

1. Title -- Research and Development Efforts in integrated Root grub Management in Arecanut in Hill and Coastal Zones of Karnataka

2. Category- Agriculture, Horticulture, Integrated pest management

3. Challenge

White grubs or root grubs (Coleoptera: Scarabaeidae: Melolonthinae) are important pests of palms, mainly areca nut and coconut in Western Ghat region of India. Three important species that infests roots of these crops are *Leucopholis lepidophora*, *Leucopholis burmeisteri* and *Leucopholis coneophora*. Among these three, *L. lepidophora* is considered as a major species distributed throughout the high rainfall regions of India. Feeding by these root grubs damage the roots resulting in symptoms of yellowing of leaves, stem tapering and nut fall, ultimately leading to reduced vigor and yield. Grubs show a particular preference for feeding on tender roots. The roots are fed on from the tip or cut across at various points. When population densities increase, the entire base of the bole is denuded. Affected palms loose anchorage and topple when disturbed. A few grubs (6–8) are enough to kill trees. Kalleshwaraswamy et al. (2015) reported 27.86–36.97% damage of this species with a yield reduction of 39.79–41.60% in different districts of hilly regions of Karnataka. Their cryptic life cycle and a much-to-be-understood biology limit the range of management options. Several strategies have been advocated. These include larval collection by digging the soil, soil application of biocontrol agents and insecticides and adult collection during their emergence. Insecticidal application viz., chlorpyrifos, imidacloprid and phorate to the soil targeting grubs is a widely followed method that provides considerable control. However, absolutely there is no information regarding timing of application which effectively reduced the population of white grubs.

However, insecticide use on white grub management must be reconsidered in light of the fact that, the Western Ghat region is one of the biodiversity hot spots. Keeping in view the effect of chemicals on soil biodiversity, there is a need to identify eco-friendly techniques, which provides satisfactory control of white grubs. Hence, there is a need to understand the biology and ecology aspect of these insects. Our survey also indicated that 80-90% of the areca growers have no idea about its life cycle of arecanut whitegrubs which is crucial for pest management (See

Tables 1 & 2). The benefit accrued from learning this will have both economical and ecological impact in this region.

Hence the research was carried out in RKVY project which brings out some valid information which can be given as information to farmers for successful management of white grubs.

So the major challenges were

- i. Insecticidal use for early management of white grubs
- ii. Understanding their insect ecology and behavior for their management with the aim of educating the farmers regarding arecanut whitegrub ecology

Table 1. Farmer's Knowledge on the Life cycle of Root grubs in different taluks

Taluk	Level of knowledge (Percentage farmers) *
Sringeri	88
Hosanagara	32
Sagara	42
Theerthahalli	45
Soraba	29
Shimoga	26
Kundapura	52
Udupi	57

Table 2. Farmer's Knowledge on the IPM of Root grubs in different taluks

Taluk	Level of knowledge (Percentage farmers) *
Sringeri	73
Hosanagara	42
Sagara	45
Theerthahalli	55
Soraba	33
Shimoga	13
Kundapura	65
Udupi	71

- ❖ There was poor level of knowledge on the life cycle of the insect in all the taluks except Sringeri
- ❖ There was poor level of knowledge on IPM of insect in all the taluks except Sringeri, Kundapura and Udupi

The data from above 2 tables indicated that the need of extension activities* with respect to life cycle and IPM of Arecanut whitegrubs.

4. Initiative

Under the RKVY project, in the year 2012-13 and 2013-14, number of training programme conducted to sensitize the farmers in the areca growing areas w.r.t. to biology and management. Farmers were trained in detection of infestation, method of insecticidal spray, flooding and utilize the females for attraction of male beetles during night time. An indigenous trap was developed to attract and kill the male beetles which reduce the population over time.

Experiments were conducted in farmers fields so that the dissemination of technology is easier. Field study was carried out in two areca gardens of 15 and 18 year old planted at a spacing of 8ft X 8ft. Insecticidal application was made two times. First application was taken up during August-2013 (Spraying throughout the field per hectare basis) and second treatment (drenching the insecticide around the root zone per tree basis) was done during November-2013. The experiment was initiated with eight treatments by adopting randomized block design (RBD), with three replications. Each treatment consist 45 palms in which 15 palms were selected for sampling root grubs. In the first application, recommended quantity of insecticide solution was sprayed on the soil per hectare basis (Volume of the spray solution used was 2250 liters per ha) by using power sprayer except the phorate 10 G, where in, chemical was broadcasted by mixing with sand at 1:10 ratio. During the second spray, aqueous solution of chlorpyriphos 20 EC, emamectin benzoate 5% SG, imidacloprid 17.8 SL, fipronil 5 SC and chlorantraniliprole 18.5% SC were drenched around the palm. The recommended dosage was applied per palm basis *i.e.*, 3 liter insecticidal solution around 1feet distance from the base of palm through hole made by a crowbar. Granular insecticide *i.e.*, phorate 10 G (25 g per palm) was applied in a small pit made around the palm and then covered with soil. After first application, the observations were recorded by digging the soil in between the palms in an area of 0.5 X 0.5 m and at base of the tree (around the palm by digging the palm to a depth of 60cm, 30cm away from the base) in randomly selected 15 palms per treatment. Larval counts were taken in between and around the palm before and 60 days after treatment. Second application *i.e.*, drenching of insecticides around the palm targeting root zone was taken at 60 days after first treatment. Observation after second spray was recorded by digging the soil at the base of the tree (around the palm 30cm away from the palm to a depth of 60cm and width of 30 cm) at 105 days after first treatment

imposition (*i.e.*, 45 days after second treatment). The data were subjected to square root transformation and means were compared using critical difference (CD $p=0.05$). Mean data of both the location was pooled and analyzed to further strengthen the results.

* An animated movie was developed under RKVY project which was being used regularly for disseminating information with respect to biology and management of White grubs.



Figure 1

5. Key result/insight/interesting fact

Among the different newer chemicals tested, chlorantraniliprole 18.5% SC 658ml/ha was found to be effective in reducing the early instar root grub population at both the locations. After the 105 days of treatment imposition in both the locations imidacloprid 17.8 SL @ 1 l/ha and fipronil 5 SC @ 2.5 l/ha followed by chloropyriphos 20 EC @10 l/ha and chlorantraniliprole 18.5% SC @ 658ml/ha gave good reduction over the untreated check. That means, these insecticides are effective for later instars also. In our study, up to 80% reduction over control

was observed mainly due to different methodology/spray schedule adopted for imposition of treatments.

Another interesting result obtained from the **RKVY** project was that the identification of female produced semiochemical that attracts males. Our findings provided new insights for incorporating adult collection using female-baited traps in IPM against areca nut white grubs.

Farmer 1. Gurunatha, Bilave, Thirthahalli taluk, Shivamogga

In his Arecanut field, about 50% incidence was recorded during 2013. We guided him to follow new strategies which we developed in RKVY project. Our studies indicated that early instar grubs are distributed throughout the garden (both in between the palms and around the palms) during July to October (rainy season) and later instars are restricted to root zone (only around the palm) from November onwards (when moisture content in the soil gets reduced). With this basic idea of spatial distribution of grubs, we are suggesting farmers to follow two time application of insecticides once during July- August and another during November- December. The farmer followed our techniques and he sprayed insecticide imidacloprid 17.8SL @ 1l/ha to the entire garden during August followed by application of insecticide only to the root zone during December after filling drainages with water and flooding for 8 days (see photo). This successfully reduced the white grubs damage. This method of two time application and flooding was developed under the RKVY project and successfully employed by the farmers. The farmer is trying to convince other farmers and the technology is spreading faster now. The technology is under farm trial now and will be given as a package from the university as a package for this dreaded pest of Areca nut.

2. Deepak, Gulukoppa, Hosanagara taluk, Shivamogga

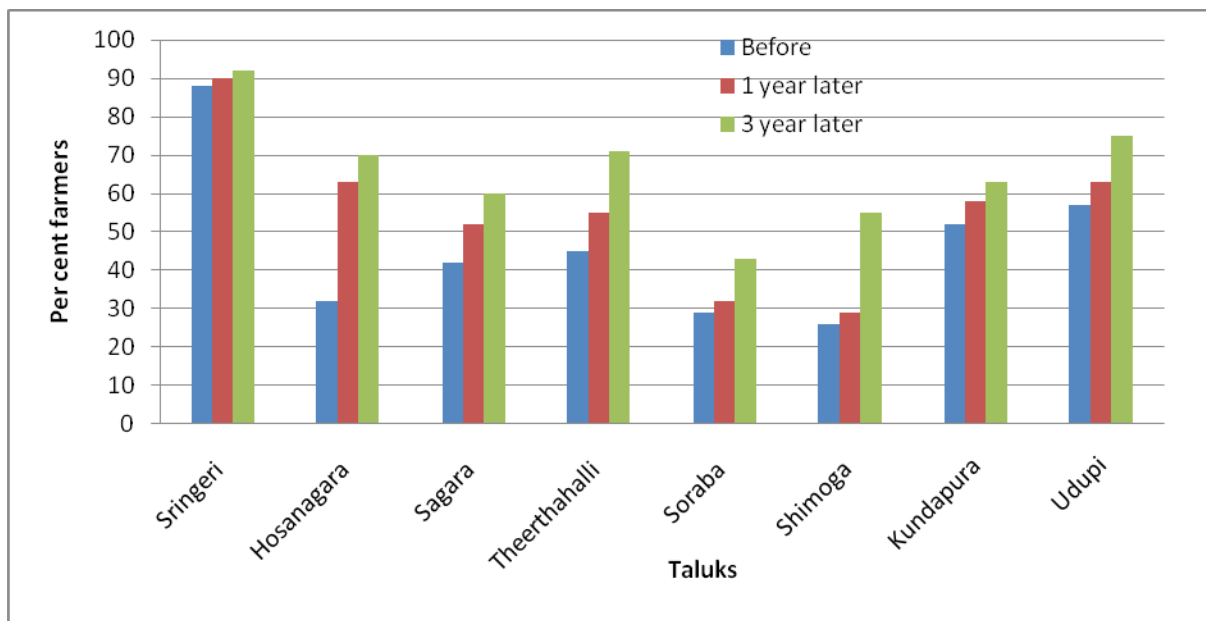
Under the RKVY project number of training programme conducted to sensitize the farmers to collect the beetles during night time. Existence of female produced sex pheromone was first time was demonstrated and was successfully employed for large scale mass trapping of male beetles. Female baited traps were used to capture the male beetles in his field and the farmer Deepak, successfully using this technique for mass trapping adult beetles which emerges only between July and September. He able to capture 600 and 1843 beetles during 2013 and

2014 respectively. With experience during 2015 and 2016, he collected over 3000 beetles. The incidence is almost reduced to 10% in his field by 2016.

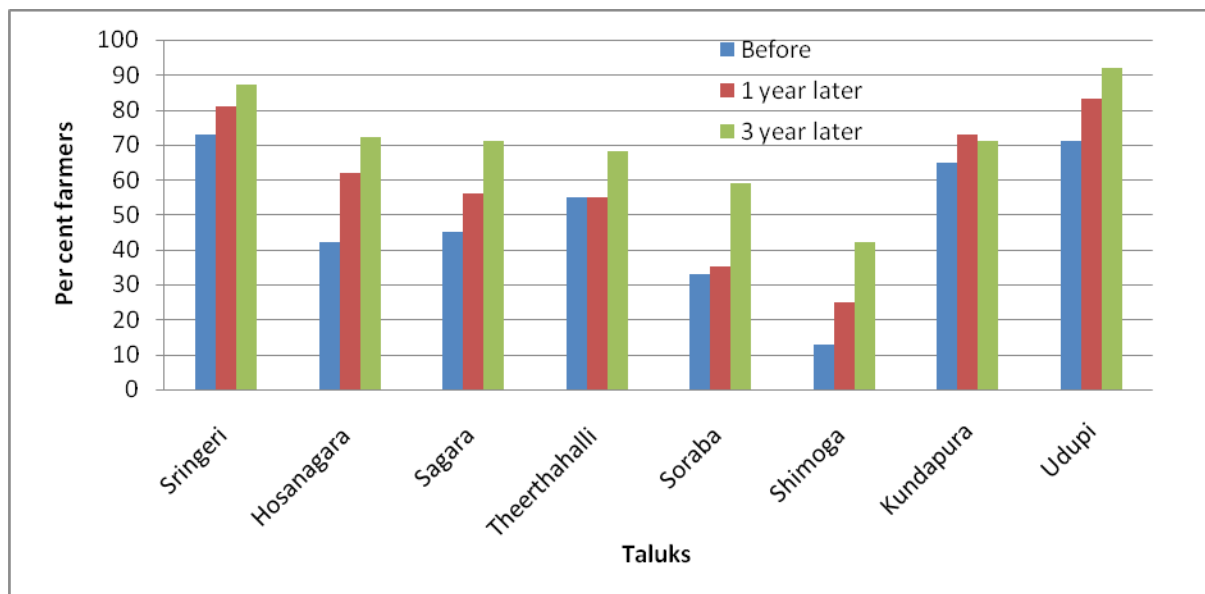
6. Impact :

Now farmers are being trained with respect to timing of insecticidal application, identification of females, trap setting and adult collection in their fields and is being practiced by hundreds of farmers. There was increase in the knowledge among farmers with respect to white grub biology and also their understanding about the importance of Integrated pest management (Graph 1 and 2). Our survey also indicated 60-75% higher reduction of white grubs compared to farmers who took single application of insecticides. The yield are gradually increasing as the farmers as to repeat the insecticidal application for 3-4 years to completely eliminate the population from their fields. The farmers are delightful and thanking university for this innovation.

From a practical perspective, the females of *L. lepidophora* could be used as a source of attraction for males in IPM. Now Deepak is suggesting other farmers for this effective technique which actually led to reduction in white grub incidence in his field. About 3000 leaflets were published and distributed to farmers.



Graph 1. Farmer’s Knowledge on the Life cycle of Root grubs in different taluks before the start and at the end of the project



Graph 2. Farmer’s Knowledge on the IPM of Root grubs in different taluks before the start and at the end of the project

7. Lessons learned:

1. What did you learn in this process? What was difficult or challenging?

The understanding of biology and ecology of insects is must for designing management strategies for these white grubs. The challenge was to train the farmers who were reluctant to collect the beetles during night time as they come out of soil only during night time.

2. How did you overcome the challenges faced?

As the ambassador farmers were able to understand the effectiveness, the challenge of training individual farmer was not a problem.

8. Supporting Quotes and Images

1. Insecticidal management of White grubs



Filling drainages with water and flooding



Drenching of imidacloprid around the palm

Spraying of imidacloprid throughout the garden



2. Collection of adult beetles



Large scale collection of male beetles using female baited trap

Additional information

Journal articles

1. https://www.researchgate.net/publication/284130895_Adult_emergence_pattern_and_utilization_of_females_as_attractants_for_trapping_males_of_whitegrubs_Leucopholis_lepidophora_Coleoptera_Scarabaeidae_infesting_Arecanut_in_India
2. www.aapmhe.in/index.php/pmhe/article/download/295/276
3. www.currentbiotica.com/CB/Journals8-Issue-IV/CB-8-4-Short-notes-4.pdf
4. <https://www.cabdirect.org/cabdirect/abstract/20153371331>

Name and Address of farmers

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2. Mr. Deepak

Gulukoppa, Humcha

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Checklist No.	Question to consider	Yes	No
1	Is the story interesting to the target audience of the project/activity report?	Yes	
2	Does the story explain what new insights the project brings? What is the main lesson learned from this story? Does the story describe a key insight on what works and what doesn't and something that future project could build on	Yes	
3	Does the story describe the outcomes the project produced and the people who are benefitting? What changes—in skills, knowledge, attitude, practice, or policy—has the project brought, and who is benefitting from these changes?	Yes	
4	Does the story make a compelling point that people will remember? Does the story show how the project makes a difference to improving livelihoods and lessening poverty?	Yes	
5	Does the story provide an interesting fact that people will remember? For example, how much yields increased, how many hectares of land could become more productive from this innovation or technology?	Yes	
6	Does the story explain what kind of impact this innovation or technology could have if scaled up?	Yes	
7	Does the story show which partners contributed and how?	Yes	
8	Does the story include quotes from Stakeholders or beneficiaries?		no
9	Have I provided links to other media (journal articles, website news, newsletter, blogs, annual reports of other Programme/ project) that also feature this story?	Yes	
10	Have I provided the contact details of people who can provide more information?	Yes	