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Article

Cheyletid mites (Acari: Trombidiformes) in stored grains in Iran

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ABSTRACT
In Iran, cheyletid mites (Acariformes: Cheyletidae) were collected over 15 years (1996–2010) in stored cereal. Samples were collected from silos, flour-mills, barn and rice-mills in 12 provinces scattered throughout the North, Centre, East and West of Iran. 8 genera and 13 species were recorded: *Acaropsellina sollers* (Kuzin, 1940), *Cheletomorpha lepidopterorum* (Show, 1794), *Cheyletus bidentatus* Fain & Nadchatrum, 1980, *Cheyletus carnifex* Zachvatkin, 1935, *Cheyletus eruditus* (Schrank, 1781), *Cheyletus malaccensis* Oudemans, 1903, *Cheyletus malayensis* Culiffe, 1962; *Cheyletus trouessarti* Oudemans, 1903, *Culifella variegata* (Barilo, 1985), *Lepidocheyla gracilis* Volgin, 1963, *Nodele calamondin* Muma, 1964, *Neoeucheyla iranica* Fain & Ardeshir, 2000, *Zachvatkiniola reticulata* (Cunliffe, 1962). *Cheyletus bidentatus* is a new record for the mite fauna of Iran. The widespread mites were *Acaropsellina sollers* and *Cheyletus malaccensis* (the most frequent species found in all samples). The greatest presence of predatory mites (25%) was recorded in wheat and dust.

KEY WORDS: *Acaropsellina sollers*; Cheyletidae; *Cheyletus bidentatus*; *Cheyletus malaccensis*; Prostigmata.

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INTRODUCTION

The Cheyletidae family is comprised of 75 genera, 438 species around the world (Zhang *et al*. 2011). Bochkov and Fain (2001) suggested that the parasitic Cheyletiae were primarily free living predator, frequently associated with nests of vertebrate and they adapt to parasitism on the vertebrate. The parasitism on vertebrates has arisen independently in several phylogenetic lines of the cheyletids associated with nest of vertebrates (Bochkov 2004). About a quarter of cheyletid species are parasites of vertebrate and remained of them are considered predators. Species of *Cheyletus*, *Cheletomorpha*, *Nodele* and *Acaropsis* are free-living predatory mites which are often found associated with acarid mites in grain storages (Walter *et al*. 2009). The most part of the free-living cheyletid mites are associated with Holarctic region (87%) and, therefore, this family, probably, originated there (Bochkov 2004)

Until 1994, 22 species and 14 genera of predatory Cheyletidae mites were recorded in Iran (Kamali *et al*. 2001) and six species were reported from stored grains, *Cheyletus carnifex* Zachvatkin, 1935, *C. eruditus* (Schrank, 1781), *C. malaccensis* Oudemans, 1903, *C. trouessarti* Oudemans, 1902, *C. malayensis* Cunliffe, 1962 and *Nodele* sp. (Khalilmanesh 1973; Sepasgozarian 1978; Faraji *et al*. 1993; Ostovan 1993; Fathipour 1994). The Iranian cheyletids were reviewed by Bochkov *et al*. (2005). These authors recorded 28 species of 18 genera. Two additional species of Cheyletidae, *Cheletonella vespertillionis* Womersley, 1941 and *Cheyletus kuznetzovi* Bochkov and

Khaustov, 1999 were reported from orchard soil in Iran (Doğan *et al*., 2011). Hajizadeh *et al*. (2011) reported *Chelacheles strabismus* Baker, 1958 from rice barns in Guilan province, North of Iran.

The present study is based on surveys of cheyletid mite fauna in stored cereals in 12 provinces of Iran carried out from 1996–2010.

MATERIALS AND METHODS

Samples were taken during 15 years (1996–2010) from different types of cereal stores such as silos, barns, flour-mills and mills located in 12 provinces of Iran. The materials were examined to determine the presence and the relativee abundance of mites in stored grains (wheat, rice, paddy, maize, bran and barley) as well as in theirs waste products (chaff, dust, broken wheat, broken rice and brass scrap). The products are generally stored in different quantities. Wheat was stored in large quantities in silos (5000–103000 tons) while, the other materials of cereals in flour-mills, rice-mills, mills and granaries were reserved in bags (approx. 100–150 kg each) or in open storerooms.

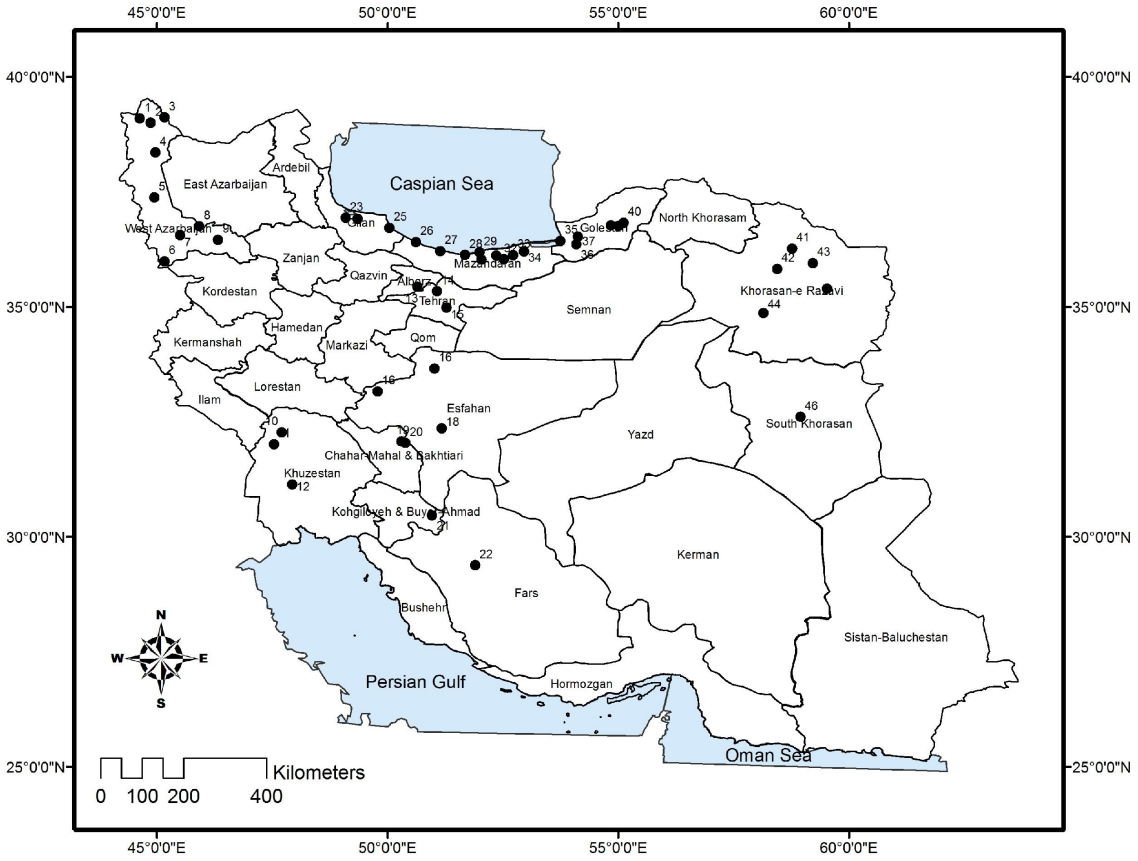

Figure 1. Map of Iran and sampling sites in 12 provinces: West Azarbijan (1. Mako, 2. Shot, 3. Poldasht, 4. Khoy, 5. Urmia, 6. Sardasht, 7. Mahabad, 8. Miandoab, 9. Shahin Dezh); Khuzestan (10. Andimeshk, 11, Shoush, 12. Ahvaz); Alborz (13. Karaj); Tehran (14. Tehran, 15. Varamin); Isfahan (16. Kashan, 17. Golpayegan, 18, Isfahan); Chaharmahal & Bakhtiari (19. Shahr-e Kord, 20. Farrokh Shahr); Kohgiluye & Boyer-Ahmad (21. Yasuj) Fars (22. Shiraz); Guilan (23. Sowméeh Sara; 24. Rasht; 25. Rudsar); Mazandaran (26. Tenekabon, 27. Nur, 28. Amol, 29. Mahmoud Abad, 30. Babol, 31. Chalus, 32. Ghaemshah, 33. Sari, 34, Neka); Golestan (35. Bandar Torkaman, 36. Gorgan, 37. Agh Ghala, 38. Gonbad-e Kavus, 39. Minodasht, 40, Galikesh); Khorasan (41. Chenaran, 42. Neyshabur, 43. Mashhad, 44. Kashmar, 45. Fariman, 46. Birjand).

A total of 2415 samples of approximately 150 g each were taken from different cereal products. All samples were taken by hand, from the external layer (< 10 cm depth) of the silos (Brett 1967). For sampling in bags a double tube spear was used. The Berlese-Tullgren funnel was used to extract mites present in samples. Each sample (150 g) was left in the funnel for 5 days.

Sampling in provinces (Fig. 1)
Alborz (Karaj): 125 samples, from October 1997 to 2005–2006; Chaharmahal & Bakhtiari (Farrokh Shahr; Shahr-e Kord): 115 samples, during 2006–2007; Isfahan (Isfahan; Golpaygan; Kashan): 170 samples, during 2005–2006; Fars (Shiraz): 140 samples, during 2006–2007; Guilan (Rasht; Rudsar; Sowméeh Sara): 135 samples, June 2007; Golestan (Gorgan; Gonbad-e Kavus; Galikesh; Minodasht; Bandar Torkaman; Agh Ghala): 420 samples, in 7 times, from October 1997 to October 2007; Khorasan (Khorasan-e Razavi, North Khorasan and South Khorasan: Mashhad; Neyshabur; Fariman; Kashmar; Chenaran; Birjand): 260 samples, during 2005–2006; Khuzestan (Ahvaz; Abdimeshk; Shoush): 125 samples, June 2009; Kohgiluyeh & Boyer-Ahmad (Yasouj): 15 samples, during 2006-2007; Mazandaran (Amol; Babol; Chalus; Ghaemshahr; Mahmoud Abad; Neka; Nur; Sari; Tenekabon): 650 samples, in six times, from December 1996 to August 2007; Tehran (Tehran; Varamin): 110 samples, during 2005–2006; West Azarbijan (Uromia; Khoy; Mahabad; Shot; Poldasht; Shahin Dezh; Sardasht; Mako; Miandoab): 350 samples, during 2005–2006.

RESULTS

Distribution of cheyletid mites in different type of materials in stored grains

Acaropsellina sollers (Kuzin, 1940)

World Distribution – Holarctic: England, Scotland, Russia, USA (Hughes 1976), Greece (Eliopoulos and Papadoulis 2001), Iraq (Mahmood 1992).
Distribution in Iran – Fars (Ostovan 1993); E. Azarbijan (Fathipour *et al*. 1999); Guilan (Hajizadeh *et al*. 2011); Alborz (Seiedy *et al*. 2012).
Material examined – Alborz province (Karaj), 1997 (silo: grain and dust); 1998 (silo: grain and dust); 2005–2006 (silo mill and flour-mills: grain, broken wheat, dust and chaff). Chaharmahal & Bakhtiari (Farrokh Shahr and Shahr-e Kord), 2006–2007 (silo and flour-mill: grain and dust). Isfahan province (Isfahan, Golpaygan and Kashan), 2005–2006 (silos, barns and flour-mills: grain, dust and chaff). Fars province (Shiraz), 2006–2007 (silo and flour-mills: grain and chaff). Golestan province (Gorgan), 1997 (silo: grain and dust); 1998 (Flour-mills: dust); (Gorgan and Gonbad-e Kavus) 2005–2006 (silo and flour-mill: grain, broken wheat, dust and chaff); (Gorgan and Gonbad-e Kavus), 2006–2007 (silo, flour-mill and barn: grain, barley and bran). Khorasan-e Razavi and South Khorasan provinces (Mashhad, Neyshabur, Fariman, Kashmar and Chenaran), 2005–2006 (silos and flour-mill: grain, broken wheat, dust and chaff). Khuzestan province (Ahvaz, Andimeshk, Shoush), 2006–2007 (silos, flour-mills: grain, dust and chaff). Kohgiluyeh & Boyer-Ahmad (Yasouj), 2006–2007 (silo: grain). Mazandaran province (Sari, Neka), 1998 (silo and flour-mills: grain, broken wheat and dust); (Sari and Babol), 2006–2007 (rice-mill and flour-mill: rice, brass scrap and dust). Tehran province (Tehran and Varamin), 2005–2006 (silos, flour-mills and mills: grain, broken wheat, dust and chaff) and West Azarbijan (Uromia, Khoy and Mahabad), 2005–2006 (silos, flour-mills: grain and dust).
Remarks – This species is very abundant in Iran and both sexes can easily collect from different provinces.

Cheletomorpha lepidopterorum (Show, 1794)

World Distribution – Holarctic: England (Griffiths 1960); Peru (Caceres and Fain 1977); Taiwan (Tseng 1979); Pakistan (Aheer *et al.* 1997).
Distribution in Iran – not mentioned (Sepasgozarian 1978; Modaress Awal 1994; Fathipour 1994).
Material examined – Golestan province (Gorgan), 2006–2007 (15 ♀ in rice mills and barn: paddy and brass scrap). Mazandaran province (Neka), 1996 (1 ♀ in silo: grain); (Sari), 1997 (1 ♀ in Flour-mills: grain); (Sari), 2006–2007 (4 ♀ in rice-mill and barn: paddy and brass scarp).

Cheyletus bidentatus Fain & Nadchatram, 1980

World Distribution – Oriental region: Malaysia (Fain & Nadchatram 1980).
Distribution in Iran – This species is a new record for the mite fauna.
Material examined – Isfahan province (Golpaygan), 2005-2006 (3 ♀ in Flour-mill: dust). Golestan province (Gorgan and Galikesh), 2005-2006 (4 ♀ and 1 ♂ in Silos: grain, broken wheat and dust); Golestan province (Gorgan), 2006-2007 (7 ♀ in flour-mill, rice mills and barn: chaff, paddy and brass scrap). Khorasan-e Razavi province (Mashhad), 2005-2006 (2 ♀ in silo: broken wheat and dust). Mazandaran province (Chalus, Amol, Mahmoud Abad, Ghaemshahr), 2006-2007 (7 ♀ in rice mills: paddy, bran and brass scrap). Tehran province (Varamin), 2005-2006 (3 ♀ in mill: dust and chaff) and West Azarbijan province (Shot and poldasht), 2005-2006 (1 ♀ in flour-mills: dust).

Cheyletus carnifex Zachvatkin, 1935

World Distribution – Holarctic: Tadjikistan, Mongolia, Ukraine, Uzbekistan, Kirghizia (Zachvatkin 1935; Fain and Bochkov 2001); Egypt (Zaher and Soliman 1967); Czech, USA (Hughes 1976).
Distribution in Iran – Mazandaran (Faraji 1993); Fars (Ostovan 1993); E. Azarbijan; (Mirfakhraii 1994); Guilan (Hajizadeh *et al*. 2011); Alborz (Seiedy *et al*. 2012).
Material examined – Alborz province (Karaj), 2005-2006 (flour-mills: grain, broken wheat, dust and chaff).Chaharmahal & Bakhtiari (Shahr-e Kord), 2006-2007 (flour-mill: dust). Guilan province (Rasht and Rudsar), 2006-2007 (rice-mill, barn: rice, paddy, brass scrap). Golestan province (Gonbad-e Kavus, Gorgan and Galikesh), 2005-2006 (Silos and flour-mill: broken wheat and dust); (Gorgan, Gonbad-e Kavus), 2006-2007 (flour-mill and animal food factory: grain). Khorasan-e Razavi and Soud Khorasan provinces (Mashhad, Fariman and Birjand), 2005-2006 (silos: grain and broken wheat). Khuzestan province (Ahvaz), 2006-2007 (flour-mill: grain). Mazandaran province (Sari, Nur, Mahmoud Abad, Tenekabon, Babol and Ghaemshahr), 2006-2007 (flour-mill and rice-mills: broken wheat, bran, brass scarp and paddy). Tehran province (Tehran and Varamin), 2005-2006 (silo, mills and flour-mill: grain, broken wheat, dust and chaff) and West Azarbijan province (Uromia, Shahin Dezh, Sardasht and Mako) 2005-2006 (silo and flour-mills: grain, dust and chaff).
Remarks – This species is very abundant in Iran and both sexes can easily collect from different provinces.

Cheyletus eruditus (Schrank, 1781)

World Distribution – Cosmopolitan: England (Griffiths 1960); Canada (Liscombe and Watters 1962); Japan (Sinha 1968); Afrotropical (Fain 1979); Taiwan (Tseng 1979); Croatia (Pagliarini 1979); China (Lung-Shut 1984).
Distribution in Iran – Mazandaran (Sepasgozarian 1978; Modaress Awal 1994); Guilan (Hajizadeh *et al*. 2011); W. Azarbijan (Fathipour 1994).

Material examined – Alborz province (Karaj), 2005–2006 (2 ♀ in flour-mills: dust and chaff). Guilan province (Rasht and Sowméeh Sara), 2006-2007 (11 ♀ in rice-mill, barn: rice, paddy). Mazandaran province (Sari), 2006-2007 (1 ♀ in rice-mill: brass scarp). Tehran province (Tehran and Varamin), 2005-2006 (2 ♀ in Silo and mill: dust and chaff).

Cheyletus malaccensis Oudemans, 1903

World Distribution – Cosmopolitan: Egypt (Zaher and Soliman 1971); Peru (Caceres and Fain 1977); Afrotropical (Fain 1971, 1979); China (Lung-Shut 1984); India (Mathur and Mathur 1982); Pakistan (Zaman 1990); Iraq (Mahmood 1992); Greece (Eliopoulos *et al*. 2000); Czech Republic (Stejskal *et al*. 2003).
Distribution in Iran – Khuzestan (Sepasgozarian 1978; Kamali 1990; Modaress Awal 1994); Fars (Ostovan 1993), Guilan (Hajizadeh *et al*. 2011), Alborz (Seiedy *et al*. 2012).
Material examined – Alborz province (Karaj), 1997 (silo: grain); 1998 (silo: grain and dust); 2005–2006 (silo and flour-mills: grain, broken wheat, dust and chaff). Chaharmahal & Bakhtiari (Shahr-e Kord), 2006–2007 (flour-mill: dust). Isfahan province (Golpayegan and Kashan), 2005–2006 (silos, barns and flour-mills: grain. Fars province (Shiraz), 2006–2007 (flour-mills: grain). Guilan province (Rasht, Sowméeh Sara, Rudsar), 2006–2007 (rice-mill, barn: rice, bran, paddy, brass scrap). Golestan province (Gorgan), 1997 (silo and flour-mills: grain and dust); 1998 (silo and flour-mills: grain, broken wheat, dust and chaff); (Galikesh and Gonbad-e Kavus) 2005–2006 (silo and flour-mills: grain and chaff); (Gorgan, Gonbad-e Kovus, Minodasht, Bandar Torkaman and Agh Ghala), 2006–2007 (silo, barn, flour-mill and animal food factories: grain, chaff, dust, paddy and brass scrap, barley and maize). Khorasan-e Razavi and South Khorasan provinces (Mashhad, Neyshabur, Chenaran and Birjand), 2005–2006 (silos and flour-mill: grain, broken wheat and dust). Mazandaran province (Sari, Neka), 1996 (silo and barn: grain, broken wheat, dust and chaff); 1997 (silo and flour-mills: grain, broken wheat, dust and chaff); 1998 (silo, barn and flour-mills: grain, broken wheat, dust and chaff); (Sari, Neka, Nur, Mahmoud Abad, Tenekabon, Babol and Ghaemshahr), 2006–2007 (rice-mills and flour-mills: rice, paddy, broken rice, bran, brass scrap, grain, barley, broken wheat, dust and chaff). Tehran province (Tehran and Varamin), 2005–2006 (silo, flour-mill and mills: grain, broken wheat, dust and chaff) and West Azarbijan (Uromia, Khoy, Mahabad, Takab, Shahin Dezh, Sardasht, Mako, Poldasht and Miandoab), 2005–2006 (silos, flour-mills: grain and chaff).
Remarks – This species is very abundant in Iran and both sexes can easily collect from different provinces.

Cheyletus malayensis Culiffe, 1962

World Distribution – Oriental region: Russia, Hawaii (Summers and Price 1970), Malaysia (Cunliffe 1962) and Philippines (Corpuz-Raros 1988).
Distribution in Iran – Guilan and Fars (Sepasgozarian 1978; Ostovan 1993; Fathipour *et al*. 1999), Alborz (Seiedy *et al*. 2012).
Material examined – Mazandaran province (Babol, Mahmoud Abad, Ghaemshahr), 2006-2007 (4 ♀ in rice mills: bran and brass scrap).

Cheyletus trouessarti Oudemans, 1903

World Distribution – Cosmopolitan: England (Griffiths 1960); Peru (Caceres and Fain 1977); Taiwan (Tseng 1979); Malaysia (Fain *et al*. 1980); China (Lung-Shut 1984); Greece (Eliopoulos and Papadoulis 2001); Czech Republic (Stejskal *et al*. 2003).

Distribution in Iran – Fars (Sepasgozarian 1978; Ostovan 1993; Modaress Awal 1994; Fathipour *et al*. 1999).
Material examined – Isfahan province (Golpaygan), 2005–2006 (1 ♀ in Flour-mill: grain). Guilan province (Rasht), 2006–2007 (2 ♀ in rice mill: barn and rice). Golestan province (Gorgan, Minodasht and Gonbad-e Kavus), 2006–2007 (35 ♀ and 2 ♂ in flour-mill, rice mill, barn and animal food factories: grain, paddy, barley and maize). Mazandaran province (Sari and Chalus), 2006–2007 (7 ♀ and 2 ♂ in flour-mill and rice-mill: dust, rice, bran, brass scarp and paddy). West Azarbijan province (Urmia and Miandoab), 2005–2006 (10 ♀ and 2 ♂ in Mill and flour-mill), grain, dust and chaff.

Culifella variegate (Barilo, 1985)

World Distribution – Uzbekistan (Barilo 1985); Russia (Bochkov and Miranov 1997).
Distribution in Iran – Isfahan.
Material examined – Isfahan province (Isfahan), 2005–2006 (1 ♀in flour-mills: dust).

Lepidocheyla gracilis Volgin, 1963

World Distribution – Eastern Europe (Gerson *et al*. 1999)
Distribution in Iran – Tehran (Bochkov *et al*. 2005) and Khorasan (Khaleghabadian *et al*. 2015**).**
Material examined – Tehran province (Varamin), 2005–2006 (1 ♀ in mill: dust).

Nodele calamondin Muma, 1964

World Distribution – USA (Muma 1964), Egypt (Wafa and Soliman 1968)
Distribution in Iran – Mazandaran province (Sari), 1997 (3 ♀ in flour-mills: chaff); Golestan province (Gorgan), 1997 (silo and flour-mills: 15 ♀ and 5 ♂ in grain and 19 ♀ in dust) (Bochkov *et al*. 2001).

Neoeucheyla iranica Fain & Ardeshir, 2000

World Distribution: Iran (Fain *et al*. 2000).
Distribution in Iran: Karaj (Fain *et al*. 2000), Khorasan (Khaleghabadian *et al*. 2015).

Zachvatkiniola reticulata (Cunliffe, 1962)

World Distribution: Russia (Volgin 1969).
Distribution in Iran – Mazandaran province (Neka), 1997 (8 ♀ in silo: grain); 1998 (1 ♀ in silo: dust) (Bochkov *et al*. 2001; Ardeshir 2002).

Key to the family Cheyletidae in stored grain in Iran (adapted from Bochkov *et al*. 2005)

1. Guard seta (*ft*) of solenidion ω1 on tarsi I lanceolate or fan-like ……..……..…….. 2
– Guard seta (*ft*) of solenidion ω1 on tarsi I filiform ……..……..……..…… 3
2. Rostrum slightly narrower than rostral shield, rostral shield with straight anterior margin, peritrems arc-like ……..……... *N. iranica* Fain & Ardeshir, 2000
……..……..……..……..… ...*Neoeucheyla* Radford, 1950
– Rostrum about 2 times narrower than rostral shield, rostral shield with widely rounded anterior margin, peritremes arch-like with concave apex ..... *C. variegate*
…….……..……..…….. *Culifella* Volgin, 1969

3. Palpal tarsi with one comb-like eupathidia, *acm* and *sul* ……... *A.sollers* (Kuzin, 1940)
……..……..... *Acaropsellina* Summers, 1976
……..……..…Acaropsellini Bochkov & Fain, 2001
– Palpal tarsi with two comb-like eupathidia, *sul*…….…….……..…….……. 4
4. Palpal femur with three-four setae, leg I moderately elongated, tibia I distinctly shorter than tarsus I, setae *vs* of tarsus I situated almost at the same level as solenidion *ω*1 ……...…. 5
……..…….……..… Cheyletini Leach, 1815
– Palpal femur with five setae, leg I extremely long, about 1.5 times longer than leg IV, tarsus and tibia subequal in length, setae *vs* of tarsus I situated distinctly anterior to solenidion *ω*1 ……..….
…..... *C. lepidepterorum* (Shaw, 1794)
……..……..……...… *Cheletomorphini* Bochkov & Oudemans, 2001
……..……..……..… *Cheletomorpha* Oudemans, 1904
5. Eyes present …….…… 12
– Eyes absent ……..... 6
6. Tibia I with five setae and short solenidion, hysteronotal shield bearing 1–3 pairs of median setae or none, in the Iranian species, median setae of dorsal shield distinctly shorter than lateral setae, dorsal shields without reticulated ornamentation …….……. 7
……...……....…….……..*Cheyletus* Latreille, 1797
– Tibia I with four setae and short solenidion, hysteronotal shield bearing four pairs of median setae, median setae fan-like, subequal in length to lateral setae, dorsal shields with distinct reticulate ornamentation ……..……...… *Z. reticulata* (Cunliffe, 1962)
…….……...…… *Zachvatkiniola* Volgin, 1969
7. Dorsal shields without median setae, guard seta *(ft)* of solenidion *ω*1 on tarsus rudimentary ….. 8
– Dorsal shields with transparent flag-like or cloud-like median setae (sometimes indistinct) or broken), guard seta *(ft)* on tarsus I longer than solenidion *ω*1 ……..…..... 9
8. Peritremes M-shaped, hysteronotal shield with three pairs of median setae .....
……..... *Cheyletus trouessarti* Oudemans, 1902
– Peritremes Π-shaped, hysteronotal shield with one pairs of median setae .....
..... *Cheyletus carnifex* Zachvatkin, 1935
9. Femur IV with one setae ……..……..……..…… 10
– Femur IV with two setae …….…... *Cheyletus eruditus* (Shrank, 1781)
10. Rostrum with a pair if triangular dorsolateral projection …….……
……..……..…… *Cheyletus bidentatus* Fan & Nadchatram, 1980
– Rostrum without a pair if triangular dorsolateral projection …….…….……. 11
11. Propodonotal and hyteronotal shield subequal in length, distance between these shields less than 1/2 length of *d2*. Setae *e2* situated far behind the anterior margin of hyteronotal shield …….
…… *Cheyletus malayensis* Cunliffe, 1962
– Propodonotal shield 1.5 times or longer than hyteronotal shield, distance between these shields and length of setae *d2* almost subequal, setae *e2* situated almost on anterior margin of hyteronotal shield ……...……...…… *Cheyletus malaccensis* Cunliffe, 1962
12. Palpal femur with three setae, genu with two setae, legs I subequal or longer than idiosoma 13
…….…….……. *Nodele* Muna, 1964
– Palpal femur with four setae, genu with one setae, legs I shorter than idiosoma ……..... 14
…..…….....….... *Lepidocheyla* Volgin, 1963
13. Hyteronotal shield unpaired, with pair of deep lateral incision between metapodosoma and opisthosoma, opisthosoma bluntly pointed posteriorly, pseudoanal setae ps3 situated dorso-laterally, above level of posterior margin of hysteronotal shield …….. *L. gracilis* Volgin, 1963

– Palpal claws with single basal projection, lateral and median setae of dorsal shield thickened, rod-like, guard seta (*ft*) of tarsus I distinctly developed ……*N. calamondin* Muna, 1964

Discussion

Cheylethid mites have a worldwide distribution and they occur on all the continents. Some species of cheyletids mites often occur as predators in grain storages infested by graminivorous mites (Bochkov and Fain 2001; Walter *et al*. 2009). During 1996–2010, *A. sollers* was the commonest mite in stored grain distributed in 11 provinces of Iran. This species was presented in 91.6% of sampling locations (Table 1) and 25% of all samples (Fig. 1). The second common mite and the most frequent species in samples (30%) was *C. malaccensis* (Fig. 2), which was collected from 10 provinces (83.3%). *Cheyletus carnifex* was the next common species and found in 75% of the locations. *Cheyletus bidentatus* was a new record for the mite fauna of Iran and observed in all of the sampling materials in half of the 12 provinces. Although *Cheyletus malaccensis* was seen in all types of materials collected in storages, it was the most common species on wheat and rice. *Acaropsellina sollers* was present in more than 83% of the materials sampled followed by *C. trouessarti* and *C. carnifex*, observed in 75% of different type of materials, respectively. During this study, three rare species, *C. variegata*, *L. gracilis* and *N. iranica* were encountered in only one of the warehouses and that was in dust (Table 1).

Table 1. Distribution of cheyletid mites in stored grains located in 12 provinces of Iran (+ = present, − = absent).

Species	Provinces												Total
	A	CB	I	F	Gu	Go	Kho	Khu	KB	M	T	WA	
Acaropsellina sollers	+	+	+	+	−	+	+	+	+	+	+	+	11
Cheletomorpha lepidopterorum	−	−	−	−	−	+	−	−	−	+	−	−	2
Cheyletus bidentatus	−	−	+	−	−	+	+	−	−	+	+	+	6
Cheyletus carnifex	+	+	−	−	+	+	+	+	−	+	+	+	9
Cheyletus eruditus	+	−	−	−	+	−	−	−	−	+	+	−	4
Cheyletus malaccensis	+	+	+	+	+	+	+	−	−	+	+	+	10
Cheyletus malayensis	−	−	−	−	−	−	−	−	−	+	−	−	1
Cheyletus trouessarti	−	−	+	−	+	+	−	−	−	+	−	+	5
Culifella variegata	−	−	+	−	−	−	−	−	−	−	−	−	1
Nodele calamondin	−	−	−	−	−	+	−	−	−	+	−	−	2
Lepidocheyla gracilis	−	−	−	−	−	−	−	−	−	−	+	−	1
Neoeucheyla iranica	+	−	−	−	−	−	−	−	−	−	−	−	1
Zachvatkinola reticulata	−	−	−	−	−	−	−	−	−	+	−	−	1
Total	5	3	5	2	4	7	4	3	1	10	6	5	55

A = Alborz, CB = Chaharmahal & Bakhtiari, I = Isfahan, F = Fars, Gu = Guilan, Go = Golstan, Kho = Khorasan, Khu = Khuzaestan, KB = Kohgiluyeh & Boyer-Ahmad, M = Mazandaran, T = Tehran, WA = West Azarbijan.

Among the provinces sampled, Mazandaran was home to 64% of the total identified mites with the highest species number of mites. The main reason is probably due to the presence of its prey species in Mazandaran stored products in which acarid mites are associated with suitable weather conditions (According to Hansen weather classification Mazandaran is warm temperate zone).

The highest species number of mites was found in dust, wheat and chaff (Fig. 3). The highest percentage of predatory mites was present in wheat and dust (25%) fallowed by chaff and broken wheat samples (14 and 11% respectively). The results indicate that the frequency of predatory mites

in flour-mills and rice-mills was higher than silos (Fig. 4). This may be in relation to chemical control and enclosed area of silos rather than mills.

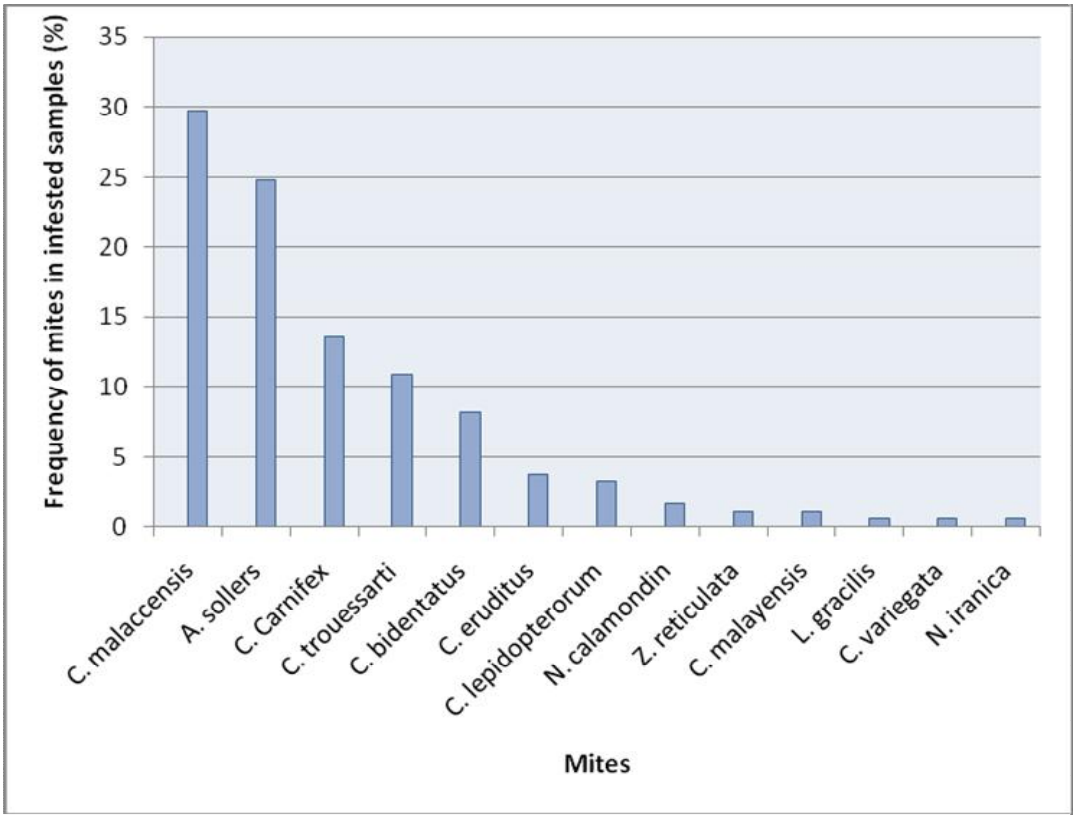

Figure 2. Frequency of cheyletid mites species in infested samples.

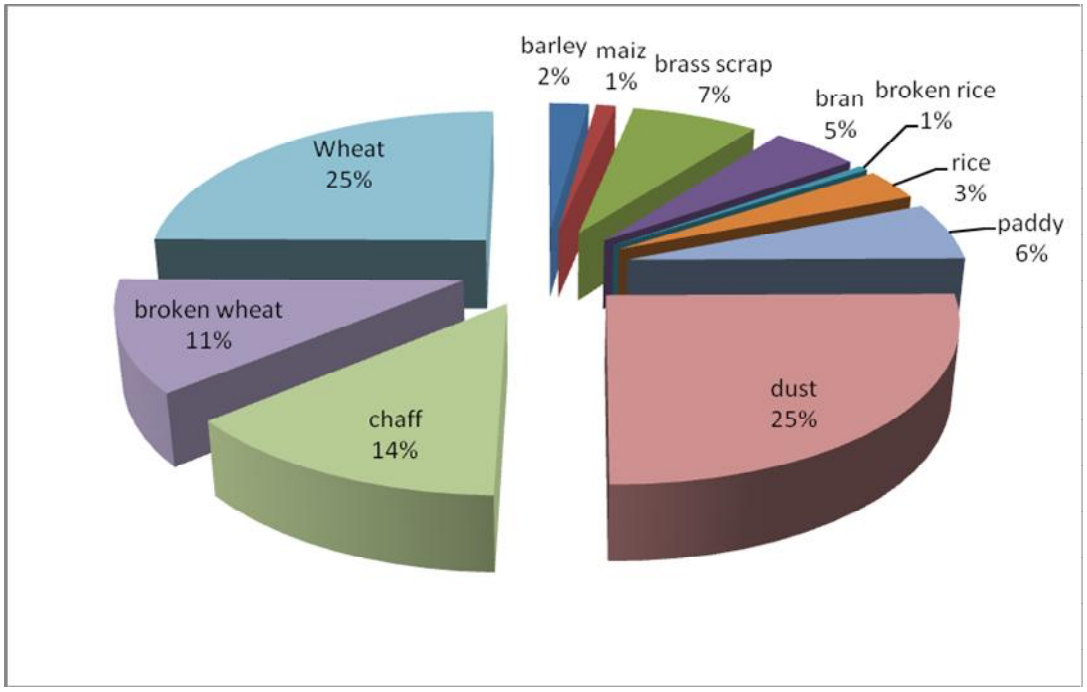

Figure 3. Percentage of cheyletid mites in different types of samples.

According to Bochkov and Fain (2001), in the family Cheyletidae, the mites of the tribe Acaropsellini and the members of the *Cheyletus* group in the tribe Cheyletini are associated with stored products, plants, and soil, or sometimes occur in nest of rodents and birds. Similarly, the results of this study show that *A. sollers*, *C. malaccensis*, *C. trouessarti* and *C. carnifex*, were associated together (the highest incidence in > 10% of infested samples and distribution of species in > 50% of the locations in the sampled warehouses).

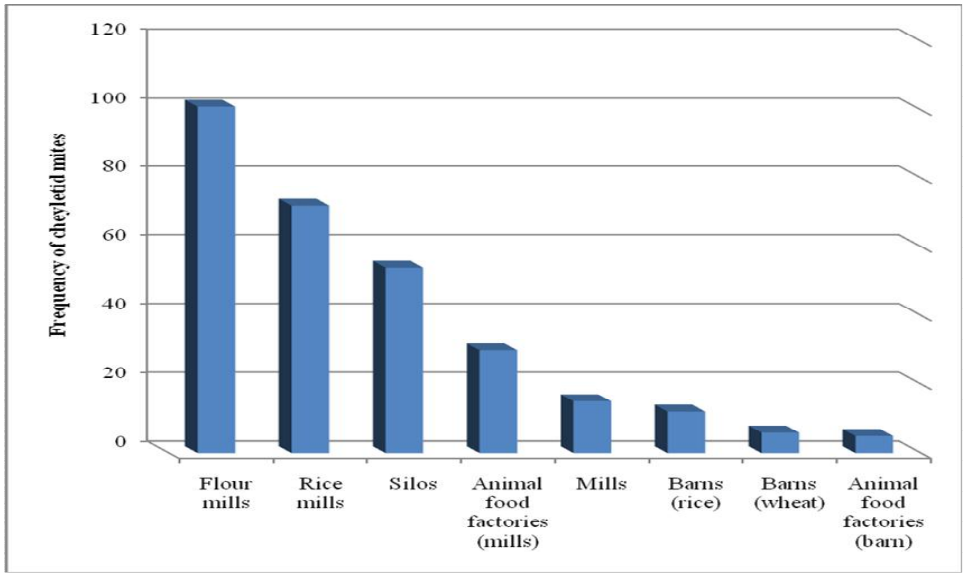

Figure 4. Frequency of cheyletid mites in different types of storages.

Until now, biological control of stored product mites has been used by the predatory mite, *C. eruditus* (Pulpan and Verner 1965; Žďárková 1998). However, no study has been done to document the Cheyletidae species in stored products of Iran, but the results of this study indicates that four species, namely *C. malaccensis*, *A. sollers*, *C. trouessarti* and *C. carnifex*, should be focused for future studies. The existence of *C. malaccensis* in all types of materials indicates the potentiality of this species to be used in biological control programs of grain mites in Iran.

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کنه‌های کیلتید (Acari: Trombidiformes) در انبارهای غلات ایران

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چکیده

در ایران، کنه‌های کلیتید (Acariformes: Cheyletidae) طی بیش از ۱۵ سال (۱۹۹۶–۲۰۱۰) در غلات ذخیره شده جمع‌آوری شدند. نمونه‌ها از سیلوها، کارخانه‌های آرد، انبار و کارخانه‌های برنج که در ۱۲ استان کشور اعم از شمال، مرکز، شرق و غرب ایران پراکندگی داشتند، جمع‌آوری شدند. در نتایج این مطالعه ۸ جنس و ۱۳ گونه ثبت شد: *Acaropsellina sollers* (Kuzin, 1940)، *Cheletomorpha lepidopterorum* (Show, 1794)، *Cheyletus bidentatus* Fain & Nadchatrum, 1980، *Cheyletus carnifex* Zachvatkin, 1935، *Cheyletus eruditus* (Schrank, 1781)، *Cheyletus malaccensis* Oudemans, 1903، *Cheyletus malayensis* Culiffe, 1962، *Cheyletus trouessarti* Oudemans, 1903، *Culifella variegata* (Barilo, 1985)، *Lepidocheyla gracilis* Volgin, 1963، *Nodele calamondin* Muma, 1964، *Neoeucheyla iranica* Fain & Ardeshir, 2000، *Zachvatkiniola reticulata* (Cunliffe, 1962). گونهٔ *Cheyletus bidentatus* گزارش جدیدی برای فون کنه‌های ایران محسوب می‌شود. بیشترین پراکندگی را گونه‌های *Acaropsellina sollers* و *Cheyletus malaccensis* (با بیشترین فراوانی در تمام نمونه‌ها) داشتند. بیشترین حضور کنه‌های شکارگر (۲۵٪) در گندم و گرد و خاک ثبت شد.

واژگان کلیدی: *Acaropsellina sollers*؛ Cheyletidae؛ *Cheyletus bidentatus*؛ *Cheyletus malaccensis*؛ زیرراستهٔ پیش‌استیگمایان.

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