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Virology

Influence of *Groundnut bud necrosis virus* on the Life History Traits and Feeding Preference of Its Vector, *Thrips palmi*

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ABSTRACT

The effect of *Groundnut bud necrosis virus* (GBNV) infection on the life history traits of its vector, *Thrips palmi*, and its feeding preference on GBNV-infected plants were studied. A significant difference was observed in the developmental period (first instar to adult) between the GBNV-infected and healthy thrips, wherein the developmental period of GBNV-infected thrips was decreased. However, there was no effect on the other parameters such as preadult mortality, adult longevity, and fecundity. Further investigation on a settling and feeding choice assay of *T. palmi* to GBNV-infected and healthy plants showed that *T. palmi* preferred GBNV-infected cowpea plants more than the healthy cowpea plants. This preference was also noticed for leaf disks from GBNV-infected cowpea, groundnut, and tomato plants.

Additional keywords: tospovirus, virus–vector interaction.

Most plant viruses (76%) are reported to be vector borne, and the majority (55%) are transmitted by insects belonging to hemipteran groups such as aphids and whiteflies as well as thrips (order Thysanoptera) (Hogenhout et al. 2008). Crop plants can be affected directly by thrips through feeding injuries (Childers and Achor 1995; Childers and Bullock 1999; Heming 1993; Lewis 1973) and also indirectly by transmitting plant viruses (Riley et al. 2011). Among the many plant viruses transmitted by insects, tospoviruses are transmitted exclusively by several thrips species (Riley et al. 2011). Thrips-borne tospoviruses damage several economically important crops and ornamental plants, causing significant economic losses throughout the world (Belliure et al. 2005; Culbreath et al. 2003; Goldbach and Peters 1994; Jones 2005; Pappu et al. 2009; Pearce 2005; Persley et al. 2006; Riley et al. 2011; Rotenberg et al. 2015; Whitfield et al. 2005; Wijkamp et al. 1996). In Asia, *Groundnut bud necrosis virus* (GBNV) is considered to be the most economically important *Tospovirus* sp. that affects several vegetable crops and ornamental plants. It is estimated that GBNV alone causes more than U.S.$89 million losses annually (Reddy et al. 1995). It has been reported that GBNV causes more than 70 to 90% yield loss in peanut (Singh and Srivastava 1995), and up to 29% yield loss on potato in India (Singh et al. 1997). Furthermore, GBNV has been reported to affect several other important crops such as soybean (Bhat et al. 2002), pea (Akram and Naimuddin 2010), mungbean (Jain et al. 2002; Thien et al. 2003), cowpea (Jain et al. 2002), and tomato (Jain et al. 2002; Raja and Jain 2006). Recently a new tospovirus, *Soybean vein necrosis virus* (SVNV), transmitted by *Neohydatothrips variabilis*, was found to be an emerging virus on soybean and is widespread in the United States (Keough et al. 2016).

In nature, tospoviruses are transmitted by several thrips species in a propagative and persistent manner from one plant to another (Birithia et al. 2013; Inoue et al. 2010; Sherwood et al. 2000; Ullman et al. 1993; Whitfield et al. 2005; Wijkamp et al. 1993). The uniqueness of the thrips–tospovirus relationship is that only the adult thrips and, in part, the second-instar larvae can transmit the virus, if acquisition occurs during the first-instar larval stage (Moritz et al. 2004; Ullman et al. 1992). After acquisition, the virus initially infects the midgut epithelium and then infects the surrounding muscles, subsequently reaching the salivary glands. The virus further replicates in the salivary gland and finally gets transmitted to healthy plants through saliva during the feeding process (Moritz et al. 2004; Ullman et al. 1992).

Tospoviruses not only infect plants but also affect their vectors by replicating in the midgut and other parts of the insect body (Birithia et al. 2013; German et al. 1992; Moritz et al. 2004; Tsuda et al. 1996; Ullman et al. 1992; Wijkamp et al. 1993). It is believed that the infection of *Tospovirus* spp. on vector species is likely to cause behavioral and other physiological changes that influence the overall fitness and performance of the vector. It has also been reported that *Tomato spotted wilt virus* (TSWV) and *Iris yellow spot virus* (IYSV) replicate inside the vector species (Birithia et al. 2013; Wijkamp et al. 1993) and, thus, thrips also serve as a virus host. Several studies have been conducted which showed that plant virus infection alters the fitness of the vector. It has been shown that virus also modifies the feeding behavior of the vector, such that TSWV-exposed *Frankliniella occidentalis* thrips fed more than their healthy counterparts (Ogada and Poehling 2015) and *F. occidentalis* male thrips infected with TSWV fed more than uninfected males (Stafford et al. 2011). In contrast, in one study, nonviruliferous *F. fusca* fed more than TSWV-infected *F. fusca* (Shrestha et al. 2012). Plant viruses have also been reported to increase or decrease fecundity (Jiu et al. 2007; Keough et al. 2016; Ogada et al. 2013; Shrestha et al. 2012), mortality (Ogada and Poehling 2015; Ogada et al. 2013; Stumpf and Kennedy 2005, 2007), developmental period (Ogada and Poehling 2015; Shrestha et al. 2012; Stumpf and Kennedy 2005, 2007), and longevity of their vectors (Inoue and Sakurai 2006; Jiu et al. 2007; Ogada and Poehling 2015; Ogada et al. 2013). They also affect morphological characteristics of their vector

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