

Chemical interaction between Cherry Blossom and its pest

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Abstract

Sakura, the symbol for Japan's quietude and calmness, is dignified as the country's national flower. More commonly known to the rest of the world as the 'Cherry Blossom'. Ranging from sublime pink flowers to pristine white flowers, it belongs to the genus *Prunus*, and has over 400 species. However, in recent decades, its unparalleled beauty is being attacked by various pests, the most prominent being *Parthenolecanium corni*. This infamous pest attack is notorious for the plants growth and development. This pest is responsible for the

deposition of honeydew remnants on plant leaves, flowers and fruits which inhibits photosynthesis in plants, resulting in wilting, curling and twisting of leaves. In greater concentration, the leaves can become yellow and eventually die. Therefore, in order to save *Sakura* from the wrath of *Parthenolecanium corni* extensive studies should be conducted on utilising the chemicals secreted by the tree during the blooming season to combat the latter's degrading impacts and preserve the beauty of 'Cherry blossom'.

Keywords: *Sakura*, pest, honeydew, *Parthenolecanium corni*, Japan.

1. Introduction

The cherry blossom (*Prunus Spp*), extensively cultivated on a global scale, holds the esteemed position of being Japan's official national flower. It is well known for its high ornamental value [1]. The cherry blossom is commonly known as Sakura in Japanese, which symbolizes peace and tranquillity.

It has been recently observed that in the North-East region especially Mao, Manipur and Meghalaya, the pest *Parthenolecanium corni* (European fruit lecanium) causes extensive damage in bark of plant. It has become a severe problem [2]. This pest attacks the ornamental and fruit plants mostly. Also, it sucks juices from leaves and twigs. The pest generates significant quantities of honeydew, posing a substantial issue that promotes the development of sooty mold. The presence of sooty mold, thriving on the honeydew, can lead to the formation of darkened patches on leaves and fruit. This may sometimes result into premature leaf drop or defoliation due to the accumulation of sooty molds growing on the honeydew [40]. During a severe infestation, the plant's survival may be jeopardized. Utilizing integrated pest management (IPM) represents a viable approach to pest control that aims to minimize associated risks [3]. Other options, such as pesticides, can result in diverse adverse impacts on the environment and human well-

being. In order to develop control measures, we need to study about the chemical interaction between *Prunus Spp* and pest *Parthenolecanium corni* [4].

2. General Description of Prunus

Interesting foliage offered by the species of the Prunus genus, tasty fruits and pretty flowers also [5]. The *Rosaceae* family encompasses numerous well-known items found in grocery stores, such as almonds, apricots, peaches, nectarines, plums, and cherries [6]. This genus comprises over 400 distinct species. Cherry blossoms are predominantly observed in various regions of Japan, and some varieties of cherry blossoms are employed in culinary applications after being preserved by soaking them in vinegar with salt. Researchers conducted tests on the components of an aqueous ethanol extract obtained from cherry blossoms (CBE) and successfully isolated cinnamoyl and flavonol glucosides. To assess the pharmacological properties of CBE and its constituents, as well as their impact on AGE (advanced glycation end-products) induced fibroblast damage, experiments were conducted. The primary compounds present in CBE are CBE itself and 1-O-(E)-caffeoyl- β -D-glucopyranoside (CaG). Notably, CaG plays a significant role in inhibiting the production of AGEs, which

result from the interaction between glucose and albumin, at a concentration of 100 µg/mL. Within the group of flavonol glucosides, quercetin 3-O-β-D-glucopyranoside (QG) demonstrated notable inhibitory activity with an IC₅₀ of 30 µg/mL. Both CBE and CaG effectively reduced glyoxal-induced AGE production in fibroblasts at a concentration of 10 µg/mL, while QG did not exhibit the same effect. Furthermore, CBE and its constituents, except for kaempferol 3-O-(6"-malony)-β-D-glucopyranoside, successfully suppressed fibroblast apoptosis induced by carboxymethyl lysine-collagen at a concentration of 10 µg/mL [7]. These findings demonstrate that the cinnamoyl and flavonol glucosides found in cherry blossom flowers have the capacity to decrease the production of AGEs and inhibit fibroblast apoptosis induced by AGEs. This suggests that cherry blossom flowers might offer an effective means of countering AGE-related skin damage and fibroblast impairment caused by AGEs [8].

2.1. Prunus Flowers

While Prunus trees are commonly cultivated for their fruit and the aesthetic appeal of their blossoms, these trees typically feature flowers with five petals and five sepals, often in a white hue. Certain cultivars have been selectively bred to yield a wider array of novel and captivating characteristics. It's important to note that successful pollination in Prunus

trees and shrubs necessitates the presence of two distinct varieties.

2.2. Prunus Fruits

Prunus trees and shrubs are often referred to as stone fruits because their fruits are enclosed by a hard stone or pit, scientifically categorized as drupes. The classification of Prunus fruits primarily depends on the manner in which the flesh surrounding the stone develops. Freestone fruits possess pulp that easily separates from the pit, allowing for effortless consumption when fresh. In contrast, Clingstone fruits have pulp that adheres more tightly to the pit and cannot be separated without causing damage.

2.3. Problems

Planting the aforementioned trees and shrubs can pose risks when there are livestock present, as the foliage of many Prunus species is highly toxic to ruminant animals like cows, goats, and young livestock. While birds are attracted to these fruit trees, this can also present challenges. Prunus species are generally resilient to pests and diseases, but there are options for managing these issues, including both organic and chemical methods [9].

3. General Description of Parthenolecanium corni

Preferred Scientific Name:
Parthenolecanium corni

Preferred Common Name: Peach scale

Taxonomic Tree Domain: Eukaryota

Kingdom: Metazoa

Phylum: Arthropoda

Subphylum: Uniramia

Class: Insecta

[9]

It is a type of insect which is very harmful for *Prunus*. It basically depends on the climate. It is a useful pest for only vine wards. They lived in a clustered formation and ate plants to live their life. It's worth mentioning that in California, USA, this plant is not classified as a pest, likely due to the region's favorable climate, which supports the cultivation of numerous vines [10]. Outbreaks of this pest is very dangerous.

4. Detailed description of Sakura

Sakura (*Prunus serrulate*) is the Japanese term used to refer to the flowers of cherry blossom trees. Cherry blossom or sakura (Kingdom – Plantae; Division – Magnoliophyta; Class – Magnoliopsida; Order – Rosales; Family - *Rosaceae*; Subfamily – *Amygdaloideae*; Genus – *Prunus*;) are cherry trees, *Prunus serrulata*, and their blossoms. Cherry blossoms are different from other cherry trees, the main difference being cherry blossoms do not bear fruits [11]. The fruit comes from a different species. Rather than producing leaves, these trees display exquisite pink or white blossoms every spring, although their flowering period lasts merely one to two weeks.

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Cherry blossom trees hold an iconic status in Japan as a symbol of spring, and hence they are often referred to as Japan's unofficial national flower [12].

The progress of the blossoming cherry trees is tracked by Japanese people. It is called the sakura zensen, or cherry blossom front. The Himalayan Wild Cherry holds sacred significance in Hindu mythology and is native to regions including Sikkim, Myanmar, and Northeastern India. Its blossoms gradually advance northward with the arrival of warmer weather, commencing in Okinawa around January and reaching Kyoto and Tokyo by early April [13]. Japanese people partake in Hanami festivities as cherry trees blossom in various regions, a tradition deeply rooted in history where people gather for picnics beneath the blooming cherry blossoms. These traditions, dating back centuries, involve festivals and celebrations dedicated to honoring the beauty of cherry blossoms. Among the various types of Sakura, the Someiyoshino is the most renowned. Interestingly, there are approximately 400 distinct cherry tree varieties, as they have a propensity to undergo mutations easily. The blooms are generally white or pink with five petals, although some have almost a hundred petals [14].

5. Major pests of Cherry blossom

The wild cherry trees are a frequent target of several insects and pests are belongs to the family Rosacea . Bugs and bees are attracted

to the fragrant, nectar filled cherry blossoms. Like other trees cherry trees are also affected by various pests and insects and cause several diseases which can be bacterial, fungal even viral also. *Pseudomonas syringae*, *Apiosporina morbosa*, *Monilinia fructicola*, *Coccomyces hiemalis*, Stem borer, short hole borer, pear psylla, thrips, cherry bugs, aphid these are few name of bacteria and fungus , pests by which cherry plants are effected [15]. Common problems for these pests infection include yellow brown spot on leaf, bacterial canker, discolouration of leaf ,defected buds etc. Bacterial canker may occur in flower and leaf buds and cause wounds, another black knot symptoms are very common in cherry trees. Basically caused by fungal attack, this knot is elongated swellings upon wood and brunches of the tree. Besides these there are various type of infections like brown rot or brown discolouration in cherry fruit, spot on leaf, rustion upon leaf. Fungal infection may lead to dull and stunted leaf.

5.1.Black Chery Aphids: Black cherry aphids are tiny black insect that suck the liquid from tree leaves, they used to lay eggs in leaf. This population increase during the spring. Bugs and bees are attracted to the fragrant,nectar filled cherry blossoms. Black cherry aphids are tiny black insect that suck the liquid from tree leaves, they used to lay eggs in leaf [16]. This population increase during

the spring. Cherry aphids cause curling of leaves and sooty black mold on leaves.

5.2.Cherry Slug: Larvae of black sawflies are known as slug. These larvae are approximately 0.5 inch in length and initially white yellow in colour [17]. After hatching these larvae turns into brownish green in colour. The slugs feed on leaves, leaving behind leaf vains and skeletonized foliage.

5.3.Peach Twig Borer: *Anarsia lineatella* are short caterpillar like pest, they form bore in shoot tips and fruits and end of the stem [18].

5.4.Spider Mites: Damages by spider mite include small yellow spots on leaf and brunches, yellowing of leaf [18].

5.5.Fruittree Leafroller: The species *Archips argyrospila*, commonly referred to as the fruittree leafroller, deposits its eggs on the upper surface of cherry leaves. The larvae of this leafroller insect consume nutrients from the plant's leaves and buds, resulting in damage to the tree [19].

6. Effect of the pest *Parthenolecanium corni* (European fruit lecanium) on the plant the cherries blossom (*Prunus spp*)

As we all know that the Himalayan cherry or the cherry blossom plant is well known for its great ornamental value. Cherries encompass various types of flowers from trees belonging to the *Prunus* genus. The Japanese cherry tree (*Prunus serrulata*) is among the most well-known varieties [20]. In terms of its worth, this plant possesses not only significant ornamental value but also commercial importance. Various components of the tree find application as ingredients in traditional dishes, such as sakura-cha or salted cherry blossom tea. Additionally, the plum vinegar extract derived from cherry blossoms serves as both a coloring and flavoring agent, attributed to its red-purple hue and sakura-like aroma. It also contains caffeic acid, which is a yellow solid characterized by its phenolic and acrylic functional groups [21].

The initial stages of *P. corni* infestation typically target the foliage, primarily on the leaves. Infestation is more favorable on the undersides of leaves, while the later stages of infestation tend to occur on the stems and branches [22]. In the case of evergreen hosts, the complete life cycle of *P. corni* can be sustained exclusively on the foliage. Infestations by *P. corni* inevitably lead to reduced vigor and an overall weakening of the host plant. Severe infestations inflict substantial harm to the plants, often resulting in symptoms such as iron deficiency anemia, premature leaf shedding, and weakened stems,

which can also make the plant susceptible to diseases [23].

Honeydew, when deposited on leaves and fruit, serves as a medium for the proliferation of dark sooty molds. These molds subsequently reduce the photosynthetic surface area and diminish the market value of ornamental plants and agricultural produce [24].

7. Chemical Interaction

The European fruit lecanium (EFL), scientifically known as *Parthenolecanium corni* Bouché (Hemiptera: Coccoidea), is a prevalent and destructive soft scale insect that infests the branches and trunks of its host plants. It primarily targets *Fraxinus* spp. and certain other ornamental and fruit-bearing plants. In severe infestations, the plant's survival may be jeopardized, potentially leading to its demise [25]. Plants frequently experience defoliation as a consequence of the buildup of sooty molds that thrive on honeydew. The initial stages of *P. corni* infestation typically target the foliage, particularly on the undersides of leaves, with later stages occurring on the stems and branches. On evergreen hosts, the full life cycle can be carried out exclusively on the foliage. Infestations of *P. corni* lead to a decrease in vitality and a general weakening of the host plant [26, 27]. Severe infestations can cause the development of chlorotic spots and early leaf shedding, as well as stem wilting and dieback. The presence of honeydew on

leaves and fruit provides a conducive environment for the proliferation of dark sooty molds. These molds subsequently lead to a decrease in the photosynthetic surface area and a decrease in the market worth of both ornamental plants and agricultural produce [28,29].

8. Recent Research

Numerous research studies have directed their attention toward investigating the antioxidant characteristics of these compounds, particularly those present in different cherry blossom species. In a study focusing on a specific species, *P. lannesiana*, scientists identified caffeic acid as the primary antioxidant compound within the plum vinegar extract obtained from these cherry blossoms [30]. While caffeic acid is distinct from caffeine, it can still be present in your morning coffee and various other food and beverage items, including prune juice. When introduced into your body, this compound serves as a potent antioxidant and is anticipated to effectively neutralize superoxide anions and free radicals in vivo [31]. In this research, scientists discovered that the plum vinegar extract derived from cherry blossoms contains a greater amount of caffeic acid compared to prune juice [32]. This suggests that the extract could serve as a valuable food product and a potential source of antioxidants. Remarkably, these antioxidant properties are not limited to just this particular cherry blossom species [33]. Subsequent studies conducted over the

years have demonstrated that different cherry blossom species encompass a diverse range of antioxidants, including compounds like quercetin and glucoside [34]. Antioxidants of this nature remain a widely discussed subject within the realms of health and the food industry. Future research focusing on the biochemistry of sakura blossoms has the potential to unveil further insights into their capacity to combat free radicals within the body [35].

9. Future Prospects

Talking about the current research in this particular field, there is not much work done but in progress. The cherry blossom (sakura) tree components, apart from being a popular ingredient in cultural dish, also finds its application as an antioxidant [36]. The plum vinegar extract, known for its red-purple color, derived from cherry blossoms has garnered considerable attention from scientists due to its multifaceted properties. In addition to serving as a coloring and flavoring agent, this extract is of particular interest because of its documented antioxidative, anti-inflammatory, antimicrobial, and anti-tumor characteristics [37]. Scientists are trying to focus mainly on the anti-oxidative feature, based on which are expecting results in future. Scientists have identified caffeic acid as the primary antioxidant within the plum vinegar extract from cherry blossoms [38]. There is potential for future research on the biochemistry of sakura blossoms to provide additional insights

into their capacity to combat free radicals in the human body, potentially leading to advancements in the fields of health and food science [39]. As there are several *Prunus* species, so it may provide an opportunity of wide spectrum of research [40].

10. Conclusion

Cherry blossom has its own historical importance in Japan as it was believed that the blooming of their flowers marked the beginning of rice-planting season. Besides being an iconic visual beauty, it also finds its wide applications in Japanese cuisine. Infestation by *Parthenolecanium corni* have left a serious impact on sakura which can be controlled by the following ways:

10.1. Chemical control: One of the most effective way of controlling this pest population can be applying some organic mineral oil spray in the dormant or delayed-dormant period.

10.2. Cultural control: The scales can be scraped off from the infested twigs just to reduce the number of scales.

The use of synthetic chemicals, insecticides, and pesticides can have detrimental effects on the environment and may pose risks to human health. In such situations, an alternative approach involves biological control, utilizing natural predators of the pest. If the pest population reaches a critical level, resorting to

additional pesticide measures might be necessary. Integrated pest management (IPM) emerges as one of the most favored strategies for attaining sustainable agricultural production while minimizing environmental and health impacts.

In summary, leveraging our knowledge will lead us towards exploring marker-assisted plant breeding methods to develop plants that can adapt to diverse environmental challenges. It's worth noting that the pace of abiotic and biotic changes can often outstrip traditional plant breeding efforts. As demonstrated in the present review, an innovative approach involving the precise control of flowering time through the use of environmentally friendly chemicals holds great relevance. Research pertaining to the chemical regulation of cherry blossom flowering and its relationship with pests has seen continuous advancement over the past few decades. Further research is imperative to obtain validated results. Additionally, it's crucial to explore the presence of secondary metabolites in various plants, as they serve as general defense mechanisms against predators, thereby contributing significantly to our understanding. Furthermore, delving into the chemical interactions between different species to compare their antioxidant properties and their impact under varying conditions is an essential avenue of study.

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