



Xin Centenary and Progress in Chinese Acarology: an introduction*

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This commemorative volume is dedicated to Prof Xin Jie-Liu (1909–1994)—a pioneer and founder of acarology and several other branches of zoology in China. Prof Xin was born in November 1909. To celebrate the centenary of his birth in November 2009, Dr Zhang Zhi-Qiang and Dr Hong Xiao-Yue organized a special commemorative symposium “Progress in Acarology in China” during the 9th *National Congress of Acarology* in Nanjing, China (Zhang, 2009). This volume, however, was conceived prior to the symposium and several leading acarologists in China were invited to prepare reviews of research progress in their area of study for this volume. Some of them also presented their reviews during the symposium. After the symposium, several additional chapters were invited and prepared for this volume.

This volume collects a paper in tribute to Prof Xin (Zhang & Dong, 2010) plus 18 reviews of progress in various aspects of acarology in China; 17 of these are mainly on the taxonomy of these taxa and each includes a historical review of faunistic studies on the group and also a checklist of taxa with bibliography (Table 1). These reviews cover major groups of mites of agricultural and environmental importance in China. We focus on mites of agricultural and environmental importance because (1) Prof Xin was mainly interested in these mites and (2) we were unable to include all mite groups due to the lack of time, the lack of currently active specialists for many other groups (e.g. medically important groups) and also the limitation of the expertise of the editors.

This book includes a total of 3089 species in 818 genera and 193 families (Table 1). These represent significant increases over 238 species in 76 genera and 23 families reported in *Agricultural Mites of China*¹ (Jiangxi University, 1984) and 788 species in 258 genera and 90 families listed in the agricultural acarology section of *Researches of Acarology in China*² (Chen & Ma, 1992), even when oribatid mites and water mites in this book were excluded from total counts.

At the end of the book we included two appendices providing English-Chinese translation of author names and journal/book titles cited in this volume. An index to supraspecific mite taxa was also included.

We hope that these reviews of progress in this volume will both stimulate and facilitate further studies of mites in China, and at the same time also facilitate access to Chinese literature on mites for researchers outside China. The authors of each chapter had tried to provide updates on various taxa

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1. This book does not include water mites and oribatid mites but includes acarid mites (Astigmata).
 2. This book includes oribatid mites, but not water mites

in China and included key references on these taxa. It should be noted not all references on those taxa were included in reviews for some chapters due to the lack of time for preparing the review and also the lack of space for this volume.

TABLE 1. A summary of number of mite taxa of agricultural and environmental importance in China reviewed/ listed in this volume.

Taxa	No. families	No. genera	No. species	Reference
Bdelloidea	2	25	74	Lin & Zhang, 2010a
Penthaleidae	1	1	2	This paper
Tydeoidea	4	14	41	Lin & Zhang, 2010d
Eriophyoidea	3	187	932	Hong <i>et al.</i> , 2010a
Anystidae	1	3	5	This paper
Hydrachnidia	19	36	193	Jin <i>et al.</i> , 2010
Terrestrial Parasitengona (except chiggers)	9	24	47	Zhang, 2010b
Raphignathoidea	8	31	112	Fan & Chen, 2010
Tetranychidae	1	28	212	Hong <i>et al.</i> , 2010b
Tenuipalpidae	1	9	56	Zhang, 2010a
Tuckerellidae	1	1	7	This paper
Cheyletidae	1	24	48	Xia, 2010
Dolichocyboidea, Pygmephoroidae, Scutacaroidae and Trochometridioidea	6	17	49	Gao & Zou, 2010
Pyemotidae	1	1	4	This paper
Tarsonemidae	1	16	105	Lin & Zhang, 2010c
Oribatida	97	275	599	Chen <i>et al.</i> , 2010
Acaridia	14	50	136	Fan <i>et al.</i> , 2010
Psoroptidia	20	49	70	Wang & Fan, 2010
Macrochelidae	1	4	37	Lin & Zhang, 2010b
Blattisociidae	1	3	56	Zhang & Fan, 2010
Phytoseiidae	1	20	304	Wu <i>et al.</i> , 2010
Total	193	818	3089	

Four small families have a few species each and do not warrant separate chapters for them. They are briefly discussed below.

Penthaleidae

Penthaleus major (Dugès, 1834) and *P. minor* (Canestrini, 1886) are the only two species of this family known in China (Liu & Wang, 1953; Yuan & Qian, 1984; Wang *et al.*, 1996).

Penthaleus major. This species was first reported as a pest of wheat in China by Liu & Wang (1953). Liu & Tang (1959) provided a comprehensive account of its morphology, ecology and chemical control on wheat in Sichuan, where it was found on plants of 23 species in 10 families and was a major pest of wheat (up to 15% reduction in yield). It had three generations per year (egg aestivation in summer and no hibernation in winter). They reported female longevity of 48 days (25–74) days and oviposition period of 30 (27–73) days, with fecundity averaging 22 eggs per female. Chung *et al.* (1963) studied the biology of this species in Shanxi and Beijing, where it had two or three generations per year and was one of the most important pests in irrigated wheat fields. It

passed through winter as adults or eggs. Overwintering eggs hatched in February to early March, while adults deposited eggs on the root, stubble or soil. The first generation of adults occurred in large numbers in late March and early April, when second generations of eggs were laid; these eggs would not hatch until mid-October. Adults were found damaging wheat from late October to early November. Yuan & Qiang (1984) provided detailed descriptions of the morphology and biology of *P. major* and also its damage to wheat in North and East China. Wang (1993) studied the damages and loss due to this mite in winter wheat and developed a control threshold for local conditions in Shandong. Chen (2002) studied the biology and control of this species in wheat fields in Hubei, where mite populations reached the peak in late March and early May. Tang *et al.* (2004) recently reported that it caused damage to corn seedlings in Sichuan, with 20–50% of the plants infected in March.

Penthaleus minor. Wang *et al.* (1996) reported this species from garlic crop in Guanzhong area in Shaanxi. It occurred in mixture with *P. major* on garlic leaves with similar damage symptom, but much less in numbers compared to *P. major*.

Tuckerellidae

Seven species of *Tuckerella* have been recorded from China, with no reports on their biology and control so far.

Tuckerella hainanensis Lin & Fu, 1997. Lin & Fu (1997b) described this species from *Coffea arabica* in Hainan Province.

Tuckerella jianfengensis Lin & Fu, 1997. Lin & Fu (1997b) described this species from *Anona muricata* in Hainan Province.

Tuckerella knorri Baker & Tuttle, 1975. Lin (1982) recorded this species on *Achras zapota*, *Carica papaya*, *Anona muricata*, *Camellia assamica* and *Litchi chinensis* in Hainan Province.

Tuckerella ornata Tucker, 1926. Lin (1982) recorded this species on *Hevea brasiliensis*, *Hibiscus rosa-sinensis*, and *Mangifera indica* in Hainan Province.

Tuckerella parvoniformis (Ewing, 1933). Wang (1981) and Ma *et al.* (1984) described this species and recorded it from Zhejiang, Guangdong and Taiwan.

Tuckerella xiamenensis Lin, 1982. Lin (1982) described this species from *Achras zapota* from Xiamen, Fujian.

Tuckerella xinglongensis Lin & Fu, 1997. Lin & Fu (1997a) described this species from *Polyscias fruticosa* var. *plumata* and *Camellia sinensis* in Hainan Province.

Anystidae

An undetermined species of *Anystis*³ was first reported by Cheng & Ming (1979) as a predator of *Matsucoccus matsumurae* Kuwana in Jiangsu and had an important role in reducing pest populations. Four named species have been recorded from China (Berlese, 1923; Su *et al.*, 2006).

Anystis baccarum (Linnaeus, 1758). Ming *et al.* (1983) first reported this species as a predator of *Matsucoccus* in Jiangsu. Wu & Shen (1990) reported that its adults could consume over 100 newly emerged nymphs of *Hemiberlesia pitysophila* in Guangdong. Wu (1994) did a detailed life history of this species in the laboratory and found that it took on average 100 days for development from egg to adult at 21 °C. In the field, it could complete 2–3 generations per year in Guangzhou, with no diapause in winter but an aestivation appeared in summer at over 28 °C. He also showed that it could feed on a number of pests: *Panonychus citri* (33 larvae or nymphs per day), *Phyllocoptruta oleivora* (52 per day), *Diaphorina citri* (15 per day) and *Aphis citricola* (15 per day). Zeng *et al.* (2007) reported that this species was a major natural enemy of the tea leafhopper (*Empoasca vitis*) in Fujian, but its effectiveness was reduced by pesticides. In Guangdong, this species was an important natural

3. Later reported as *Anystis baccarum* (Linnaeus) in Ming *et al.* (1983)

enemy of *Oligonychus coffeae* (Liao *et al.*, 2010). In the last few years, this species was recorded as *A. agilis* by Su *et al.* (2006) from litchi trees in Guangdong, by Lin *et al.* (2009a) from mango in Guangdong and by Lin *et al.* (2009b) from *Phellodendron chinense* in Guangdong.

Anystis salicinus (Linnaeus, 1758). Su *et al.* (2006) first recorded this species from litchi trees in Guangdong.

Anystis wallacei Otto, 1992. Su *et al.* (2006) first recorded this species from litchi trees in Guangdong. Lin *et al.* (2009a) recorded it from mango in Guangdong.

Bareillea sinensis (Berlese, 1923). Berlese (1923) described this species as *Anystis sinensis* based on males and females collected by A. P. Jacot in Beijing, China. There have been no further records of this species in China.

Walzia australica Womersley, 1942. Su *et al.* (2006) first recorded this species from litchi trees in Guangdong.

Pyemotidae

Only four species have been recorded from China so far, but several undescribed species were discovered by Yu Lichen and colleagues (He & Yu 2004; Yu & Zhang unpublished research). *Pyemotes tritici* (LaGreze-Fossat & Montagne, 1851) was reported (e.g. Zhong *et al.*, 2007), but unpublished studies by Yu & Zhang showed that it is likely a mis-identification.

Pyemotes herfsi (Oudemans, 1936). Hu & Yang (1990) and Yang & Hu (1990) reported this species as a pest of silkworm and studied its anatomy and ultrastructure.

Pyemotes moseri Yu & Liang, 1996. Yu & Liang (1996) described this species parasitic on bark beetles in Hebei.

Pyemotes scolyti Oudemans, 1936. Yu *et al.* (1997) reported this species from Hebei, where it could complete many generations per year. It was an effective natural enemy of *Scolytus* species. It was reported to have short generation time (8 days) at 25 °C with fecundity of 60 offspring per female and high female: male ratio of 30: 1–2. Further life-table studies at the same temperature by He & Yu (2004) showed its intrinsic rate of increase was 0.4361.

Pyemotes ventricosus (Newport, 1850). Anonymous (1980) reported it as a natural enemy of *Trogoderma granarium*.

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References

- Anonymous (1980) *Pediculoides ventricosus* (Newport) is a natural enemy of *Trogoderma granarium*. *Entomological Knowledge*, 1980, 79–80 [in Chinese].
- Berlese, A. (1923) Centuria sesta di Acari nuovi. *Redia*, 15, 237–262.
- Chen, J., Liu, D. & Wang, H.-F. (2010) Oribatid mites of China: a review of progress with a checklist. *Zoosymposia*, 4, 186–224.
- Chen, J.-N. (2002) A study on the biological character and IPM techniques of *Penthaleus major* (Duges). *Journal of Anhui Agricultural Sciences*, 30(5), 745–746 [in Chinese].

- Chen, X.-B. & Ma, E.-P. (1992) *Researches of Acarology in China*. Chongqing Publishing House, Chongqing, China. 170 pp + 15 plates.
- Cheng, H.-Y. & Ming, W.-J. (1979) Population dynamics and biological control of *Matsucoccus matsumurae* Kuwana (Homoptera: Margarodidae). *Acta Entomologica Sinica*, 22(2), 149–155 [in Chinese with English abstract].
- Chung, C.-C., Wei, H.-C. & Tieng, Y.-C. (1963) The biology of the round wheat mite (*Penthaleus* sp.) and brown wheat mite (*Petrobia latens* (Müller)). *Acta Phytophylatica Sinica*, 2(3), 277–284 [in Chinese with English abstract].
- Fan, Q.-H. & Chen, Y. (2010) Raphignathoidea of China: A review of research progress in systematics and biology. *Zoosymposia*, 4, 120–132.
- Fan, Q.-H., Chen, Y. & Wang, Z.-Y. (2010) Acaridia (Acari: Astigmatina) of China: A review of research progress. *Zoosymposia*, 4, 225–259.
- Gao, J.-R. & Zou, P. (2010) Dolichocyboidea, Pygmephoroidae, Scutacaroidae and Trochometruidae of China: a review of progress with a check list. *Zoosymposia*, 4, 165–174.
- He, L.-M. & Yu, L.-C. (2004) Life-table construction and analysis of *Pyemotes* laboratory population. *Hebei Fruit Trees*, 2004(3), 9–10 [in Chinese].
- Hong, X.-Y., Xue, X.-F. & Song, Z.-W. (2010a) Eriophyoidea of China: a review of progress with a checklist. *Zoosymposia*, 4, 57–93.
- Hong, X.-Y., Zhang, Z.-Q. & Li, G.-Q. (2010b) Tetranychidae of China: a review of progress with a checklist. *Zoosymposia*, 4, 133–150.
- Hu, J.-Y. & Yang, B. (1990) Studies on *Pyemotes herfsi* damaging silkworm—II. microscopic structure of internal organs of females. *Sichuan Sericulture*, 1990(2), 1–3 [in Chinese].
- Jiangxi University (ed.) (1984) *Agricultural Mites of China*. Shanghai, Shanghai Science and Technology Press. [in Chinese].
- Jin, D.-C., Yi, T.-C. & Guo, J.-J. (2010) A review of progress in taxonomy of water mites from China (Acari: Hydrachnidia). *Zoosymposia*, 4, 106–119.
- Liao, D.-Q., Liang, G.-W. & Cen, Y.-J. (2010) Effects of the predation of big red mite *Anystis baccarum* on tea red mite *Oligonychus coffeae*. *Journal of Fujian Agriculture and Forestry University (Natural Science Edition)*, 39(2), 117–122 [in Chinese with English abstract].
- Lin, J.-Z. & Zhang, Z.-Q. (2010a) Bdelloidea of China: a review of progress on systematics and biology with a checklist of species. *Zoosymposia*, 4, 42–50.
- Lin, J.-Z. & Zhang, Z.-Q. (2010b) Macrochelidae of China: a review with a checklist. *Zoosymposia*, 4, 272–279.
- Lin, J.-Z. & Zhang, Z.-Q. (2010c) Tarsonemidae of China: a review of progress on the systematics and biology, with an updated checklist of species. *Zoosymposia*, 4, 175–185.
- Lin, J.-Z. & Zhang, Z.-Q. (2010d) Tydeoidea of China: a review of progress with a checklist. *Zoosymposia*, 4, 51–56.
- Lin, L., Laing, F., & Hu, X.-N. (2009a) Investigation of mite resources on mango in Guangdong and studies on population dynamics. *Guangdong Agricultural Sciences*, 2009(10), 100–102 [in Chinese].
- Lin, L., Laing, F., & Hu, X.-N. (2009b) Investigation of mite resources on *Phellodendron chinense* in Guangdong and studies on population dynamics. *Guangdong Agricultural Sciences*, 2009(11), 86–89 [in Chinese].
- Lin, Y.-M. (1982) A new species and two new records of *Tuckerella* from China (Acari: Tuckerellidae). *Acta Entomologica Sinica*, 25(4), 448–449 [in Chinese with English abstract].
- Lin, Y.-M. & Fu, Y.-G. (1997a) A new species of the genus *Tuckerella* from China (Acari: Tuckerellidae). *Acta Entomologica Sinica*, 40(3), 311–312 [in Chinese with English abstract].
- Lin, Y.-M. & Fu, Y.-G. (1997b) Two new species of the genus *Tuckerella* from Hainan Island, China. *Acta Zootaxonomica Sinica*, 22(2), 150–153 [in Chinese with English abstract].
- Liu, C.-L. & Wang, P.-Y. (1953) What mites injure wheat in China? *Acta Entomologica Sinica*, 3(1), 119 [in Chinese].
- Liu, Y.-C. & Tang, L. (1959) Preliminary study on the wheat mite, *Penthaleus* sp. in Yahan, Szechwan. *Acta*

- Entomologica Sinica*, 9(2), 125–136 [in Chinese with English abstract].
- Ma, E.-P., Yuan, Y.-L. & Qian, Y.-H. (1984) Spider mites. In: Jiangxi University (ed.) *Agricultural Mites of China (Zhong-Guo-Nong-Ye-Man-Lei)*. Shanghai, Shanghai Science and Technology Press. pp. 88–164 [in Chinese].
- Ming, W.-J., Ge, Q.-J. & Cheng, H.-Y. (1983) Studies on the predatory natural enemies of several species of *Matsucoccus*. *Journal of College of Forestry Product Industry*, 7(3), 19–29 [in Chinese].
- Su, Z.-H., Lin, L., Wu, H.-J. & Ye W.-M. (2006) Resources investigation and richness analysis of Litchi mites. *Guangdong Agricultural Sciences*, 2006(3), 90–93 [in Chinese].
- Tang, Y., Yang, R.-Y. & Zeng, W. (2004) *Penthaleus major* damaging corn seedlings in Da County. *China Plant Protection*, 24(6), 33 [in Chinese].
- Wang, F.-K., Zhang, H.-C. & Ju, J.-L. (1996) The taxonomic identification of new garlic injurious mites. *Acta Universitatis Agriculturae Boreali-occidentalis*, 24(6), 43–47 [in Chinese with English abstract].
- Wang, H.-F. (1981) *Acariformes: Tetranychoida*. *Economic Insect Fauna of China, Fasc 23*. Beijing, Science Press. 1–150 pp [in Chinese].
- Wang, J.-Z. (1993) Damage and loss wheat due to *Penthaleus major* during winter and preliminary studies on its control threshold. *Plant Protection*, 19(6), 11–12 [in Chinese].
- Wang, Z.-Y. & Fan, Q.-H. (2010) Psoroptidia (Acari: Astigmatina) of China: A review of research progress. *Zoosymposia*, 4, 260–271.
- Wu, H.-J. (1994) Preliminary studies on *Anystis baccarum* (Linnaeus) (Acari: Anystidae). *Natural Enemies of Insects*, 16(3), 101–106 [in Chinese with English abstract].
- Wu, W.-J. & Shen, S.-P. (1990) Preliminary observation on the control of *Hemiberlesia pitysophila* by *Anystis baccarum*. *Natural Enemies of Insects*, 12(2), 100 [in Chinese].
- Wu, W.-N., Liang, L.-R., Fang, X.-D. & Ou, J.-F. (2010) Phytoseiidae of China: a review of progress with a checklist. *Zoosymposia*, 4, 288–315.
- Xia, B. (2010) A review of progress on the systematics and biology of the family Cheyletidae in China, with a checklist of the Chinese cheyletids. *Zoosymposia*, 4, 158–164.
- Yang, B. & Hu, J.-Y. (1990) Studies on *Pyemotes herfsi* damaging silkworm—I. Electromicroscopic observation on the ultrastructure of *Pyemotes herfsi*. *Sichuan Sericulture*, 1990(2), 1–3 & 63–64 [in Chinese].
- Yu, L.-C. & Liang, L.-R. (2006) A new species of *Pyemotes* (Acari: Pyemotidae) parasitic on bark beetles (Coleoptera: Scolytidae) from Hebei, China. *Systematic & Applied Acarology*, 1, 167–171.
- Yu, L.-C., Liang, L.-R., Ao, X.-B., Shi, W.-C., Zhang, X.-Y. & Ho, L.-M. (2007) Studies on the morphology and biology of *Pyemotes scolyti* (Oudemans). *Acta Arachnologica Sinica*, 1997(1), 47–52 [in Chinese with English abstract].
- Yuan, Y.-L. & Qian, Y.-H. (1984) Penthaleidae. In: Jiangxi University (ed.) *Mites in Agriculture in China*. Shanghai Science and Technology Publishing House, Shanghai, pp. 254–255 [in Chinese].
- Zeng, Z.-H., Zhou Z., Wei, Z.-J., Chen S.-B., You, M.-S. (2007) Toxicity of five insecticides on predatory mite (*Anystis baccarum* L.) and their effects on predation to tea leafhopper (*Empoasca vitis* Göthe). *Journal of Tea Science*, 27(2), 147–152 [in Chinese with English Abstract].
- Zhang, Z.-Q. (2009) The centenary of the birth of Prof Jie-Liu Xin celebrated in a commemorative symposium “Progress in Acarology in China”. *Systematic & Applied Acarology*, 14, 179–181.
- Zhang, Z.-Q. (2010a) Tenuipalpidae of China: a review of progress with a checklist. *Zoosymposia*, 4, 151–157.
- Zhang, Z.-Q. (2010b) Terrestrial Parasitengona (except chiggers) of China: A review of progress in systematics and biology, with a checklist of species. *Zoosymposia*, 4, 94–105.
- Zhang, Z.-Q. & Dong, H.-Q. (2010) The life and contributions of Prof Xin Jie-Liu (1909–1994). *Zoosymposia*, 4, 11–41.
- Zhang, Z.-Q. & Fan, Q.-H. (2010) Blattisociidae of China: a review with a checklist. *Zoosymposia*, 4, 280–287.
- Zhong, B.-Z., Weng, L.-Q. & Xu, Z.-F. (2007) First record of *Pyemotes tritici* (Lagrange-Fossat et Montagne) as ectoparasite of *Habrobracon hebetor* (Say) (Hymenoptera: Braconidae). *Natural Enemies of Insects*, 19(3), 142–146 [in Chinese with English abstract].