PLANT PROTECTION DIRECTORATE

Good Agricultural Practice (GAP) for Fig Tree Cultivation

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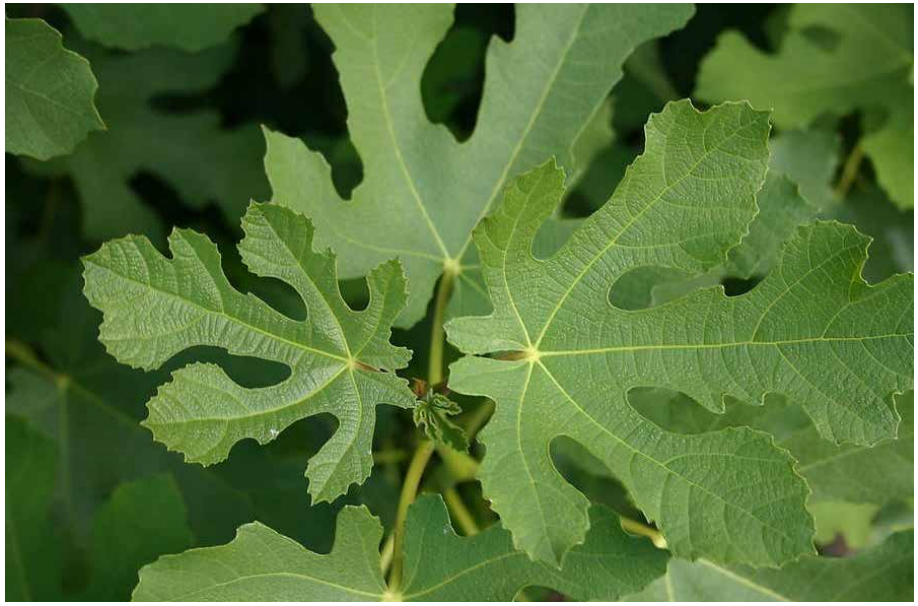
1. Introduction to Fig trees

The fig tree, *Ficus carica,* originated in the Middle East and has been under cultivation for at least 11,000 years since the Neolithic period. It has well adapted to the Mediterranean conditions and grows well on the Maltese Islands. More than thirty different varieties of fig trees used to be cultivated in Malta but this number has now decreased. The fig tree produces early fruit maturing around mid-June known as “bajtar ta’ San Ġwann”, which are plump and tender. Late figs known as “tin” are produced from the same tree but mature some six weeks when the tree stops producing early figs.



1.1 Fig tree varieties of the Maltese Islands

Thirty-two fig tree varieties are officially recognised in Malta (Borg, 1922). The most common varieties are described below.

Caprifig (Dukkaru): These originate from seedlings of white or light-coloured edible varieties which produce inedible fruit. These caprifigs are important for the proper development of the pollinating wasp, *Blastophaga psenes*. In Malta we find two colour forms, the **White Caprifig (Dukkar abjad)** and the **Red Caprifig (Dukkar aħmar).** The white caprifig is much more common, having whitish green fruit, whereas the red ones have smaller fruit of a rusty greenish red colouration.

Black Bourgeassotte (Parsott iswed) and **White Bourgeassotte (Parsott abjad):** A vigorous tree with imperfectly lobed leaves having a very productive crop. The fruit are broad, top-shaped or flattened with a short stalk. The fruit of the black variety are dark violet in colour and almost black at maturity, whereas the ones of the white variety are whitish or yellowish green at maturity.

Long Violet Fig (Farkizzan): A fast growing tree attaining a large size with well lobed foliage. The fruit is oblong in shape and large with vertical or longitudinal fissures. The pulp is soft and watery.

Long Black Fig (Bżengul iswed): A fast growing tree attaining a relatively large size, with less deeply lobed and more rounded foliage than the long violet fig. Two crops are produced, one maturing in June and consisting of a few large figs, whereas in later weeks a fairly abundant main crop which is smaller in size is produced. The early figs are long, dark violet or almost black in colour with a long slender stalk and a dark red flesh. The main crop is smaller in size, very long and swollen at the stalk-end.

St. John's Fig (Tin tal-bajtar, Tin ta' San Ġwann): A vigorous tree attaining a large size with broad and well-lobed leaves. It is the most common type of fig tree on the Maltese Islands. Two crops are produced: an early crop (Bajtar ta' San Ġwann), which is generally very abundant and matures in May and a later crop (tin), which is equally abundant. The early crop is very large in size, short-stalked, top-shaped, greenish brown without netting and does not require caprification. Its flesh is light pink, watery and of a very good flavour. The latter crop requires caprification and is characterised by very flattened fruit which is commonly used for drying.

Round Violet Fig (Tin iswed): A large and vigorous tree with a very good fruit productivity. A short-stalked fruit, almost round and of a reddish violet colour. Flesh is yellowish red, sugary and soft.

'Dikkiena' Fig (Tin tad-dikkiena): This varietal used to be cultivated mainly in Siġġiewi. The tree is similar to that of the Bourgeassotte, but the fruit is tan or rusty red in colour. The flesh is light red and very sugary.

Common White Fig (Tin abjad): A large sized tree, (but not vigorous) with small leaves often imperfectly lobed. Fruits are small but abundant, pear-shaped and with a very tender rind. Yellowish-pink pulp are firm in consistency and sugary. The fruit from this fig tree is mostly consumed fresh, but can also be used for drying.

1.2 *Hypocryphalus scabricollis* attack on fig trees

Fig trees host more than thirty insect pests and diseases of which some can be detrimental to the tree. One of the most important pest is a bark beetle, *Hypocryphalus scabricollis*. This bark beetle was recorded for the first time in Malta in 1991 (Mifsud & Knížek, 2009).

It was discovered over a hundred years ago in Burma, Asia where it is considered as a harmful organism. The beetle was first recorded in Malta on *F. retusa* (Mifsud & Knížek, 2009), but recently it has been mainly found on wild and cultivated fig trees, *F. carica* (Mifsud et al., 2012) resulting in tree death. This beetle has been destroying fig trees on the Maltese Islands for these last eight years and more than 50% of these trees have already been destroyed. It has recently also been recorded in Sicily on *F. carica* (Faccoli et al., 2016). This pest has not yet been regulated in Malta or the European Union.

2. Good Agricultural Practice

Trees are subjected to a variety of factors that reduce vigour and may eventually lead to population decline and death. Almost all of these factors are the result of human activity.

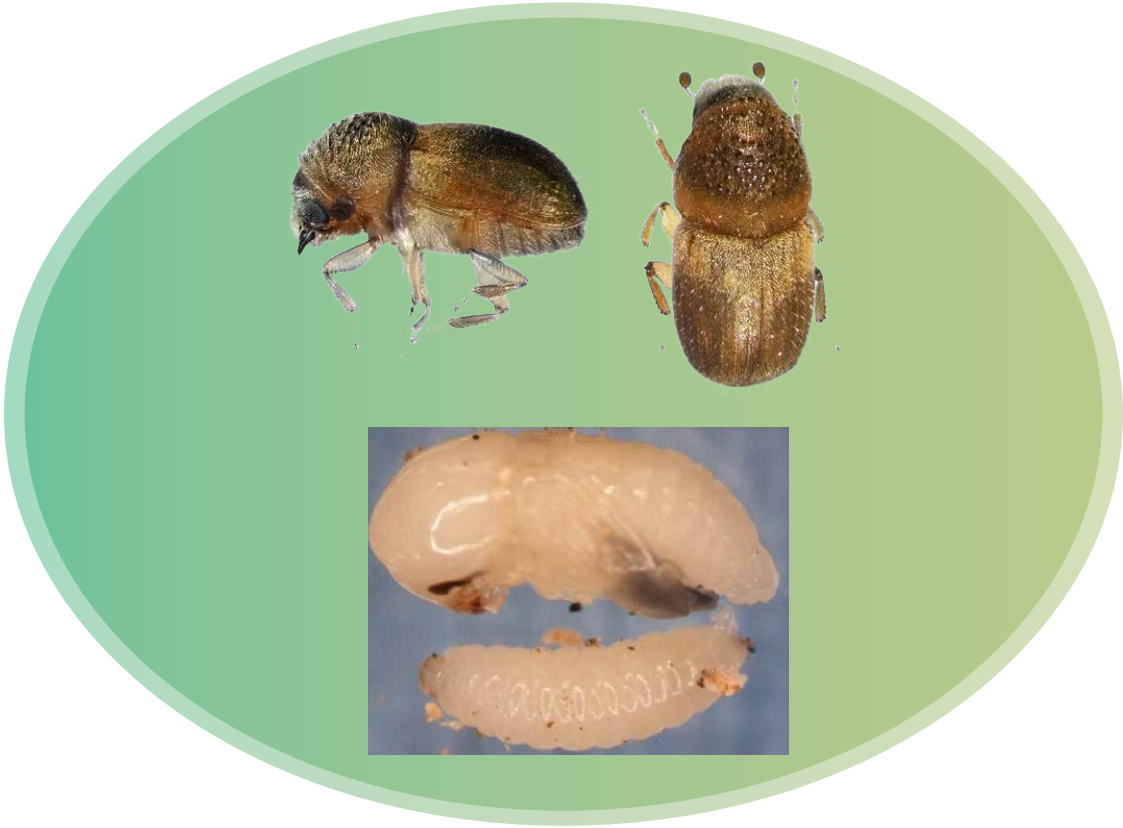
In the last years, Mediterranean regions have been invaded by a large number of alien wood-boring bark beetles (Family Scolytidae) (Kirkendall & Faccoli, 2010; Knížek, 2011; Rassati *et al.,* 2016). International trade of goods, commodities, wood packaging materials and live plants represent the most common pathways for introduction of these beetles (Liebhold *et al.,* 2012). In Malta, a total of twenty-one bark beetle species have been recorded (Mifsud & Knížek, 2009). Bark beetles can be pests of all natural and 'plantation' systems. They can cause limb or even tree death if present in high enough numbers. Bark beetles frequently attack trees weakened by drought, disease, injuries, nutritional deficiencies and sun scald.

2.1 Integrated Pest Management (IPM)

Ideally, farming techniques create an environment that is not conducive to pests or disease in the first place, and can keep pest populations in balance naturally. Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management. The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home and garden. It starts off with the proper identification of the pest species.

2.1.1 Identification of *H. scabricollis*

Proper identification of the main pest causing the damage, the bark beetle, *H. scabricollis,* is essential, especially since other similarly looking bark beetles might be present in the same tree at the same time. *H. scabricollis* adults are small, cylindrical, hard-bodied insects about the size of 2mm. *H. scabricollis* is dark brown/black. When viewed from above, the head is partly or completely hidden by the pronotum (the top of the body part behind the head). Larvae are off-white, robust, grublike, and may have a dark brown head.



2.1.2 Identifying Bark Beetles by their damage and signs

The location of damage on the tree can also help in identifying the bark beetle species.

It attacks from the mid-trunk and spreads up and down. The larvae feed on inner bark and complete their development in the outer bark. The beetle is usually not the only beetle found attacking the tree.

Galleries chewed by larvae are packed with frass (dry boring dust) which gets pushed out onto the bark surface from small holes of a diameter of less than 1mm (from which new adults emerge).

2.1.3 Life cycle

The beetle has at least two generations per year. Bark beetle females lay small, oval, whitish eggs just beneath the outer bark. After the eggs hatch, the tiny larvae mine galleries that branch out from the egg-laying gallery. Pupation occurs beneath the bark. Pupae are plump and whitish.

Adults can emerge at any time of year, if they are fully developed and the temperatures are high, but emergence is most common in late spring and again in late summer to early autumn. After emergence, adults may re-infest the same tree or, in most cases, disperse to attack other susceptible trees elsewhere.

2.1.4 Evidence of infestation – damage and signs

Trees should be checked for bark beetle infestation by physical inspections. Boring dust (frass) in the bark crevices and at the tree base is one of the first signs of bark beetle attack. Often, numerous small holes with a diameter of about 1 mm appear on the main trunk of infested trees.

Once a mass attack is established, the foliage begins to fade. The leaves change from green to a light straw colour within a few weeks to one year after attack and eventually become reddish-brown.

Trees that have been successfully colonised in a mass-attack cannot be saved from eventual death and need to be properly disposed of as mentioned in later sections.

Bark beetles mine the inner bark (the phloem-cambial region) on twigs, branches, or trunks of trees and shrubs. Frass accumulates in bark crevices or may fall down and be visible on the ground or in spider webs. Small emergence

holes in the bark are a good indication that bark beetles are present. However, the presence of one or two holes does not necessarily indicate that a beetle attack was successful. Removal of the bark with the emergence holes often reveals dead and degraded inner bark and sometimes new adult beetles that have not yet emerged.

3. Monitoring

Except for general cultural practices that improve tree vigour, little can be done to control most bark beetles once trees have been attacked. The bark beetle is a significant pest but can be controlled. The key control components are thinning the stand, supplemental watering and preventive application of a liquid insecticide before April.

3.1 Cultural control

It is important to learn the cultural requirements of trees, and provide proper care to keep them growing vigorously. Healthy trees are less likely to be attacked and are better able to survive attacks from a few bark beetles.

3.1.1 Prevention

This is the most effective method of managing bark beetles and related wood-boring insects. In most instances, it is the only available control. Injuries to roots and trunks, as well as damage and soil compaction during construction activities should be avoided. Trees should be protected from sunburn (sunscald) and other abiotic disorders. Dense stands of susceptible trees should be thinned (complete removal of some trees) to increase vigour and ability to withstand an attack of the remaining trees. Properly regulated irrigation is also important during dry summer months especially in drought years. Practices such as caprification, pruning, tillage, fertilisation, irrigation, and plant protection should be done in a timely manner.

3.1.2 Reducing tree stress

Particular attention should be given to old trees, crowded groups of trees and newly planted trees in the area. Stress placed on a tree caused by poor planting or planting at the wrong time of year, or lack of proper care will increase a tree's susceptibility to the bark beetle. Cultivation practices, both in the orchard and in the vicinity that might disperse the beetle, should be adhered to. Agricultural devices and equipment used should not damage fig trees or cause cross contamination with pests. Figs come from warm Mediterranean climates and in southern regions, and thus will thrive in a sunny and sheltered position with well-drained soil.

3.1.3 Tree selection

Where bark beetles have been a problem, planting non-host trees (trees not attacked by the beetle) may reduce the spread of the beetle since they might not find a new host. A mixture of tree and shrub species will reduce mortality resulting from bark beetles.

3.1.4 Irrigation

Good water management, including regular irrigation and mulching, helps maintain tree health and vigour. Most fig tree roots are close to the soil surface and can easily dry out. For these reasons, water should be given to the trees as drying develops. Slight leaf wilting in the afternoon is an indication of water stress. If that is observed, water more frequently during hot weather. Irrigation should be implemented during periods with high temperatures and/or inadequate rainfall during the growing season to minimise tree stress, however, irrigation water should be prevented from coming into contact with the figs and foliage. Mulching with straw or clippings helps maintain uniform soil moisture and reduces weed competition for available soil water. Do not over-water in areas of clay soil with poor drainage.

Irrigate when appropriate around the outer canopy, not near the trunk. Avoid the frequent, shallow type of watering. A general recommendation is to irrigate trees infrequently, such as twice a month during drought periods. However, a sufficient amount of water must be used so that the water penetrates deeply into the soil (about 1 foot below the surface). The specific amount and frequency of water needed varies greatly depending on the site and size of the tree.

3.1.5 Pruning

Fig trees must be pruned lightly and all the branches and other plant parts must be removed from the orchard and disposed of to avoid potential contamination by emerging bark beetles. Direct incorporation of any plant parts into the soil must be avoided. Healthy fig trees are productive with or without heavy pruning. This is essential only during the initial years. In subsequent growing seasons, pruning is only necessary to stimulate new growth or to control size. To stimulate new growth, one should thin out older trees which grow very little each year. Thinning also increases fruit size.

All weak, diseased or dead limbs should be removed each dormant season. Timing of pruning is important to avoid creating fresh pruning wounds during the adult beetles' flight season. Pruning should be carried out when the tree is dormant, between leaf fall and bud burst (usually between November and early March).

Heavily pruned fig trees can be susceptible to sunburn, so it is a good idea to whitewash trees after heavy summer pruning with interior white latex paint, diluted 50-50 with water or with 'kupru' or a Bordeaux mixture. In places with mild winters such as Malta, it is suggested that fig trees are trained to a single trunk, open vase-type tree.

Unseasoned, fresh cut wood should not be piled near woody landscape plants. Freshly cut wood and trees that are dying or have recently died provide an abundant breeding source for many wood-boring bark beetles. Wood should be tightly sealed beneath clear plastic 10mm thick and placed in a sunny location for several months to exclude beetle attacks and kill any beetles already infesting the wood. To be effective, solar/ plastic treatment requires vigilance and careful execution. It is important that wood piles are kept small, high-quality clear plastic resistant to UV (ultraviolet light) degradation is used, edges thoroughly sealed and holes are promptly patched to prevent beetles from escaping. Alternatively, the wood can also be burnt to kill any beetles.

3.1.6 Site requirements

Plentiful sunlight is a key factor to maximising fruit production. Figs require full sun all day to produce edible fruit. Fig trees will shade out anything growing beneath the canopy so nothing needs to be planted under the tree. Fig roots are abundant, traveling far beyond the tree canopy and will invade garden beds.

Early morning sun is particularly important to dry dew from the plants; thereby reducing the incidence of diseases. However, high temperatures and arid conditions in spring and summer can increase sunscald and result in early leaf fall if severe, causing substantial problems. Thus ideally, trees should be planted in warm spots and places where they can receive reflected light.

3.1.7 Soil requirements and irrigation

The plants can tolerate all types of soil conditions and fare better than most fruit trees in wet conditions as long as

the soil has good drainage. Ideally, the soil should be well-draining and should contain organic matter. Good drainage is a more important consideration than soil fertility. Soils and sites where water stands for more than 24 hours after rain should be avoided. In areas of poor drainage, roots receive insufficient oxygen and will die, resulting in stunted growth and eventual death of the tree. Fig trees can be grown in a wide range of soils such as sandy, clayey or loamy.

Soil Type: Know if your soil is sandy, loamy or clayey. If too much water is applied to a sandy soil, the water readily drains below plant roots and this is wasteful. Incorporate organic matter into sandy soils to increase the soil's water holding capacity. Also develop a sense of how much water needs to be applied to moisten the soil just to the ends of the roots.

Overwatering clay soils can result in saturated soils. Plants roots require oxygen and will not grow or function well in saturated soils, hence plants decline. Plants grown under these conditions can even wilt.

A soil depth of at least 1-2 meters accelerates the growing of fig trees which have fibrous and shallow roots. The optimum pH range for soil is 6.0-7.8. The chemical (such as pH) and physical properties of the orchard soil can influence the intake of plant nutrients and consequently resistance to stress conditions, thus soil properties should be fully evaluated before orchard establishment.

Ideally, the level of the underground water table must not be limiting. Availability of irrigation water is an asset to overcome drought stress.

3.1.8. Fertilising

Generally, fig trees do not require regular fertilising. The fig tree mostly requires potassium but does not need much nitrogen fertiliser, which tends to cause over-development of the vegetation and under-development of the fruit. In well-balanced soils one should use a fertiliser such as 4-8-12 (100g/150/m^2) or 10-20-25 (50/70g/m^2) which means (N-Nitrogen/P-Phosphorus/K-potassium such as 1-2-3 or 1-2-2.5). A general-purpose fertiliser with an analysis of 8-8-8 or 10-10-10 is also good to use. In poor soil, compost with pure potassium added in the form of potassium sulfate (20/25g/m^2) or 'patenkali' (a potash fertiliser) (30/35g/m^2) is preferred. Fertiliser should be added at the end of winter.

It is best to provide fertiliser for fig trees only when the tree shows symptoms of slow growth or pale leaves, but there are a couple of exceptions where fig trees need regular feedings. Regular fertilising of figs is usually necessary only for potted trees or when they are grown on sandy soils, due to nutrient leaching. Fig trees that are surrounded by other plants that compete for nutrients also require fertilisation to avoid improper ripening of fruit. Fig trees should be fertilised if the branches grow less than a foot from the previous year. Since timing is key, it is best to split the feeding over several months so the tree does not get too much nitrogen at one go. Trees which are one up to two years old should be fed 28g of fertiliser a month, beginning when the tree starts to grow new leaves and stopping before the end of July. Older trees should be fed 150g of fertiliser per 30cm of bush height three times a year in late winter, mid-spring and mid-summer. When fruits appear, they should be fed weekly with a high-potassium liquid plant food (such as tomato fertiliser).

Fertiliser applications must be based on soil and plant analysis and all recommendations must be made by an authorised body (Nitrates Action Programme Malta, 2011). Many studies have shown that natural fertilizers are the best for many trees and thus where possible, this practice is recommended.

Fertiliser should be spread under the branches of the tree rather than around the foot of the tree, over the tree's root zone and beyond the reach of the canopy. A space of at least 30cm between the base of the tree and the fertiliser should be left. Most of the feeder roots are around the tree's drip zone, so most of the fertiliser should be used in this area. Fertiliser should be watered slowly into the soil so that it does not wash away.

3.1.9 Ongoing care

The canopy of a fig tree protects the trunk from exposure to the sun and heat. Gardeners can protect exposed trunks with whitewash to avoid damage. Young trees need regular watering, about three times a week, especially during the first year. Mature trees need deep watering, about two to four times per month. Adding mulch to the soil around trees can help preserve moisture. Trees that lack moisture develop yellowed foliage, leaf drop and a decrease in fruit production. On the other hand, too much rain can cause fruit to split. Trees do not need much pruning unless gardeners want to limit the size of the tree. The best time for pruning is right after the late summer or autumn crop harvesting.

3.2 Biological control

When bark beetles attack trees, natural enemies are attracted to feeding and mating bark beetles. The two main groups of natural enemies are predators and parasites. Predators are more

important in regulating bark beetle populations than parasites. Natural enemies are unlikely to save an infested tree, but they can reduce bark beetle population size, thereby reducing the number of nearby trees that are attacked and killed by bark beetles. The release of predators and/or parasites into sites infested with bark beetles has not been an effective tactic to suppress bark beetle populations and no locally present predators or parasites have been found to attack *H. scabricollis* up till now.

3.3 Behavioural control

Bark beetles locate mates and attract or repel other individuals of the same species by emitting species-specific airborne chemicals called pheromones. Pheromones are naturally occurring chemicals that are widely used as baits to monitor bark beetles by attracting them to traps.

The interactions among host trees and beetles and their pheromones are complex and still poorly understood. Behavioural chemicals are currently recommended for use only by specially trained professionals familiar with bark beetle management, since the techniques to control bark beetles using pheromone-based management techniques, is not yet reliable on fig trees.

Locally, ethanol traps are recommended for detecting the presence of the adult beetles in the vicinity. The detection of adult beetles in the area serves as a warning sign for the grower to properly check the trees for signs of beetle infestation.

3.4 Chemical control

Unless trees are monitored regularly so that bark beetle attack can be detected early, any chemical spray application

made once the beetles have aggregated and penetrated the bark, is likely to be too late and ineffective. Treatment must target the adults by spraying the bark so that beetles are killed when they land on trees and attempt to bore into the bark to lay eggs. Chemically treating trees that have been previously attacked will provide no benefit and could kill beneficial insects. Seriously infested trees, or trees that are dead or dying due to previous beetle attacks, cannot be saved with insecticide treatments and should be removed. Systemic insecticides, meaning those that are implanted or injected through the bark or applied to soil beneath trees, have not been shown to prevent attack or control populations of bark beetles. Although new systemic products are being investigated, they are not currently recommended for bark beetle control.

3.4.1 Circumstances for effective use of insecticides

Highly valued, uninfested host trees may be protected by spraying their bark with a persistent, registered insecticide labelled as a preventive spray for bark beetles. Look for signs of recent infestation to help decide whether preventive spraying of nearby, lightly attacked or unattacked trees may be justified. Spraying a persistent insecticide on valuable, uninfested host trees near infested trees may be warranted to protect uninfested host trees from bark beetles. However, do not substitute preventive sprays for proper cultural care.

The infestation status of a tree can be determined by inspecting the trunk or limbs for fresh emergence holes or frass; peeling a small portion of the outer bark from the trunk or limbs and looking for signs of adult beetles or larvae; and inspecting the foliage for yellow or yellow-green leaves. Frequently the infestation is diagnosed after the beetles have vacated the tree. For example, when reddish brown foliage is observed the tree is dead and the new generation of bark beetles has already emerged from the tree. Fading foliage throughout the tree crown indicates a dead tree and no insecticide treatment will be effective. Because each bark beetle species attacks only certain tree species, spray only healthy trees that are susceptible to the beetle species attacking nearby trees. It is not recommended to use an insecticide spray against the bark beetle that bores deep and narrow holes, and against cedar or cypress beetles.

Uninfested host trees may be protected by spraying their bark with a persistent, registered insecticide labelled as a preventive spray for bark beetles. As already mentioned above, spraying a persistent insecticide on valuable, uninfested host trees near infested trees may be warranted to protect healthy host trees from bark beetles. Also, preventive sprays should not be

substituted for proper cultural care and care should be taken to not over-use insecticides to avoid pests from building resistance.

3.4.2 How to Apply Insecticides

Protective spraying for bark beetles must be done by a licensed pesticide applicator. The applicator must use a product with bark beetles listed on MCCAA (Malta Competition and Consumer Affairs Authority) list of allowed PPPs (Plant Protection Products) and is authorised to be used on fig trees. Proper application involves thoroughly drenching the main trunk, exposed root collar near the base of the tree, and larger branches with a pyrethroid containing cypermethrin, carbaryl, permethrin and/or bifenthrin as the active ingredient (Note: These products are not yet registered for use on fig trees). The material must be applied before the new adults penetrate the bark surface of the tree. Regardless of the insecticide used, the applicator should mix only what is needed and dispose of any excess insecticide by properly following label directions. Insecticide products currently registered for use on fig trees (Etofenprox 30%) are not effective for bark beetle control.

Remember: Once insecticide sprays have dried on trees, they represent little risk to humans or other mammals (Berisford *et al.,* 1981). However, in the process of spraying for bark beetles, non-target organisms, such as beneficial insects like bees, pets, fish and water supplies, may be adversely affected. Care must be taken by not spraying under windy conditions or near fresh water ponds or streams. When near edible crops, do not spray more than necessary to wet the bark as excessive spray only runs off. It is also important to note that pesticides should never be sprayed if tree is fruiting and/or is ready for harvest.

3.4.3 When to apply insecticides

Preventive treatments must be applied to the tree trunk or branches to kill adults before they penetrate the bark and lay

eggs. Treatment following successful attacks and egg laying will not be effective. The time to apply is in late winter to early spring (February - March). For most insecticide treatments associated with bark beetles listed on the insecticide label, generally only one application per year is necessary to provide season-long control. This should be applied before adults arrive on new trees (around February-March). This should provide enough control to implement cultural practices to improve the vigour and defence of trees. However, depending on local conditions, the life cycle of the beetle and the insecticide used, in a few situations a second application may be needed several months later to protect individual trees. Also, if strong spring rains or regular irrigation sprinkling of the stem remove the insecticidal barrier, a second application may be necessary. Remember that spraying trees which are already infested is ineffective.

3.5 Remedial control (Controlling the infection/ attack)

3.5.1 Chemical control

Except for general cultural practices (mentioned above) that improve tree vigour, little can be done to control most bark beetles once trees have been attacked. Beetles establish themselves beneath the bark, making the application of insecticides ineffective. If trees or shrubs are infested, beetle infested limbs need to be pruned and properly disposed of. If the main trunk is extensively attacked by bark beetles, the entire tree or shrub should be removed. Unless infested trees are cut and infested materials are quickly removed, burned or chipped on site, large numbers of beetles can emerge and kill

nearby host trees, especially if live, unattacked trees nearby are weakened or stressed by other factors. Infested material should never be piled adjacent to a live tree.

Unless trees are monitored regularly so that bark beetle attack can be detected early, any chemical spray application made once the beetles have aggregated and penetrated the bark, is likely to be too late and ineffective. Treatment must target the adults by spraying the bark so that beetles are killed when they land on trees and attempt to bore into the bark to lay eggs. Chemically treating trees that have been previously attacked will provide no benefit and could kill beneficial insects. Trees that are dead or dying due to previous beetle attacks, cannot be saved with insecticide treatments and should be removed. Systemic insecticides have not been shown to prevent attack or control populations of bark beetles.

Chemicals will protect healthy trees and/or kill broods of beetles within infested trees if they are used properly. The cost of spraying is often small when weighed against the value placed on the tree, the cost of tree removal and potential damage of expanded beetle infestations. If chemical control is selected, the most cost-effective control is to properly observe and correctly identify the beetle species involved, the careful selection of trees to be treated, and the correct application of the insecticides.

3.6 Physical control

3.6.1 Pruning and selective removal

For eradication of beetles, an alternative to complete tree removal is by pruning and selective removal of infected

plants. This will reduce production loss and has potential to eradicate the pathogen in some cases. Infested limbs should be properly pruned and dying trees removed and disposed of so that bark-boring insects do not emerge and infest other nearby trees. Timing of pruning is important; therefore one should avoid creating fresh pruning wounds during the adult beetles' flight season. Any freshly cut wood should not be piled near other trees. Freshly cut wood and trees that are dying or have recently died provide an abundant breeding source for some wood-boring beetles. These should be disposed off by burning or storing properly as explained below.

3.6.2 Disposal

Solar/plastic treatment: In the case that growers/landowners need to store chopped wood in the fields, these should be sealed tightly beneath clear plastic sheets 10mm thick placed in a sunny location for several months to exclude beetle infestation and to kill any beetles which could have already infested the wood. However, to be effective, solar/plastic treatment requires vigilance and careful execution. It is important to keep wood piles small, use high-quality clear plastic resistant to UV (ultraviolet light) degradation, thoroughly seal edges and promptly patch holes to prevent beetles from escaping.

Pile and Burn: This may be a viable option for small infestations. Attacked trees and a border of healthy trees should be felled. Heavy equipment is often necessary to pile trees together so they can be burned. Burning should be done according to GAEC standards.

Burning is often the preferred method of disposal as it eliminates the affected material and immediately kills any pathogens and

beetles it may contain. However, there are numerous examples where burning has reduced incidence or contained pathogens, but not eradicated them.

3.7 Conclusion

In recent years, several species of alien beetles associated with wood were accidentally introduced in the Mediterranean basin. Some twenty one species of such beetles were recorded from Malta. Sometimes the cause of death of some trees can be attributed to the presence of some of these beetles. Once a tree is infested with such insects, not much can be done to save such trees. A very important one which is classified as an invasive alien is the fig borer, *Hypocryphalus scabricollis* which is the main cause of death of fig trees.

It is very important not to damage branches or roots of trees and great care and regular monitoring needs to be in place for older trees. Trees which were planted incorrectly could also increase the risk of attacks from such beetles since they will be stressed. Preventions from attacks of these beetles on trees include regular watering, removal of weeds, use of natural fertilizers, and other practices which all help the tree to remain healthy.

Chemical control should be directed towards the control of the adult beetles by spraying directly on infected branches. Direct contact of the chemical will kill the adult beetle. Those trees which are already highly infested by this beetle or are already dying cannot be saved by this method. When chemical control is properly used many of these beetle infestations in trees can be controlled. It is imperative to note that when applying such chemicals, beneficial insects such as honeybees can die.

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Good Agricultural Practice (GAP) for Fig Tree Cultivation

This Good Agricultural Practice, or GAP, has been formulated in light of the fig tree die-out caused by the invasive beetle, *Hypocryphalus scabricollis.* The aim of this GAP is to give practical tips and advice to fig tree growers on how to manage their trees in the most optimal way to both reduce and control the risk of attack from the beetle.

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