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(II)
Factors affecting Lac insect settlement

Lac insect is a tinny creature and is a parasite to its host plants. The insect is the only source of animal resin which is a product of commerce. Total lac production figure of the country is about 21 thousand tons (Yogi *et al.,* 2014). Lac grows mainly in the states like Arunachal Pradesh, Assam, Andhra Pradesh, U.P., Chhattisgarh, Karnataka, Gujarat, Jharkhand, W. Bengal and M.P. Propagating material of the insect *i.e.* broodlac forms the major component for the cost of lac cultivation. Quality broodlac can ensure good emergence of lac crawlers and subsequently a good settlement on lac growing branches. On the other hand poor quality broodlac leads to uneven settlement and untimely insect mortality *i.e* few days after settlement. There could be many factors governing the quality of broodlac. Some of these are source of broodlac, per cent coverage by encrustation, compactness of encrustation, encrustation thickness, transportation hours, type of packaging before transportation, ventilation and exposure to sunshine during inoculation etc.

Normally, broodlac grown in a particular area perform well when used in the same area. But sometimes lac crop failure takes place in some areas and as a result, broodlac requires to be imported from other areas of the country. During transportation, there should be sufficiently porous gunny bags for proper ventilation of living lac insect within the broodlac. Stacking should be proper so that blocking/ joining of lac sticks do not take place. Heavy blocking of broodlac during transportation renders it unfit for use as broodlac. However, broodlac which have relatively lesser degree of blockage can be separated without any damage to it or with minor damage. These can be used partially as broodlac. Un-perforated gunny bags stagged in an improper fashion leads to improper ventilation which ultimately increases R.H., temperature and CO_2 concentration of the limited storage area of the vehicle used for transportation. All these factors working together lead to death of lac insect. Some insects are left living but give birth to weak crawlers which die few days after settlement. Similarly, settlement greatly depends on the placement site of the broodlac. If it is placed in shade, then relatively lesser number of crawlers emerges. When these factors are combined, there is possibility of generation of much more information. The present study gives an idea how lac insect settlement is affected due to faulty packaging of broodlac during long hours of (36 hours) transportation and inoculation site.

Inoculation of *kusmi* broodlac was done in July month on a 6 years old *Flemingia semialata* plantation having six months of shoot age as per recommended rate (Jaiswal and Singh, 2012) in the Institute Research Farm of ICAR-IINRG, Ranchi for winter season crop of 2014-15. Normally, broodlac is procured from nearby places. But in this case a portion was procured from Madhya Pradesh undergoing 36 hours of journey. Moreover, broodlac containing bags were stacked one over the other inside a carriage vehicle. It suffered a poor transportation condition. This condition is supposed to affect the insect biologically. Besides, during sorting out of broodlac, some amount of damage was effected during separation of one stick from the other. Sometimes, despite of being a good quality broodlac, lac insect do not emerge due to placing the same in a shady/ dark place *i.e* behind the leaf. Quality of brood in terms of its resin weight per meter length (>200 g.), predator population (<10/ meter length), living cell density (>10/ cm^2) and stage of broodlac (~5% cells with yellow spot) etc. were satisfactory for both the sources of broodlac. Therefore, during experimentation, we took three factors *e.g.* long/ short hours of transportation, physically damaged/ undamaged broodlac and mode of inoculation *i.e.* open/ under leaf, under Randomized Block Design in factorial mode so that variation created by each factor can be separated. Details of the factors are as follows:

A) Transportation
- i) 36 hours of transportation
- ii) Local brood with half an hour of transportation

B) Physical damage
- i) Damaged
- ii) Not damaged

C) Site of inoculation
- i) Under shade of leaf
- ii) Inoculation at open place

There were 6 treatment combinations and each was replicated five times. *Phunki* (empty broodlac) was removed 21 days after inoculation. Lac insect settlement was studied on the branches of *F. semialata* for reporting. Effect of all the factors was separated so that influence of each can be quantified separately. All the treatment combinations were subjected to similar crop protection methodologies as recommended by the Institute. Insect matured uniformly at the same time and harvest was done in the mid February next year for whole experiment.

Length of settlement of lac insect on *semialata* emerging from 50 g broodlac transported through a long way of 36 hours journey, having both physically damaged and without damage samples was compared to that with transported broodlac from nearby place

taking negligible journey time (Fig. 1). Length of settlement of lac insect (from 50 g broodlac) was 180 cm from local brood while the same figure reduced to 47 cm only (73 per cent reduction) when broodlac was transported in above mentioned way. Settlement was found to be 30 per cent lesser when broodlac was damaged physically while separating from blockage or otherwise. However no significant difference in settlement was observed for placing brood in shade or in open place during inoculation.

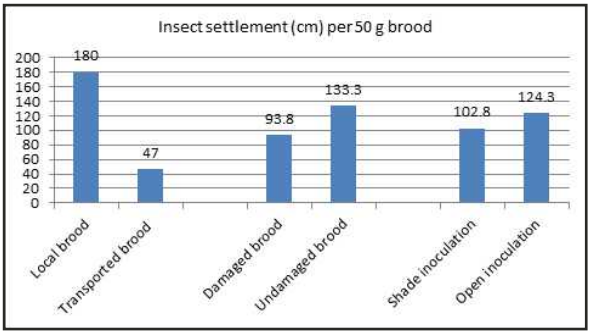

Fig.1: Insect settlement as affected by transportation, physical damage and mode of inoculation

It is clear from the observation that significant reduction in settlement took place due to long hours of transportation and poor packaging. Reduced settlement could be attributed to large scale mortality of gravid female/ crawlers inside the female. There could be two types of changes in the surroundings of lac insect i.e. reduction in oxygen level in the vicinity of insect and increase in temperature of surroundings. Since many insects have adapted to discontinuous pattern of gaseous exchange to reduce water loss and also to reduce loss of tissue damage due to oxidation even at low level of oxygen concentration (Stefan and Timothy, 2005), possibility of the first reason is lesser to act for lac mortality. They also emphasized that in between open and closed phase of respiration, there is a flutter phase where release of CO_2 is very low.

Rise in temperature on the other hand increases metabolic activity which in turn increases respiration rate till a critical thermal limit is reached. Besides metabolic activity, there is chance of breakdown of nervous and endocrine system (Lisa, 2000). Therefore, it seems that large scale mortality of lac insect transported in aforesaid manner could be due to rise in temperature.

Blockage of resin encrustation takes place due to enhanced pressure and temperature due to improper stacking of bags. When these broodlac encrustations are separated from each other, mechanical injury takes place due to which either some lac insect females are injured, or some are affected due to blockage of crawler emergence pores. This could be the reason for thirty per cent lesser settlement in the case of damaged broodlac.

Improper packaging of broodlac with un-perforated bags stacked one above the other and its subsequent long hours of transportation leads to affect broodlac quality, which ultimately affects lac insect emergence and settlement. Average length of settlement of lac insect (from 50 g broodlac) was observed to be 180 cm from local brood while the same figure reduced to 47 cm only (73 per cent reduction) when broodlac was transported in above mentioned way. Settlement was found to be 30 per cent lesser when broodlac was damaged physically while separating from blockage or otherwise. However no significant difference in settlement was observed for placing brood in shade or in open place during inoculation. Therefore, it is advisable to use local broodlac; in case of long transportation, broodlac should be packed on perforated gunny bags and stacking should be done judiciously.

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