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Population dynamics, distribution and control of drosicha mealybug, *Drosicha sp.* (Homoptera: Coccidae) on willow tree (*Salix wilhelmsiana)* in district Skardu Gilgit-baltsitan, Pakistan

Syed Arif Hussain Rizvi [1], Sajjad Ahmed[1], Kamran Sohail [1],Muhammad Akbar[3],Farida Begum[3], Ghulam Raza[3], Muhammad Ali[3], Saleem Jaffar[1]

[1]*Department of Entomology, The University of Agriculture Peshawar, Pakistan*

[2]*Dept. of Horticulture, The University of Agriculture, Peshawar,, Pakistan*

[3]*Department of Environmental Sciences Karakoram International University Gilgit, Baltistan, Pakistan*

Key words: *Drosicha* mealybug, *Salix wilhelmsiana*, Sticky band, Gunny bag, insecticides.

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Abstract

Field experiment was conducted at district Skardu Gilgit Baltistan during year 2014 to record the population dynamics, distribution, control measures and natural enemies associated with *Drosicha* mealybug on Willow tree (*Salix wilhelmsiana)*. Sticky bands and gunny bag wrapping measures were applied in last week of February .Gunny bag wrappings along mud paste revealed that only 12.33 numbers of mealy bug across in 1st week and 71.76 numbers of mealy bug plant^{-1} were noted in 4th week March while untreated plants population of mealy bug noted after 1st week was 417.33 and 931 mealy bugs plant^{-1} after 4th week of March was recorded. Four pesticides Difenthuron, Confidence, Neem and Jozer were applied in month of June 2014 when infestation of mealy bug were highest data were taken after 24th ,48th ,72h ,1st week and 2nd week .Maximum mortality rates were observed after 72 hours by Jozer (Imadachlorpid +actameprid (20.0% 19.8% w/w) caused 47.013 % while Confidence, Neem and Difenthuron caused 11.117 ,4.380 and 6.89 % mortalities respectively. Statistically Jozer was significantly more effective than other three pesticides. Population trend of mealy bug with temperature were correlated and the data revealed that a positive significant correlation ($p<0.005$) was founded with this showed that temperature greatly affect the population and reproduction of mealy bug in Skardu. The natural enemies so for recorded during the studies were Green lace wing (*Chrysoperlla cornea*) and lady bird beetle (*Sumnius vestitus*).

***Corresponding Author:** Syed Arif Hussain Rizvi ✉ Arifrizvi@aup.edu.pk

Introduction

Mealybugs are soft body insects belong to family coccidae order Homoptera. About5000 species of mealybug have been identified from 246 families of plants from all over the world fifty six species have been reported from 15 genera of family Malvaceae, including cotton and many other plants having economic importance (Ben, 1994). Mealybugs are feeding on sap of plant by sucking due to modification in their mouth parts constitute a family about 2000 species, some of them are serious pests of agricultural crops and plants(Williams, 1985).

The name Mealy has been given is because of secretion of mealy wax that cover their body. Winged males and wingless females of mealybug (*P. solenopsis*) have two and three nymphal instars, respectively (Hodgson *et al*., 2008).Mealybugs is serious pest of agricultural and mostly horticultural crops. In last decade the trend of their seriousness increases in wild and agricultural crops including Cotton, vegetables and Fruits. Due to certain change in a biotic factors and climates. Earlier Mealybugs is considered as miner pest now is becoming a serious and major pest in Agriculture (Tanwar *et al*., 2007).

The Mealybug is a polyphagus insect, which has been recorded to feed on numerous plant species. There are numerous species of mealybugs (Green, 1908). Cotton mealybug is a soft-bodied insect that sucks the cell sap and plays havoc with the crop (Aijun *et al*., 2004). The insect also produces honey dew resulting in sooty mold growth, which hinders photosynthesis process (Saeed *et al.,* 2007). Willow tree have aesthetic value and grown all over in Gilgit Baltistan willow trees are the primary host of mealybug. Mealybug are the new invasive pest appear before 5 years ago in Baltistan region mealybug has serious threats to willow trees but now it is diverted to fruit orchards as well. Yet no research was conducted on mealybug in research area. So keeping in view the above facts and threats we conducted this research to get rid of mealybug by knowing their dispersal behavior, Population dynamics and chemical control.

Materials and methods

The experiment was carried out in Randomized Complete Block design (RCBD) having six treatments and each treatment was replicated three times.

Sticky Bands

Before emergence of mealybug a layer of 10cm sticky material e.g. greece, (sticky bands) was applied at trunk of trees at a height of 100cm above the soil surface to avoid crawl of mealybug. Base of tree was also be ploughed to expose the eggs and nymph to sun rays and birds.

Gunny Bag wrapping along mud filling in cracks

Mud paste was applied to fill the cracks in trunk of willow trees before emergence of mealy bug the main purpose is to minimize space for mealybug movement across. The gunny bag was wrapped over wet mud paste in such a way that its upper part was tight with threads and lower portion was quite loose because mealy bug hide in loose portion of wraps easily and form clustering under the lose portion of gunny bag at trunk of trees. Gunny bags were wrapped at a height of 100cm from ground.

Chemical application

After chemical application data was recorded on randomly selected tagged / branches from different sides of the plants by counting the numbers of bugs on each branch. Data were noted after 24, 48, and 72 hours 7 days and 14 days after the first application. If the infestation is started again then second application of the treatments will be applied after 14 days and vice versa.

Natural enemies associated with mealybug

Branch of willow tree was wrapped with muslin cloth for parasitism. Branches having mealy bugs were collected from different locations of Skardu and were kept in the laboratory for parasitoid emergence.

Dispersal behavior of mealybug in district Skardu

For knowing dispersal behavior of mealy bug, Skardu region was divided in three parts Chumick, Hassan

colony and Halqa two. Survey was mad to record the dispersal behavior of mealy bug.

Population trend in spatial relation to temperature

Temperature was recorded from the metrological station and was correlated with the population of mealy bugs. We selected willow trees on five places in Baltistan region on basis of elevation and count numbers of mealybug on those particular trees for observing population trend.

Statistical analysis

The experiment was laid out in randomized complete block design with three replications. The collected data was subjected to ANOVA and means was separated, using LSD test at 5% level of significance (Steel and Torrie, 1980).

Results

Sticky Bands

Population of mealy bug after treatment with sticky bands data revealed that in the first week of March lowest mean population (23 mealy bugs plant^{-1}) was recorded in the treated plants as compare to the untreated plants where the population recorded was highest *i.e.* 315 mealy bugs plant^{-1}. In the fourth week of March the crawling of mealy bugs increased and reached to 301 mealy bugs' plant^{-1} in the treated plants and mealy bugs 905.5 plant^{-1} in the untreated plants Haider (2010). The population of mealy bug was highest in the untreated plants and tends to continue up to the fourth week of April Fig 4.1. The statistical analysis of the data indicated that there was significant difference in the treated and untreated plants. After emergence nymph start crawling from base of willow trees when the nymph reached near the sticky band they are unable to cross the bands and with the results clustering of mealy bugs occurred near the bands which helps in control of mealy bug simply by smashing. Application of sticky band is not recommended on willow trees because after week stickiness of bands decrease due to adhering dust particles. Initially bands prove well but after few weeks bands need refresh. Sticky bands are not too cheap that's why these practices are not adopted by farmers on willow trees. However these practices are strongly recommended on fruit orchards and other valuable plants (Karar *et al.* (2008).

Gunny Bags wrapping along mud filling in cracks

Population of mealy bug after treatment with Gunny bags showed that in the first week of March lowest mean population of mealy bugs (12.33 plant^{-1})was recorded in treated plants whereas the highest population was recorded in the untreated plants *i.e.* 71.6 mealy bugs plant^{-1}. In the fourth week of March climbing of mealy bugs increased and was noted lowest population (417 mealy bugs plant^{-1}) in treated one and highest population was recorded on untreated plants (931 mealy bugs plant^{-1}).

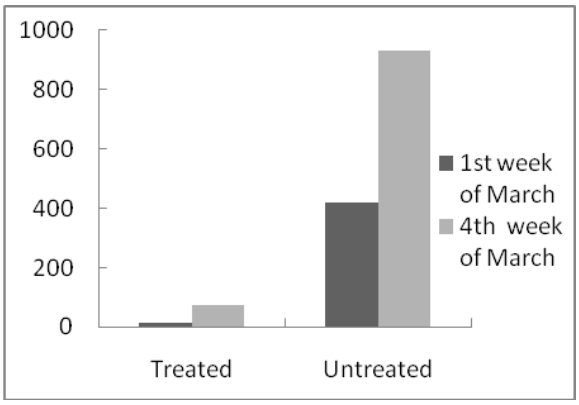


Fig. 4.1. Results of sticky bands during 2014.

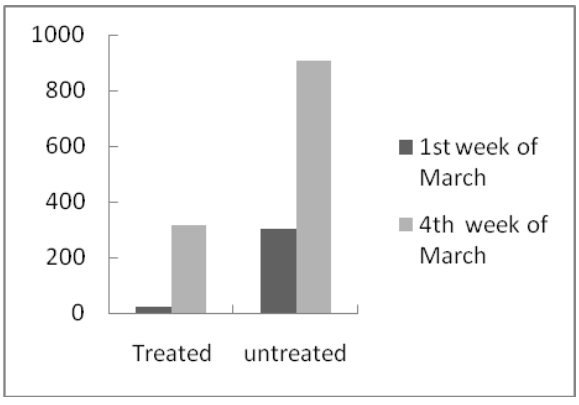


Fig.4.2. Results of gunny bag wrappings during 2014.

The statistical analysis of the data showed that treated plants with gunny bags wrapping along mud filling in cracks show significant difference from the untreated

.In the present study the population of mealy bugs was very low as compare to the control Fig 4.2. The mealy bugs cannot crawl over the gunny bags and were assemble in cluster under the gunny bags. The rapping of gunny bags provides excellent control over the mealy bugs by stopping their crawling. Our findings are not in accordance with the results of Karar *et al.* (2010), Chandra *et al.* 1991), Haq & Akmal (1960), they stated that old technique including gunny bags are not much useful to stop the upward movements of nymph of mealy bugs but in our study gunny bags proved best result due to modification of gunny bag wrappings technique filling of mud paste.

Chemical control

Percent Mortality of Mealy bug after application of pesticides: Data after 24 hours of application data showed that Jozer caused 7.2233 % mortality and Neem caused 4.340 % mortality (Johnson, 2009) while Confidence and Difenthuron caused 1.2300 and 1.2300 % mortalities as compared to control treatment where mortality due to environmental condition was 0.3200%. Data after 48th hours of application revealed that highest mortality was recorded by Jozer (12.21%) followed by Confidence, Neem and Difenthuron where the percent mortalities were 7.78, 6.80 and 5.70 respectively in descending order. After 72 hours of application all pesticides showed maximum mortalities then the control results but statistically Jozer was significantly different from all other treated and untreated plant. Maximum mortality rates were observed after 72 hours of application. The data further revealed that Jozer caused mortality of 47.013% while Confidence 11.117, Difenthuron and Neem caused mortalities of 6.897 and 4.380 % respectively in ascending orders while on control treatment mortality were noted 0.887%. Karar *et al.* (2010).The data after 1st week showed that maximum mortality was noted on Jozer (9.1900%) followed by Difenthuron where mortality recorded was (2.023%) ,Neem and Confidence caused mortalities 1.4200 and 1.326 % respectively in ascending orders. The data after second week of application showed that effects of pesticides were decreased and very low mortality rates were observed. Here data revealed that Jozer caused maximum mortality of mealy bugs that was recorded 6.6133 % fallowed by Confidence that was recorded 4.5600 %, where Difenthuron and Neem caused mortalities 3.3667 and 1.3600% in ascending order Table No 1. The data after statistical analysis revealed that Jozer had significant difference from the rest three pesticides however all the treatments were founded significant from the control where we applied simple water spray here mortality was 0.8034%.

Table 4.1. Percent Mortalities of Mealy bug after application of pesticides.

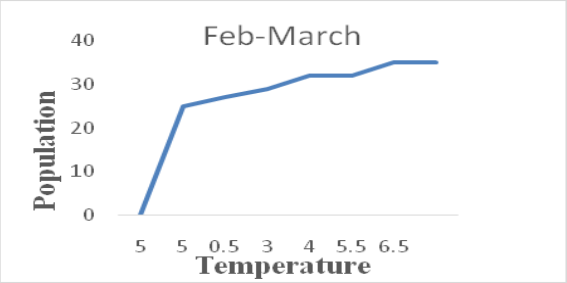
Treatment	24th Hours	48th Hours	72 hours	1st week	2nd week	Overall Means
Difenthuron	1.2300 c	5.700 b	6.897 b	2.0233 b	3.3667 b	3.8434 c
Confidence	1.3333 c	7.780 b	11.117 b	1.3267 b	4.5600 b	5.2234 b
Neem	4.3400 b	6.800 b	4.380 b	1.4200 b	1.3233 c	3.65266 c
Jozer	7.2233 a	12.210 a	47.013 a	9.1900 a	6.6133 a	16.44992 a
Control	0.3200 c	0.600 c	0.887 b	0.8500 b	1.3600 c	0.8034 d

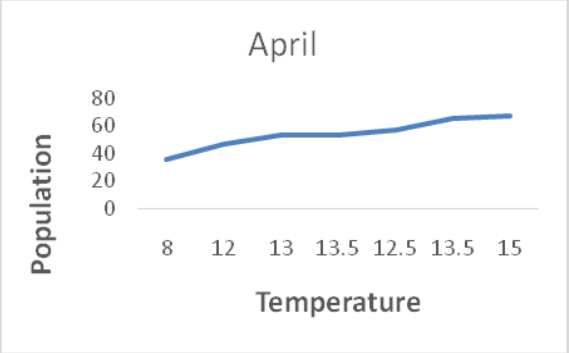
- Mean in column followed by dissimilar letters are statistically different at 5 % level of probability.

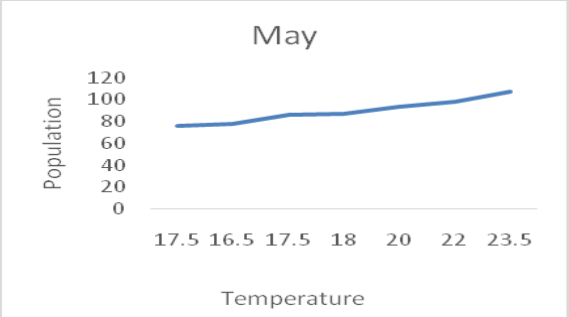
Natural enemies associated with mealybug: In the present research work the natural enemies recorded were lady bird beetle and green lace wing. In the study area species of *Sumnius vestitus* were observed during data collection on 24th of June and 29th of May willow trees where heavy infestation of mealy bug but population of *Sumnius vestitus* was negligible observation was taken to check the predation of theses Coccinellideae species on mealy bugs but during our research no evidence was found that they feed on mealybug. In previous literature species of Coccinellideae including *Sumnius vestitus, Sumnius renardi*, are the predators of *Drosicha* mealy bug (Ishaq, 2004) but in our research *Sumnius vestitus,* was found

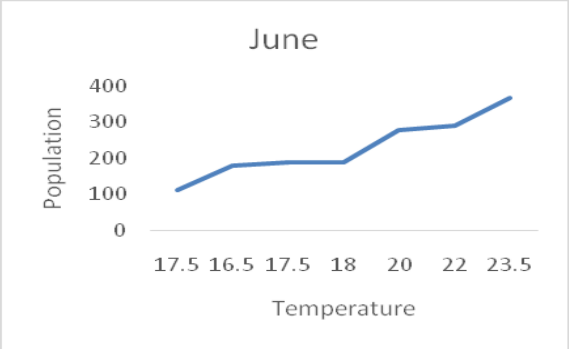
in the research area but their population was negligible and no evidence was found that they feed on mealy bugs. Spreading behavior of mealybug is quite unique. Infestation is decreasing as altitude is increasing. Infestation at Chumick is more as compare to Hassan colony. In the study area heavy infestation occur on those trees which were near to the water channels compared to those willow trees which were not nearer to water channels. In Skardu trees are usually planted near the water channel or grown naturally on the corner of water channels. The reason of heavy infestation on trees near water channel may be due to more sap in trees. Infestation increased along road sides and on those places where humans and Cattles are easily reached that shows humans and animals may help in dispersal of mealy bug.

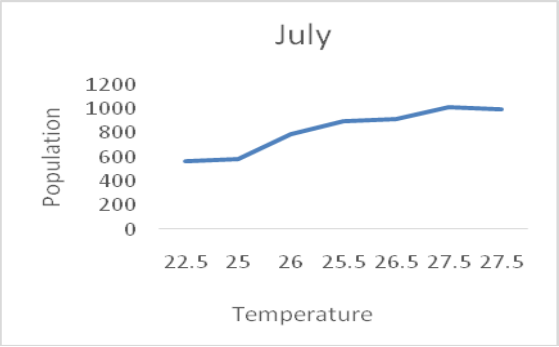
Population trend of mealy bugs in spatial relation to temperature : Data revealed that bugs starts appearing in March. An increase in population was recorded during the whole month. As temperature starts increasing in April population of mealy bug were also tends to increasing showed that severe crawling starts in April and nymph starts feeding on willow trees and their size also increased. In May nymph's size increased and can be seen easily. After 20th of May mealy bugs population increased and starts clustering on branches of willow tree. In April due to heavy feeding mealy bugs starts releasing honey dew data revealed that population of mealy bugs increased significantly in May as compared to March and April. In June temperature increased as a result of increasing in temperature population of mealy bugs was also increased. Males were also appeared in June and starts mating. July there was 1016 numbers of mealy bugs per plants.

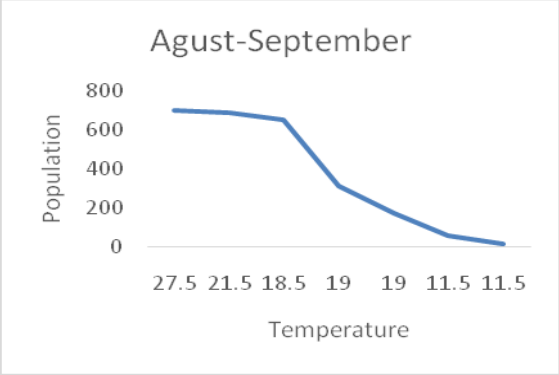












That showed that temperature was optimum in July which ranged from 22-27c Pregner and Ling (2001). The population of mealy bug reached to its highest during July and peak infestation was recorded. In 5th of August temperature starts declined in Skardu and at this time mealy bugs wrap themselves after 25 of August temperature starts decreasing at this time mealy bugs wrap themselves in waxes and drastic decreased in population was noted. A significant positive correlation (P<0.005) was found between the population of mealy bugs and temperature Taylor (1981).

Discussion

From our research we able to say that gunny bag wrappings and sticky bands along with soil wracking proved best results. Data revealed that the number of mealy bugs per plants that across the bands and wraps. Data taken after 4th week of application revealed that due to lose of stickiness because of adhering dust particles bands unable to stop crawlers to across the numbers of mealy bug across after 4th week were 945 numbers of meal bug as the number s were 69 mealy bugs in first week .While gunny bag wrapping proved best results the number of mealy bugs was noted in 4th was 215 numbers of mealy bugs as it was 37 mealy bugs in 1st week. The present research showed that gunny bag wrappings have positive affect to stop the crawlers to across from finding of our research we recommended that farmer should apply gunny bag wrapping before 25th of February to control mealybug infestation. Overall mortalities were caused by Jozer that was 16.4 fallowed by Confidence 5.22 while Difenthuron and Neem caused mortalities 3.84 and 3.65 % respectively. The present study revealed that from four pesticides used Jozer which formulation was (Imadachlorpid +actameprid (20.0% 19.8% w/w) showed maximum mortality against mealy bugs, from above facts we suggested that if infestation of mealybug occurs in Baltistan region and it reach economic injury level then apply Jozer for its immediate control . Spreading behavior of mealybug observed as altitude and latitude effect the population of mealy bugs in Skardu population at Chumick is more as compare to Hassan colony because of difference in elevation. Infestation of mealy bugs was highest on those trees which are nearer to the water channels as compared to those willow trees which was fare from the water channels in. Reason of heavy infestation on trees nearer to the water channel was because of availability of water as plants nearer to water contain more sap in bark. Humans and animals may helps in dispersal of mealy bug. Temperature and population of mealy bugs were noted in March, April, May, June, July, August and September. The data revealed that there was positive significant correlation (p<0.005) was founded every increase and decrease in temperature showed fluctuations in the population of mealy bug in Skardu.

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