ± 0.622 (5.039±0.062) | 22.93 ± 0.167 (4.892±0.017) | 19.1 ± 0.039 (4.483±0.004) | 22.88 (4.88) |
| 6 | Castor leaf extract 10% | 60 lit/ha | 26.63 ± 0.125 (5.256±0.012) | 23.71 ± 0.456 (4.97±0.046) | 23.1 ± 0.409 (4.909±0.042) | 19.97 ± 0.405 (4.579±0.044) | 17.83 ± 0.01 (4.339±0.001) | 21.15 (4.69) |
| 7 | Lantana leaf extract 5 % | 30 lit/ha | 26.16 ± 0.204 (5.211±0.02) | 24.92 ± 0.35 (5.091±0.034) | 23.91 ± 0.386 (4.991±0.039) | 22.8 ± 0.403 (4.878±0.041) | 18.32 ± 0.315 (4.395±0.036) | 22.45 (4.83) |
| 8 | Lantana leaf extract 10 % | 60 lit/ha | 25.23 ± 0.552 (5.121±0.054) | 23.08 ± 0.252 (4.907±0.026) | 22.63 ± 0.048 (4.861±0.005) | 19.33 ± 0.191 (4.509±0.021) | 17.4 ± 0.199 (4.289±0.023) | 20..61 (4.64) |
| 9 | *Verticilliumlecanii* | 1.5 kg/ha | 26.1 ± 0.326 (5.206±0.031) | 22.17 ± 0.277 (4.813±0.029) | 21.1 ± 0.209 (4.701±0.022) | 17.1 ± 0.098 (4.254±0.011) | 16.93 ± 0.202 (4.234±0.024) | 19.32 (4.50) |
| 10 | Control | --- | 26.08 ± 0.176 (5.204±0.017) | 30.1 ± 0.627 (5.576±0.056) | 34.1 ± 0.55 (5.924±0.046) | 37.89 ± 0.769 (6.236±0.061) | 40.12 ± 0.313 (6.412±0.024) | 35.55 (6.03) |
| **CD at 5%** | | | **N/A** | **0.118** | **0.099** | **0.106** | **0.072** | **0.037** |
| **SE.m.±** | | | 0.032 | 0.039 | 0.033 | 0.036 | 0.024 | 0.012 |

Data given in parentheses are $\sqrt{X + 0.50}$ transformed values

DAS= Days after spray

DBS = Days before Spray

**(Second Spray- 2021-22)**

Data presented in table-3 revealed that NSKE 10 % as spray on standing crop reduced maximum percentage *i.e*. 34.80 per cent population reduction over control proved best among all treatments by reducing mean population of *Lipaphiserysimii.e.*4.874 per plant. The second effective treatment applied to the mustard crop on standing crop as spray form was NSKE 5% with 33.88 per cent population reduction over control with mean population *i.e*. 4.94 per plant. **Divya *et. al.*, (2015)**

The medial treatments in term of efficacy, spraying to the crop was Cow Urine 10 %, *Verticilliumlecanii,* Lantana leaf extract 10 %, Castor leaf extract 10 %, Lantana leaf extract 5 % and Castor leaf extract 5 % with 32.84, 31.87, 31.34, 30.97, 29.24 and 28.88 per cent population reduction over control and mean population *i.e.*5.02, 5.09, 5.13, 5.16, 5.28 and 5.31, respectively.

Treatment cow urine 5 % as splitting form on standing crop was found most inferior among all the treatments with 28.62 per cent population reduction over control with mean population *i.e*. 5.33 per plant, however, it was statistically superior in comparison to control in which 7.476 mean population of*Lipaphiserysimi*were recorded.

**Table-3Effect of different bio-rational insecticide on the population of *Lipaphiserysimi* in mustard during *Rabi* 2021-22 (Mean per cent infestation)**

**(Second Spray)**

Data given in parentheses are $\sqrt{X + 0.50}$ transformed values

DAS= Days after spray

| S.N. | Treatment | Dose/ha | Papulation of *Lipaphiserysimi* on mustard | | | | |
|---|---|---|---|---|---|---|---|
| | | | After spray | | | | |
| | | | 1 Day | 3 Day | 5 Day | 7 Day | Mean |
| 1 | Cow Urine 5% | 30 lit/ha | 31.46 ± 0.693 (5.697±0.061) | 30.2 ± 0.148 (5.586±0.013) | 25.2 ± 0.228 (5.118±0.022) | 23.43 ± 0.285 (4.943±0.029) | 26.32 (5.33) |
| 2 | Cow Urine 10% | 60 lit/ha | 26.93 ± 0.168 (5.285±0.016) | 26.82 ± 0.056 (5.274±0.005) | 22.67 ± 0.118 (4.865±0.012) | 20.71 ± 0.119 (4.659±0.013) | 23.24 (5.02) |
| 3 | NSKE 5 % | 30 lit/ha | 26.17 ± 0.395 (5.212±0.038) | 25.8 ± 0.026 (5.177±0.003) | 22.2 ± 0.035 (4.817±0.004) | 19.83 ± 0.134 (4.564±0.015) | 22.6 (4.94) |
| 4 | NSKE 10 % | 60 lit/ha | 25.83 ± 0.027 (5.18±0.003) | 25.42 ± 0.172 (5.14±0.017) | 21.41 ± 0.19 (4.734±0.02) | 18.73 ± 0.029 (4.442±0.003) | 21.84 (4.87) |
| 5 | Castor leaf extract 5% | 30 lit/ha | 31.2 ± 0.422 (5.674±0.037) | 30.1 ± 0.078 (5.577±0.007) | 25.01 ± 0.286 (5.1±0.028) | 23.17 ± 0.072 (4.916±0.007) | 26.09 (5.31) |
| 6 | Castor leaf extract 10% | 60 lit/ha | 28.52 ± 0.623 (5.433±0.058) | 28.4 ± 0.443 (5.422±0.041) | 23.81 ± 0.223 (4.981±0.022) | 22.09 ± 0.506 (4.805±0.053) | 24.55 (5.16) |
| 7 | Lantana leaf extract 5 % | 30 lit/ha | 30.7 ± 0.575 (5.63±0.051) | 29.81 ± 0.45 (5.55±0.041) | 24.91 ± 0.57 (5.09±0.056) | 22.89 ± 0.023 (4.888±0.002) | 25.85 (5.28) |
| 8 | Lantana leaf extract 10 % | 60 lit/ha | 28.41 ± 0.532 (5.423±0.049) | 28.01 ± 0.291 (5.386±0.027) | 23.4 ± 0.463 (4.939±0.047) | 21.87 ± 0.398 (4.782±0.042) | 24.27 (5.13) |
| 9 | *Verticilliumlecanii* | 1.5 kg/ha | 27.83 ± 0.492 (5.369±0.046) | 27.6 ± 0.1 (5.348±0.009) | 23.01 ± 0.264 (4.9±0.027) | 21.6 ± 0.124 (4.754±0.013) | 23.86 (5.09) |
| 10 | Control | --- | 49.4 ± 0.694 (7.099±0.049) | 53.01 ± 0.054 (7.349±0.004) | 58.01 ± 0.483 (7.682±0.031) | 59.44 ± 1.114 (7.774±0.072) | 56.21 (7.47) |
| **CD at 5%** | | | **0.128** | **0.067** | **0.096** | **0.099** | **0.054** |
| **SE.m.±** | | | 0.043 | 0.022 | 0.032 | 0.033 | 0.018 |

DBS = Days before Spray

**(Third Spray- 2021-22)**

Data presented in table-4 revealed that NSKE 10 % as spray on standing crop reduced maximum percentage *i.e*. 33.04 per cent population reduction over control proved best among all treatments by reducing mean population of*Lipaphiserysimii.e.*5.61 per plant. **Singh *et. al.*, (2008)**

The second effective treatment applied to the mustard crop on standing crop as spray form was NSKE 5% with 31.80 per cent population reduction over control with mean population *i.e*. 5.72 per plant.

The medial treatments in term of efficacy, spraying to the crop was Cow Urine 10 %, *Verticilliumlecanii,* Lantana leaf extract 10 %, Castor leaf extract 10 %, Lantana leaf extract 5 % and Castor leaf extract 5 % with 31.20, 30.66, 28.45, 29.55, 28.45 and 28.09 per cent population reduction over control and mean population *i.e*.5.77, 5.81, 5.88, 5.91, 6.00 and 6.03, respectively. Flowed by **Nagar *et. al.*, (2012)**

Treatment cow urine 5 % as splitting form on standing crop was found most inferior among all the treatments with 27.77 per cent population reduction over control with mean population *i.e*. 6.06 per plant, however, it was statistically superior in comparison to control in which 8.39 mean population of*Lipaphiserysimi*were recorded.

**Table-4Effect of different bio-rational insecticide on the population of *Lipaphiserysimi* in mustard during *Rabi* 2021-22 (Mean per cent infestation)**
**(Third Spray)**

| S.N. | Treatment | Dose/ha | Papulation of *Lipaphiserysimi* on mustard | | | | |
|---|---|---|---|---|---|---|---|
| | | | After spray | | | | |
| | | | 1 Day | 3 Day | 5 Day | 7 Day | Mean |
| 1 | Cow Urine 5% | 30 lit/ha | 47.87 ± 0.536 (6.99±0.038) | 38.97 ± 0.864 (6.321±0.069) | 30.78 ± 0.42 (5.637±0.037) | 27.1 ± 0.158 (5.301±0.015) | 36.18 (6.06) |
| 2 | Cow Urine 10% | 60 lit/ha | 44.3 ± 0.991 (6.73±0.073) | 34.63 ± 0.505 (5.969±0.042) | 28.1 ± 0.439 (5.394±0.041) | 24.03 ± 0.313 (5.003±0.031) | 32.76 (5.77) |
| 3 | NSKE 5 % | 30 lit/ha | 43.61 ± 0.567 (6.619±0.043) | 33.72 ± 0.509 (5.892±0.043) | 27.8 ± 0.535 (5.366±0.05) | 23.6 ± 0.061 (4.96±0.006) | 32.18 (5.72) |
| 4 | NSKE 10 % | 60 lit/ha | 42.81 ± 0.512 (6.619±0.039) | 32.61 ± 0.679 (5.797±0.059) | 26.73 ± 0.417 (5.266±0.04) | 22.01 ± 0.069 (4.797±0.007) | 31.04 (5.61) |
| 5 | Castor leaf extract 5% | 30 lit/ha | 47.4 ± 0.617 (6.957±0.044) | 38.82 ± 0.626 (6.31±0.05) | 30.42 ± 0.348 (5.605±0.031) | 26.75 ± 0.056 (5.268±0.005) | 35.84 (6.03) |
| 6 | Castor leaf extract 10% | 60 lit/ha | 45.93 ± 0.956 (6.85±0.07) | 36.1 ± 0.037 (6.091±0.003) | 29.7 ± 0.711 (5.54±0.064) | 25.73 ± 0.495 (5.17±0.048) | 34.36 (5.91) |
| 7 | Lantana leaf extract 5 % | 30 lit/ha | 46.92 ± 0.537 (6.922±0.039) | 38.7 ± 0.886 (6.3±0.071) | 29.97 ± 0.25 (5.565±0.022) | 26.4 ± 0.55 (5.234±0.053) | 35.49 (6.00) |
| 8 | Lantana leaf extract 10 % | 60 lit/ha | 45.72 ± 0.666 (6.835±0.049) | 35.87 ± 0.597 (6.072±0.049) | 29.3 ± 0.412 (5.504±0.037) | 25.3 ± 0.461 (5.128±0.045) | 34.04 (5.88) |
| 9 | *Verticilliumlecanii* | 1.5 kg/ha | 45.01 ± 0.468 (6.783±0.035) | 34.81 ± 0.362 (5.984±0.03) | 28.6 ± 0.238 (5.441±0.022) | 24.7 ± 0.039 (5.07±0.004) | 33.28 (5.81) |
| 10 | Control | --- | 68.1 ± 1.737 (8.311±0.1105) | 67.84 ± 0.742 (8.297±0.045) | 69.14 ± 0.468 (8.375±0.028) | 72.8 ± 0.036 (8.591±0.002) | 69.47 (8.39) |
| **CD at 5%** | | | **0.17** | **0.144** | **0.112** | **0.09** | **0.058** |
| **SE.m.±** | | | 0.049 | 0.057 | 0.048 0.038 | 0.03 | 0.019 |

Data given in parentheses are $\sqrt{X + 0.50}$ transformed values

DAS= Days after spray

DBS = Days before Spray

**(First Spray- 2022-23)**

Data presented in table-5 revealed that NSKE 10 % as spray on standing crop reduced maximum percentage *i.e*. 32.84 per cent population reduction over control proved best among all treatments by reducing mean population of*Lipaphiserysimii.e.*4.02 per plant. The second effective treatment applied to the mustard crop on standing crop as spray form was NSKE 5% with 19.42 per cent population reduction over control with mean population *i.e*. 4.21 per plant. flowed by **Aswitha *et. al.*, (2023)**

The medial treatments in term of efficacy, spraying to the crop was Cow Urine 10 %, *Verticilliumlecanii,* Lantana leaf extract 10 %, Castor leaf extract 10 %, Lantana leaf extract 5 % and Castor leaf extract 5 % with 25.77, 25.39, 22.64, 22.25, 15.86 and 19.81 per cent population reduction over control and mean population *i.e.*4.44, 4.47, 4.63, 4.63, 5.04 and 4.80, respectively.

Treatment cow urine 5 % as splitting form on standing crop was found most inferior among all the treatments with 19.42 per cent population reduction over control with mean population *i.e*. 4.82 per plant, however, it was statistically superior in comparison to control in which 5.994 mean population of*Lipaphiserysimi*were recorded.

**Table-5Effect of different bio-rational insecticide on the population of *Lipaphiserysimi* in mustard during *Rabi* 2022-23 (Mean per cent infestation)**

**(First Spray)**

Data given in parentheses are $\sqrt{X + 0.50}$ transformed values

| S.N. | Treatment | Dose/ha | Papulation of *Lipaphiserysimi* on mustard | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Before spray | After spray | | | | |
| | | | DBS | 1 Day | 3 Day | 5 Day | 7 Day | Mean |
| 1 | Cow Urine 5% | 30 lit/ha | (26.01 ± 0.23)<br>5.19 ± 0.02 | 24.78 ± 0.2<br>(5.07 ± 2.02) | 23.1 ± 0.36<br>(4.90 ± 0.03) | 22.6 ± 0.29<br>(4.85±0.03) | 19.02 ± 0.11<br>(4.47±0.01) | 22.37<br>(4.82) |
| 2 | Cow Urine 10% | 60 lit/ha | 26.06 ± 0.55<br>(5.2.1± 0.05) | 22.2 ± 0.31<br>(4.81 ±0.03) | 20.73 ± 0.36<br>(4.66±0.053) | 16.8 ± 0.29<br>(4.21±0.03) | 15.8 ± 0.18<br>(4.09±0.02) | 18.88<br>(4.44) |
| 3 | NSKE 5 % | 30 lit/ha | 25.1 ± 0.13<br>(5.10 ± 0.01) | 19.5 ± 0.36<br>(4.52± 0.04) | 17.2 ± 0.34<br>(4.26±0.04) | 15.9 ± 0.10<br>(4.11±0.1) | 14.8 ± 0.1<br>(3.97±0.01) | 16.85<br>(4.21) |
| 4 | NSKE 10 % | 60 lit/ha | 25.89 ± 0.10<br>(5.18 ± 0.01) | 18.2 ± 0.39<br>(4.38± 0.04) | 16.3 ± 0.35<br>(4.15±0.04) | 14.2 ± 0.15<br>(3.89±0.02) | 12.4 ± 0.12<br>(3.66±0.01) | 15.25<br>(4.02) |
| 5 | Castor leaf extract 5% | 30 lit/ha | 25.91 ±0.45<br>(5.18 ± 0.04) | 24.23 ± 0.59<br>(5.02 ± 0.05) | 23.07 ± 0.08<br>(4.90±0.00) | 22.4 ± 0.01<br>(4.83±0.00) | 18.9 ± 0.42<br>(4.46±0.04) | 22.15<br>(4.80) |
| 6 | Castor leaf extract 10% | 60 lit/ha | 25.62 ±0.04<br>(5.15 ± 0.00) | 23.57 ± 0.51<br>(4.95 ± 0.05) | 22.25 ± 0.31<br>(4.82±0.03) | 19.8 ± 0.30<br>(4.56±0.03) | 17.5 ± 0.38<br>(4.30±0.04) | 2.78<br>(4.65) |
| 7 | Lantana leaf extract 5 % | 30 lit/ha | 26.09 ± 0.17<br>(5.20 ± 0.01) | 24.03 ±0.51<br>(5.00 ± 0.025) | 23.04 ±0.31<br>(4.90±0.02) | 22.2 ± 0.45<br>(4.81±0.04) | 28.7 ± 0.04<br>(5.45±0.00) | 24.49<br>(5.04) |
| 8 | Lantana leaf extract 10 % | 60 lit/ha | 25.92 ± 0.41<br>(5.18± 0.04) | 23.2 ± 0.30<br>(4.91 ± 0.03) | 22.16 ± 0.43<br>(4.81±0.04) | 19.6 ± 0.49<br>(4.53±0.05) | 17.3 ± 0.37<br>(4.27±0.04) | 20.56<br>(4.63) |
| 9 | *Verticilliumlecanii* | 1.5 kg/ha | 26.7 ± 0.19<br>(5.26± 0.01) | 22.08 ± 0.20<br>(4.80 ± 0.02) | 21.02 ± 0.31<br>(4.69±0.034) | 17.2 ± 0.15<br>(4.26±0.01) | 16.02 ± 0.18<br>(4.12±0.02) | 19.08<br>(4.47) |
| 10 | Control | --- | 25.03 ± 0.05<br>(5.10 ± 0.00) | 29.2 ±0.47<br>(5.49 ± 0.04) | 33.3 ± 0.29<br>(5.85±0.02) | 38.2 ± 0.45<br>(6.26±0.03) | 39.5 ± 1.00<br>(6.36±0.07) | 35.05<br>(5.99) |
| **CD at 5%** | | | **0.083** | **0.115** | **0.039** | **0.097** | **0.106** | **0.015** |
| **SE.m.±** | | | 0.028 | 0.038 | 0.055 | 0.032 | 0.035 | 0.015 |

DAS= Days after spray DBS = Days before Spray

**Effect of different biorational insecticides against mustard aphid, *Lipaphiserysimi*Kalt. (Second Spray- 2022-23)**

Data presented in (table-6) revealed that NSKE 10 % as spray on standing crop reduced maximum percentage *i.e*. 34.38 per cent population reduction over control proved best among all treatments by reducing mean population of*Lipaphiserysimii.e.*4.86 per plant. The second effective treatment applied to the mustard crop on standing crop as spray form was NSKE 5% with 33.24 per cent population reduction over control with mean population *i.e*. 4.95 per plant**Singh and Singh (2013)**.

The medial treatments in term of efficacy, spraying to the crop was Cow Urine 10 %, *Verticilliumlecanii*, Lantana leaf extract 10 %, Castor leaf extract 10 %, Lantana leaf extract 5 % and Castor leaf extract 5 % with 32.16, 31.96, 30.76, 30.60, 29.13 and 29.11 per cent population reduction over control and mean population *i.e*.5.03, 5.04, 5.13, 5.14, 5.25 and 5.25, respectively.

Treatment cow urine 5 % as splitting form on standing crop was found most inferior among all the treatments with 28.78 per cent population reduction over control with mean population *i.e*. 5.28 per plant, however, it was statistically superior in comparison to control in which 7.42 mean population of*Lipaphiserysimi*were recorded.

**Table-6Effect of different bio-rational insecticide on the population of *Lipaphiserysimi* in mustard during *Rabi* 2022-23 (Mean per cent infestation)**

**(Second Spray)**

| S.N. | Treatment | Dose/ha | Papulation of *Lipaphiserysimi* on mustard | | | | |
|---|---|---|---|---|---|---|---|
| | | | After spray | | | | |
| | | | 1 Day | 3 Day | 5 Day | 7 Day | Mean |
| 1 | Cow Urine 5% | 30 lit/ha | 30.9 ± 0.31 (5.648 ±0.028) | 29.6 ± 0.21 (5.532 ±0.019) | 24.7 ± 0.137 (5.069 ±0.014) | 22.9 ± 0.299 (4.889 ±0.031) | 27.05 (5.28) |
| 2 | Cow Urine 10% | 60 lit/ha | 28.2 ± 0.455 (5.403 ±0.042) | 27.4 ± 0.043 (5.329 ±0.004) | 22 ± 0.195 (4.796 ±0.02) | 20.2 ± 0.305 (4.604 ±0.033) | 24.45 (5.03) |
| 3 | NSKE 5 % | 30 lit/ha | 27.2 ± 0.241 (5.31 ±0.023) | 26.4 ± 0.563 (5.234 ±0.054) | 21.6 ± 0.506 (4.753 ±0.053) | 19.4 ± 0.081 (4.517 ±0.009) | 23.65 (4.95) |
| 4 | NSKE 10 % | 60 lit/ha | 26.8 ± 0.307 (5.272 ±0.029) | 25.2 ± 0.026 (5.119 ±0.003) | 20.9 ± 0.294 (4.68 ±0.031) | 18.4 ± 0.124 (4.404 ±0.014) | 22.82 (4.86) |
| 5 | Castor leaf extract 5% | 30 lit/ha | 30.7 ± 0.176 (5.63 ±0.016) | 29.4 ± 0.398 (5.513 ±0.036) | 24.4 ± 0.482 (5.039 ±0.048) | 22.6 ± 0.494 (4.857 ±0.051) | 26.77 (5.25) |
| 6 | Castor leaf extract 10% | 60 lit/ha | 29.5 ± 0.43 (5.522 ±0.039) | 28.3 ± 0.265 (5.413 ±0.025) | 23.4 ± 0.353 (4.939 ±0.036) | 21.3 ± 0.067 (4.722 ±0.007) | 25.62 (5.14) |
| 7 | Lantana leaf extract 5 % | 30 lit/ha | 30.6 ± 0.573 (5.621 ±0.051) | 29.4 ± 0.092 (5.514 ±0.008) | 24.4 ± 0.139 (5.04 ±0.014) | 22.6 ± 0.012 (4.858 ±0.001) | 26.75 (5.25) |
| 8 | Lantana leaf extract 10 % | 60 lit/ha | 29.3 ± 0.229 (5.504 ±0.021) | 28.3 ± 0.486 (5.413 ±0.045) | 23.2 ± 0.036 (4.919 ±0.004) | 21.2 ± 0.221 (4.712 ±0.023) | 25.5 (5.13) |
| 9 | *Verticilliumlecanii* | 1.5 kg/ha | 28.4 ± 0.443 (5.422 ±0.041) | 27.5 ± 0.458 (5.338 ±0.043) | 22.1 ± 0.264 (4.806 ±0.027) | 20.4 ± 0.021 (4.626 ±0.002) | 24.6 (5.04) |
| 10 | **Control** | ---- | 48.6 ± 0.028 (7.043 ±0.002) | 52.6 ± 0.849 (7.321 ±0.058) | 56.4 ± 0.734 (7.576 ±0.048) | 58.9± 0.032 (7.74 ±0.002) | 54.12 (7.42) |
| **CD at 5%** | | | **0.096** | **0.109** | **0.099** | **0.061** | **0.047** |
| **SE.m.±** | | | 0.032 | 0.036 | 0.033 | 0.029 | 0.016 |

Data given in parentheses are $\sqrt{X + 0.50}$ transformed values

DAS= Days after spray

DBS = Days before Spray

**Effect of different biorational insecticides against mustard aphid, *Lipaphiserysimi*Kalt. (Third Spray- 2022-23)**

Data presented in table-7 revealed that NSKE 10 % as spray on standing crop reduced maximum percentage *i.e*. 32.62 per cent population reduction over control proved best among all treatments by reducing mean population of*Lipaphiserysimii.e.*5.68 per plant. The second effective treatment applied to the mustard crop on standing crop as spray form was NSKE 5% with 31.92 per cent population reduction over control with mean population *i.e*. 5.74 per plant. Flowed by **Mishra *et. al.*, (2023)**

The medial treatments in term of efficacy, spraying to the crop was Cow Urine 10 %, *Verticilliumlecanii*, Lantana leaf extract 10 %, Castor leaf extract 10 %, Lantana leaf extract 5 % and Castor leaf extract 5 % with 30.86, 30.53, 29.59, 29.41, 28.36 and 28.19 per cent population reduction over control and mean population *i.e*.5.82, 5.85, 5.93, 5.95, 6.04 and 6.05, respectively.

Treatment cow urine 5 % as splitting form on standing crop was found most inferior among all the treatments with 27.98 per cent population reduction over control with mean population *i.e*. 6.07 per plant, however, it was statistically superior in comparison to control in which 8.43 mean population of*Lipaphiserysimi*were recorded.

**Table-7ffect of different bio-rational insecticide on the population of *Lipaphiserysimi* in mustard during *Rabi* 2022-23 (Mean per cent infestation)**

**(Third Spray)**

| S.N. | Treatment | Dose/ha | Papulation of *Lipaphiserysimi* on mustard | | | | |
|---|---|---|---|---|---|---|---|
| | | | After spray | | | | |
| | | | 1 Day | 3 Day | 5 Day | 7 Day | Mean |
| 1 | Cow Urine 5% | 30 lit/ha | 48.4 ± 0.035 (7.029±0.002) | 38.8 ± 0.699 (6.308±0.056) | 31.6 ± 0.688 (5.709±0.06) | 26.5 ± 0.45 (5.244±0.043) | 36.32 (6.07) |
| 2 | Cow Urine 10% | 60 lit/ha | 45.2 ± 0.07 (6.797±0.005) | 35.2 ± 0.715 (6.016±0.059) | 29.1 ± 0.606 (5.486±0.055) | 24.2 ± 0.416 (5.02±0.041) | 33.42 (5.82) |
| 3 | NSKE 5 % | 30 lit/ha | 44 ± 0.756 (6.708±0.056) | 34.2 ± 0.837 (5.932±0.071) | 28.2 ± 0.235 (5.404±0.022) | 23.2 ± 0.133 (4.919±0.013) | 32.4 (5.74) |
| 4 | NSKE 10 % | 60 lit/ha | 43.4 ± 0.519 (6.663±0.039) | 33.6 ± 0.402 (5.882±0.034) | 27 ± .253 (5.291±0.024) | 22.9 ± 0.012 (4.889±0.001) | 31.72 (5.68) |
| 5 | Castor leaf extract 5% | 30 lit/ha | 48.3 ± 1.056 (7.021±0.075) | 38.6 ± 0.944 (6.292±0.075) | 31.4 ± 0.114 (5.692±0.01) | 26.2 ± 0.137 (5.215±0.013) | 36.12 (6.05) |
| 6 | Castor leaf extract 10% | 60 lit/ha | 46.6 ± 1.188 (6.898±0.086) | 37.2 ± 0.581 (6.18±0.047) | 30.3 ± 0.583 (5.594±0.052) | 25.4 ± 0.119 (5.138±0.012) | 34.87 (5.95) |
| 7 | Lantana leaf extract 5 % | 30 lit/ha | 48.2 ± 0.727 (7.014±0.052) | 38.2 ± 0.696 (6.26±0.055) | 31.2 ± 0.503 (5.674±0.044) | 26.2 ± 0.491 (5.215±0.047) | 35.95 (6.04) |
| 8 | Lantana leaf extract 10 % | 60 lit/ha | 46.2 ± 0.817 (6.87±0.059) | 37.2 ± 0.813 (6.18±0.066) | 30.1 ± 0.36 (5.577±0.032) | 25.2 ± 0.092 (5.119±0.009) | 34.67 (5.93) |
| 9 | *Verticilliumlecanii* | 1.5 kg/ha | 45.6 ± 0.949 (6.826±0.07) | 35.5 ± 0.222 (6.041±0.018) | 29.5 ± 0.076 (5.523±0.007) | 24.4 ± 0.254 (5.04±0.025) | 33.75 (5.85) |
| 10 | **Control** | --- | 68.6 ± 1.142 (8.342 ± 0.068) | 68.2 ± 0.887 (8.318±0.053) | 70.4 ± 0.147 (8.45±0.009) | 73.3 ± 0.043 (8.62±0.002) | 70.12 (8.43) |
| **CD at 5%** | | | **0.18** | **0.159** | **0.115** | **0.079** | **0.041** |
| **SE.m.±** | | | 0.06 | 0.053 | 0.038 | 0.027 | 0.014 |

Data given in parentheses are $\sqrt{X + 0.50}$ transformed values

DAS= Days after spray

DBS = Days before Spray

**Effect of different bio- rational insecticides of *Lipaphiserysimi* in mustard. (Pooled data analysis Year- 2021-22 and 2022-23)**

Pooled Data presented in (table-8) revealed that NSKE 10 % as spray on standing crop reduced maximum percentage *i.e*. 33.51 per cent population reduction over control proved best among all treatments by reducing mean population of*Lipaphiserysimii.e.*4.85 per plant. The second effective treatment applied to the mustard crop on standing crop as spray form was NSKE 5% with 31.92 per cent population reduction over control with mean population *i.e*. 4.96 per plant.

The medial treatments in term of efficacy, spraying to the crop was Cow Urine 10 %, *Verticilliumlecanii,* Lantana leaf extract 10 %, Castor leaf extract 10 %, Lantana leaf extract 5 % and Castor leaf extract 5 % with 30.11, 29.63, 28.30, 27.92, 26.05 and 25.74 per cent population reduction over control and mean population *i.e.* 5.10, 5.13, 5.23, 5.26, 5.40 and 5.42, respectively.

Treatment cow urine 5 % as splitting form on standing crop was found most inferior among all the treatments with 25.73 per cent population reduction over control with mean population *i.e*. 5.41 per plant, however, it was statistically superior in comparison to control in which 7.30 mean population of*Lipaphiserysimi*were recorded.

**Table -8 Effect of different bio-rational insecticide of *Lipaphiserysimi* in mustard. (Pooled data analysis Year-2021-22 and 2022-23)**

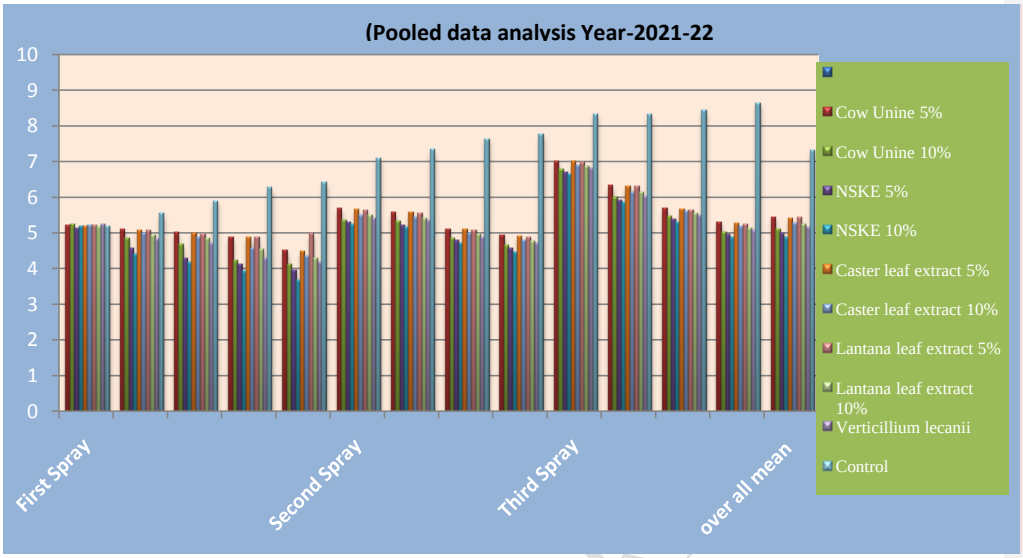
| Treatment | First Spray | | | | | Second Spray | | | | Third Spray | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 DBS | 1 DAS | 3 DAS | 5 DAS | 7 DAS | 1 DAS | 3 DAS | 5 DAS | 7 DAS | 1 DAS | 3 DAS | 5 DAS | 7 DAS | Over all mean | OCR% |
| **Cow Unine 5%** | 26.12±0.12 (5.20±0.01) | 24.99±0.10 (5.09±0.01) | 24±0.33 (5.0±0.03) | 22.80±0.18 (4.89±0.01) | 19.21±0.03 (4.49±0.04) | 31.18±0.23 (5.67±0.02) | 29.9±0.13 (5.55±0.01) | 24.95±0.17 (5.09±0.01) | 23.16±0.20 (4.91±0.02) | 48.13±0.25 (7.01±0.01) | 38.88±0.39 (6.31±0.03) | 31.19±.013 (5.67±0.01) | 26.8±0.19 (5.27±0.01) | 28.70 (5.42) | 25.73 |
| **Cow Unine 10%** | 26.22±0.43 (5.22±0.04) | 22.4±0.30 (4.83±0.03) | 20.83±0.29 (4.67±0.03) | 16.76±0.13 (4.21±0.01) | 15.90±0.22 (4.11±0.02) | 27.56±0.30 (5.34±0.02) | 27.11±0.02 (5.30±0.02) | 22.33±0.15 (4.83±0.01) | 20.45±0.16 (4.63±0.01) | 44.75±0.52 (6.76±0.03) | 34.91±0.31 (5.99±0.02) | 28.6±0.45 (5.44±0.02) | 24.11±0.26 (5.01±0.02) | 25.45 (5.10) | 30.11 |
| **NSKE 5%** | 25.05±0.07 (5.10±0.01) | 19.61±0.17 (4.54±0.01) | 17.10±0.19 (4.25±0.02) | 15.90±0.16 (4.11±0.02) | 14.51±0.07 (3.39±0.01) | 26.68±0.31 (5.26±0.03) | 26.1±0.26 (5.20±0.02) | 21.9±0.26 (4.78±0.02) | 19.61±0.10 (4.54±0.01) | 43.80±0.57 (6.69±0.04) | 33.96±0.58 (5.91±0.05) | 28±0.34 (5.38±0.03) | 23.4±0.05 (4.94±0.01) | 24.16 (4.96) | 31.92 |
| **NSKE 10%** | 25.81±0.09 (5.18±0.01) | 18.35±0.12 (4.39±0.03) | 16.13±0.13 (4.13±0.01) | 14.31±0.06 (3.91±0.08) | 12.25±0.05 (3.64±0.07) | 26.31±0.16 (5.22±0.01) | 25.31±0.08 (5.12±0.00) | 21.15±0.12 (4.70±0.01) | 18.56±0.06 (4.42±0.00) | 43.10±0.12 (6.64±0.01) | 33.10±0.47 (5.84±0.04) | 26.86±0.32 (5.27±0.03) | 22.45±0.03 (4.830.00±) | 23.17 (4.85) | 33.51 |
| **Caster leaf extract 5%** | 25.81±0.25 (5.21±0.01) | 24.66±0.37 (5.06±0.03) | 23.73±0.26 (4.97±0.02) | 22.66±0.07 (4.86±0.02) | 19.0±0.22 (4.47±0.02) | 30.95±0.28 (5.65±0.02) | 29.75±0.18 (5.54±0.04) | 24.70±0.37 (5.07±0.03) | 22.88±0.28 (4.88±0.02) | 47.85±0.31 (6.98±0.02) | 38.71±0.41 (6.30±0.01) | 30.91±0.20 (5.64±0.01) | 26.47±0.04 (5.24±0.01) | 28.43 (5.39) | 26.05 |
| **Caster leaf extract 10%** | 26.12±0.08 (5.21±0.01) | 23.64±0.42 (4.96±0.04) | 22.67±0.36 (4.86±0.03) | 19.88±0.18 (4.57±0.02) | 17.66±0.19 (4.32±0.02) | 29.01±0.50 (5.47±0.04) | 28.35±0.19 (5.41±0.01) | 23.60±0.21 (4.96±0.02) | 21.69±0.23 (4.76±0.02) | 46.26±1.07 (6.87±0.07) | 36.65±0.27 (6.13±0.02) | 30±0.16 (5.56±0.01) | 25.56±0.22 (5.15±0.02) | 26.86 (5.26) | 27.92 |
| **Lantana leaf extract 5%** | 26.12±0.13 (5.16±0.02) | 24.47±0.16 (5.04±0.02) | 23.47±0.05 (4.94±0.06) | 22.5±0.21 (4.84±0.02) | 23.51±0.17 (4.95±0.01) | 30.65±0.13 (5.62±0.04) | 29.60±0.18 (5.53±0.01) | 24.65±0.34 (5.06±0.03) | 22.74±0.05 (4.87±0.00) | 47.56±0.32 (6.96±0.02) | 38.45±0.68 (6.28±0.05) | 30.58±0.36 (5.62±0.03) | 26.3±0.36 (5.22±0.03) | 28.60 (5.42) | 25.74 |
| **Lantana leaf extract 10%** | 25.57±0.25 (5.24±0.01) | 23.14±0.27 (4.91±0.02) | 22.39±0.20 (4.83±0.02) | 19.46±0.16 (4.52±0.01) | 17.35±0.28 (4.28±0.03) | 28.85±0.17 (5.46±0.01) | 28.15±0.37 (5.39±0.03) | 23.3±0.24 (4.92±0.02) | 21.53±0.27 (4.74±0.02) | 45.96±0.53 (6.85±0.03) | 36.53±0.10 (6.12±0.01) | 29.7±0.37 (5.54±0.03) | 25.25±0.25 (5.12±0.02) | 26.56 (5.23) | 28.30 |
| ***Verticilliumlecanii 1.5 kg/ha*** | 26.4±0.07 (5.15±0.01) | 22.12±0.04 (4.80±0.04) | 21.06±0.22 (4.69±0.02) | 17.15±0.08 (4.26±0.01) | 16.47±0.09 (4.18±0.01) | 28.11±0.23 (5.39±0.02) | 27.55±0.20 (5.34±0.02) | 22.55±0.18 (4.85±0.01) | 21±0.07 (4.69±0.01) | 45.30±0.41 (6.80±0.03) | 35.15±0.20 (6.01±0.01) | 29.05±0.12 (5.48±0.01) | 24.55±0.10 (5.05±0.01) | 28.89 (5.13) | 29..62 |
| **Control** | 25.55±0.09 (5.15±0.01) | 29.65±0.55 (5.53±0.05) | 33.7±0.17 (5.89±0.01) | 38.04±0.45 (6.24±0.36) | 39.81±0.44 (6.38±0.03) | 49±0.35 (7.07±0.02) | 52.80±0.44 (7.33±0.03) | 57.20±0.44 (7.62±0.02) | 59.17±0.54 (7.75±0.03) | 68.35±1.25 (8.32±0.07) | 68.02±0.58 (8.30±0.03) | 69.77±0.20 (8.41±0.01) | 73.05±0.03 (8.60±0.01) | 53.26 (7.29) | ----- |
| **CD @ 5%** | **0.06** | **0.086** | **0.077** | **0.059** | **0.062** | **0.081** | **0.063** | **0.076** | **0.063** | **0.13** | **0.104** | **0.081** | **0.056** | **0.05** | |
| **SE(m)** | 0.02 | 0.029 | 0.026 | 0.028 | 0.021 | 0.027 | 0.021 | 0.025 | 0.021 | 0.044 | 0.035 | 0.027 | 0.019 | 0.017 | |

Data given in parentheses are $\sqrt{X + 0.50}$ transformed values

DAS= Days after spray

DBS = Days before Spray

**Fig. 1: Effect of different bio-rational insecticide of *Lipaphiserysimi* in mustard. (Pooled data analysis Year-2021-22 and 2022-23)**




**Conclusion:**

The treatmentsThe trend of management of different treatments against tested insect mustard aphid in both the years i.e. 2021-2022 & 2022-2023 in descending order are NSKE 10 % > NSKE 5 % > Cow Urine 10% >*Verticilliumlecanii* 1.5kg/ha.> Lantana leaf extract 10 % > Castor leaf extract 10% > Lantana leaf extract 5 % > Castor leaf extract 5% > Cow Urine 5%. The treatment NSKE 10 % was proved best and significantly superior over all treatments with highest reduction of Infestation of *Lipaphiserysimi*kalt.in both the years. The treatment cow urine 5 % was found poorest treatments which reduced minimum Infestation of *Lipaphiserysimi*Kalt**.** in both the years.

**Comment [U7]:** In the treatment, the. Recast this sentence



**References**


1. Annonymous. All India Production Final Estimates 2014- 2015. Department of Agriculture and Cooperation, 2014.
2. Bakhetia DRC, Sekhon BS. Insect-pests and their management in rapeseed-mustard. *Journal Oilseeds Research.* 1989; 6:269-299.
3. Sarwar M. Population synchronization of rapeseedmustard pests and exploitation of food attractants for predator. *Biological Diversity and Conservation.* 2009; 2(2):85-89.
4. Amer M, Aslam M, Razaq A, Afzal M. Lack of plant resistance against aphids, as indicated by their seasonal abundance in canola, *Brassica napus* (L.) in Southern Punjab. *Pakistan Journal of Botany.* 2009; 41:1043-1051.

**5.** Aslam M, Razaq M, Amer M, Ahmad F, Mirza YH. Lack of plant resistance in Raya, *Brassica juncea* (L.) varieties against two aphid species in Southern Punjab. *Pakistan Journal of Zoology*. 2009; 41:463-468.

**6.** Aslam M, Razaq M. Arthropod fauna of *Brassica napus* and *Bbrassicajuncea* from Southern Punjab (Pakistan). *Journal of Agricultural Urban Entomology.* 2007; 24:49- 50.

**7.** Sahito HA, Lanjar AG, Mal B. Studies on population dynamics of sucking insect pests of mustard crop. *Pakistan Journal of Agricultural Science*. 2010; 26(1):66- 74.

**8.** Brown J, McCaffrey JP, Harmon BL, Davis JB, Brown AP, Erickso DA. Effect of late season insect infestation on yield, yield components and oil quality of *Brassica napus*, B. rapa, B. *juncea* and Sinapis alba in the Pacific Northwest region of the United States. *Journal of Agricultural Science.* 1999; 132:81-288.

**9.** Singh C. Bio-efficacy of plant extracts against insectpests with major emphasis on mustard aphid, *Lipaphiserysimi* (Kalt.) in Brassica oilseed crops, M.Sc. (Ag.) Entomology Thesis Dept. of Entomology N.D.U.A&T., Kumarganj, Faizabad, 2007.

**10.** Bakhetia, D. R. C., Sekhon, B. S., Brar, K. S., &Ghorbandi, A. W. (1989). Determination of economic threshold of *Lipaphiserysimi* (Kaltenbach) on Indian mustard. *Journal of Aphidology*, 3(1-2), 125-134.

**11.** Singh, C. P., & Sachan, G. C. (1999, ). Ecofriendly management of *Lipaphiserysimi* (Kalt.) in *Brassica carinata*. In Proceedings of the 10th *International Rapeseed Congress* (pp. 26-29). Canberra, Australia: The Regional Institute Ltd.

**12.** Dhaliwal, L. K., & Hundal, S. S. (2004). Growth dynamics and radiation interception in Indian mustard (*Brassica juncea*). *Indian Journal Of Agricultural Sciences*. 6(4)136-140

**13.** Jandial, V. K., & Kumar, A. (2007). Seasonal incidence and population fluctuation of mustard aphid, *Lipaphiserysimi*Kalt. in relation to ecological parameters. *Indian Journal of Entomology*, 69(2), 162.

**14.** Divya, C., Kalasariya, R. L., & Kanara, H. G. (2015). Seasonal incidence of mustard painted bug, *Bagradahilaris* (Burmeister) and their correlation with abiotic factors on mustard. *Journal of Insect Science*, 28(1), 92-95.

**15.** Singh, R. K., & Verma, R. A. (2008). Relative efficacy of certain insecticides against mustard aphid (Lipaphiserysimi) on Indian mustard *(Brassica juncea*). *Indian Journal of Agricultural Sciences*, 78(9), 821.

**16.** Nagar, A., Singh, S. P., Singh, Y. P., Singh, R., Meena, H., & Nagar, R. (2012). Bioefficacy of vegetable and organic oils, cakes and plant extracts against mustard aphid *Lipaphiserysimi* (Kalt.). *Indian Journal of Entomology*, 74(2), 114-119.

**17.** Awasthi, C. J. (1993). Incidence of mustard aphid (*Lipaphiserysimi*Kalt.) in arid zone. *Uttar Pradesh Journal of Zoology*, 13(1), 31-32.

**18.** Mishra, S. K., Kumar, R., Singh, A. P., & Tiwari, D. K. Y. B. (2023). Bio-efficacy of novel insecticides against mustard aphid (*Lipaphiserysimi*Kalt.) in mustard crop (*Brassica campestris* L.).12(5): 3685-3690