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**Review Article**

# MANAGEMENT OF MUSTARD SAWFLY, ATHALIA LUGENS PROXIMA (KLUG) (TENTHREDINIDAE: HYMENOPTERA); REVIEW LITERATURE ON SAFER INSECTICIDES

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**ABSTRACT**

The larvae of Athalia lugens proximafed voraciously on leaves. Apart from mustard it also fed on radish and other allied plants. It feeds during morning and evening from the margin of the leaf towards the center. During daytime, it prefers to stay in the soil. The female possesses a saw-likeovipositor and inserts the eggs very near the leaf margin.



## INTRODUCTION

Mustard Saw Fly, *Athalia lugensproxima*is one of the very few hymenopterous insects noticed to infest Cruciferous crops all over India. It is a pest of cold weather, generally active during October to March.

### *Review*

Bogawat (1968) studied the effect of temperature on the larval development of *A. proxima* and reported that the larval development of whichwas affected significantly under the influence of various temperatures. Fastest larval development took place at 28 °C. There was a gradual increase in the larval period as the temperature decreased. At 30 °C, all larvae died within 24 hours. The larvae also attained maximum weight at 28 °C. Choudhary and Bhamburkar (1970) reported that when the newly hatched larvae of *A. proxima* were exposed to alternating low and high temperature, their development accelerated in comparison with that of larvae constantly kept at a higher temperature. The most favorable temperature range for both larvae and adults were found to be 10 to 29°C at 60 percent R.H. They further pointed out that such conditions were prevailing in the field at Nagpur from August to February where temperature and humidity ranged from 9 to 30°C and 30 to 90 percent, respectively.

Srivastava and Srivastava (1972)observed the maximum incidence of mustard sawfly at 22 to 26°C temperature and 62 to 82 percent relative humidity.Wahla *et al. (*1979) studied*A. proxima* at 19, 23 and 29°C, and found that larval period decreased and daily weight increased with increasing temperatures. But total weight gain was similar to all above constant temperature.Thakur (1976) recorded that the optimum temperature ranging from 19.7-24.8°C with 62.2 - 75.0 percent R.H. favored multiplication of this insect. Highest larval population on toria was recorded when the maximum temperature ranged from 26.9 to 32.1°C and R.H. from 78 to 87 and 38 to 40 percent at 7.12 and 14.12 hours, respectively. Verma (1992) in another study, the optimum temperature for larval development has been found to be 19 to 30°C, while 35°C proved to be lethal.

Singh and Sachan (1997) observed that the effect of different temperature on the development behavior of *Athalia proxima*

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Klug is indicating that 25°C was most suitable to this insect on with shorter larval period, higher pupation and adult emergence. The minimum (13.1 to 15.9°C) and maximum (20.0 to 27.2°C) temperature alongwith64 percent R.H favored its multiplication. Anonymous, (1998) showed the minimum (13.1 to 15.9°C),and maximum temperature (20.0 to 27.2°C) along with 64 percent R.H favored its multiplication.
Manzar *et al.,*(1998 and 2000) observed that the peak population of *Athalia proxima* Klug (3.4 larvae/plant) during the 49th standard week when temperature ranged between 23.8°C to 7.6 °C. In another study, the temperature of 25.60 °C to 7.74°C and 24.03 °C to 14°C (maximum and minimum) favored the occurrence.Gupta *et al.,*(2002) found that lower temperature produced conducive conditions for the development of *Athalia proxima*while the effect of humidity could not be established.

Srivastava (1958) recorded that maximum feeding had taken place on turnip followed by radish, mustard, rai, cauliflower,and cabbage in laboratory condition while in field maximum and minimum infestation was noticed on turnip and cabbage respectively. However, Bindra and Mehra (1964) recorded more grubs on mustard and turnip than on radish, cauliflower and 12 cabbages in the field. Similarly, in laboratory trail of host choice, the grubs consumed more leaf area of mustard and turnip than a radish, cauliflower,and cabbage.

Srivastava *et al.,*(1972) reported that in field condition, T-42 was least susceptible whereas Varuna was the most susceptible. Comparatively number of mustard sawfly grubs was reported on *Brassica juncea* and least on *B. napus* and *B. carinata* cultivars. Patil and Pokharkar (1973) observed that female of *Athalia lugens* sub sp. *proxima* (Klug) laid their eggs single on the young leaves, close to the margin. Hatching took place in 5-7 days, and the larval stage lasted 13-15 days. There were six larval instars. Pupation took place in the soil, and the pupal stage lasted 8-12 days. The life cycle was completed in 30-39 days.

Sehgal *et al.*(1975)reported the feeding response of *Athalia proxima* on 42 plants species belonging to 17 families indicated that preference of this insect was restricted only to the members belonging to Cruciferae and Tropaeolaceae thus indicating a narrow host range of this species. Sachan and Sumati (1985) observed that *A. proxima* (*A. lugens*) laid most eggs on plants of *B. juncea* cultivars PR 18 (69.6 eggs/plant), Varuna (67.9) and Porbiraya (57.6), and on plants of *Sinapis alba* (47.3). Fewest eggs were found on *B. napus* cultivars (4.0-5.0), followed by *B. juncea* cv. Stoke (7.0) and *B. carinata* cultivars Pc1 and Pc2 (7.3). Some larvae/10 plants on three-week-old plants were highest for Porbiraya (11.3) and lowest for *B. napus* and *B. carinata* cultivars (0.6-1.6).

Verma (1987) reported the feeding preference of *Athalia proxima* on different cultivars of toria, rai and yellow sarson in laboratory and field conditions indicated that toria cultivar T-9 was more preferred by the grubs of this insect as compared to PT-303 under laboratory conditions while under field conditions PT-30 was considered to be 13 most susceptible followed by PT-507 and PT-303. Among the cultivars of rai and yellow sarson Krishna was more preferred for feeding than PR-35 under laboratory conditions. However, under field conditions, Varuna and Kranti were more susceptible as compared to PYS-6 and YST-151. Feeding of this insect on 22 exotic germplasm of rai indicated that BEC-135, 111 and 108 were more preferred while more grubs were attracted on BEC-142, 144, 129, 149, 109 and 164.

Anonymous, (1989) reported that *Brassica alba, B. napus,*and*B. carinata* were least susceptible to this insect. Among the *B. carinata* lines B 26 M, DBO-54, HC-1, 2, 4, 5 and JGM-87-1 were tolerant while in case of rai, olga, trawse, porbiraya, EC 126746, EC 175439 call exotic and PHR-1, B-85, YRT-3, PYSR-3 (while flower glossy). CSR-83, 224, 247, DIRA-333, 335, NDR-871, 873, 8601, RK-8501, 8701, 8801, 8802, RLM-198, RW-2-2, RW 32-2 and Varuna (all indigenous) were tolerant to this pest.

Sachan and Ujagir (1989) found that presence of hairiness and some strong chemical defense in leaves acts as inhibitor/suppressant for ovipositor. The cultivar RC-781 (*B. juncea*) had significantly more eggs (57.8),and lowest eggs (2.8) were laid on cultivar Stoke, which is exotic. Varuna had more eggs (36.0) than the other cultivarsexcept for RC-781 and R-3245. Among native cultivars, all host plants were highly preferred for ovipositor except PR-15. The wild mustard, *B. tournifortii,*and black mustard, *B. nigra* were not preferred like exotic cultivars,and only 4.8 and 7.6 eggs were laid, respectively.

Khan *et al.,*(1991) conducted the field studies in Bangladesh to determine insect abundance in the mustard (*B. juncea*) variety Sonali, Tori-7, TS-72, Rai-5, Daulat, M-287, Bina-3, Sampad, Bina-1 and M-49 about plant age and variety. *Athalia proxima* was the most abundant species on all varieties of *B. juncea,* Daulat, Rai-5,and Sonali showed more resistance to this insect.

Sachan (1992 ) screened more than 750 germplasm of toria and 1000 germplasm of rai against *Athalia proxima* from 1982 to 1988 and reported that PT-30, PT-75, TLC-1, PT-41, PT-48, PT-49, PT-79, PT-80, PT-81, PT-82, PT-83, PT-500, PT-501`, PT-5078, RAUT-17, TGC-1, TGC-3, TGC-5, TK-5503, TK-8202, TKCSP-56, DIDNS-53, PT-12 and PT-303 were found tolerant. In 14 cases of *Rabi* PR-15, PR-34, PR-1002, PR-1003, PR-29, RLM-29-25, PR-18, PR-1, PR-6, P-1/26, RL-11/1, 54/12, 5501, RH-7-355, Rai-36, Raya-159 and 5503 were least susceptible to this insect. Among the nine oleiferous *Brassicae* viz., toria brown sarson, yellow sarson of *B. campestris* group, *B. nigra, B. carinata, B. alba, B. napus, B. juncea and E. sativa,* the sawfly has more preference for ovipositor and feeding for *B. campestris* followed by *B. juncea* under field as well as laboratory conditions. These hosts are also highly suitable for the growth and development of this insect *E. sativa*and *B. napus* are not preferred and unsuitable for this insect as hosts. Exotic materials are less suitable than indigenous ones for the survival of this insect.

Verma and Sachan (1997) studied on the larval population of *Athalia proxima* on three cultivars of *Brassica,*i.e., toria (*B. campestris*), rai (*B. juncea*) and sarson (*B. campestris*) and revealed a significantly higher larval population, 14 days after sowing on all cultivars. Indian mustard (*B. juncea*) cv. Varuna, Vardan, Rohini,and Vaibhav were sown on a different date. Vaibhav was the most tolerant to *Athalia proxima* (Singh *et al.,*1998). Manzar *et al.,*(1999) made studies on population dynamics of mustard sawfly and recorded some sawfly on *B.*

*campestris* than on *B. juncea.* The genotype MJ-91-49 and SKM-92-66 were found least susceptible.Parsana, (2000) recorded 1.04 and 1.28 larvae/10 plants, respectively, whereas, Varuna, Bio-902, MJ-94-15 205 (recorded highest number of larvae 3.11 per plants) and SKM-93-46 were comparatively more susceptible to Mustard Sawfly.

Considerable work has been done on the chemical control of this pest. Patel *et al.,*(1971) tested nine different insecticides including endosulfan (0.05%) Malathion (0.05%) and carbaryl (10%) dust against the pest and reported that BHC 5 percent dust was most effective and economical as compared to other treatments. Krishnaiah and Lal (1975) tested 0.03 percent spray of dimethoate, which gave effective control of *A. proxima* for five days.

Rai *et al*., (1978)recorded the mortality after 24 hours of spraying against *Athalia proxima* and determined the decreased efficacy of Malathion and fenitrothion when used combine while Malathion and fenitrothion alternate application maintained their effectiveness. The data of 28 hours denote that malathion, malathion + fenitrothion,and fenitrothion, gave 100 percent mortality and were found significant over quinalphos, fenthion,and endosulfan where the mortality was 94.44 percent, 83.35 percent,and 72.22 percent respectively. Judging from the overall toxic effects of insecticides, Malathion, Malathion + fenitrothion,and fenitrothion gave the highest mortality as against fenthion and endosulfan, though, all treatments were significant over control.

Patel *et al.,*(1993) studied that larval populations of mustard sawfly *A. lugens proxima* reveal the effectiveness of all the insecticides tested as compared to control. However, among the insecticides, application of quinalphos 1.50 percent dust @ 25 kg/ha at ETL two larvae/900 sq. Cm area gave cent percent mortality of mustard sawfly larvae within 24 hours of application and showed significant superiority to formations 0.025 percent and endosulfan 0.035 percent whereas, after 48 hours endosulfan 2 percent dust, quinalphos 0.025 percent and monocrotophos 0.036 percent spray gave cent percent larval mortality and showed superiority to formothion and endosulfan.

Sinha *et al.,* (2001) observed the relative toxicity of insecticides against mustard aphid in laboratory test and found that phosphamidon was most toxic insecticide followed by dimethoate, lindane, thiometon and chlorpyriphos; phosphamidon remained most effective up to 14 days followed by dimethoate, lindane, thiometon, carbaryl, malathion, chlorpyrifos, endosulfan, and quinalphos.Men *et al.,*(2002) reported that the 0.03 percent dimethoate, 0.05 percent endosulfan and the combination of 0.5 kg/ha *B. thuringiensis*and 0.03 percent endosulfan caused a maximum reduction in the mustard sawfly, *A. proxima* population. Ameta *et al.,*(2005) experimented the efficacy of imidacloprid seed treatment @ 5, 7 and 14 g/kg seed and reported that imidacloprid @ 7 g/kg seed was found *at par* to the @ 14 g/kg seed in terms reduction in the population of *A. proxima*. They have also reported that the seed treatment with imidacloprid @ 7 and 14 g/kg seed yielded 18.79 and 20.39; 19.42 and 19.73 q/ha during 2002-03 and 2003-04, respectively

Chopra *et al.,*(1949) edited an excellent book “Poisonous plants of India” and quoted that leaves of neem (*Melia azadarach*) have been used in India for the protection of woolen fabrics, books,and leather goods, they have tabulated 74 plant species having insecticidal and repellent properties.

Mane (1968) studied that aqueous suspension of neem seed kernel used against phytophagous pest viz., *Uproctia lunata, Acrida exelta, Prodina litura* and *Utetheria pulchella*protected the castor leaves at 0.5 percent concentration. Patel *et al.,*(1968) tested the neem seed kernel suspension @ ten g/10 liters of water to 100 g/10 liters of water on sunhemp against hairy caterpillar (*Amsacta moorei*) both in the case and in the field. In case of the field, it was observed those 24 hours after the treatment, all the caterpillar migrated to adjoining unsprayed plot and were feeding normally.Patnaik *et al.*(1987) observed that 3.0 percent neem oil caused 100 percent larval mortality of *A. proxima* Klug as compared to no mortality in the untreated check. The abrupt decline in pupation was noticed in a concentration above 0.4 percent. No practicable abnormality was observed in the emerged adults though emergence was very low beyond 0.4 percent strength.

Dimetry (1993) has described the unique properties of neem (Meliaceae). These properties of the toxic principals are toxicant, repellent, antifeedant,and insect growth regulator combined with low-cost local availability, safety on the environment and compatibility with the agro-ecosystem which emphasizes their potential in the insect-pest management system. Singh *et al.,*(1993) tested some plant products to control mustard sawfly (*Athalia proxima* Klug) under field experiment with a concentration of 0.5, 1.0 and 1.5 percent. Spray applications of *Azadirchata indica, Saussurea lappa,*and*Lantana camera* was more effective in reducing the pest incidence and significantly yield was also higher in comparison to other extracts.

Agrawal and Saroj (2003) observed the maximum larval mortality (47.5%) of *Athalia proxima* in 2 percent concentration followed by 30, 22.5, 15 and 6.25 percent mortality with the treatment of 1, 0.5, 0.25 and 0.125 percent concentration of neem oil in comparison to no mortality in control. Among allconcentration 2 percent neem oil was most effective in causing larval mortality, pupal inhibition, inhibition of adult emergence larval antifeedant and larval repellent effect. Srivastava and Singh (2003) reported that soil application of neem leaf powder @ 75 kg/ha at the time of sowing in furrows, reduced the population of mustard sawfly and increased the grain yield 5.2 percent over control.

Chandel (2011) revealed that the plant extract of *Alpinia galanga* caused maximum mortality (80.8%) larval mortality of *Athalia proxima* followed by 67.9% in *C. longa*, 66.3% in *A. melegueta* and 62.1% in *Z. officinale* and compared to 6.6% in control. The plant extract of *Alpinia galanga* differed significantly from remaining plant extracts except for *C. longa.* The concentration of 2.0% was superior to 1.0 and 0.5%. It was also observed that the difference in the percentage kill of larvae between concentrations 1.0% and 2.0% was greater than the difference in mortality between 0.5% and 1.0% in all the three periods. It was also seen that 2.0% induced 83.5% larval mortality within 6 hrs of exposure but in another 18 hrs, larval mortality increased only by 7.58%.

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