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Abundance of Citrus Red Mite *Panonychus citri* (McGregor) (Acari: Tetranychidae), Other Mites and its Natural Enemies at Several Citrus Plantation Locations

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ABSRACT

Abundance of citrus red mite (CRM), *Panonychus citri*, phytophagous mite, and CRM natural enemies were observed at five citrus plantations in Indonesia. Eight leaves/ plants were sampled based on point of compass. At Cibeureum and Situ Tengah Bogor plantations sampling was done once a week, whereas at Cianjur and Malang plantations leave sample was picked once a month. The results showed that CRM population peak generally occurred in May and June. The highest CRM population (11.03 CRM per leaf) observed at Malang. The CRM population at Cibeureum and Kebun Pala was higher than that at Situ Tengah Bogor. These differences seemed to be correlated with the difference of agronomic practiced between those plantations. Others phytophagous mites found were mite that grouped in Family Acaridae and sub ordo Oribatida. CRM natural enemies observed in this study were predator mite *Amblyseius longispinosus* Evans (Phytoseiidae) and Stigmaeidae, predator insect *Scolothrips sexmaculatus* (Pergande) (Thysanoptera: Thripidae), and entomoacaripathogen fungi *Hirsutella* sp.

Key words: Abundance, citrus red mite, phytopahagous mites, population dynamic, natural enemies.

INTRODUCTION

Citrus red mite (CRM), *Panonychus citri* is one of the tetranychid mites that cause serious problem in Indonesia citrus plantations. This mite is exotic mite that found at the first time on 1992 in citrus plantation around Malang, East Java [1]. However, so far information on the abundance of CRM abundance is still very limited [2]. The abundance of tetranychid mite population is influenced by local weather, agronomic practices and plant condition due to climate [3]. The weather factors influence tetranychid population includes temperature, relative humidity [4] and rain fall [5]. Commonly, high temperature and low relative humidity would accelerate the growth of mite population [6]. In other hand, high humidity will increase their natural enemy, especially fungi, hence would suppress mite population. The study conducted in USA [4] and Israel [7] showed that CRM prefer upper leaf surface than lower leaf surface.

In Indonesia, data on the abundance of CRM population and others mites, leaf surface preference, as well as CRM natural enemy is limited. This information was necessary to decide the strategy for controlling mite population [1, 2].

The objectives of this research was to study: (1) the abundance of CRM population on several citrus species that receive different agronomic practices on several citrus plantation, (2) the abundance of phytophagous mite population, predator insect and mite as natural enemies of CRM, and others natural enemies at the same location, (4) leaf surface preference of CRM, and (5) stage composition of CRM

MATERIALS AND METHODS

CRM population abundance and Phytophagous mite

The research was conducted at four citrus plantations; three plantations in West Java Indonesia, i.e. Cibeureum plantation, Situ Tengah plantation (both at Bogor district) and Kebun Pala plantation (Cianjur district); and one in East Java, Indonesia, i.e. Kusuma Agrowisata, Malang district. The selection of these plantations was based on the differences in climatic condition, and agronomy practices. West Java is relatively has a higher rainfall and relative humidity compared to East Java. At Cibeureum plantation there are two varieties of citrus gown close each to other, whereas in other plantations there is only one citrus species.

Sampling was done by systematic diagonal system. At Cibeureum plantation, 10 plants (each species) were used for sample plants from which 8 leaves/plants were picked at each point of compass. At orange plantation Situ Tengah plantation, the sample plants used were 15 plants, whereas at Kebun Pala and Kusuma Agrowisata plantations used 20 sample plants.

At Cibeureum and Situ Tengah plantations, leaf samples were picked every one week, whereas at Kebun Pala and Kusuma Agro plantations, leaf samples were taken at every month. This was done for 6 months, from April to September 2004. Each

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leaf sample was placed in plastic bag, and then put in a cool box to keep mite did not move, after which it was put in refrigerator at 5^0 C. Observation was conducted under stereo microscope to count abundance of all stage of CRM, phytophagous mites on every pieces of sample leaf.

Identification was done by using mite preparate slide with medium Hoyer liquid under compound microscope to determine species phytophagous mite and others mite by guiding identification key [8,9].

Abundance of Phytoseiid, and other mite enemies

This abundance study Phytoseiid and other natural mite enemy was conducted at the same time with the mite study and the methodology employed was similar to that of mite study. Every phytoseiid, others arthropod predator, CRM natural enemies besides arthropod that found on every leaf was counted and recorded. Phytoseiid predator identification was conducted based on the identification method [10].

RESULTS AND DISCUSSION

Agronomic practices

Cibeureum plantation grows 2 citrus varieties which planted close each to other, i.e. *Citrus lemon* and *C. macrophylla,* whereas other plantation only grow one citrus variety, i.e. *Citrus lemon* in Kebun pala plantation, *C. cinensis* 'Java' in Situ Tengah plantation, and *C. cinensis 'Valencia'* in Kusuma Agrowisata plantation.

Due to budged limitation, citrus plantation at Kebun Pala did not receive intensive agronomic practices. The plants did not receive any fertilizer since 2 years ago, so that all the plants seemed senescence with yellow leaves. There was no insecticide treatment for pest control. During observation, branch pruning and weeding were only done once. Branch pruning was done only by cutting the dry branches. The similar practices were observed at Situ Tengah plantation. Cibeureum plantation had slightly better agronomic treatments: the plantation relatively cleans from weeds; although rarely, the citrus plants were fertilized, and pest control with insecticide was done weekly.

Kusuma Agrowista plantation, in other hand, got very intensive agronomic. This plantation was managed for Agro-tourism. Weeding, fertilizing, pruning, and pesticide application were done regularly.

Population characteristic of CRM

All growth stages of CRM (egg, larvae, and nymph, male and female adult) were observed during observation. Egg stage population was the highest, followed by larvae and nymph, and the lowest were male and female adult. The highest CRM population was observed at Kusuma Agrowisata Malang with average egg stage of 70%, but the highest egg stage occurred at Cibeureum plantation, with the average of egg stage of 80%,. The lowest CRM population was observed at Situ Tengah Plantation with 6 eggs, one adult female and one adult male. At Kebun Pala and average egg stage were 70%.

In general, the peak population occurred during May to June (Figure 1). At Cibeureum (Bogor), at early observation, CRM population on *C. lemon* was relatively high (12.98 eggs, nymph, females and males per leaf and 0.49 females per leaf), then increased rapidly in the middle of May, and reaching a peak density (27.35 all stage of CRM with 1.22 females per leaf) in the middle of June; after which decreased and the occurrence disappeared in the end of August. A similar population trend, except with much lower population, was observed on *C. macrophylla*. At early observation, CRM population was less than 1.0 CRM per leaf. The population start to increase in 3rd week of May, reached a peak in the middle of June (16.25 all stages CRM with 0,46 females). Then the population decreased continuously, and diminish at the end of observation.

At Situ Tengah plantation, there was only found 6 eggs, one female, and two males. This population did not develop during observation period. A low CRM population was also observed at Kebun Pala plantation, but still had population changes during observation period. The trend of CRM fluctuation population in this plantation was similar CRM population at Cibeureum. At early observation there were no CRM population. The population increased from May, reaching a peak density in the middle of June (0.58 all of CRM stages with 0.063 females), and then decreased rapidly.

The difference of CRM population among citrus plantations seemed to correlate with difference of agronomic practices; this is including variety, fertilizer, and pesticide application. Addition of fertilizers with no enough pest control like at Cibeureum, plantation resulted in the high CRM population. Fertilization could increase tetranychid fecundity through better food quality [10].

The high CRM population abundance at Kusuma Agrowisataa was unexpectedly. This plantation received a very intensive management, include pest control with pesticide. It was possible that the pesticide used or the time of pesticide treatment did not meet the requirement. In other hand, a good fertilization treatment in this plantation was able to increase food quality for mite [9], and to provide a better microhabitat for phytophagous mite [2]. Another reason for high CRM population at Kusuma Agrowisata plantation is CRM had relatively resistant to pesticide used for pest control. The similar phenomenon had also been found in Japan [11].

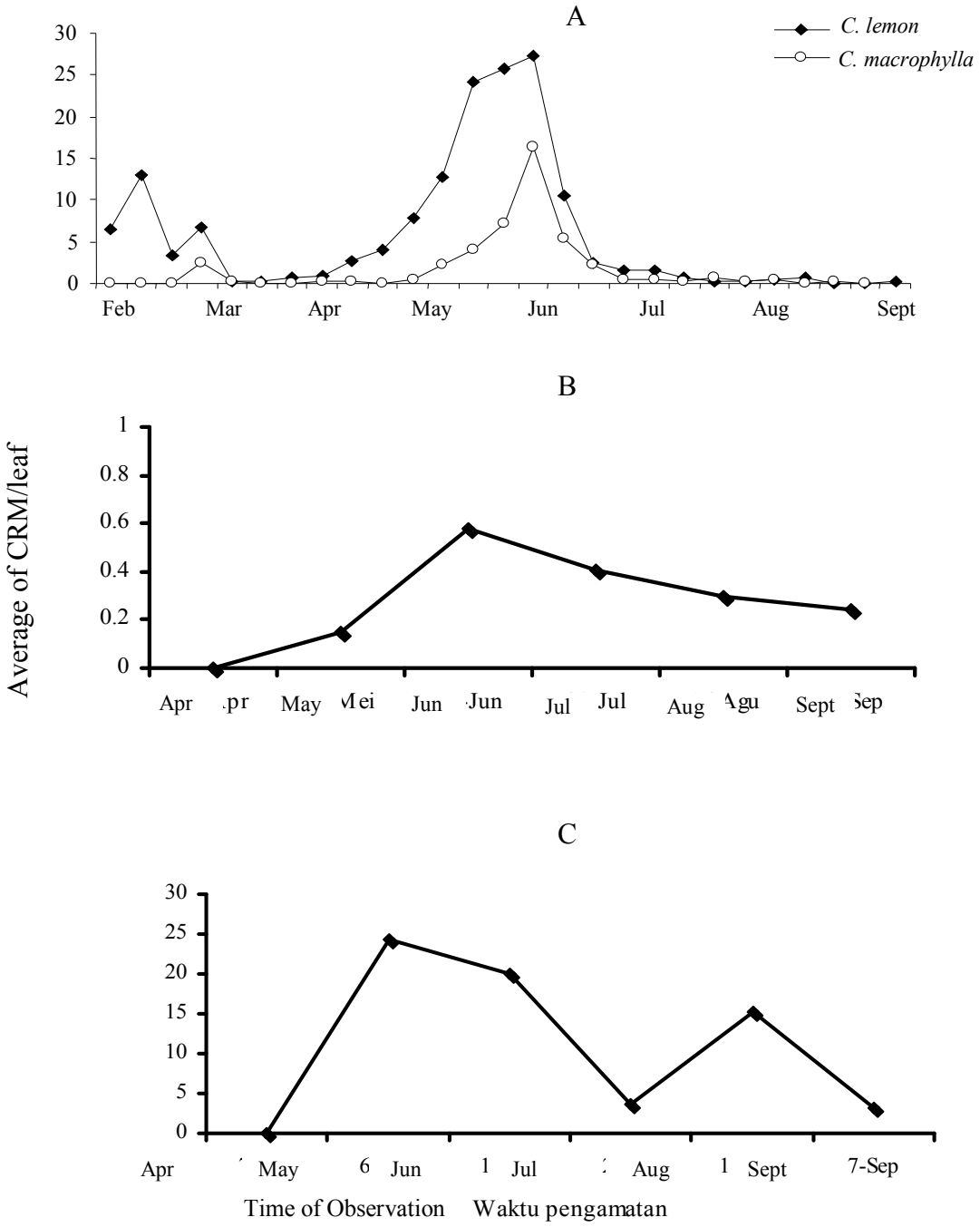

Figure 1: Abundance of CRM at Cibeureum Bogor (A), Kebun Pala, Cianjur (B), and Kebun Kusuma Agrowisata, Malang (C)

The dynamics of CRM population seemed to correlate with weather change. During High rainfall is not suitable for mite; there for the peak population in West Java (Cibeureum, Situ Tengah dan Kebun Pala plantations) occurred on May. During this month, although almost everyday rain, but rainfall was low (5-50 mm/day) with average temperature approximate to 26^{o} C and relative humidity approximate 82%. The highest CRM population at East Java (Kusuma Agrowisata plantation) might be also due to a better environment for mite development. Kusuma Agrowisata has a relative dryer weather than the other 3 plantations. The average of temperature: 24^{o} C, relative humidity, and rainfall during observation at this plantation were 24^{o}C, 55 %, and 2.1 mm/day respectively.

The larvae, nymph and mite adult moving actively, therefore the preference of CRM on leaf surface was observed based on egg number only. The result showed that eggs were found on both leaf surface, but except at Kusuma Agrowisata plantation, it preferred on upper leaf surface (Figure 2). At

Cibeureum, 64.34% and 77.43% CRM eggs were found on upper leaf of *C. lemon* and *C. macrophylla* respectively. At Kebun Pala, 59.40% eggs were laid on upper leaf surface, and at SituTengah, all 6 CRM eggs were laid on upper leaf surface.

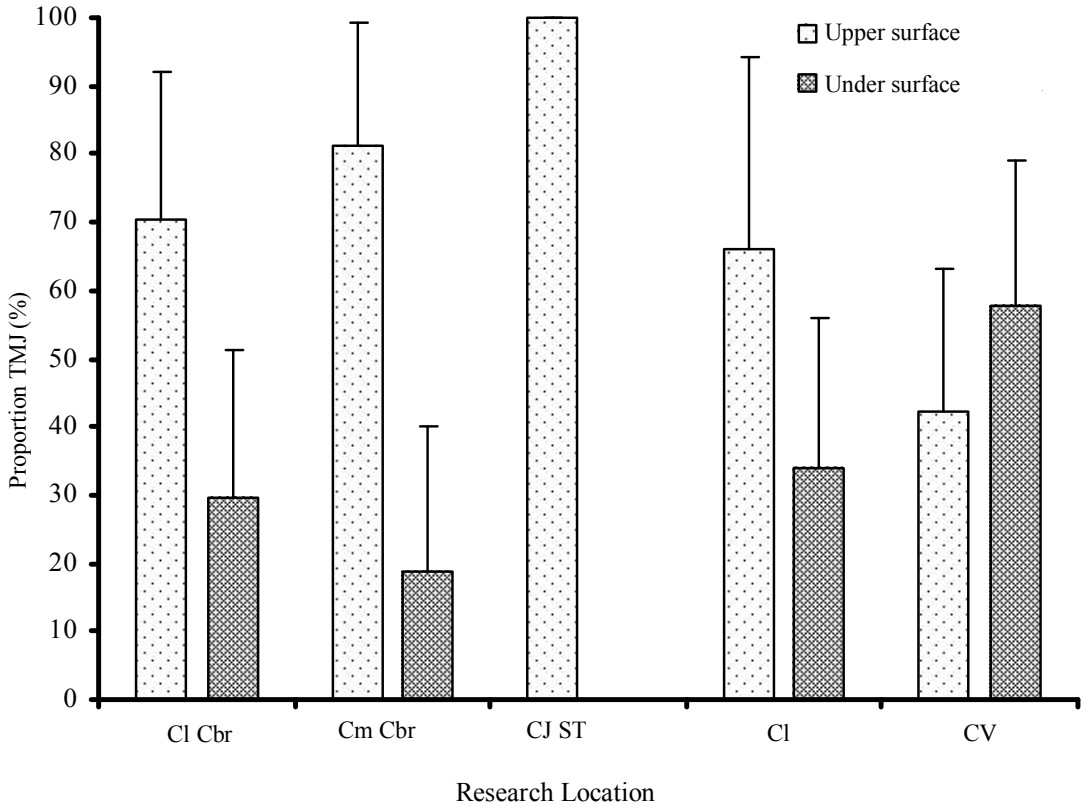

Figure 2 Proportion of CRM on upper and under citrus leaf surface at Kebun Cibeureum, Bogor (Cl Cbr : *C. lemon* Cibeureum, Cm Cbr : *C. macrophylla* Cibeureum); Kebun Situ Tengah, Bogor (CJ ST : *C. sinensis* java Situ Tengah); Kebun Pala, Cianjur (Cl : *C. lemon*); and Kusuma Agrowisata, Malang (CV: *C. cinensis* valencia) from March to September 2004

Different pattern was observed at Kusuma Agrowisata plantation. During the first two month observation, the preference was similar to the other plantations, i.e. 54.50 % CRM eggs were laid on upper leaf surface. However, observation during July to September, most of CRM eggs were under leaf surface (Figure 3). In late June, Malang area had dust rain that came from Mount Semeru which caused all upper leaf surface covered by dust. Because of dry season, the dust that covered upper leaf surface was observed until end observation. The dust that covered upper leaf surface disturbed CRM activity. On every leaf sample, the dust covered almost all of part of upper leaf surface; therefore most of CRM population were on under leaf surface.

Other phytophagous mites

Other phytophagus mites found during this study were belongs to family Acaridae, Tenuipalpidae, Eriophyidae and sub order Oribatida.

Tenuipalpidae, *Brevipalpus phoenicis* Geijkes species, were found in all plantations. Eryophyidae was found at Cibeureum and Situ Tengah plantation. Eriophyid abundance in Situ Tengah was 43.33 CRM per leaf.

CRM natural enemies

The natural enemies found in research location were: 1) predator mite, 2) entomoacaripathogen fungi, and 3) predator insect. The predator mite could be classified in to genus of phytoseiid, i.e. *Amblyseius longispinosus* Evans, and genus stigmaeid. Predator stigmaeid was important predator to tetranychid after phytoseiid [12]. Its preys at citrus plantation were tetranychid *Eotetranychus sexmaculatus* (Riley) and CRM. Others preys were *Brevipalpus phoenicis* (Geijski) on tea at Indonesia [13], eriophyid, tetranychid *Tetranychus* sp., and *Panonychus ulmi* Koch [12].

A. longispinosus and stigmaeid were found in observation locations. The population sbundance of *A. longispinosus* in all of citrus plantation location was higher than that of stigmaeid. The highest population of *A. longispinosus* was found in Kusuma Agrowisata Malang; then followed in Kebun Pala. Similar to A.

longispinosus population, the highest Stigmaeid population was found at Kusuma Agrowisata, then followed by Ciberureum plantation (on C. *lemon*).

The entomoacaripathogen fungi found during in this study belongs to *Hirsutella* sp. which infected CRM nymph and or adult mite. However, this fungus was found only at Cibeureum and Situ Tengah plantations. At Cibeureum plantation, from total population of 1845 CRM nymph and adult mite on lemon citrus, 34 CRM or 1.84 % were infected *Hirsutella* sp; and from 368 CRM nymph and adult mite observed on *C. macrophylla*, 12 CRM or 3.26 % were infected by the fungi. At Situ Tengah plantation, from 9 CRM population 44.4% were infected by *Hirsutella* sp. In Kebun Pala Cianjur and Kusuma Agrowisata Malang there was no CRM infected by *Hirsutella* sp. As discussed above, Kusuma Agrowisata had a dryer weather condition with relative humidity of 55%, that was not suitable for the fungi to growth. It seemed the application of fungicide at this plantation suppressed fungi growth as well.

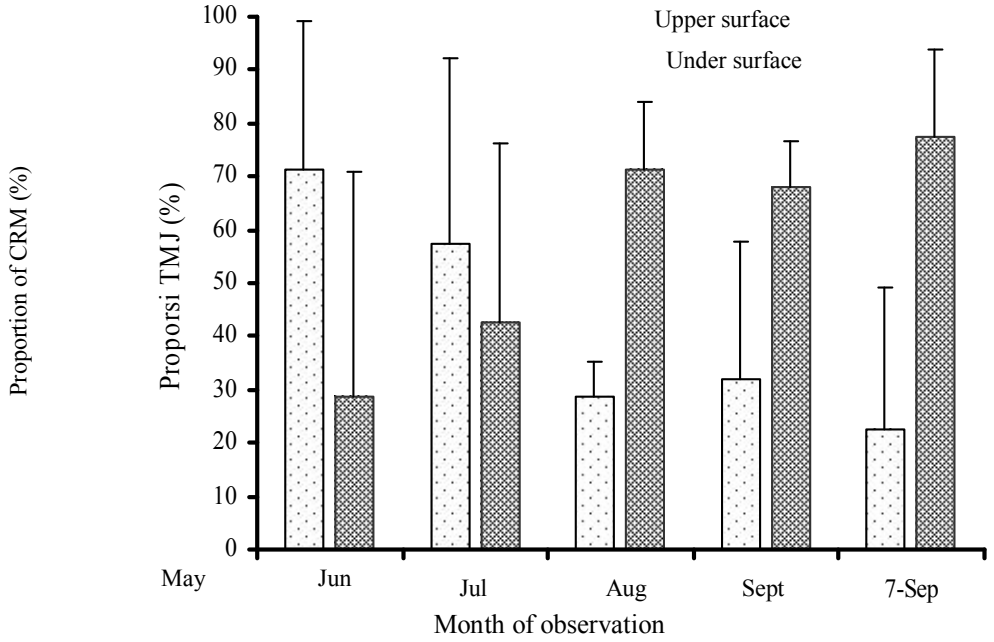

Figure 3 Proportion of CRM on upper and under citrus leaf at Kebun Agrowisata Malang

The predator insect found were found in all plantation and belongs to trips, but the abundance was low (<0.009/leaf). The thrips body is yellow with black spot on every its fore wing. Species with this character is *Scolothrips sexmaculatus* (Pergande) [14]. *S. sexmaculatus* was tetranychid specialist predator (10), and it prefered CRM egg [15]. In California *S. sexmaculatus* consumed CRM and avocado tetranychid mite *Oligonycus punicae*, (Hirst) although its control potential was not clear [16].

CONCLUSSION

The highest CRM population abundance was observed at Kusuma Agrowisata citrus plantation, although this plantation had an intensive agronomic practices (include the use of pesticide), then followed by Cibeureum plantation which had less agronomic treatment (fertilized only). The CRM population at the other 2 plantation, which had no agronomic treatment, was very low. Kusuma Agrowisata plantation had a relative drier weather condition. Thus it can be concluded that the abundance of CRM population was influenced by agronomic practice and climatic conditions. Fertilizer application resulted in a better food quality for mite, hence increase CRM population. The use of improper pesticide increases the resistance of mite, so that it did not capable of decreasing mite population. CRM preferred above leaf surface than under leaf surface. The highest stage proportion of CRM was egg, followed by larvae and nymph, and the lowest was adult. In research location beside CRM, we found phytophagous mite, i.e. oribatid, acarid, tenuipalpid, dan eriophyid. Natural enemies of CRM found in citrus plantation were predator mite phytoseiid *A. longispinosus,* stigmaeid, thrips predator insect *S. sexmaculatus*, and entomoacaripathogen fungi, *Hirsutella sp.*

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