NITRIC OXIDE FUMIGATION FOR POSTHARVEST PEST CONTROL

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Abstract

Nitric oxide fumigation is effective against all arthropod pests at various life stages tested. Nine insect pests at various life stages and bulb mites were subjected to nitric oxide fumigation treatments under ultralow oxygen conditions of $\leqslant$50 ppm O_2 in 1.9L glass jars as fumigation chambers. The insect species are codling moth, confused flour beetle, Indian meal moth, lettuce aphid, light brown apple moth, long-tailed mealybug, spotted wing drosophila, and western flower thrips. The nine insect species represent different body sizes, taxonomical groups, host materials (fresh plants vs stored products), and feeding habits (external vs internal) of the pests. Nitric oxide concentrations, treatment times, and temperatures varied by species and life stages due to variations among different pest species and life stages in susceptibility to nitric oxide fumigation. Complete control of all pest species at various life stages was achieved.

In general, smaller soft body insects such as aphid and thrips are more susceptible to nitric oxide fumigation than larger insects such as lepidopteran larvae and hard body insects such as beetle and weevil. Eggs are more tolerant to nitric oxide fumigation than other life stages. The efficacy of nitric oxide fumigation increases with CxT (Concentration x Time) product increases and is also positively related to temperature. The treatment for small soft body insects can be as short as 2 h at low temperatures for cold storage of fresh products. Longer treatments of 24-48 h may be needed for eggs of stored product insects depending on nitric oxide concentration and temperature. These data suggest that nitric oxide fumigation has the potential to control most insect pests and mites at various life stages.

Nitric oxide fumigation is also safe to fresh products when it is terminated by flushing with nitrogen to reduce the nitric oxide level in the fumigation chamber first before exposing products to ambient air to avoid reaction between nitric oxide and oxygen. Nitric oxide fumigation was also found to improve postharvest quality of strawberries in comparison with controls. This can bring important benefits to some delicate fresh products with short shelf-life. These results suggest that nitric oxide fumigation has potential to be an effective and safe alternative treatment for postharvest pest control on fresh commodities.