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MASS-REARING OF BROAD MITE, *Polyphagotarsonemus latus* (Banks)(Tarsonemidae, Acari), ON ALUGBATI, *Basella rubra* L. (Basellaceae), WITH NOTES ON ITS FEEDING DAMAGE, DEVELOPMENT AND POPULATION GROWTH

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ABSTRACT

Alugbati, *Basella rubra* L., and several reported host plants of the broad mite were evaluated initially for use as feed in the laboratory. Only alugbati supported active growth of the broad mites while seedlings of castor (*Ricinus communis* L.), eggplant [*Solanum melongena* (L.) (Walp.)], pepper (*Capsicum annuum* L.) and stringbeans (*Vigna unguiculata* L.) became etiolated inside the laboratory and did not sustain active growth and development of the pest. The leaves of alugbati shoot terminals are softer, more succulent and would last longer under laboratory conditions because roots develop under water, keeping them fresh longer.

A laboratory mass- rearing technique developed for *Polyphagotarsonemus latus* (Banks) on alugbati is presented. The technique makes use of alugbati shoots for oviposition and feeding, glass containers for holding the alugbati, and tap water to keep the host materials fresh. A total of 1573 eggs, larvae, deutonymps and adults of *P. latus* was produced after a week of rearing on alugbati from an initial total population of 603. Alugbati shoot remains attractive for oviposition and feeding of the broad mites for about 10 days and needs to be replaced for continuous rearing and production of the mites.

Alugbati is now included as additional host plant of *P. latus*, together with saluyot (*Corchorus olitorius* L.), cholesterol plant (*Gynura nepalensis* DC), and castor.

Key words: broad mite, tarsonemid mite, alugbati, mass-rearing

INTRODUCTION

The broad mite, *Polyphagotarsonemus latus* (Banks), is a cosmopolitan species, highly polyphagous, and a serious pest of crops in the field and greenhouse. It has been recorded on 35 host plant species in the Philippines (Gabriel 1997) and more

than 100 in the world (Gerson 1992). Its recorded Philippine hosts include *Acacia mangium*, *Arachis hypogaeae*, *Asparagus officinalis*, *Cajanus cajan*, *Capsicum annum*, *C. frutescens*, *Carica papaya*, *Citrus* sp., *Dahlia* sp., *Gossypium hirsutum*, *Glycine max*, *Hibiscus esculentus*, *Jatropha curcas*, *Lablab niger*, *Lycopersicon lycopersici*, *Momordica charantia*, *Morus alba*, *Nicotiana tabacum*, *Pachyrrhizus erosus*, *Persia americana*, *Phaseolus lunatus*, *P. vulgaris*, *Pisum sativum*, *Psidium guajava*, *Psophocarpus tetragonolobus*, *Solanum melongena*, *Solanum tuberosum*, *Tamarindus indicus*, *Vigna unguiculata*, and *Vitis vinifera*.

Damage of *P. latus* on its hosts reduces market yield and injures plants by reducing leaf number and area, deforming leaves, flowers and fruits (Schoonhoven et al. 1978, Gerson 1992) and, under heavy infestation, plants become stunted and die (Pena and Bullock 1994). The injury it causes has also been mistaken for virus diseases, herbicide toxicity or micronutrient deficiency (Beattie and Gallatley 1983, Cross and Basset 1982). In cucumber for instance, infested plants showed growth inhibition and a decrease in leaf number and area and aberrations in the whole leaf tissue, such as complete loss of epidermis and thickening and distortion of mesophyll cell walls (Grinberg et al. 2005).

P. latus disperses by wind, human transport of infested products and also through insects living on plants like *Bemisia tabaci* on *Phaseolus vulgaris* in Colombia and on *Cucumis sativus* and *Sesamum indicum* in Venezuela (Bautista et al. 2005, Soroker et al. 2003), colonizing new host plants and habitats.

P. latus is potentially serious on several cultivated crops in the Philippines. Heavy infestation on potato in the lowlands resulted in economic yield loss to the growers (Eusebio and Bernardo 1999). It is an emerging pest of *Jatropha curcas* (Navasero 2010). However, it is an excellent prey for predators of the families Phytoseiidae (e.g. *Amblyseius asiaticus, A. cinctus, A. largoensis, A. tamatavensis, Chanteius contiguous, Euseius ovalis, Neoseilus calorai, Paraphytoseius orientalis, Phytoseiuscoheni, Ph. glareosus, Proprioseiopsis lenis, Typhlodromusasiaticus, T. beelarong, Typhlodromus* (*Anthoseius*) *transvaalensis, T. philippinensis*), Cheyletidae (e.g. *Cheletomimus* (*Hemicheyletia*) *wellsina*), Ascidae (e.g. *Asca garmanioides*), Bdellidae (e.g. *Bdellodes harpax*), Cunaxidae (e.g. *Cunaxa lukoschusi, C. womersleyi*), and Stigmaeidae (e.g. *Mullederia filipina*) (Corpuz-Raros 2005, Corpuz-Raros and Navasero 2005).

This paper presents additional records on host plants, localities where found, and data on development and population build-up of *P. latus* on alugbati, including a laboratory method for mass-rearing of the broad mite for predator-prey studies.

MATERIALS AND METHODS

Stock culture

The initial laboratory stock of *P. latus* was collected from apical shoots of alugbati in Mayondon, Los Baños, Laguna in February 2013. Since then, the mites have been maintained on rooted shoots of alugbati in the laboratory at the National Crop Protection Center-Crop Protection Cluster, in UP Los Baños. A purified stock of *P. latus* was maintained on rooted cuttings of alugbati and from which test mites for various experiments in the laboratory were taken (Figure 1).

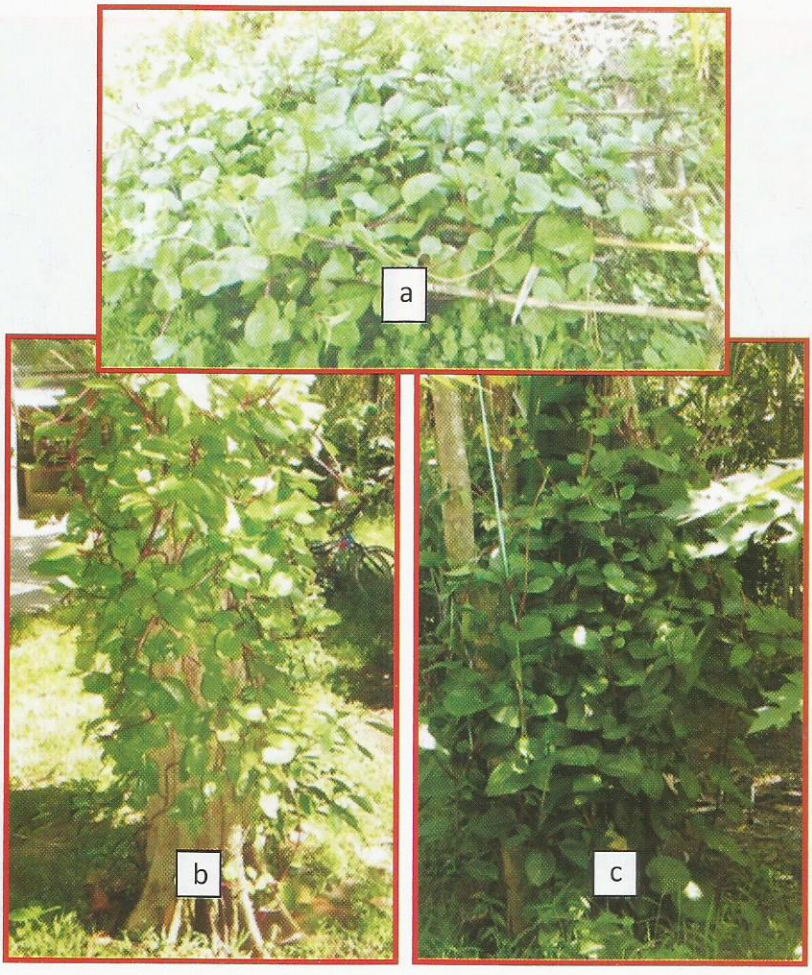

Figure 1. Home grown *Basellar ubra,* natural host of *Polyphagotarsonemus latus,* as source of the laboratory stock culture of the broad mite. Note the vigorous stand of the plant when grown and supported by a) bench type bamboo trellis, b) cut trunk of lanzones tree, and c) rooted and growing branch of kakawate tree.

Selection of host plants

Preliminary trials with various natural host plants were conducted to find suitable host(s) for rearing P. *latus* under laboratory conditions. Selection of a host was based on its availability, ease of propagation and maintenance under laboratory conditions, and its acceptability to the mite as manifested by the pest's readiness to settle and reproduce. Several host plants (Figure 2) were evaluated for their suitability as hosts in the mass culture of the broad mite. Apical shoots of the new host plants were used since the broad mites are usually observed feeding on expanding leaves on

Figure 2. Host plants used in the mass rearing experiments on *Polyphagotarsonemus latus* under laboratory condition: (a) pepper (*Capsicum annuum*), (b) castor (*Ricinus communis*), (c) eggplant (*Solanum melongena*), and (d) stringbean (*Vigna unguiculata*), in addition to *Basellar ubra*.

the upper part of the plant. Using a fine-pointed camel's hair brush, three female deutonymphs, each carried by a male, were carefully placed on the youngest expanding leaf of each host plant. They were allowed to reproduce on each host for at least two weeks, after which the eggs, larvae, deutonymphs, adult males and females were counted and recorded. Three shoots per host plant were inoculated and monitored.

Mass Rearing of *P. latus*

Glass bottles (500 ml capacity) were used to hold the host plant shoots. Each bottle was filled with tap water and placed on top of a table with provision to ward off ants and predators which may invade the culture (Figure 3). Infested shoots from the stock culture were collected. A shoot was placed in the middle of each bouquet of fresh alugbati shoots. After about two weeks the host became fully infested by the broad mites and other containers with bouquet of fresh alugbati shoots were prepared for infestation. The process was repeated continuously to maintain the cultures of broad mites.

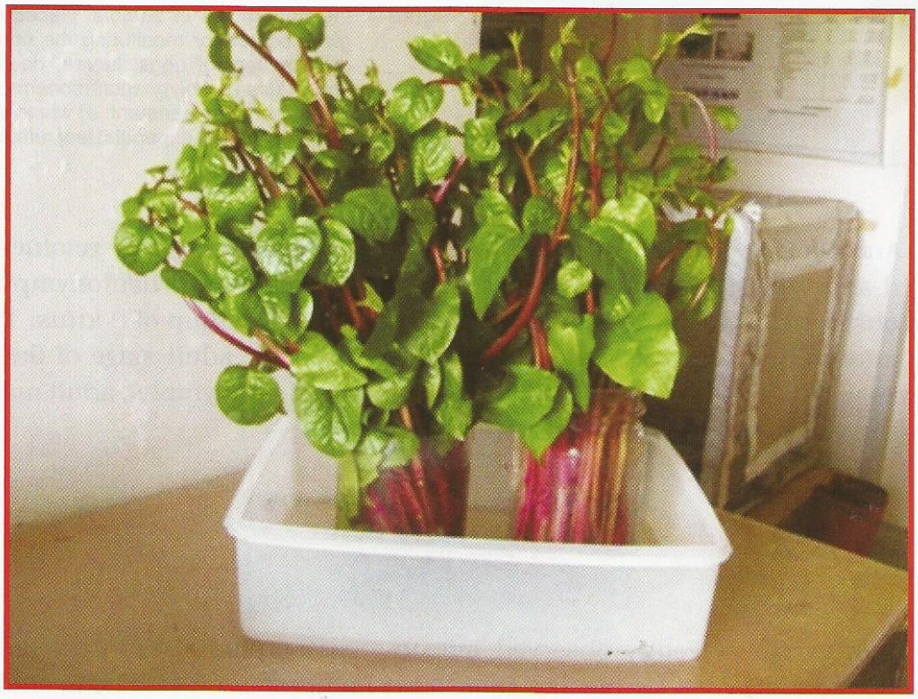

Figure 3. Mass rearing set-up for *Polyphagotarsonemus latus* using alugbati shoots in glass containers with water. The glass containers are kept inside plastic containers with water to prevent ants from attacking the mites.

The suitability of alugbati as host for the mass rearing of *P. latus* was evaluated within four weeks of continuous rearing on said host. Ten infested shoots were selected at random and numbered accordingly (Figure 4). Samples were monitored every five to seven days and the eggs, larvae, deutonymphs, adult males and females per leaf per shoot were counted and recorded.

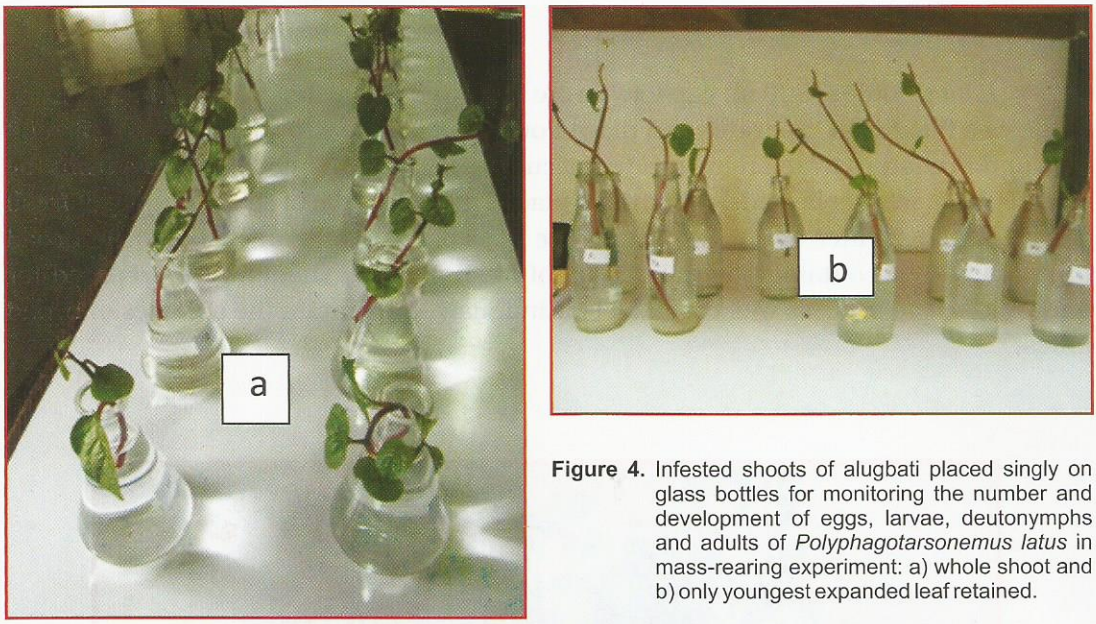

Figure 4. Infested shoots of alugbati placed singly on glass bottles for monitoring the number and development of eggs, larvae, deutonymphs and adults of *Polyphagotarsonemus latus* in mass-rearing experiment: a) whole shoot and b) only youngest expanded leaf retained.

Another ten shoots, with only the youngest expanding leaf retained, were prepared and infested separately with a male carrying a female deutonymph on its back to observe closely the development and population build-up of *P. latus*. The pair was monitored daily up to two weeks for molting into the adult stage of the female deutonymph, and then the number of eggs laid, larvae, deutonymphs, adult males and females produced were counted and recorded.

RESULTS AND DISCUSSION

Host plants of *P. latus*

P. latus was recently observed infesting castor plants grown in the NCPC greenhouse and recorded for the first time in the Philippines on said host, cholesterol plant, saluyot, and alugbati. However, only alugbati supported active growth of the broad mites under laboratory conditions. Seedlings of castor, eggplant, pepper and stringbeans became etiolated inside the laboratory and did not sustain active growth

and development of the broad mites. It will be interesting to evaluate cholesterol plant and saluyot as potential laboratory hosts in the future. The mites were usually found on the youngest expanding leaves of apical shoots feeding, resting and reproducing. *P. latus* laid few eggs on seedlings of castor, eggplant, soybean, pepper, and potted ratooned *Jatropha curcas*. It was only alugbati that showed potential as an efficient laboratory rearing host of *P. latus*. Good rate of development using the production of eggs of *P. latus* as indicator, is shown in Table 1. Significantly higher number of eggs were laid on the third apical leaf of the shoots.

Table 1. Total number of eggs laid by *Polyphagotarsonemus latus* on the first five leaves of apical shoots of alugbati.

LEAF NO.*	REPLICATE			MEAN**	% OF EGGS
	I	II	III		
1	3	0	10	4.3 c	3.55
2	13	38	36	29.0 bc	23.97
3	40	10	127	59.0 a	48.76
4	0	28	10	12.7 bc	10.47
5	45	0	0	15.0 bc	13.22
TOTAL	101	76	183	121.0	100

*consecutive from youngest open leaf to oldest leaf.
**Means followed by a common letter are not significantly different at 5% LSD.

Feeding damage of *P. latus*

Feeding damage of *P. latus* produced a variety of symptoms on different hosts and plant parts but in general, plant growth was inhibited (Pena and Bullock 1994, Cho *et al.* 1996) and the young apical leaves were heavily damaged, distorted (Basset 1981, Cross and Basset 1982, Gerson 1992, Cho *et al.* 1996), more rigid and curled downwards on the edges (Basset 1981, Cross and Basset 1982, Gerson 1992, Cho *et al.* 1996). The fruits, if any, may be cracked and sometimes reticulated (Basset 1981, Cross and Basset 1982, Gerson 1992, Cho *et al.* 1996).

On alugbati, the broad mites fed almost entirely on the lower leaf surface causing the young leaves to become rigid and curled downwards at the margins. Feeding injury was confined to young expanding leaves. When the leaves became fully infested, part of the colony moved up the shoot onto a younger leaf to feed and reproduce. Generally, when the host started to deteriorate and the mites moved down the stalk to transfer to new or fresh host, many individuals drowned.

Development of *P. latus* on Alugbati

The developmental stages, feeding habits, reproduction, rearing conditions needed for proper growth and development, and suitability of alugbati as laboratory host plant in mass rearing *P. latus* under laboratory conditions, were determined.

Under laboratory conditions, *P. latus* underwent four developmental stages, namely, egg, larva, deutonymph or pupa, and adult. The eggs hatched in a day, adult female emerged in 3-4 days after hatching from the egg, and each laid more than 50 eggs in a lifetime of about 15 days.

The eggs are normally laid on the lower leaf surface of alugbati. They are oval and elongate, transparent with longitudinal rows of white tubercles which become opaque just before hatching.

The newly hatched larva is minute and resembles the adult; pale or colorless but becomes white as it feeds and settles on the lower leaf surface. Once settled, the larva continuously grows and increases in size until it settles down and become quiescent. Reports indicated (eg. Jeppsoneter et al., 1975) that the protonymphal and the deutonymphal stages remain inside the larval skin. From the more enlarged deutonymph, called pupa, emerges the adult female. The adult female which is large, oval and broad, at first is white, turns yellow as it ages, is the biggest among the stages and occupies also the lower leaf surface where it feeds and oviposits.

The adult male which emerges from a quiescent pupa is short, broad, tapers at the posterior end, has long legs, colorless when young, but turns dark when fully developed. It seems not to feed much because it was observed guarding a prospective mate, a female deutonymph, which it carries on its back when disturbed and transfers it to a new feeding and breeding site.

Population Growth of *P. latus* on Alugbati

Table 2 shows the number of eggs, larvae, deutonymphs, and adults of *P. latus* per 10 shoots of infested alugbati. The total count was 1,573 individuals from all stages of the mite after a week, representing an increase of 2.6 times that of the initial population, suggesting active population growth. This number was reduced to 493 and 68 after two and three weeks, respectively, of continuous rearing. This suggests that cut alugbati shoots are suitable host only for a week and had to be replaced to sustain the growth and development of the broad mites. The alugbati leaves had matured and hardened and were no longer preferred by the mites.

P. latus is a small sized mite with a short generation time, high fecundity and protected habitat. These characteristics render the broad mites amenable to laboratory rearing on a suitable host like alugbati.

Table 2. Distribution of eggs, larvae, deutonymphs and adults of *Polyphagotarsonemus latus* on the first, second, third, fourth and fifth expanded leaves of ten apical shoots of alugbati.

Developmental Stage/ Sampling Date	Leaf Number*					Total	Percentage
	1	2	3	4	5		
A. May 10, 2013**							
Egg	20	106	125	218	175	644	40.94
Larva	10	46	62	70	87	275	17.48
Deutonymph	3	26	46	41	79	195	12.04
Adult	6	56	104	155	138	459	29.18
TOTAL	39	234	337	484	479	1573	100
B. May 16, 2013***							
Egg	11	27	32	24	16	110	22.36
Larva	2	10	20	19	13	64	13.01
Deutonymph	2	25	13	23	21	84	17.07
Adult	16	45	71	65	37	234	47.56
TOTAL	31	107	136	131	87	492	100

*Leaf position from the base of the alugbati shoot, 1 being the first and 5 the last and youngest expanding leaf
**Initial counts of eggs, larvae, deutonymphs and adults of *P. latus* were 361, 76, 62 and 96, respectively (total of 603), on May 2,2013.
***Final counts of eggs, larvae, deutonymphs and adults were 3, 10, 7 and 68,respectively (total of 88), on May 21, 2013.

SUMMARY AND CONCLUSION

The injury of the broad mite, *Polyphagotarsonemus latus* (Banks), on its hosts is a significant problem in vegetable production in the Philippines. Crops at risks are eggplant, tomato, pepper, potato, and the indigenous saluyot and alugbati, among others.

Alugbati, *Basellar ubra* L., and several reported host plants of the broad mite were evaluated initially for use as feed in the laboratory. However, only alugbati supported active growth of the broad mites while seedlings of castor, eggplant, pepper and stringbeans became etiolated inside the laboratory and did not sustain active growth and development of the pest. Leaves of alugbati shoot terminals are softer, more succulent and would last longer under laboratory conditions because roots develop under water keeping them fresh longer.

In mass rearing the broad mites on alugbati shoots, glass bottles (500 ml capacity) were used to hold the host plant shoots. Each bottle was filled with tap water and placed on top of a table with provision to ward-off ants and predators which may invade the culture.Infested shoots fromthe stock culture were collected and placed in the middle of a bouquet of fresh alugbati shoots. After about a week when these became fully infested by the broad mites, another container of fresh alugbati shoots was prepared for infestation. The process was repeated continuously to maintain the cultures of broad mites.

Results of the study undertaken showed that alugbati is suitable for supporting a growing population of *P. latus* inside the laboratory. Growth and development appeared normal, and the mites are vigorous and active. The use of alugbati as laboratory host for mass rearing of tarsonemid mite like *P. latus* for use as prey of biological control agents, gives more value to this indigenous vegetable species. The apical shoots of alugbati produce roots within a week of immersion in a bottle of tap water, leaving them fresh for over a month, and this facilitates and makes rearing work less tedious and more convenient. Furthermore, *P. latus* is easy to rear and maintain on alugbati, making it easier and faster to produce sufficient quantity of prey for detailed laboratory experiments in biological control.

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LITERATURE CITED

BASSET P. 1981. Observations on broad mite (*Polyphagotarsonemus latus*) (Acarina: Tarsonemidae) attacking cucumber. Crop Protection Conference on Pest and Diseases 1: 99-103.

BEATTIE G & GELLATNEY J. 1983.Mite pests of Citrus.-Department of Agriculture, New South Wales, 6p.

CHO MR, JEON HY, LA SY, KIM DS & YIEM MS. 1996. Damage of broad mite, *Polyphagotarsonemus latus* (Banks), on pepper growth and yield and its chemical control. Korean Journal of Applied Entomology 35: 326-331.

CORPUZ-RAROS LA & NAVASERO MM. 2005.Survey, biology and mass-rearing of common phytoseiid predators of ornamental mite pests. Terminal Report. Department of Agriculture, Bureau of Agricultural Research.

CROSS JV & BASSET P. 1982. Damage to tomato and aubergines by broad mite *Polyphagotarsonemus latus* (Banks). Plant Pathology 31: 391-393.

EUSEBIO JE & BERNARDO EN. 1999. Techniques of potato germplasm evaluation for broad mite (*Polyphagotarsonemus latus* (Banks) resistance. 13(1): Philipp Ent. 35-41.

GABRIEL BP. 1997. Insects and mites injurious to Philippine crop plants. National Crop Protection Center, University of the Philippines, Los Baños, College of Agriculture, College, Laguna. 171p.

GERSON U. 1992. Biology and control of the broad mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae). Experimental & Applied Acarology 13: 163-178.

GRINBERG M, PERI-TREVES R, SHOMER I & SOROKER V. 2005. Interaction between cucumber plants and the broad mite, *Polyphagotarsonemus latus*: from damage to defense gene expression. Entomologia Experimentaliset Applicata 115: 135-144.

JEPPSON H, KEIFER H & BAKER E. 1975.Mites injurious to economic plants. University of California Press. Riverside. 614p.

NAVASERO MM, CORPUZ-RAROS LA, GARCIA RC & NAVASERO MV. 2004. Mass rearing of *Tetranychustruncates* Ehara (Tetranychidae, Acarina) on water hyacinth, *Eichhorniacrassipes* L. 18(2): Philipp Ent. 121-126.

NAVASERO MM, CORPUZ-RAROS LA, GARCIA RC& NAVASERO MV. 2005. Mass rearing of the two-spotted mite, *Tetranychusurticae* Koch, on water hyacinth. The Philippine Entomologist 19(1): 78-83.

PALEVSKY E, SOROKER V, WEINTRAUB P, MANSOUR F, ABO-MOCH F & GERSON U. 2001. How species-specific is the phoretic relationship between the broad mite, *Polyphagotarsonemus latus* (Acari: Tarsonemidae), and its insect hosts? Experimental & Applied Acarology 25(3): 217-224.

PENA JE & BULLOCK RC. 1994. Effects of feeding of broad mite (Acari: Tarsonemidae) on vegetative plant growth. Florida Entomologists 77(1): 180-184.

SOROKER V, NELSON DR, BAHAR O, RENEH S, YABLONSKI S & PALEBSKY E. 2003. Whitefly wax as a cue for phoresy in the broad mite, *Polyphagotarsonemus latus* (Acari: Tarsonemidae). Chemoecology 13: 163-168.