Implementation of Mineral Oil...

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IMPLEMENTATION OF MINERAL OIL FOR CONTROLLING APHID AND WHITE RUST DISEASE OF CHRYSANTHEMUM

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ABSTRACT

The main constraints that determine chrysanthemum flower quality are white rust disease and aphid as pest and vector of viral diseases. Preliminary study on oil application was conducted farmer plastic house in Wonokerso, Sleman, Yogyakarta. Five blocks of chrysanthemum plants, as replicates. Each block comprised of four plots as oil treatments: 0.125%, 0.250%, 0.500% v/v of horticultural mineral oil (HMO), and 0% or water. Application was conducted fortnightly, started from eight weeks after planting up to harvested (three months). Oil application could not prevent the increase of population. There was no significant difference between oil concentration treatments. However, oil in concentrations of 0.250% and 0.500% were able to decrease the spread of white rust, with the disease severity of 69.44% and 65.00% respectively after the third application. Higher concentration or frequency was required to achieve significant control on aphid population.

Keywords: chrysanthemum, white rust, mineral oil, vector,

INTRODUCTION

Chrysanthemum is one of favourite cut flowers, especially for the middle class and above. Quality of chrysanthemums and other cut flowers is the main factor that determines consumer preference. The main constraints that determine its quality is white rust disease and aphid. Chrysanthemum white rust (CWR) can be a serious disease of chrysanthemum crops. According to Kristina *et al*. (1994), white rust disease (*Puccinia horiana* P. Henn.) may decrease freshness of chrysanthemum flowers (vase - life) into only 5 days, significantly shorter than the healthy ones. It freshness can last up to 12 days at room temperatures (27-29°C). Chrysanthemum yield loss caused by white rust disease is reaches 30% in Indonesia (Suhardi 2009a), 80% in Turkey (Gore 2007), and 100% in New England (Ellis 2007). Some insects reported as vector of some virus diseases, i.e. *Aphis craccivora, Acyrthosiphon pisum,* and *Myzus persicae* (Rahardjo *et al.,*2005) *Macrosiphoniella sanborni, Rophalosiphum sp.* (Aphididae) (Djatnika *et al.*, 1994; Balithi, 2007) also attack leaves of chrysanthemum.

Various pest and disease control measures has been done, such as the use of tolerant varieties, culture technique (i.e. cutting infected leaves and setting watering), the use of natural enemies, and the application of synthetic pesticides. However, the intensity of pest and disease still high. There has been a resurgence in interest in horticultural

mineral oil in the past decade for a variety of agricultural uses (Beattie *et al.*, 2002). Its pesticidal effects cover a broad range of arthropod pests and include acute mortality, repellency, and oviposition deterrence (Zwick and Westigard, 1978; Davidson *et al.*, 1991; Fernandez *et al.*, 2001). Recent investigations have elucidated the mode of action against plant diseases (Northover & Schneider, 1996), and oils have shown promise against mildew diseases of grape, cherry, and apple (Northover and Schneider, 1996; Grove, 1999; Grove and Bo[illegible], 2002). Recently, mineral oils were found to be highly effective against citrus pest (Rae *et al.* 1996; Cen *et al.* 2002). Horticultural mineral oil (HMO) is highly refined mineral oils originated from crude petroleum oils. It is paraffinic compound (≥60% of carbon atoms occur in chains). It has unsulfonated residue (UR) values ≥92 % (therefore it contains ≤8% aromatic molecules). It molecule weights vary and is reflected in the number of carbon atoms. The lightest oils are nC21 oils, and the heaviest oils are generally *n*C25 oils. These values reflect the median equivalent n-paraffin carbon numbers and distillation temperatures (Agnello 2002; Beattie 2005). Several factors favor the use of horticultural mineral oil, including low cost, low mammalian toxicity, and few deleterious environmental effects (Fernandez *et al.*, 2005).

MATERIALS AND METHOD

Preliminary research was conducted in farmer plastic house in Wonokerso, Sleman, Yogyakarta. Five blocks of chrysanthemum plants, as replicates, were set in the plastic house. Each block divided into four plots as treatments. Each plot consisted of 25 plants. The treatments were 0.125%, 0.250%, 0.500% v/v of horticultural mineral oil (HMO: *n*C21 Sunspray Ultra Fine®, Amtrad[illegible] Pty), and 0% or water. They were set randomly in each block. The oil spray was applied evenly to foliage to the point of initial run-off. The upper and lower side of leaves, twigs and branches were sprayed thoroughly. Application was conducted fortnightly, started from eight weeks after planting up to harvested (three months). Agitation of oil was started when the oil was added to water and was maintained during spraying. The plants were irrigated every two days, and fertilized with N, P, and K with the dose of 75, 75, and 25 gram/plant respectively.

Assessment was conducted on aphid population and the spread of white rust disease. Aphid population were assessed fortnightly before oil spray application on nine randomly chosen central plants within each plot. Visual observations determined the number of aphid per leaf on five chosen leaves on upper part of tree. The spread of white rust was assessed at same samples as aphid assessment by recording fortnightly the number of leaves infected based on the rating scale of severity (Table 1.)

Table 1. Disease severity rating scale used to access the spread of white rust

Severity rating	Description
0	Leaf without any symptom
1	< 25% part of leaf showing symptom
2	25% up to < 50% part of leaf showing symptom
3	50% up to < 75% part of leaf showing symptom
4	≥ 75% part of leaf showing symptom

Data were subjected to one-way ANOVA (analysis of variance). Duncan's multiple range test (DMRT) was used to determine the differences among treatments when the ANOVA was significant (Gomez and Gomez, 1983). Significance different was arise at $P< 0.05$. Analysis was performed using SPSS® version: 10.0.5 (SPSS, 1999).

RESULTS AND DISCUSSION

The aphid population did not develop rapidly, even though the population keeps rising with or without the application of oil (Figure 1.). It may due to humid condition of the plastic house. Oil application could not prevent the increase of population. There was no significant difference between oil concentration treatments (Table 2.). It seemed that oil film could not provide a barrier by masking the feeding and oviposition stimulants, hence preventing the aphid from locating, accepting or using the host plant. It was not consistent with the report on the adult females of two spotted mite (*Tetranychus urticae* Koch [Acari: Tetranychidae]) (Liu & Beattie 2002), Asiatic citrus psylla (*D. citri* Kuwayama) (Rae *et al.* 1997), whiteflies (*Bemesia argentifolii* Bellows and Perring [Hemiptera: Aleyrodidae]) (Stansly *et al.* 2002), greenhouse thrips (*Heliothrips haemorrhoidalis* Bouche [Thysanoptera: Thripidae]) (Liu *et al.* 2002). They do not lay their eggs on plant treated with oils. Density of damage spots caused by citrus red mite (*Panonychus citri* McGregor [Acari: Tetranychidae]) feeding activity was reduced significantly on plant treated with these oils (Cen *et al.* 2002). Greenhouse thrips preferred untreated fruit to HMO-treated fruit as feeding site (Liu *et al.* 2002).

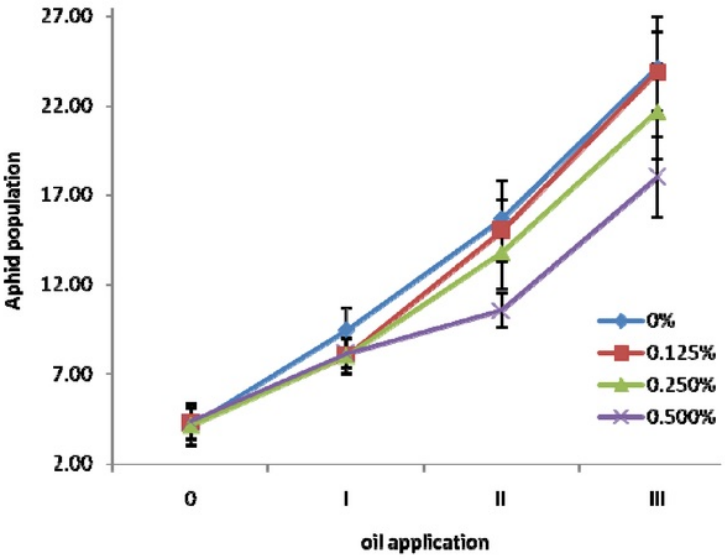

Figure 1. Aphid population (Mean ± SE) on chrysanthemum leaf treated with 0%, 0.125%, 0.250%, and 0.500% v/v oil application

Disease severity of white rust on chrysanthemum leaves was quite high. It increased rapidly on the control (0% oil) and on the 0.125% oil application with the severity of 43.89% and 45.00% into 88.89% and 86.67% respectively (Figure 2.). Oil application in

concentrations of 0.250% and 0.500% were able to decrease the spread of white rust, with the severity of 69.44% and 65.00% respectively (Table 2.). Oil might be caused deformation of appressoria and affected on uredospores germination to infect chrysanthemum plants. Similar result has been reported by Sallam *et al,* (2001) on wheat rust (*Puccinia recondite* f. sp. *Tritici.*). Oils could also provide a mechanical barrier to prevent the invasion of uredospores germ tube (Tawfik *et al.*, 2001). The success of oil in suppressing plant disease was also achieved on powdery mildew (Fernandez *et al.*, 2006).

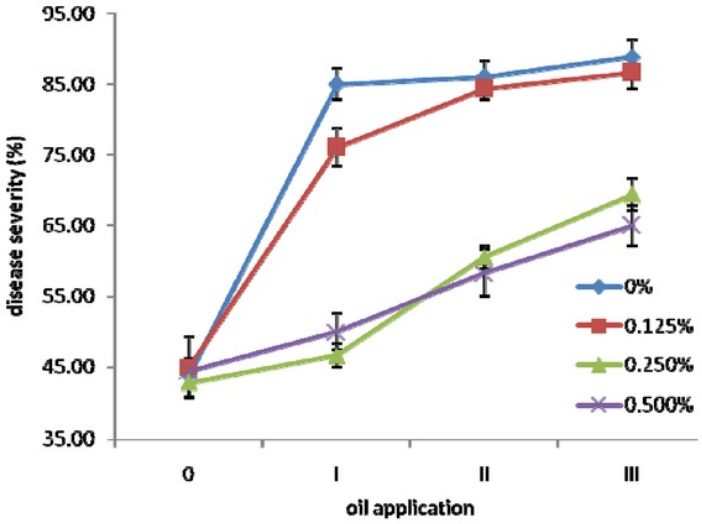

Figure 2. Disease severity (Mean ± SE) of white rust on chrysanthemum leaf treated with 0%, 0.125%, 0.250%, and 0.500% v/v oil application

Table 2. Aphid population and disease severity of white rust (Mean ± SE) on chrysanthemum leaf after third application of 0%, 0.125%, 0.250%, and 0.500% v/v oil

Oil concentration (% v/v)	Aphid population	Disease severity (%)
0	24.11 ± 2.86 q	88.89 ± 2.47 a
0.125	23.89 ± 2.20 q	86.67 ± 2.36 a
0.250	21.67 ± 2.66 q	69.44 ± 2.27 b
0.500	18.00 ± 2.25 q	65.00 ± 2.89 b
Probability (*P*)	0.298	< 0.001

Numbers in columns followed by the same letter are not significantly different

Significant suppression of aphid would likely require either higher concentration of oil or more frequent application of oil then were used in this study to form appropriate oil layer density on leaves surfaces. The level of suppression related to the number of

applications (Fernandez *et al.*, 2006). It should be thick enough to prevent the emitting of leaves volatile.

CONCLUSION

Oil application on concentration of 0.250% and 0.500% was able to suppress the severity of white rust on chrysanthemum. Higher concentration or frequency was required to achieve significant control on aphid population.

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