PennState
College of Agricultural Sciences

PROPOSAL TRANSMITTAL

Date: 12/15/2017 **PSU Ref. No: 199259**

Title: Utilization of insecticide treated nets as an alternative method to monitor and manage brown marmorated stink bug

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Proposed Project Period: 04/01/2018 - 03/31/2019 **Total Project Request:** $23,167

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TITLE: Utilization of insecticide treated nets as an alternative method to monitor and manage brown marmorated stink bug.

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PROJECT DURATION: Two Years.
Year 1 Funding Request

JUSTIFICATION: The current recommendations to manage brown marmorated stink bug (BMSB) *Halyomorpha halys* (Stäl) (Hemiptera - Pentatomidae) continue to rely mostly on the judicious use of insecticide applications. Although, due to continuous improvement in our understanding of BMSB biology and behavior, we are a long way from the initial recommendations of multiple, the calendar based applications, broad spectrum insecticides still remain the most reliable and economical tool to control BMSB. Utilization of BMSB monitoring traps to better understand the movement of the bugs into orchards and the relative abundance of the pest helped in the decision process "if and when" the treatments are really needed.

Biological control of BMSB in its native range in Asia is very effective and basically eliminates the need for the use of any insecticides against this particular species of stink bug. Our multi-year attempts to evaluate the complex of beneficial insects potentially able to influence the BMSB population around orchards resulted in at best mixed results. Generalist predators such as spiders, praying mantis, lacewings, assassin bugs, damsel bugs or even lady bugs are fully capable to feed on various BMSB instars, however, by their nature, their real practical impact is very limited and they are not able to keep the BMSB population in orchards below levels that required chemical intervention. The generally more effective group, native parasitoid wasps usually feeding on eggs, which are quite reliable in keeping the population of native stink bugs in check, are mostly not interested in feeding on BMSB eggs. The orchards observations by Hillary Peterson, my graduate student identified some native parasitic wasps such as species from genera *Anastatus* spp., *Telenomus* spp., and *Trissolcus* spp. attempting to attack BMSB eggs, but their success ratio in parasitizing BMSB eggs is very low. The recent discovery of samurai wasp, *Trissolcus japonicus* (Ashmead), a BMSB specific parasitoid in one of Pennsylvania orchards provides a much better chance for successful biological control of this pest.

During last few seasons our research activities concentrated mostly on the development and validation of effective BMSB monitoring systems and effective management strategies. Although broad spectrum insecticides are still the basis for an effective BMSB management program, utilization of BMSB monitoring practices and use for the treatment threshold the

presence of BMSB nymphs allowed us to significantly reduce the number of insecticide applications targeting BMSB. Also, the utilization of "ghost traps "and Attract and Kill (A&K) strategy proved very promising in reducing the reliance on pesticides to reduce fruit injury caused by BMSB. During the 2016 and 2017 seasons we started to evaluate the new ZeroFly® nets (Vestergaard, Lausanne, Switzerland) baited with regular BMSB attractants as a potential tool for use in the A&K program. Insecticide treated nets placed between the orchard and the source of invading BMSB (e.g., woods) were very effective in capturing adults and nymphs BMSB.

With the expected US EPA registration of the insecticide treated nets more detailed studies are necessary to provide practical recommendation for their use in the field. During the 2017 season the nets were placed in mid-July around five commercial apple orchards. Each net was placed on 8 ft tall shepherd hook and baited with multiple BMSB lures. To monitor the number of potentially affected bugs, some nets had 6 ft diameter plastic tarp placed under the trap. Although the BMSB capture results were variable in various orchards, under heavy BMSB pressure situation in surrounding vegetation, some traps were able to collect hundreds of BMSB adults and nymphs per trap/week. With an expected usually strong movement of adults and nymphs toward the orchards, the intercepted bugs never made it to the orchard. Late summer and fall nymphal and adult feeding is especially intensive as the BMSB individuals are preparing for the diapause and tend to accumulate resources to survive the winter. Disrupting the BMSB adult seasonal waddling behavior combined with utilization of the most effective insecticides can hopefully significantly reduce the reliance of repeatable insecticide applications.

The most effective insecticides against BMSB such as pyrethroids, carbamates and neonicotinoids are also detrimental to beneficial insects present in orchards. The recent shift back toward utilizing mating disruption and effective selective soft insecticides such as Altacor ®, Delegate®, or Cyd-X®, which are not effective against BMSB, if combined with the insecticide treated nets could potentially allow for an orchard system which will be much more friendly toward beneficial organisms such as parasitic wasps or predatory mites. The improvements in BMSB monitoring tools and alternative management strategies should provide better options for re-establishment and strengthening of integrated pest management strategies in Pennsylvania orchards.

During this project we plan to evaluate and validate the options for the practical use of insecticide treated nets for the monitoring and potential control of brown marmoarted stink bug. With insecticides still representing the most effective BMSB management option, the research emphasis will be placed on understanding the most effective and economical ways to incorporate insecticide treated nets into practical management strategies. Re-introduction of CM/OFM effective management practices (i.e., mating disruption) combined with alternative BMSB treatments should also reduce the outbreaks of secondary pests. The ultimate rational and cost effective management of BMSB needs to be fully interwoven within other established effective IPM practices.

OBJECTIVES:

1. Evaluate the practical field effectiveness of insecticide treated net "ghost traps" as an alternative to the spray based BMSB monitoring/management options within the whole-orchard pest management program.

2. Evaluate the most effective, practical and cost effective options for utilizing nets in BMSB monitoring and management practices.

3. Evaluate the impact of alternate BMSB management program on IPM related balance and its effect on management of traditional fruit pests including secondary pests.

4. Educate the grower community on results and possible constrains of using this alternative BMSB management option.

WORK STATEMENT:

1. *Evaluate the practical field effectiveness of "ghost traps' ...*- the "ghost traps" strategy including ZeroFly nets be evaluated in commercial orchards settings. The "ghost traps" will be placed outside of the orchard, close to potential sources of BMSB influx with the goal to not only to arrest the movement of BMSB toward orchard but also to attract BMSB from the orchard. The "mark and recapture" experiment will be conducted around the "ghost traps" to precisely evaluate the attractiveness and arrestment ability of ghost traps toward BMSB. Standard BMSB monitoring traps deployed inside the evaluated blocks as well as visual timed observations will be conducted to monitor the resident BMSB population present in orchard. Fruit injury levels will also be assessed periodically on the same trees as used for visual BMSB counts.

2. *Evaluate the most effective, practical and cost effective options for ...* The preliminary study with insecticide treated nets conducted during the 2017 season utilized predetermined number of lures used per net as well as set distance between nets. During the 2018 we will evaluate and compare the attractiveness of various numbers of lures (e.g., 1, 3, 5 per ghost trap) and the importance of the distance between traps. Additionally, we will evaluate the most optimal placement of the ghost traps in relation to orchard border and the border of potential source of stink bugs (e.g., woods). Another aspect of this objective will include the evaluation of usefulness of deer fences already present in some orchards.

3. *Evaluate the impact of alternate BMSB management program on IPM related balance ...*- Comprehensive seasonal IPM based BMSB pest management programs based on *in-situ* pest monitoring and economic thresholds (when available) will be established and evaluated for their efficacy in controlling BMSB. Additionally, where possible, mating disruption against CM/OFM complex will be incorporated into the system. For validation and comparison of results, pest management programs with standard insecticide applications directed against BMSB will be used as a control. Fruit evaluations conducted at monthly intervals and timed visual monitoring of BMSB presence in the

orchard will be used to evaluate the field efficacy of various BMSB management programs.

4. *Educate the grower community...* - All information resulting from this research project will be disseminated to the general grower community using Cooperative Extension educational program methods such as newsletter articles, web-based information resources, summer field days, and winter grower meetings. The results of the on-going programs will be presented to all fruit growers and industry personnel through winter educational meetings.

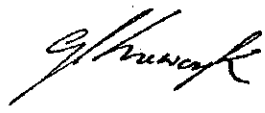
BUDGET – Year 1:

Hourly wages (field data collections, insect colonies maintenance, etc. …)	*$ 18,000*
Fringe benefit (@ 7.9%	*$ 1,423*
Travel (3 months fleet operation vehicle lease @ $748/month)	*$ 2,244*
Supplies (Trapping supplies, insect colonies, greenhouse fees at FREC, etc.)	*$ 1,500*
TOTAL for the 1st year of the project:	**$ 23,167**

DURATION OF PROJECT: **2018 - 2020**

Year 1: April 1, 2018 – March 31, 2019 $23,167

SUBMITTED BY:



Greg Krawczyk, Ph.D.
Principal Investigator

Other support: Researcher salary and some clerical support are provided by The Pennsylvania State University College of Agricultural Sciences.