ACTIVATED CARBON-CONTROLLED RELEASE FUMIGATION OF HARVESTED AGRICULTURAL COMMODITIES

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Recently, it has been demonstrated that several natural plant volatiles including acetaldehyde and benzaldehyde control postharvest decay of a variety of agricultural commodities. However, in many cases prolonged exposure of the commodities to an antifungal volatile caused deleterious physiological changes. To overcame this shortcoming, we have developed a formulation that permits the delivery of non-phytotoxic concentrations of pesticidal volatiles that reduce the incidence of decay without causing tissue damage. This formulation is made by adsorbing selective natural volatile pesticides into activated carbon which permits the controlled release of the pesticide into the atmosphere.

To some extent, adsorption always occurs when a clean solid surface is exposed to a condensable vapor. In selected carbons, the amount of adsorbed gas is enhanced as the result of their large surface area per unit mass. Surface area is in turn a function of particle size, particle shape, and porosity. Invariable, the amount adsorbed on a solid surface will depend upon the absolute temperature T, the partial pressure P, and the interaction potential E between vapor (adsorbate) and the surface (adsorbent). Therefore, at some equilibrium pressure and temperature the weight W of gas adsorbed on a unit weight of adsorbent is given by:

$$W = F(P,T,E)$$

Optimal fumigating performance, for a given fumigant, can be achieved by judicious selection of the characteristics of the adsorbent carbon carrier, including internal and external surface area, unimodal or multimodal pore size distribution (or apertures leading into larger pores), pore shape (cylindrical-, slit-shaped or both), surface energetic heterogeneity, surface chemical and physical texture. The pivotal characteristics of the adsorbate fumigant(s) to consider as adsorbate, include minimum molecular cross-sectional area, molecular symmetry, heat of adsorption, and level of fumigant saturation. By considering all these factors, the plant volatiles were impregnated on the carbon microporous surface and subsequently desorb in a highly controlled manner.

This method holds promise of replacing a number of our present uses for methyl bromide for the fumigation of postharvest commodities and quarantine treatments. It also may provide an alternative method to synthetic fungicides which are being withdrawn from the market because of safety and environmental concerns. Since the pesticides used in this method are natural fruit volatiles, which will be released in a highly controlled manner and only in as-needed small quantities at any given time, they should pose no threat to man or the environment.

We have demonstrated that fumigation with benzaldehyde-impregnated carbon was effective in controlling decay and can significantly lengthen the storage life of strawberries, apples, and peaches three highly perishable agricultural commodities. Furthermore, fumigation with carbon impregnated benzaldehyde proved superior to liquid benzaldehyde fumigation in controlling postharvest decay of apple, pear and strawberries. This is attributed to the slow controlled release of the non-phytotoxic concentrations of fumigant made possible by the physical properties of the carbon adsorbent.

Using this methodology volatile pesticides can be released into enclosed environments containing agricultural commodities at a concentration which will control pests but not damage the commodity.