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Chapter

Cytoplasmic Matrix and Viroplasms Inclusions in the Presence of Gold Nanoparticles (AuNPs)

Noorah Abdulaziz Othman Alkubaisi and Nagwa Mohammed Amin Aref

Abstract

Cellular ultrastructure micrographs revealed striking changes resulting from the Barley Yellow Dwarf Virus (BYDV-PAV) infection in Electron microscopy. In the cytoplasm, the Gold nanoparticles (AuNPs) may bind with different cytoplasmic organelles and interfere with the treated site's metabolic processes. The micrographs of the treated plant leave with AuNPs showing; Endosomes, amorphous bodies, slender filaments fibers, myelin bodies with a high concentration of virus particles, and Gold Nanoparticles distributed in a circulated shape in the cytoplasm with virus particles.

Keywords: Cytoplasmic matrix, Barley Yellow Dwarf Virus (BYDV-PAV), Gold nanoparticles (AuNPs), Endosomes, Amorphous bodies, Slender filaments fibers, Myelin bodies

1. Introduction

In subsequent stages, significant accumulations of virus particles as in **Figures 1(E)** and **2(D)** and filaments were visible outside the nucleus throughout the cytoplasm, as in **Figure 1(D)**. When the virus was common throughout the cytoplasm, vesicles with fibrils were often still clustered around vacuole like areas in the cytoplasm, **Figure 1(A)–(C)**.

In addition to that, amorphous cellular inclusion bodies, was shown in **Figures 1(B)** and **2(A)–(C)**, numerous filamentous shapes appeared in **Figure 1(E)**. Endosomes as in **Figure 2(A)–(D)**, deformed invagination of the cell wall, **Figure 2(A)** virus localization, and cytopathic alterations of barley *Hordeum vulgare L*. were studied in root tissues infected with BYDV in root phloem tissues examined seven days after inoculation [1]. The virus was restricted to the phloem tissues, i.e., sieve elements, companion, and phloem parenchyma cells. Virus progeny was observed in the nucleus at an early stage of infection. No or few virions were observed in the cytoplasm at this stage, and cell organelles remained normal in their appearance. Uptake and presence of AuNPs in the cytoplasm various organelles of root and leaf cells of poplar plant by transmission electron microscopy were observed [2] and measured by inductively coupled plasma mass spectrometry (ICP-MS), **Figure 3(A)** and **(B)**.

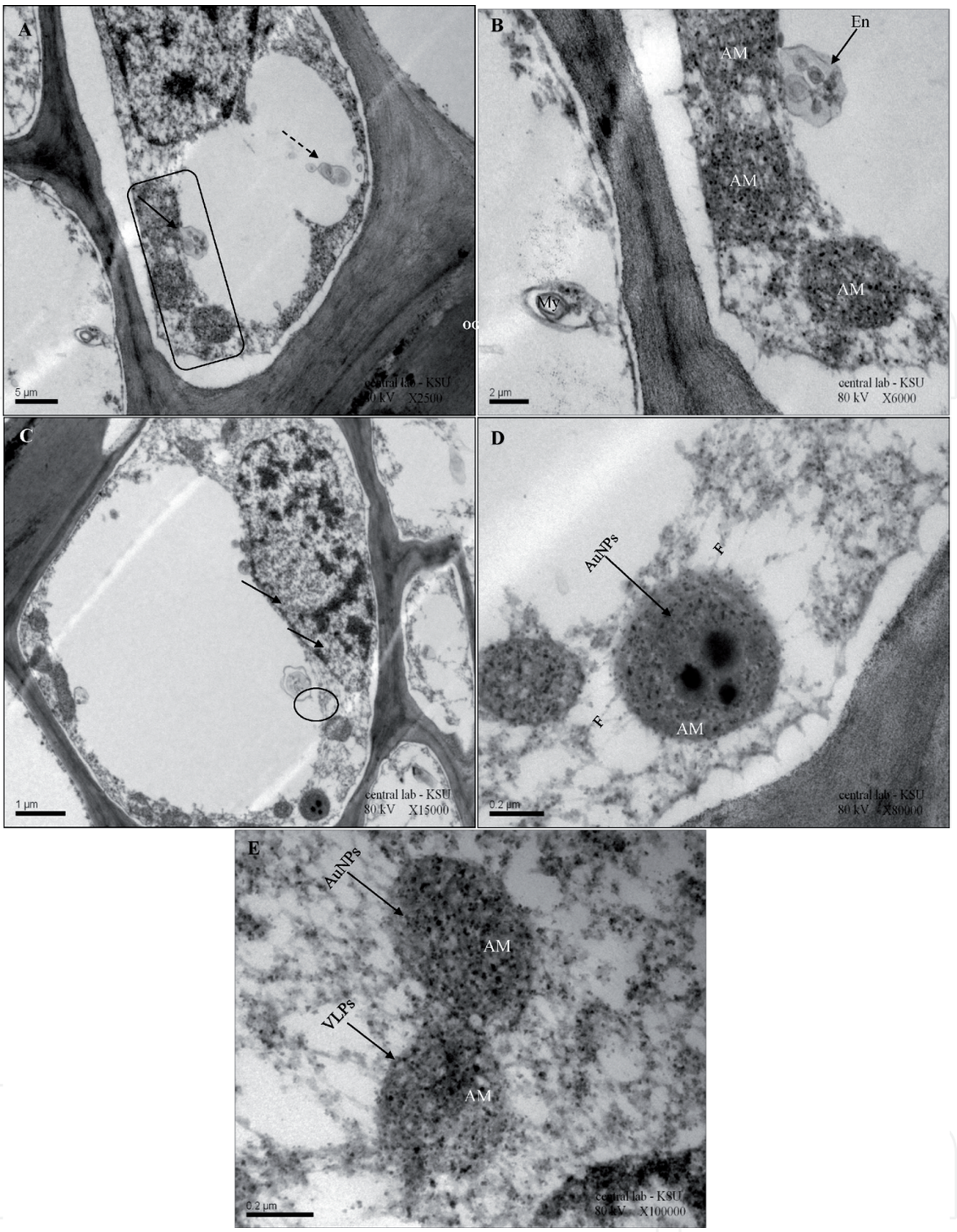


Figure 1.
Endosomes, amorphous bodies, and slender filaments fibers. *(A and C) Micrographs of general view for one cell contain an amorphous body (box outlined), myelin bodies (dashed arrow), and endosomes (arrow). Scale bars 5 µm, 1 µm. (B) Higher magnification of A indicated one endosome crossing the cell wall from the neighbouring cells to the other cell with VLPs. Scale bars 2 µm. (D) Higher magnification of C shows some slender filament fibers and VLPs with AuNPs near to amorphous bodies, Scale bar 0.2 µm. (E) smooth-surfaced structure with numerous AuNPs, Scale bar 0.2 µm.*

2. Viroplasms and gold nanoparticles

Inclusions of virus-derived material in virus-infected cells termed viroplasms. It may be quasicrystalline, amorphous, or crystalline, in appearance the accumulation of nascent virions in the host cell from some inclusions aggregates of viral proteins, **Figures 1(D)** and **(E)** and **2(A)–(C)**. Large aggregates of convoluted,

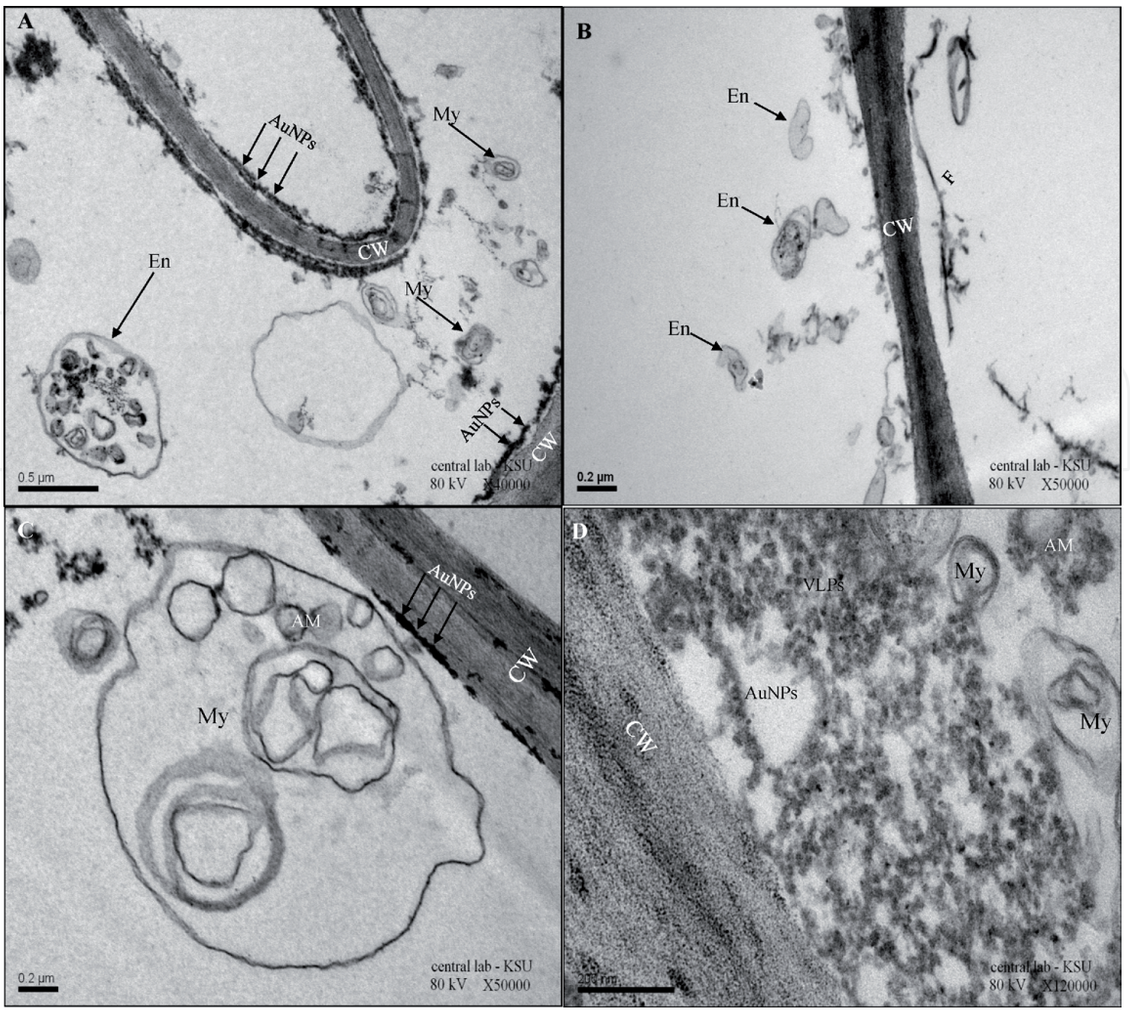


Figure 2.
Endosomes and myelin bodies with a high concentration of virus particles. *(A) Numerous endosomes (arrow) have AuNPs distributed in the cytoplasm of different sizes. Compact multi membrane structure (arrow) decorated in and out with a dense layer of AuNPs. Scale bar 0.5 µm. (B) The area around the cell wall in the cell endosomes along the cell wall with different sizes (arrows), filamentous shape particles in the other sides of the cell wall. Scale bar 0.2 µm. (C) Amorphous inclusion materials are surrounded by the bundle sheath myelin body (My). Scale bar 0.2 µm. (D) Micrograph of cellular myelin body trapped with both AuNPs and VLPs near the cell wall. Scale bar 200 nm.*

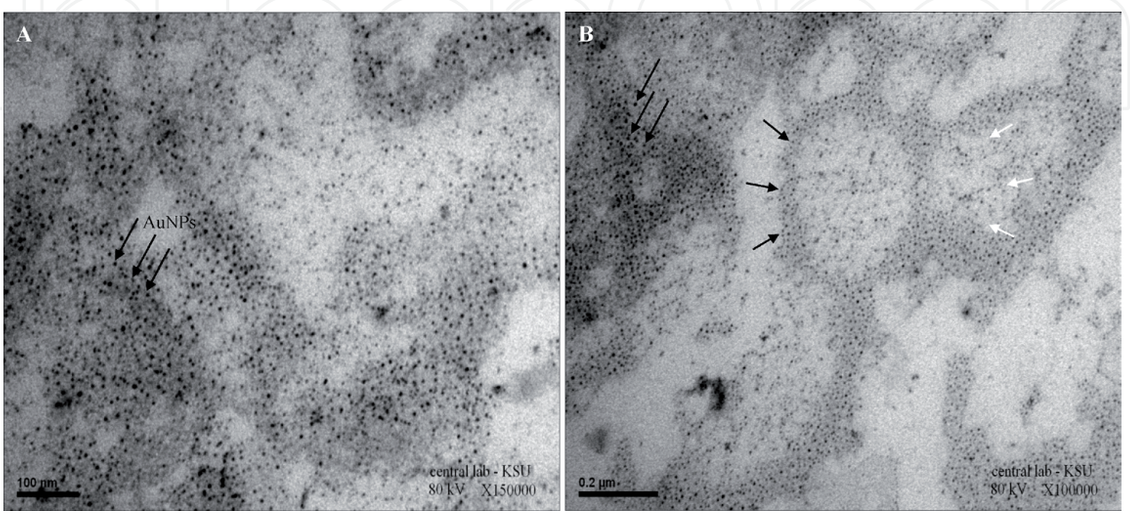


Figure 3.
Gold Nanoparticles distributed in a circulated shape in the cytoplasm with virus particles. *(A and B) Showed the VLPs (white arrows) and AuNPs (black arrows) gathering in the cytoplasm in circulated unregulated shapes having borders occupying the whole lumen of the cytoplasm. Scale bar 100 nm and 0.2 µm.*

branched, tubular bodies and myelin bodies as in **Figures 1(B)** and **2(A), (C),** and **(D)**, assumed to originate from the ER., were also observed in some parts of the cytoplasm. A densely staining amorphous material occurred both within and outside the tubules. Vesicles containing densely staining amorphous material or without any apparent contents were occasionally seen within these aggregates but were more common around the periphery, **Figure 1(B)**. These tubular aggregates persisted through the remaining stages of the infection, but the vesicles with fibrils decreased markedly in number as the infection progressed, **Figure 2(A)** and **(B)**. Remnant vesicles usually occurred singly, and many were still enclosed in the second membrane.

Abbreviations

AuNPs	Gold nanoparticles
ICP-MS	Inductively coupled plasma mass spectrometry
ER	Endoplasmic reticulum
En	Endosome
AM	Amorphous
F	Filament
VLPs	Virus-like particles
My	Myelin body
CW	Cell Wall

Author details

Noorah Abdulaziz Othman Alkubaisi[1*] and Nagwa Mohammed Amin Aref[2]

1 Department of Botany and Microbiology, College of Science, King Saud University, Riyadh, Kingdom of Saudi Arabia

2 Department of Microbiology, College of Agriculture, Ain Shams University, Cairo, Egypt

*Address all correspondence to: nalkubaisi@ksu.edu.sa

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