EFFICACY AND RESIDUE ANALYSIS OF NITRIC OXIDE FUMIGATION FOR POSTHARVEST PEST CONTROL

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Nitric oxide (NO) is a newly discovered fumigant for postharvest pest control. In the present study, small and large scale laboratory experiments of NO fumigation were conducted to determine the efficacy of NO fumigation for control of lettuce aphid (*Nasonovia ribisnigri*) and western flower thrips (*Frankliniella occidentalis*) on lettuce and spotted wing drosophila (*Drosophila suzukii*) on strawberries and residues on fumigated products. Lettuce aphid and western flower thrips are quarantine pests in Japan and Taiwan, respectively. Spotted wing drosophila is a quarantine pest in New Zealand and Australia. Safe and effective alternative treatments are needed to control the pests on exported lettuce, strawberries and other fresh products.

As NO reacts with oxygen (O_2) spontaneously to form nitrogen dioxide (NO_2), NO fumigation is required to be conducted under the ultralow oxygen (ULO) conditions to preserve NO. Exposure to NO_2 can cause injuries to fresh products. Therefore, NO fumigation for fresh products also needs to be terminated with nitrogen (N_2) flush to dilute NO to avoid NO_2 generation.

Commercial iceberg and romaine lettuce with both lettuce aphid and western flower thrips were fumigated in a large chamber (442 liters) with 0.5% NO at 2°C for 16 h to determine the efficacy against the pests and effects on postharvest quality of lettuce. Sound strawberries and strawberries infested with spotted wing drosophila were fumigated with 3% NO at 2°C for 8 h to determine the efficacy against the pest and effects on postharvest quality of strawberries.

Complete control of all three pests was achieved in respective treatments. After 2 weeks of post-treatment storage, there were no significant quality reduction for fumigated lettuce as compared with controls. After one week of post-treatment storage, strawberries from NO fumigation had higher percentage of berries free of surface damage and lower percentage of berries with mold as compared with controls, indicating that NO fumigation enhanced strawberry quality.

NO fumigation can have nitrate (NO_3^-) and nitrite (NO_2^-) as residues in fumigated products. We subjected 20 fresh products to two identical NO fumigation treatments. One treatment was terminated with N_2 flush and the other with air flush and measured NO_3^- and NO_2^- at 24 h after fumigation. There were no significant increases in either NO_3^- or NO_2^- in almost all fresh products if fumigation was terminated by N_2 flush. NO fumigation with air flush resulted in significantly high NO_3^- or NO_2^- levels in some of the fumigated fresh products.

This study demonstrated that NO fumigation has the potential to be used to control lettuce for control both lettuce aphid and western flower thrips on exported lettuce and for control of spotted wing drosophila on strawberries. NO fumigation is not expected to cause significant increases in NO_3^- or NO_2^- levels in fresh products if fumigation is terminated properly. This study together with previously studies indicated that NO fumigation has good potential to become a safe and effective alternative to methyl bromide fumigation for postharvest pest control on fresh products.