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COMPARISON OF FIVE LEGUMES AS HOST OF *Tetranychus* sp. (ACARI: TETRANYCHIDAE) MASS REARING

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ABSTRACT

Two spotted mite (TSM) *Tetranychus* sp. is often used as host for predator mite Phytoseiidae mass rearing. To obtain high population of TSM in short time, it must be reared in host plants that support optimum growth and development. The objective of this research was to observe population development of TSM on legumes such as mungbean (*Vigna angularis*), adzukibean (*V. radiata*), snapbean (*Phaseolus vulgaris*) and soybean (*Glycine max*) (Wilis and Anjasmoro cultivars) and to compare the growth of the legumes based on their fresh leaf weight and leaf area, and cost seed index (CSI). The results showed that mungbean was suitable host plant for TSM mass rearing because its population on this legume was the highest. Mungbean's fresh leaf weight and leaf area was the highest. If TSM is reared in plant in greenhouse, CSI will become one of criteria for determining the host plant. Although CSI of mungbean was low because TSM population that was reared on it is the highest, the mungbean was the most suitable host plant for TSM growth and development. Another host plant that was suitable for TSM reared was adzukibean.

Keywords: legumes, mass rearing, *Tetranychus uritcae*

INTRODUCTION

Tetranychid is commonly used as a prey for mass rearing the predatory mite Phytoseiidae, an important bioagens. Release of three phytoseiid *Phytoseiulus persimilis*/m² on strawberry in greenhouse reduced the number of tetranychid *Tetranychus urticae* per leaf to less tan 1.0/leaf (Kim 2000). An adult female *P. persimilis* consumes 6.47 adult *T. urticae* per day (Naher and Haque, 2007; Shih, 1985; Lo *et al*., 1990; Zhang. 2003).

Through phytoseiid mass rearing on several plants, using tetranychid as prey was needed for large scale rear over short period. Tetranychid grows rapidly on certain host plants which ensure hytoseiid prey availability. Tetranychus is one of some genera of Tetranychidae with short life cycle.

Although various plants have been used as a host to raise tetranychid, there is no unanimity as to which one is the promising host. Sweet potato, corn, clover, and some legumes have been used as host plant (Lee *et al.,* 1999). *Phaseolus vulgaris* is the best host plant for *T. urticae* (Childs *et al*., 1976; Sivritepe, 2009; Buenob *et al*., 2009). Nevertheless, Lee *et al*. (1999) observed that *Glycine max* was the most suitable host plant for *T. urticae* and *T. kanzawai*

Furthermore no such experiments have been conducted in Indonesia as far as we are aware. Therefore, to understand population dynamic of *Tetranychus* sp. on various host plant species, this experiment was conducted.

MATERIALS AND METHODS

The greenhouse experiment used Randomized Block Design with five treatments and five replications. The treatments included mungbean (*Vigna angularis*), adzukibean (*V. radiata*), napbean (*Phaseolus vulgaris*), soybean (*Glycine max*) particularly Wilis and Anjasmoro cultivars, as host plants of TSM. Mass rearing of mite in laboratory used arena made of rubber that was soaked on Petri dish. A synthetic cotton wool was placed on the rubber and always kept wet to keep *T. urticae* on arena, and a disc of cassava leaf was placed on the wet cotton.

Mass Rearing of *T. urticae*

The aim of this rearing was to provide the number of the same stage of *T. urticae* before they infested the host plants. In this experiment we used cassava leaf, one of primary host of *T. urticae,* and it was collected from cassava plant in Brawijaya University.

A cassava leaf disc was placed on an arena, and *T. urticae* was inoculated. A soft camel hair brush (no. 0) was used to transfer the mites. The leaf disc was replaced every three days. Removing *T. urticae* to the fresh leaf was done by dividing the infested leaf into 4-5 pieces and placing it on fresh leaf using a pincer. The wet side of infested leaf was dried by using tissues, and this side was face upward.

Propagation of *T. urticae* on Legumes

Two pairs of adult *T. urticae* (two days age) were inoculated on each legume at V1 stage (complete unrolling of the primary leaf). The inoculated plant was covered with plastic cage. The propagation of *T. urtcae* was observed at the 14^{th} day after inoculation by counting egg, larvae, nymph, and adults.

Growth of Legumes

Investigating growth of legumes was conducted by preparing 500 polybags for five varieties, where each variety required 100 polybags, and one plant was grown in each polybag. The growth of legumes was observed by measuring fresh leaf weight and leaf area at V1, V2, dan V3 stages. V1 stage is the primary leaf unrolling completely. V2 stage is the 1^{st} trifoliate unrolling completely, while V3 stage is the 2^{nd} trifoliate which unrolled completely. At every stage of leaf was cut five leafs per plant to measure their fresh weight. The observation was started since the primary leaf was open. It was measured every other day for eight days. Measuring leaf area was done by using digital leaf area meter.

Cost Seed Index

Cost Seed Index (CSI) is used as one of factors in considering TSM host plant. Phyto-phagous mite rearing was more efficient and economical when it was reared on host plant with the cheapest seed. The formulation of CSI was described by Lee *et al*. (1999).

$$CSI = 1000 : (\frac{b}{100}) : a \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Remarks :
a = seed price per kg (Rp/kg)
b = 100 seed weight (g)

Proximate Analysis

Proximate analysis was carried out to know the composition of protein, carbohydrate, fat, water and mineral on legumes leaf. It was conducted in Central Biology Science Laboratory, Brawijaya University.

RESULTS AND DISCUSSION

Mass Rearing of *T. urticae* on Legumes

The result of this research shows that mungbean had the highest total population of *T. urticae* (egg, larva, nymph, and imago stages) among other varieties of Legumes, while snap-bean took the lowest (Table 1).

The highest *T. urticae* population on mungbean indicated that mungbean was probably a good food source for *T. urticae*. The development of *T. urticae* was influenced by temperature, relative humidity, and food quality (Zhang, 2003). *T. urticae* also laid more eggs on mung-bean. Razmjou *et al*. (2009) and Lee *et al*. (1999) reported that soybean was the suitable host plant for *T. urticae* development.

Although Anjasmoro had the highest protein and Wilis had the highest carbohydrate (Table 2), the population of *T. urticae* on both was poor. Mungbean leaf had the balanced nutrient levels. It was indicated by the greatest development of mite

Table 1. Total Population of *T. urticae* on Legumes on day 14 after investment

Variety of legumes	Egg	Larva	Nymph	Adult	Total
Mungbean	1.009 a	29 a	73 a	103 a	1.214 a
Anjasmoro	665 b	41 b	27 b	64 b	797 b
Wilis	466 b	9 c	79 a	43 c	597 b
Adzukibean	500 b	10 c	33 b	40 c	583 b
Snapbean	189 c	15 c	24 b	44 c	272 c

Remarks = numbers followed by different letter in same column showed significant difference at 5%

Table 2. Proximate content in leaf beans (%)

Variety of legumes	Protein	Fat	Carbohydrate	Water	Mineral
Mungbean	3.356	1.595	4.278	89.015	1.756
Anjasmoro	5.181	0.195	6.645	86.391	1.588
Wilis	4.873	0.285	11.696	81.216	1.930
Adzukibean	2.509	0.060	10.343	85.603	1.485
Snapbean	1.911	0.090	5.159	90.937	1.903

The most frequent trichome was adzukibean and soybean leaf. Adzukibean and soybean had longer trichome than mungbean and snapbean. These morphologycal characteristics could inhibit the locomotion and activity of *T. urticae* on both. The smooth leaf surface could not inhibit the locomotion and activity of mite (Kabicek, 2003; Kabicek and Koubkova, 1998; Walter, 1992).

Based on proximate analysis, trichome, leaf nutrition and morphology had influence on *T. urticae* development.Mungbean was the most favorable for *Tetranychus* sp. It was also influenced by morphological of leaf which has low trichome density and smooth surface (Table 3).

Table 3. Total trichome of legumes

Variety of legumes	Abaxial surface (mm^2)	Adaxial surface (mm^2)
Mungbean	2.6	0.6
Anjasmoro	3.2	7.2
Wilis	8.8	16.2
Adzukibean	13.0	15.2
Snapbean	0.8	0.4

Growth of Legumes

Mungbean had the highest leaf weight at three developmental stages (Table 4). It also had the greatest leaf area at all developmental stages (Table 5).

Leaf weight and leaf area of legumes were influenced by the seed size. The leaf weight, leaf area and seed size showed a positive correlation. It seemed that the legume had the weightiest seed (Table 6) and biggest seed; the leaf weight and leaf area became the highest. Leaf area can influence photosynthesis. The greater the leaf area is, the more chlorophyll the leaf contains, and the higher the photsyntate will be. The photosynthate is used as reserved food, respiration, and growth. Good photosynthesis supports plant growth development (Gardner *et al.*, 1991).

Table 4. Fresh weight leaf of legumes at three developmental stages (g/plant)

Variety of legumes	V1	V2	V3
Mungbean	0.453 a	0.521 a	0.912 a
Anjasmoro	0.100 c	0.126 c	0.135 b
Wilis	0.089 c	0.098 c	0.144 b
Adzukibean	0.053 c	0.131 c	0.132 b
Snapbean	0.329 b	0.391 b	0.442 b

Remarks = numbers followed by different letter in the same column show significant difference at 5%

Table 5. Leaf area of legumes at three developmental stages (cm^2/plant)

Variety of legumes	**V1**	**V2**	**V3**
Mungbean	112.0 a	119.4 a	179.4 a
Anjasmoro	27.2 c	38.4 c	50.4 c
Wilis	25.2 c	39.2 c	42.0 c
Adzukibean	20.0 c	21.6 d	26.6 c
Snapbean	53.6 b	60.6 b	79.8 b

Remarks = numbers followed by different word in the same column show significant difference at 5%

Cost Seed Index of Legumes (CSI)

Based on CSI, the highest CSI value was adzukibean and the snapbean was the opposite, which means that adzukibean was the cheapest (Tabel 6).

CSI played an important role in term of mass rearing program while the author made decision on the most suitable hosts (Lee *et al*. 1999). It was necessary for mass rearing of *T. urticae* as they had wide area and more seed. The biggest seed size means the lowest CSI value. Mungbean had the wider leaf area and weightier seed, but the CSI became lower than adzukibean. On the contrary, adzukibean, which had the smallest seed, had the highest CSI (Tabel 6).

Table 6. Cost seed index of legumemes

Variety of legumes	Seed size (mm)	Price (Rp /Kg)	Weight/100 seed (g)	CSI (seed/Rp)
Mungbean	18.0	9,700	39.70	0.260 d
Anjasmoro	8.5	9,500	12.24	0.862 c
Wilis	7.0	9,500	8.59	1.225 b
Adzukibean	5.0	10,000	5.59	1.785 a
Snapbean	13.0	52,300	25.67	0.071 e

Remarks = numbers followed by different word in the same column show significant difference at 5%

CONCLUSIONS

The suitable host plant for developing *T. urticae* was mungbean. Mungbean had the highest fresh leaf weight and the greatest leaf area at all developmental stages as well, although based on CSI value of mungbean is low (0.260). Adzukibean can be used as alternative host plant for mass rearing of *T. urticae,* because of its highest CSI value (1.785).

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