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Stem wrapping with non-woven fabric: A new approach in the management of coffee white stem borer, *Xylotrechus quadripes* Chevrolat

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ABSTRACT: The Coffee White Stem Borer (CWSB), *Xylotrechus quadripes* Chevrolat is a major and most devastating pest of arabica coffee in India. Because of the concealed nature of this pest, the management of this pest is challenging. Timing of management measures plays a critical role in managing this pest under the economic threshold level. One of the important management interventions for this pest is tracing and uprooting the CWSB infested plants before the flight period (April to May & October to December). Due to lack of skilled workers to identify the infested plants, presence of crop load or low price for coffee and lack of moisture to uproot the infested plants makes the planters to skip the tracing before flight period. This allows WSB adults to emerge from the infested plants and spread the infestation to healthy plants. In view of this, the present study was targeted on the CWSB infested plants with an objective to kill the emerging adults using Non- woven fabric material. Main stem and thick primaries of CWSB infested plants were wrapped with non-woven fabric material and sprayed with insecticide. Hundred percent mortality of emerging adults from the infested plants wrapped with 1.3 mm thickness Non-woven fabric material and sprayed with Chlorpyrifos 50EC + Cypermethrin 5EC @ 1.2ml per litre along with 1 ml of wetting agent was observed.

Keywords: Coffee white stem borer, wrapping, non-woven fabric, *Xylotrechus quadripes*

INTRODUCTION

The Coffee White Stem borer (CWSB), *Xylotrechus quadripes* Chevrolat (Coleoptera: Cerambycidae), is a major pest in commercial arabica coffee plantations in India, Thailand, Sri Lanka, Vietnam and China (Venkatesha and Dinesh, 2012) and it was reported in India as early as in 1838 (Stokes, 1838). This pest is one of the major limiting factors for successful coffee production in India because of its widespread and destructive nature. It can cause havoc in arabica plantations especially during the periods when environmental factors are favorable for the pest build up (Vinod Kumar, 2010). In the recent years, incidence of this pest is increasing considerably, due to several factors. The important factor is climate change with respect to the rise in both minimum and maximum temperatures from last four decades favoured the spread of CWSB (Rudragouda *et al.,* 2013). If management measures are not taken up on a timely and regular basis, considerable economic damage is inevitable.

The infestation starts by feeding of early instar larvae in the outer surface and gradually enter inside the main stem. As a result of extensive feeding, tunnels are formed inside the stem which affects the nutrient supply and leads to substantial reduction in the yield. The severity of damage depends on the size of the larval population (Seetharama *et al*., 2005). Severe infestation leads to yellowing of leaves, defoliation and subsequently death of plant. CWSB has two flight periods in India: the pre-monsoon flight period begins in April and extends to the end of May, and the post-monsoon flight starts from the end of September until the end of December (Veeresh, 1993). The important management measures are regular borer tracing and uprooting/stumping of the infested plants before the start of flight period. For the remaining healthy plants, spray the main stems and thick primaries with Chlorpyrifos 20 EC at 600 ml in 200 litres of water + 200 ml wetting agent before mid April and mid October every year (Anonymous, 2014).

The winter flight period is longer when compared to the summer flight and maximum infestation occurs during this long dry spell (Seetharama *et al*., 2005). Due to the circumstances like non availability of skilled tracers and the plants carrying reasonably good crop load, especially in times of very attractive prices or in depressed price scenarios makes the planters not go for tracing and uprooting (Venkatesha, 1999). This delay in uprooting will allow the WSB to emerge and spread to

Table 1. Different treatment details of the experiment

Treatment No.	Material details	Insecticide application details*
T_1	0.4 mm thick non-woven fabric material	Sprayed the wrapped portion immediately after wrapping.
T_2	0.4mm thick non-woven fabric strips	Sprayed on the wrapped portion immediately and repeated spray after 30 days
T_3	1.3 mm thick non-woven fabric material	Sprayed the wrapped portion immediately after wrapping.
T_4	1.3 mm thick non-woven fabric material	Sprayed on the wrapped portion immediately and repeated spray after 30 days
T_5	1.3 mm thick non-woven fabric material	Impregnated with insecticide
T_6	1.3 mm thick non-woven fabric material	Impregnated with insecticide followed by a spray after 30 days
T_7	Gunny bag stripes	Sprayed the wrapped portion immediately after wrapping.
T_8	Gunny bag stripes	Sprayed on the wrapped portion immediately and repeated spray after 30 days
T_9	1.3 mm thick non-woven fabric material	Without insecticides spray
T_{10}	Gunny bag stripes	Without insecticides spray

healthy plants. It is difficult to target the larvae inside the coffee plants and wrapping of entire estate to avoid egg lying was practically not feasible. Hence, studies were initiated in 2014-15 by (Uma *et al*., 2017) targeting the infested plants. She reported infested plants were wrapped using gunny bag strips followed by a spray with insecticide formulations, produced mortality of emerging adults due to asphyxiation. The same concept was further fine tuned by using readymade non-woven fabric material which has an advantage over gunny bag *viz.,* availability, not withering like gunny bag stripes, withstands for longer period in the field and not attacked by termites. So, the present study was aimed to check the possibility of using a non-woven fabric as a barrier to kill the emergence of CWSB adults from infested plants.

MATERIALS AND METHODS

The studies were conducted in two methods *viz.,* a systematic field trial at Central Coffee Research Institute (CCRI) research farm at Balehonnur, Karnataka, India and a large scale multi-location bulk trial at private estates of Chikamagaluru, Hassan and Kodagu districts in Karnataka. The systematically laid field experiment was conducted during the winter flight of 2018 in CWSB infested arabica coffee plants (Selection 795) of 15-20 year old at CCRI farm. The experimental area (Latitude 12°37' N and Longitude 75°83' E) had a mean rainfall of 2550 mm with tropical humid climate ranging from 19°C to 34°C. The treatments included non-woven fabric material of two different thickness, 0.4 mm and 1.3 mm (Plate.1), gunny bag strips with two of insecticide application methods at different intervals. The detailed treatment details are furnished in the table 1. Non-woven fabric materials were procured as 5 meter rolls with 5 inch width. The main stem and thick primaries of the selected infested plants were wrapped before the flight period with non-woven fabric without leaving any gap. After wrapping, the insecticide chlorpyrifos 50EC + cypermethrin 5EC, a combi product @ 1.2ml per litre along with 1 ml of any wetting agent was sprayed and in another treatment, wrapping material was impregnated with insecticide solution and dried in shade for a week and then wrapped on the main stem and thick primaries. The gunny bags also cut into long strips of 5 inch width and wrapped in same way as non-woven fabric and sprayed with insecticide. For control, non-woven fabric and gunny strips were wrapped without insecticide application and covered with nylon mosquito net to avoid the escape of adult beetles into the field.

Table 2. Evaluation of non-woven fabric material in preventing the emergence of CWSB adults for 2018 winter flight period

Treatment no.	Mortality of adults (%) (15 DAT)	Mortality of adults (%) (30 DAT)	Mortality of adults (%) (45 DAT)	Mortality of adults (%) (60 DAT)
T_1	81.14 ± 2.03^{bc}	75.93±5.25b^{c}	68.69±3.5^{e}	57.33±3.07^{e}
T_2	77.59 ± 2.51^{c}	70.47±4.76^{c}	74.56±5.06^{d}	74.29±1.94^{c}
T_3	100 ± 0^{a}	100±0^{a}	100±0^{a}	93.05±6.17^{b}
T_4	100 ± 0^{a}	100±0^{a}	100±0^{a}	100±0^{a}
T_5	100± 0^{a}	100±0^{a}	97.92±3.61^{a}	92.02±1.89^{b}
T_6	100 ± 0^{a}	100±0^{a}	100±0^{a}	96.02±3.51^{ab}
T_7	98.33 ± 2.89^{a}	96.67±5.77^{a}	75.28±2.24^{cd}	66.35±3.05^{d}
T_8	98.25 ± 3.04^{a}	95.86±3.7^{a}	92.83±1.91^{b}	90.21±6.01^{b}
T_9	83.44 ± 3.03^{b}	80.61±1.05^{b}	79.86±4.34^{c}	79.09±1.57^{c}
T_{10}	63.95 ± 7.62^{d}	59.26±2.2^{d}	63.95±2.58^{e}	59.21±2.39^{e}

*Chlorpyrifos 50EC + Cypermethrin 5EC @ 1.2ml per litre along with 1 ml of wetting agent was used for all the treatments, Note: Means followed by same letter do not differ significantly at p=0.05 according to DMRT, DAT: Days after treatment

Experiment was carried out in RCBD with three replications for each treatment and 20 plants for each replication. Five plants were examined by unwrapping the strips and recorded adult mortality at every 15 days interval after treatment. The data recorded was subjected to statistical analysis using Analysis of Variance and compared by Duncan's Multiple Range test using SPSS 10.

In another experiment, distributed non-woven fabric material of thickness 0.4 mm and 1.3 mm to the selected growers of Chikamagaluru, Hassan and Coorg districts of Karnataka during 2017 and 2018 winter flight period respectively. In each estate 100 infested plants were wrapped and sprayed with insecticide (Chlorpyrifos 50EC + Cypermethrin 5 EC at 1.2 ml per litre of water + 1 ml wetting agent) immediately after wrapping. Observations were recorded after flight season and the difference between two materials was analysed statistically using paired T-test.

RESULTS AND DISCUSSION

Results of the present study on the evaluation of different wrapping material and different insecticide application methods against CWSB adults during winter flight period of 2018 showed that the treatments T3, T4, T5 and T6 were recorded 100 percent mortality on the emerging CWSB adults up to 45 days after treatment. The treatment T7 was on-par with above treatments up to 30 days after treatment. The treatment T1, non-woven fabric of 0.4 mm thickness with single insecticide spray recorded 81.14 percent adult mortality at 15 days after treatment and decreased to 57.83 percent at 60 days after treatment. Non-woven fabric of 1.3 mm thickness showed 92 percent of adult mortality up to 60 days after treatment with a single spray of insecticide, whereas 66.12 and 57.83 percent adult mortality was recorded in gunny wrapped and 0.4 mm thickness non-woven fabric wrapped plants respectively. When insecticide spray was repeated after 30 days of first spray, the mortality recorded in non-woven fabric of 1.3mm thickness and gunny wrap was more than 96 percent even after 60 days of treatment

Table 3. Details of the multi-location trails conducted on non-woven fabric wrapping on CWSB infested plants in private estates of Karnataka

Flight period	Thickness	No.of estates	Mortality of adults (%)	T stat
Winter 2017	0.4 mm	55	74.12±3.57	0.84*
Winter 2018	1.3 mm	22	100±0	

The t-value is significant at p = 0.05

Plate. 1. Impregnation of insecticide

Plate. 2. Non -woven fabric wrapped plant WSB infested plant

Plate. 3. Mortality of adult beetle

(Plate.2). Whereas non-woven fabric of 0.4 mm thickness recorded 74.29 percent mortality of adults even after second spray (Table-2). Uma *et al.* (2017) reported that spraying of combination insecticide Chlorpyrifos 50 EC + Cypermethrin 5 EC @ 1.2 ml per liter of water on the stem borer infested stems wrapped with gunny bag strips killed 83.08 per cent of the emerging beetles. Whereas, the durability of the material is concerned. There is no significant difference in terms of adult mortality between the impregnated material and sprayed after wrapping except the 60th day observation. Whereas, significant difference was noticed in adult mortality between the 0.4 mm and 1.3 mm thickness non-woven fabric material. Overall result of the study indicated that 1.3 mm thickness non-woven fabric material is superior among the tested material even with single spray compared to 0.4mm thickness non-woven and gunny stripes. The repeated spray after 30 days recorded 100 percent mortality even after 60 days, this will assure zero percent escape of WSB adults from infested plants.

Multi-locational trials were conducted at CCRI, CRSS, Chettalli and 77 private estates during 2017 and 2018 winter flight periods using 0.4 mm and 1.3 mm thickness non-woven fabric material. For 2017 winter flight period, 0.4 mm thickness non- woven fabric wrapped plants were checked randomly for the efficacy and observed 74.12 percent adult mortality at the emergence site. Based on these encouraging results, the improved non- woven fabric with 1.3 mm thickness was evaluated for 2018 winter flight period. The experiments were repeated at CCRI, CRSS and 22 private estates of Chikmagaluru, Hassan and Kodagu districts by wrapping 100 plants at each location. The result of the improved material revealed that 100 % mortality of the adult beetles trying to emerge from the infested plants (Table 3).

Results of the experiments indicated that the infested plants can be wrapped with 1.3 mm non-woven fabric material insecticide and spraying (Chlorpyrifos 50EC + Cypermethrin 5 EC at 1.2 ml per litre of water + 1 ml wetting agent) immediately after wrapping before the onset of the flight period *i.e*. in September. One more insecticide spray on the wrapping material after 30 days after first spray is more beneficial. By doing this we can harvest the crop and restrict the adult emergence and the plants which are doubtful of infestation during the tracing and the plants which are less infested can be wrapped and wait for rejuvenation by avoiding further infestation. If the plants are not rejuvenated, then they can be removed later.

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