Red Palm Weevil

Coconut Trees in Kerala under attack of Red Palm Weevil

Prevention and Control

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Integrated Pest Management Programmes

Integrated pest management forÂ Red Palm Weevil has been developed and tested in coconut palms in India (Kurian et al., 1976; Sathiamma et al., 1982, Abraham et al., 1989). Included in the IPM programme were cultural measures such as plant and field sanitation; physical methods by preventing entry of weevils through cut ends of petioles and wounds; and use of attractants and other chemicals (including filling of leaf axils with gamma BHC and sand as a preventive measure). Abraham et al. (1989) found the IPM approach very effective in reducing the number of infested palms in Kerala, India.

Abraham et al. (1998) suggested that the major components of the IPM strategy forÂ Red Palm Weevil are surveillance, trapping the weevil using pheromones lures, detecting infestation by examination of palms, eliminating hidden breeding sites, clearing abandoned gardens, maintaining crop and field sanitation, using preventive chemical treatments, curative chemical control, implementing quarantine measures, training and education. In the Al Qatif region of Saudi Arabia, Vidyasagar et al. (2000a) successfully developed an IPM programme which, in addition to mass pheromone trapping, included a survey of all the cultivated gardens, systematic checking of all palms for infestation, periodic soaking of palms, and mass removal of neglected farms. A review of control strategies and IPM for the weevil were also presented by various other authors (Ramachandran, 1998; Nair et al., 1998; Murphy and Brisco, 1999). Faleiro (2006) has reviewed the issues and management of R. ferrugineus in coconut and date palm over the past 100 years.

Cultural and Sanitary Methods

These include prompt destruction of infested plant material (Kurian and Mathen, 1971) and prophylactic treatment of cut wounds (Pillai, 1987). Abraham (1971) suggested that leaves be cut at or beyond the region where leaflets emerge at the base to prevent entry by the weevil into the stem. Azam and Razvi (2001) found that deep cutting to completely remove the growing point of off-shoots (unwanted growths from the trunk), then treating the cut surface with an insecticide such as formothion or dimethoate and covering it with mud reduced the level of infestation to less than 4% compared to 20% for an untreated control (cut at the trunk surface).

Biological Control

Parasitoids and predators

There is not much information on the advocation of the classical approach for the use of biological control agents against Red Palm Weevil. However, Reginald (1973) reported a fortuitous occurrence when Platymerus laevicollis was imported into Sri Lanka from Western Samoa as a possible predator on Oryctes rhinoceros and was found to prefer Red Palm Weevil. There have also been studies to evaluate the potential of predators and parasites; Abraham and Kurian (1973) reported that Chelisoches morio nymphs consumed 5.3 weevil eggs and 4.2 weevil larvae per day whereas C. morio adults consumed 8.5 weevil eggs and 6.7 weevil larvae per day. In addition, they provided some information on the biology of this predator in the laboratory and field.

Entomopathogenic nematodes

Abbas and Hononik (1999) found that Steinernema riobrave, S. carpocapsae and Heterorhabditis sp. were pathogenic to both larval and adult stages of R. ferrugineus in the laboratory. They also reported that propagation of the nematodes was possible in the adult but rare in the larvae. Laboratory studies conducted by Banu et al. (1998) showed that the larva ofÂ Red Palm Weevil was host to the naturally-occurring entomopathogenic nematode Heterorhabditis indicus in Kerala, India. Salama and Abd-Elgawad (2001) baited using the greater wax moth larvae and obtained five strains of heterorhabditid nematodes, which were more virulent on R. ferrugineus than the other entomophilic nematode species in culture. However, only two of the strains survived a 24-h exposure period in palm-infested tree tissue. Hanounik (1998) reported that the application of genetically enhanced strains of Steinernema and Heterorhabditis to the larvae of R. ferrugineus resulted in 95-100% mortality in the laboratory and 50% mortality in the field. El Bishry et al. (2000) studied the impact of date palm tissues infested withÂ Red Palm Weevil on five entomopathogenic nematode strains in the laboratory. Results showed that juveniles of all strains were killed within 24 h when placed on infested tissues. The washings of these tissues also had a detrimental effect on the nematodes. The dispersal and host finding ability of three of the strains was negatively affected in palm tissues after washing and sterilization. For further information on the use of entomopathogenic nematodes against R. ferrugineus, see Monzer and Al-Elimi (2002), Saleh and Alheji (2003), Saleh et al. (2004), LlÃ¡cer et al. (2009), Dembilio et al. (2010, 2011), Jacas et al. (2011), Tapia et al. (2011) and Triggiani and Tarasco (2011).

Other entomopathogens

Dangar (1997) studied the potency of a free-living unidentified yeast isolated from the haemolymph ofÂ Red Palm Weevil as a biocontrol agent. The LD50 and LT50 values for larvae were calculated to be 8,000,000 yeasts/insect and 4 days, respectively.

Other Control Measures

Botanical pesticides

Laboratory tests in India showed that the oil derivative from garlic and its synthetic form diallyl disulphide were toxic to the weevil (Murthy and Amonkar, 1974).

Pheromones and other behavioural chemicals

Pheromones are increasingly being used as a management tool against R. ferrugineus. Detailed protocols for pheromone-based mass trapping of the weevil are provided by Hallett et al. (1999). Faleiro et al. (1999) evaluated pheromone lures for the weevil in date plantations in Saudi Arabia and found that high release lures (Ferrolure and Ferrolure+) obtained from Chem Tica Natural, Costa Rica, attracted twice as many weevils as low release formulations. These pheromone lures were equally effective in attracting the pest and were on a par with Agrisense lures from the UK. Vidyasagar et al. (2000b) measured the impact of using a pheromone-based mass trapping system as a component of IPM of the weevil in Saudi Arabia using aggregation pheromone, ferrugineol, 4-methyl-5-nonanol (Ferrolure) and/or 4-methyl-5-nonanol + 4-methyl-5-nonanone (9:1) (Ferrolure+). Adult weevil populations were reduced from 4.12 weevils per trap per week in 1994 to 2.02 weevils per trap per week in 1997 when this system was used and there was a significant reduction in the level of infestation of date palms by the weevil during this period. In terms of population dynamics, peak adult populations were trapped immediately after the winter season during April and May and a smaller peak was observed during October and November just before the onset of winter. There was a drop in captures of weevils at the onset of winter. El Garhy (1996) reported thresholds temperatures for weevil activity in the range of 12-14Â°C, with more adults captured in summer than in winter and twice as many females captured as males, irrespective of season. Faleiro et al. (1999) compared Ferrolure and Ferrolure+ and reported that the longevity of the lures was lower in summer than in winter. The longevity of both was greater under shade and when traps were exposed to sunlight; Ferrolure+ lasted longer than Ferrolure. Gunawardena et al. (1998) identified host attractants for the weevil from freshly cut coconut bark and found that a 1:1 mixture of gamma nonanoic lactone 1 and 4-hydroxy-3- methoxystyrene 2 were responsible. Perez et al. (1996) reported that there were no apparent differences between the pheromones of R. ferrugineus and R. vulneratus.

Sterile Backcrosses /Sterile Insect Technique /Chemosterilization

Ramachandran (1991) reported the effects of gamma radiation on R. ferrugineus whereby production of viable eggs decreased with increasing radiation dose, although there was no apparent effect on the F2 generation. Rahalker et al. (1973) reported that treatment of 1-2-day-old males of the weevil at a dose of 1.5 krad (15 Gy) resulted in 90% sterility with no adverse effect on survival. Treatment of higher doses increased sterility but reduced survival. A ratio of ten treated males to one normal one was needed for appreciable suppression of progeny production. Using chemosterilants Rahalkar et al. (1975) reported that treatment of male weevils with metepa or hempa did not result in a satisfactory level of sterility without adversely affecting their survival. However, metepa was more toxic than hempa.

Chemical Control

As damage symptoms byÂ Red Palm Weevil are difficult to detect during the early stages of infestations, emphasis is placed generally on preventive aspects. However, this is not always possible. The common and practical curative measure is through the use of insecticides. The use of the latter tends to be the major mode of control advocated as seen from the survey of literature. Preventive and curative measures include: trunk injection with systemic insecticides carried out during the early stages of infestations (Rao et al., 1973; Anon., 1976), recently, trunk injection using pirimiphos ethyl also gave good control (El Ezaby, 1997); treatment of wounds with repellents and filling leaf axils with insecticide dusts such as BHC mixed with sand (Mathen and Kurian, 1966; Abraham, 1971); and drenching of the crown of infested trees with insecticides (Kurian and Mathen, 1971). Barranco et al. (1998) recorded the percentage mortality of R. ferrugineus larvae treated with different rates of fipronil and azadirachtin (neem). Hernandez-Marante et al. (2003) reported highest mortality of R. ferrugineus with a combination of trunk injections and sprays with the same insecticide, with carbaryl, fipronil, and imidacloprid providing highest efficacy against the pest.