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Peach Gummosis: Causes, Mechanism and Control Measures

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INTRODUCTION

Peach (*Prunus persica* L.,) is one of the most common economically important deciduous fruit crops belonging to the Rosaceae family. Apart from its popularity as fresh fruit, demand for canning, dried fruit snacks and fruit juice have huge demand in the markets and again flowers of pinkish white color have value for the ornamental importance. The eclipse production and productivity of fruits are affected by several causes. Besides the poor cultivation practices, the fruit plants are affected by various pests and diseases which deteriorate the tree's strength to produce a reasonable yield and quality. It also affects the longevity of the fruit plants which in turn reduces the life span of orchards. Among these, the short life syndrome of peach fruit caused by the gummosis is a long-lasting issue. Gummosis is a general, nonspecific condition of stone and nut fruits (peach, cherry, nectarine, plum and almond) in which gum is exuded and deposited on the bark of trees. Gum is produced in response to any type of wound, regardless of whether it is due to insects, mechanical injury or disease.

History and causes of gummosis

Gummosis a complex phenomenon, has been linked to various microorganisms, as reported by numerous studies are not only exclusive to the peach fruits, but extended to the other stone fruit crops (apricots, cherries, plums and almonds), mango, citrus and ornamental crops like rose, hyacinth and tulip.

The occurrence of Peach gummosis was first reported in Central Georgia in 1974, where the damage was reported up to 40%. Recently a new fungal pathogen *Neofusicoccum parvum* was reported as the causal organism of Peach gummosis in Central China. In India, the Peach gummosis was first reported from Manipur state, caused by the fungal pathogen *Pestalotiopsis disseminate* in 2000. Peach gummosis comes under the invasion of various fungal pathogens besides some abiotic stresses.

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The peach gummosis is reported to be caused by various fungal species which includes *Lasiodiplodia theobromae*, *Botryosphaeria dothidea, Botryosphaeria obtuse, Botryosphaeria rhodina* and *Diplodia seriata*, while *Lasiodiplodia theoborme* has proved the most virulent, causing the largest lesions and huge gums. It was also reported that in spring the occurrence of gummosis from the result of the feeding of sucking pests like tarnished plant bug (*Lygus lineolaris*) or stink bug. These sucking insects have spent several generations per year and choose another species for host after peach petal fall. Besides this, oriental fruit moth was reported for the major economic losses as it sucks the fruits and terminal shoots. Gummosis brought on by consuming the plant parts by an oriental fruit moth has larval excrement, or frass, in contrast to plant bugs. A larva bores into a terminal shoot in the spring, causing it to wither. Subsequently, a larva might dig through the peach fruit by boring into it close to the stem. A hole with gumming and frass remains on the fruit surface as it exits the peach. The physiological causes of the gummosis are poor cultivation practices, mechanical damage and excessive pruning. Gummosis serves as a comprehensive defense mechanism against the challenges posed by biotic (Insect pest attack, infection) and abiotic stresses (flooding, water stress, physical and mechanical injury, chilling injury, frost), involving a sequence of intricate physiological and biochemical reactions as wounds, pruning cuts, stomata and lenticels. However, from a visual overview, generally, gummosis takes place in spring with the start of new growth. It may be because of incipient recovery from the dormancy and the energy exhausted to come into the productive status. Fruits with peach gummosis show clear, milky, or amber-colored sap pouring on the surface in the form of distinct beads, drops, or threads. This is sometimes accompanied by tiny punctures, depressed necrotic patches, or insect feeding scars close to the stem, which are typically brought on by pests like oriental fruit moths or stink bugs.

(Figure 1: The gum oozing out of the main stem of peach tree**)**

Symptoms of gummosis

The symptomatology fluctuates with the seasons, and the predisposition to this malady exhibits considerable variability across distinct peach cultivars. Gummosis, as the name suggests is the formation, accumulation and exudation of gum, sap or resinous compounds from tree trunk, branches, leaves, fruits and other plant parts. Gums are the crystal-like structure honey-colored and change to dark shiny brown with age. The incipient signs of fungal gummosis manifested as small elevated blisters, primarily emerging on the natural apertures like stomata and lenticels in nascent shoots or proximity to injuries. The raised blisters result from

hyperplasia, denoting the abnormal proliferation of peridermal and cortical cells in the vicinity of lenticels. Following the initial infection, necrotic lesions within the phloem and cortex tissues persist in their expansion beneath the bark. In aged tissue, sunken necrotic lesions develop, often serving as points for gum discharge. The most conspicuous indication of infection manifests as gum exudates adorning the stems and branches of the tree (Figure 1). The occlusion of vascular tissues due to pathogenic invasion and subsequent gum formation engenders limb regression and vitality of the whole plant that eventually leads to plant death. Peach trees affected with severe infections invariably succumb.

Physiological and biochemicals basis of gummosis

The formation of gums is closely associated with the physiological and biochemical changes associated with the production of enzymes like PG (Polygalacturonase) and PME (Pectin methylesterase) that unfold the degradation processes. The breakdown of the components of the cell wall produces polysaccharides, which make up the dark, glossy brown gums. The resulting changes in the cell wall structures are mainly from secretory cells and degradation of other cell wall components i.e., pectin and cellulose resulting formation of gum ducts. Gums generated under innate environmental conditions and through infection predominantly constituted polysaccharides, with approximately 15% comprising uronic acid and the remaining 85% composed of neutral sugars, prominently featuring arabinose (55%), xylose (8.5%), and galactose (20%).

Hormonal basis of gummosis

The myriad processes spanning from the initiation of germination to the eventual demise of plants constitute the intricate life cycles, wherein plant growth regulators emerge as pivotal orchestrators. Notably, plant hormones like ethylene and jasmonic acid (JA), regarded as stress-inducing hormones play pivotal roles, particularly in exacerbating cellular senescence, lysis, and expediting gum production. The interplay between these hormones is significant in understanding the multifaceted cycles. Ethylene, a known stress-responsive hormone, can be elicited under stress conditions, and the application of ethephon (2-chloroethylphosphonic acid) has been demonstrated to induce gum formation. Consequently, the process of gummosis has been elucidated as being mediated by ethylene. Furthermore, in the face of diverse stresses, the biosynthesis of jasmonic acid is heightened, and treatment with JA has been observed to augment ethylene biosynthesis by stimulating the activity of ACS (1-aminocycloproprane-1-carboxylate synthase) and ACO (1-aminocyclopropane-1-carboxylate oxidase). Consequently, gummosis is revealed to be a complex and intricately regulated phenomenon, influenced by the concerted actions of multiple hormones. Unravelling the specific interactions among these hormones during gummosis is imperative for a comprehensive understanding of this intricate physiological process in plants.

Management strategies

As gummosis is the result of multiple factors retarding tree health and productivity. So, integrated management strategies should be followed to avoid the occurrence of gummosis. Avoid pruning immediately before or after wet weather or irrigation events. Precautions should be taken while pruning water-stressed trees, and limit pruning of dead or infected parts to dry periods, followed by fungicide application to protect fresh wounds. Regularly disinfect pruning tools using rubbing alcohol or a 10% bleach solution. Improve canopy air movement with proper pruning and by removing suckers from trunk bases. Adoption of less vigorous peach varieties that require minimal pruning to reduce pathogen dispersal. Mitigate practices that increase vulnerability, like post-pruning overhead irrigation, use of excessive herbicide near the trunk, improper soil depth, mechanical injuries, and inconsistent

sanitation. Maintain proper nutrient levels and soil pH to discourage susceptible new growth. Address plant stress factors and environmental conditions, such as heat, drought, freeze injury, or compacted soil. Control weed growth around trunks to enhance air movement and prevent fungal-friendly moisture. Modifying irrigation equipment, choosing micro-sprinklers or adjusting drip systems to avoid direct trunk water contact. Establishing a consistent disease management program, considering $CaCl_2$ and copper oxychloride application for peach fungal gummosis, although no specific fungicide is currently registered for this purpose. Adopting strict surveillance of sucking pests, moths and borers and equip appropriate control measures for effective control particularly at pink flower bud stage.

CONCLUSION

Peach gummosis is a complex problem incurred from different biotic and abiotic sources. Mostly insect attacks during the spring resulted from peach gummosis leading to gum formation and a source of secondary infection. Its management strategies include avoiding severe pruning, sanitation of pruning tools, proper orchard management practices, and integrated insect pest and nutrient management. These sustainable practices will be followed for the control of gummosis in peaches.

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