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Application of Nanoparticles to Control *Cuscuta* spp. in Horticultural Orchards: A Short Communication

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THE DODDER plants are well known as holo-parasitic stem weeds and belong *Cuscuta* genius (family Convolvulaceae), including about 200 species distributed worldwide. *Cuscuta* spp. have the ability to cause a serious damage to several agricultural and horticultural crops, which estimated to be than 300 million farmers in the world, causing severe losses in the yield of many crops. The main problem of dodder plants represents in penetrating host plant tissues by the haustoria of *Cuscuta* and uptake everything from the host plants including nutrients, water, macromolecules (i.e., proteins and mRNAs), and even pathogens through vascular connections. As parasitic weeds, several applied materials have been used to control the *Cuscuta* plants like nutrients (e.g., Ca, B, K, N, and Si) and herbicides, but the nanoparticles or nanomaterials are still need concern. This is a call for submission articles including original papers, reviews, notes on the expected role of nanoparticles like nano silica on control *Cuscuta* plants in horticultural orchards. Is nano silica the right applied nanoparticles to control *Cuscuta* spp. in horticultural orchards?

Keywords: Nanoparticles, Nano-herbicides, Horticultural crops, Nano-nutrition, Nano silica.

1. *Cuscuta* sp. as a parasitic plant

As a parasitic plant, *Cuscuta* sp. can impact on the host plants and destroy their productivities by uptake the water, nutrients, proteins, metabolites, mRNAs, and pathogens like viruses (Albert et al. 2008; Zhou et al. 2021). A wide range of different crops can be infested by *Cuscuta* spp. including vegetables (e.g., asparagus, carrot, cucumber, garlic, onion, pepper, and potato), ornamental plants (e.g., chrysanthemum, dahlia, geranium, petunia, and periwinkle), and fruit trees (citrus, pomegranate, cranberry, coffee, etc.), causing a reduction in productivity and even death (Zaroug et al. 2014; Flores-Sánchez and Garza-Ortiz 2019). The genius *Cuscuta* includes more than 200 plant species (Table 1) such as *C. campestris*, *C. epithymum*, *C. europaea*, *C. gronovii*, *C. indecora*, *C. pentagona*, *C. planiflora*, *C. reflexa* and *C. suaveolens* (Wright et al. 2011, 2012; Riviere et al. 2013; Ali et al. 2017; Alamgeer et al. 2017; Aistova and Bezborodov 2017; Abu-Lafi et al. 2018; Al-Sultany et al. 2018; Flores-Sánchez and Garza-Ortiz 2019; Zhang et al. 2020; Al-Gburi 2021).

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TABLE 1. List of some plant species of genus "*Cuscuta*" as reported by several workers

***Cuscuta* spp.**	**References**
Cuscuta africana	Riviere et al. (2013); Ho and Costea (2018)
Cuscuta appendiculata	Wright et al. (2011)
Cuscuta approximata	Ho and Costea (2018)
Cuscuta attenuate	Mavlonov et al. (2008)
Cuscuta australis	Liu et al. (2020); Zhou et al. (2021)
Cuscuta campestris	Zaroug et al. (2014); Behdarvandi et al. (2015); Ho and Costea (2018); Wang et al. (2020); Al-Gburi (2021)
Cuscuta cephalanthi	McNeal et al. (2007b); Ho and Costea (2018)
Cuscuta chinensis	Marambe et al. (2002); Costea et al. (2011); Pan et al. (2013); Al-Sultany et al. (2018)
Cuscuta chapalana	Ho and Costea (2018)
Cuscuta compacta	McNeal et al. (2007b)
Cuscuta costaricensis	Banerjee and Stefanović (2019)
Cuscuta cotijana	Ho and Costea (2018)
Cuscuta epilinum	Costea and Tardif (2006); McNeal et al. (2007a)
Cuscuta epithymum	Costea and Tardif (2006)
Cuscuta europaea	McNeal et al. (2007a); Lukacova et al. (2019)
Cuscuta exaltata	McNeal et al. (2007a, b)
Cuscuta gronovii	Heide-Jorgensen (2008); Behdarvandi et al. (2015); Ho and Costea (2018)
Cuscuta indecora	McNeal et al. (2007a)
Cuscuta japonica	Ho and Costea (2018)
Cuscuta jepsonii	Costea and Stefanović (2009)
Cuscuta lupuliformis	McNeal et al. (2007a)
Cuscuta monogyna	Ho and Costea (2018)
Cuscuta nitida	McNeal et al. (2007a, 2009); Ho and Costea (2018)
Cuscuta obtusiflora	McNeal et al. (2007a, b)
Cuscuta odorata	Berg et al. (2003)
Cuscuta odontolepis	Write et al. (2012)
Cuscuta paitana	Riviere et al. (2013)
Cuscuta palaestina	Abu-Lafi et al. (2018)
Cuscuta pedicellata	Lyshede (1985, 1989)
Cuscuta pentagona	Costea et al. (2006b); Costea et al. (2015)
Cuscuta platyloba	Ahmad et al. (2017)
C.uscuta planiflora	Ho and Costea (2018)
Cuscuta polyanthemos	Wright et al. (2012)
Cuscuta purpurata	McNeal et al. (2007a); Ho and Costea (2018)
Cuscuta reflexa	Albert et al. (2010); Patel et al. (2012); Ali et al. (2017); Thomas et al. (2017)
Cuscuta rostrata	McNeal et al. (2007a)
Cuscuta rugosiceps	Costea et al. (2008)
Cuscuta tinctoria	Ahmad et al. (2017)
Cuscuta umbellate	Ho and Costea (2018)
Cuscuta umbrosa	Costea and Tardif (2006); Costea et al. (2006a)
Cuscuta veatchii	McNeal et al. (2007a)
Cuscuta warneri	Ho and Costea (2018)

Cuscuta spp. cause significant reduction in the yield of some infested crops as reported in many studies such as the reduction of yield of tomato (*Lycopersicum esculentum*) and carrot (*Daucus carota*), which infested by *C. pentagona* to 50–75% and by 70–90%; respectively (Lanini and Kogan 2005). This reduction in yield differs from crop to other and depending on the species of Cuscuta as reported for the following crops *Allium cepa* (28–58%), *Capsicum frutescens* (60–65%), *Cicer arietinum* (86%), *Lens culinaris* (87%), *Medicago sativa* (60–70%), and *Vigna mungo* (31–34%) by dodder invasion (Mishra 2009, Zaroug et al. 2014). Many plant viruses could be transferred by the *Cuscuta* spp. as reported by Sastry et al. (2019) such as tobacco rattle virus by *Cuscuta campestris* in Bulgaria (Dikova 2006), tomato yellow leaf curl virus by *Cuscuta* spp. in Spain and Cyprus (Papayiannis et al. 2011), Arabis mosaic virus by *Cuscuta* spp. in Iran (Ghotbi and Shahraeen 2005), tomato yellow ring virus by *Cuscuta* spp. in Iran (Ghotbi et al. 2005). Figs. 1 and 2 shows the death impact of Cuscuta spp. on growth some horticultural plants.

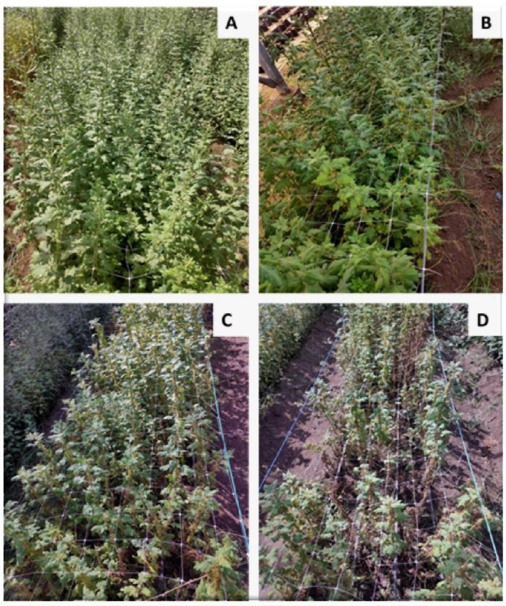

Fig. 1. The infection by *Cuscuta europaea* on the ornamental plant of *Chrysanthemum morifolium* could present in the following stages: (A) normal plant, (B) first stage of infection, (C) sever plants injury, and (D) plants died after infection

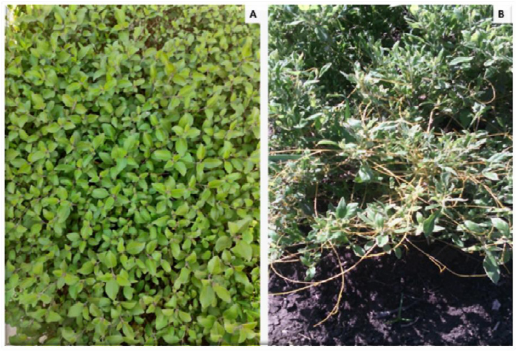

Fig. 2. An overview for the infection on the ornamental plant of *Vitex trifolia* by *Cuscuta europaea* (B) compared to normal plant (A)

2. Nano-control of Cuscuta europaea infection

Several approaches have been applied to control these parasitic plants including herbicides (Angeles Alvarez et al. 2016), different nutrients like K (potassium sulphate), Ca (Ca compounds), B (boric acid), N (urea), and Si (Al-Gburi 2021). Cuscuta as weeds can control using the mechanical methods (removing, pruning, or deep-ploughing), chemical control using herbicides, and biological control (like bioherbicides, microbial herbicides, and genetically modified plants expressing herbicidal substances (Westwood et al. 2018). Some insects could be used in the biological control of dodders like the genus *Smicronyx* including Coleoptera and Curculionidae (Aistova and Bezborodov 2017; Flores-Sánchez and Garza-Ortiz 2019). Some recent reports confirmed the using of nanotechnology for delivery of natural therapeutic substances like *Cuscuta chinensis*, which its extract is rich in lignin and flavonoid with antioxidative and hepatoprotective effects (Saka and Chella 2021). Nanotechnology can overcome the poor solubility and permeability, low stability of the pharmacological agents by using the nanosuspension (Saka and Chella 2021). On the other hand, some nanomaterials like nano silica may be has the proper impact as nano-herbicide in control the Cuscuta. Concerning the using of nanoparticles or nanomaterials in *Cuscuta* control is important approach that needs more concerns. This call by EBSS journal for submission articles including original articles, reviews or comments on this issue.

Ethics approval and consent to participate

This article does not contain any studies with human participants or animals performed by any of the authors.

Consent for publication

All authors declare their consent for publication.

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Author contribution

The MS has been written, revised and agreed by all authors

Conflicts of Interest

The author declares no conflict of interest.

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