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INTEGRATED PEST MANAGEMENT OF WHITE GRUB *HOLOTRICHIA CONSANGUINEA* BLANCHARD IN GUAVA AND GRAPES

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ABSTRACT

White grubs or cockchafer beetles are polyphagous soil dwelling pests and *Holotrichia consanguinea* Blanchard is one of the most damaging infesting agricultural and horticultural crops. A cockchafer beetle trap was devised using anisole (methoxy benzene) as a lure (aggregating pheromone) and was evaluated in an IPM module (30 traps/ ha+ flooding of fields+ weed removal) as recommended by PAU, Ludhiana in guava and grapes orchards in Punjab. The traps were placed at ground level and tied to trunk/vine with approximately 1 trap/ 11 trees in guava and 1 trap/ 55 vines in grapes orchard. In guava, leaf damage was observed to reduced from 36.90% (non-IPM fields) to 8.73% (IPM fields); and in grapes, from 47.75% (non-IPM fields) to 13.15% (IPM fields). It is an eco-friendly technique which can be used at community level to control white grubs in the orchards.

Key words: *Holotrichia consanguinea*, cockchafer beetle, anisole, fruit crops, IPM, May/June beetles, pheromone trap, Punjab, soil dwelling pests, environment friendly

White grubs or cockchafer beetle (order Coleoptera) belonging to family Scarabaeidae are the serious pests of several agricultural and horticultural crops. These are polyphagous soil dwelling pests where the grubs feed on roots and underground stem parts of the crops and adult beetles feed on the leaves and fruits, flowers of trees and orchard crops, respectively. The adult beetles are found in the fruit crop orchards during May-June soon after the monsoon showers, feeding on the leaves and reproductive parts. More than 2000 species of white grubs are known to occur in India, of which 20 species are recorded as serious insect-pests of various crops (Ali, 2001). The majority of these are phytophagous belonging to subfamilies Melolonthinae, Rutelinae, Dynastinae and Cetoninae (Mittal, 2000). Adults of Melolonthinae and Rutelinae are predominantly leaf feeders and those of Cetoninae feed on flowers and fruits, preferring juice of ripening fruits and vegetables (Srinivasa et al., 2015). White grub species such as *Adoretus* sp., *Anomala bengalensis* (Blanchard), *A. ruficapilla* (Burmeister), *Holotrichia consanguinea* (Blanchard), *H. longipennis* (Blanchard), *H. serrata* (F), *H. staudingeri*, *Lepidiota* sp., *Maladera* sp., *Popillia* sp. Brenske and *Schizonycha ruficollis* (F) have been observed on various fruit crops (Sreedevi et al., 2019). Among these, *H. consanguinea* is an important species that is pestiferous on several crops such as sugarcane, groundnut, maize, etc. (Sreedevi et al., 2014, 2017; Kumar et al., 2017); and are reported to cause epidemic in sugarcane and groundnut in 1950s (Gupta and Awasthy, 1960). In Punjab, this species has been reported to cause 20-25% damage to leaves of grapes (Sreedevi et al., 2019).

Several management tactis have been adopted for the management of white grubs including cultural, mechanical, biological, chemical and integrated methods (Srikanth and Singaravelu, 2011). Pest management strategy depends primarily on the use of highly poisonous chemical pesticides but chemical control is practically difficult and uneconomical. Also, the use of chemicals is reported to be associated with environmental pollution and pesticide residues. The emphasis has now shifted from chemicals to IPM with focus on cultural control, biological control to reduce the reliance on chemicals (Patel et al., 2022). Recent studies have demonstrated potential of pheromones as a tool for monitoring and managing the white grub

populations in the field (Bhagat et al., 2020). Anisole (Methoxy benzene) has been identified as aggregating pheromone for *H. consanguinea* (Leal et al., 1996). The use of pheromone traps is a very eco-friendly method of insect pest management (Sohrawardy et al., 2021). The scan of literature revealed that this is the first study of white grub management using pheromones in fruit crops. Most of earlier work has been done in groundnut. So, the present study was conducted to develop anisole based cockchafer beetle trap (PAU Cockchafer Beetle Trap) and its evaluation in integrated pest management approach for the management of *H. consanguinea* in grapes and guava orchards of Punjab.

MATERIALS AND METHODS

The present study was conducted during 2017-2019 at the Fruit Research Farm, Punjab Agricultural University (PAU), Ludhiana and during 2020 at three locations i.e. Fruit Research Farm, PAU, Ludhiana (30°54'16.3"N 75°47'36.3"E), PAU Zonal Research Station for Kandi Area, Ballowal Saunkhri, SBS Nagar (31°05'58.1"N 76°23'14.2"E) and at PAU Regional Research Station, Bathinda (30°11'12.1"N 74°56'52.1"E). A pheromone trap with anisole (methoxy benzene) as a lure was prepared. To prepare trap, a plastic container (22 cm dia and height-21 cm) was cut from sides to make two square windows (7 x 7cm) (for easy entry of adults as beetle is bigger in size) and a circular hole was cut through the centre of the lid of the container. A plywood septa (7.5 x 6.0 x 2.0 cm) was dipped in anisole in a glass jar for 72 hr so that septa absorb the chemical completely. Then the septa were tied in the centre of the container using a lace hanging through the lid of the container. Trap was placed at ground level and tied with the trunks of grapevines and guava trees in the orchards. Traps were installed in grapes and guava orchards during first week of May during 2017 and 2018 @ 24.7 traps/ ha (3 replications) and during 2019 @ 19.8, 24.7 and 29.6 traps/ ha (3 replications). During 2020, studies were carried out based on previous results and number of traps with best results during 2019 i.e. @ 29.6 traps was taken along with IPM strategies such as sanitation, clean cultivation, flooding and ploughing both in guava and grapes. Septa (plywood piece) were replaced once after 30 days. The number of adult beetles trapped in each trap was counted at weekly intervals during May-June 2017 and 2018, during May, June, July and August during 2019 and 2020. The plot size was 0.4 ha of guava and grapes orchards. There was total 1.2 ha of guava orchards and 0.4 ha of grapes at all locations. Along with incidence, damage data was also recorded as % damaged leaves during 2019 and 2020. The leaves were selected randomly as followed in recording data of insect pests of fruit crops and % damaged leaves was computed (based on 100 leaves). Damage data was recorded as mean of 10 trees. Similarly, damage data was also recorded from non-IPM fields (as control). Leaf damage data was statistically analyzed by ANOVA.

RESULTS AND DISCUSSION

Pheromones are used for monitoring, mass trapping, mating disruption and attract and kill (Huiting et al., 2006). So, anisole based trap was evaluated in grapes and guava orchards in Punjab and a total of 805.22 and 1756.17 beetles were trapped in 24.7 traps/ha in guava orchard during 2017 and 2018, respectively (Fig. 1). In grapes, a total of 699.01 and 1662.31 beetles were trapped during 2017 and 2018, respectively. During 2019, comparatively more beetles were trapped when traps were installed @ 29.6/ha (1551.16 beetles) as compared to 24.7 traps (1099.15 beetles) and 19.8 traps (938.6 beetles)/ ha in guava orchards. Consequently, the leaf damage due to beetles was also less (8%) in 29.6 traps/ha (Fig. 3). Similar observations were recorded in grapes orchards also (Fig. 2). The population catch (1691.95 beetles) and corresponding leaf damage (13.2%) was relatively less when traps were installed @ 29.6/ ha as compared to 24.7 traps (1116.44 beetles; 17.0% leaf damage) and 19.8 traps (1057.16 beetles; 18% leaf damage)/ha (Fig. 3). During 2020, traps were evaluated at three locations i.e. Ludhiana, Bathinda and Ballowal Saunkhri at density of 29.6 traps/ha along with cultural practices for guava and grapes (Fig. 3). A total of 1691.95, 1057.16 and 2119.26 beetles were trapped in 29.6 traps/ ha at Ludhiana, Bathinda and Ballowal

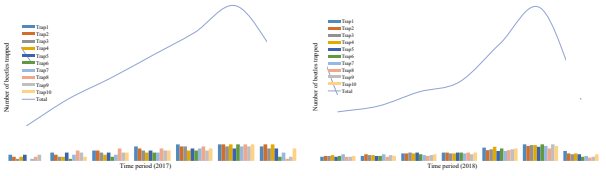

Fig. 1. Beetles trapped in guava

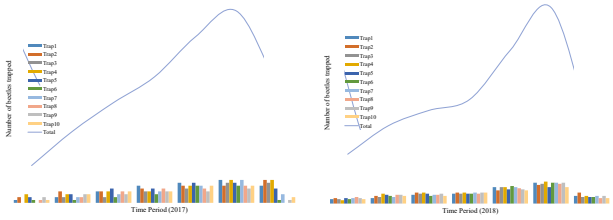

Fig. 2. Beetles trapped in grapes

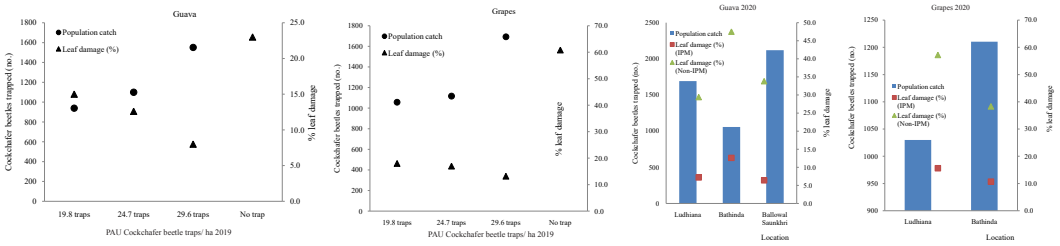

Fig. 3. Mass trapping and damage of cockchafer beetles in guava and grapes

Saunkhri, respectively. About 7.2% leaf damage was observed in fields with IPM practices while in non-IPM fields, it was 29.4% at Ludhiana. The damage observed was 12.6% at Bathinda and 6.42% at Ballowal Saunkhri in IPM fields (Fig. 3). Similarly, for grapes, traps were evaluated at two locations i.e. Ludhiana and Bathinda at density of 29.6 traps/ha along with cultural practices. At Ludhiana, a total of 1029.99 beetles were trapped whereas in Bathinda, 1210.3 beetles were trapped in 29.6 traps/ha. About 15.6% leaf damage was observed in fields with IPM practices while in non-IPM fields, it was 57.2% at Ludhiana. The leaf damage was observed to be 10.7% in IPM fields at Bathinda and 38.3% in non-IPM fields (Fig. 3).

Despite the less number of beetles trapped, the leaf damage was more in Bathinda as compared to Ballowal Saunkhri, which could be due to the reason that Bathinda is an arid-irrigated and dry area whereas, Ballowal Saunkhri is sub-montaneous area. Beetles may be feeding more voraciously in dry conditions. It was evident that clean cultivation such as sanitation along with weed removal in the guava and grape orchards helps in reducing beetle population as weeds help in survival of early stages of grubs. Ploughing around the trees during winter helps to expose and kill the hibernating adults (Gurjar et al., 2022). Irrigation at regular intervals prevents beetle from egg laying and also kill grubs and adults of the beetle. Entomopathogenic fungi have also been evaluated successfully for management of white grubs in groundnut (Patel et al., 2022). So, integrated management strategy including cultural practices and pheromone traps has the potential to efficiently manage cockchafer beetles. Anisole based Cockchafer Beetles Trap has proved to be effective in mass trapping of *H. consanguinea* in the present study. Sex pheromone traps plus bio-insecticides has been used for control of *Holotrichia parallela* Motschulsky in organic pear orchards in Korea (Jang-Hoon et al., 2018). Area wide management of chafer beetle using pheromone nano formulations have been undertaken in Rajasthan (Devanda et al., 2021) and Gujarat (Bhut et al., 2021). The major component of sex pheromone was L-isoleucine methyl ester and minor component was (R)-(-)-linalool. ICAR-NBAIR has developed a slow release nanogel pheromone formulation for the management of *H. consanguinea*. The nanogels displayed high residual activity and better efficacy during heavy rains (Bhagat et al., 2020). The pheromone, methoxy benzene has the unique property of attracting *H. consanguinea* adults from a distance of 15 meters (AINP, 2021). Pheromone dispensers loaded with methoxy benzene placed on tree @ 3-4 dispensers per tree were found effective in aggregating beetles within a radius of 15 meters. So, this is the pheromone based trap for *H. consanguinea* developed by Punjab Agricultural University, Ludhiana, Punjab (India) and this trap can be used at community level to control white grub population in the orchards. It is an environment-friendly technique with no component of insecticides. PAU Cockchafer Beetle Trap remains effective for one month and can be a good alternative to insecticides for the management of white grubs in fruit crops.

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AUTHOR CONTRIBUTION STATEMENT

SS conceived and designed research. RKS, PSS, RS and JK conducted experiments. PSS analyzed data. RKS, SS and RS wrote the manuscript. KS identified the white grub species and improved the manuscript. All authors read and approved the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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