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Hay mites in Italy (*)

Abstract - During the years 1992-1993 sampling was carried out in several barns in different Italian regions to study the hay mites. On fresh material, only a few specimens of mites belonging to species which live on vegetation or ground were found. On the other hand, a complex and characteristic coenosis was observed in samples collected after 4 to 5 months of storage and in debris collected on the ground in the barns. 19 species of mycophagous, predator and detritivorous mites were found. The most important of the first group are the Astigmata *Lepidoglyphus destructor* (Schrank, 1781), *Ctenoglyphus plumiger* (Koch, 1835) and *Tyrophagus longior* Gervais, 1844, while the detritivorous ones are the Astigmata *Ctenoglyphus canestrinii* (Armanelli, 1887) and the Prostigmata *Tydeus* sp.. The most numerous predators are the Mesostigmata *Androlaelaps casalis casalis* Berlese 1886, the Prostigmata *Cheyletus eruditus* (Schrank, 1781) and *Cheletomorpha lepidopterorum* (Shaw, 1794). The biocoenosis of hay, which also causes respiratory allergies in man, is almost constant all over Italy, and very similar to that observed in the rest of Europe, demonstrating that it is independent of local conditions but connected to the characteristic environment of the barn.

Riassunto - Gli acari del fieno in Italia.

Durante gli anni 1992-93 sono stati effettuati campionamenti in fienili di diverse regioni italiane al fine di studiare l'acarofauna del fieno. Sul materiale fresco sono stati reperiti solo pochi esemplari di acari appartenenti a specie che vivono sulla vegetazione o nel terreno. Nei campioni conservati per 4-5 mesi e nei residui raccolti a terra nei fienili è stata invece osservata una comunità complessa e caratteristica. Sono state trovate 19 specie tra micofaghe, predatrici e detriticole. Le più importanti del primo gruppo sono gli Astigmata *Lepidoglyphus destructor* (Schrank, 1781), *Ctenoglyphus plumiger* (Koch, 1835) e *Tyrophagus longior* Gervais, 1844. I predatori più nu-

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merosi sono il Mesostigmata *Androlaelaps casalis casalis* Berlese, 1886 e i Prostigmata *Cheyletus eruditus* (Schränk, 1781) e *Cheletomorpha lepidopterorum* (Shaw, 1794); i detriticoli sono rappresentati dall'Astigmata *Ctenoglyphus canestrinii* (Armanelli, 1887) e dal Prostigmata *Tydeus* sp.. La biocenosi del fieno, i cui costituenti causano anche allergie respiratorie nell'uomo, risulta pressoché costante in tutta Italia ed è molto simile a quelle osservate nel resto d'Europa, a testimonianza che essa è indipendente dalle condizioni locali e tipicamente legata all'ambiente del fienile.

Key words: Hay, mite-fauna, barn environment.

INTRODUCTION

Hay is a product obtained by the natural or artificial drying of the green mass of fodder, cut up in order to make it easier to store, and therefore of use in winter. During this process the level of humidity ranges from 80% in the fresh-cut fodder, to 12-17% in the finished product.

There are national standards for the evaluation of the quality of hay. In Germany, for example, in 1961, the Deutsche Landwirtschaftliche Gesellschaft fixed a standard which awards the various organoleptic, botanic and chemical characteristics. In this situation, the presence of dead or live mites leads to a negative evaluation. In Italy there is not such an official regulation, and thus tables of evaluation of hay are followed (Bocchi & Galli, 1984), which give a negative value in presence of mites. Research on mites associated with hay are therefore of considerable interest both faunistic and practical.

More than 200 years ago the first species of mites living in hay were identified by Schränk: *Lepidoglyphus* (= *Acarus*) *destructor* (Schränk, 1781). Later were described *Ctenoglyphus* (= *Glycyphagus*) *plumiger* (Koch, 1835), *C. palmifer* (Fumouze & Robin, 1868) and *Chortoglyphus arcuatus* (Troupeau, 1879) (= *C. nudus* Berlese, 1884).

The first real organic work on the mite-fauna of hay was published in Italy by Armanelli in 1887, who listed 16 species belonging to different suborders, and described a new species *Ctenoglyphus* (= *Glycyphagus*) *canestrinii* dedicated to Prof. Giovanni Canestrini who had guided him in this thesis entitled «Gli acari del fieno della provincia di Padova» (Hay Mites of the province of Padua)⁽¹⁾. Other fundamental faunistic studies both on hay and on stored food-stuffs are by Sorokin (1948), Woodroffe (1953) and Griffiths (1960).

(¹) The remarkable paper of Armanelli, published in Cefalù (Palermo), by Stefano Caruso & C. Printers, is not easily found. The species nominated, without the author's name and the year

The fact that the predator mites of the genus *Laelaps* C.L. Koch cause the «rognà degli stallieri» (scabies of the stableman) which is usually caught by workers handling hay, was only pointed out in 1961 thanks to Candura et al.. These mites normally live in hay feeding on detritivorous mites and occasionally stinging man causing a known form of dermatitis.

A few years later, a fundamental study of Voorhorst et al. (1964) opened a new trend of studies, demonstrating that some mites of the order of Astigmata are able to cause various pathologies of allergic nature in man.

The studies on hay were therefore taken up again all over Europe: in Iceland (Hallas, 1981; Hallas & Gravesen, 1987; Hallas & Gudmundsson, 1987) and in Faroe Islands (Hallas & Solberg, 1989), in Finland (Terho et al., 1982; Leskinen & Klen, 1987), in Scotland where Cuthbert et al., (1980, 1984) called for the first time this disorder «barn allergy» and in Sweden (Hillerdal et al., 1982; van Hage-Hamsten et al., 1985). All the contributions of these authors demonstrated without doubt that hay is an important source of allergens produced by mites responsible for rhinitis, conjunctivitis and bronchial asthma in farmers.

Gudmundsson & Hallas (1985) also demonstrated that in the initial phases of storage the number of mites increases with the loss of water because of the respiration of the hay.

A further field of studies regards the effect of the presence of mites on the nutritional value of the zootechnical food-stuffs. Braude et al. (1980) and Zdarkova & Horak (1993) demonstrated that the presence of *Acarus siro* L., 1758 in zootechnical fodder causes an alteration in quality, decreasing the nutritional value, as well as causing medical problems in the animals, such as a smaller weight increase and a decline of meat quality.

The purpose of the present paper is the characterization of the mite-fauna in fodder conserved in Italian areas with different climates.

of description, can be seen in Table 3. Some of these are mentioned using generic or specific names which are considered synonymities at present, such as *Hypoaspis stabularis* pro *Eulaelaps stabularis* (Koch, 1836); *Tyroglyphus farinae* pro *Acarus siro* L., 1758; *Glycyphagus spinipes* pro *Lepidoglyphus destructor* (Schränk, 1781); *Glycyphagus plumiger* pro *Ctenoglyphus plumiger* (Koch, 1835); *Glycyphagus canestrinii* pro *Ctenoglyphus canestrinii* (Armanelli, 1887); *Glycyphagus palmiger* pro *Ctenoglyphus palmifer* (Fumouze & Robin, 1868); *Cheyletus venustissimus* pro *Cheletomorpha lepidopterorum* (Shaw, 1794); *Ereynetes polymitus* pro *E. ministralis* (Koch, 1838); *Tydeus foliorum* pro *T. croceus* L., 1746; *Tydeus foenilis* pro *Microtydeus foenilis* (Can., 1886); *Scirus stabulicola* pro *Cunaxa setirostris* (Hermann, 1804).

MATERIALS AND METHODS

We examined samples collected from 8 farms located in Lombardy (Abbiatograsso and Montescano); in Emilia Romagna (Piacenza, 2 farms) and in Apulia (Sannicandro Garganico, Apricena, Lesina and Cagnano Varano).

To study the dynamics of grass mites infestation, in the two farms of Lombardy, in August, before hay making, samples of grass were taken, and washed with ethylic alcohol in order to separate the mites. Afterwards samples of vegetation in the first drying stage, dry residual material collected from the ground after the harvesting of the fodder and also samples of hay immediately after

Table 1 - Quantitative and qualitative distribution of mite species present in samples of hay collected after 4-5 months of storage.

Species	Lombardy		Emilia-Romagna		Apulia			
	Abbiatograsso (MI)	Montescano (PV)	Piacenza (South)	Piacenza (North)	Sannicandro Garganico (FG)	Apricena (FG)	Lesina (FG)	Cagnano Varano (FG)
<i>Androlaelaps casalis casalis</i>	*	**	*	*	*	*	—	*
<i>Tectocepheus velatus</i>	*	*	*	*	—	*	*	*
<i>Zygoribatula cognata</i>	*	*	—	*	*	*	—	—
<i>Phauloppia lucorum</i>	—	*	—	—	—	—	—	—
<i>Trichoribates trimaculatus</i>	*	*	*	*	—	—	—	—
<i>Acarus farris</i>	—	—	—	*	—	*	—	*
<i>A. siro</i>	—	*	—	*	—	*	*	*
<i>Tyrophagus longior</i>	*	*	*	*	**	*	*	*
<i>T. putrescentiae</i>	*	*	*	—	—	—	*	—
<i>Lepidoglyphus destructor</i>	**	*	**	*	**	*	*	*
<i>Ctenoglyphus canestrinii</i>	—	*	—	*	—	*	—	—
<i>C. plumiger</i>	—	**	—	**	—	**	—	—
<i>Cheyletus eruditus</i>	*	*	*	*	*	*	*	—
<i>Cheletomorpha lepidopterorum</i>	*	*	*	*	—	—	*	*
<i>Tarsonemus granarius</i>	*	*	*	*	*	*	*	*

— Species not present,

* Secondary species ($\leq 35\%$ of the total number of mites of the sample),

** Dominant species ($> 35\%$ of the total number of mites of the sample).

storage were taken. One hundred grams of hay stored for 4-5 months were then collected from the barns of all the farms, along with debris from the floor collected at the same time.

The collected material was immediately sifted. The mites were isolated from the fine dust by means of suspension in lactic acid, centrifugation, collection under the stereoscopic microscope and then finally mounted onto slides for identification. The key of species used were those of Evans et al. (1961), Hughes (1976), Evans & Till (1979) and Ottoboni & Piu (1991).

RESULTS AND DISCUSSION

There was an extremely scarce presence of mites in the samples of fresh material. A few Phytoseiids, Mesostigmata predators which live on cultivations and wild vegetation, were identified on grass before being cut, and some specimens of *Chortoglyphus arcuatus* were found on the samples of Abbiategrasso. Other Mesostigmata and Oribatida which live on the ground were found in the debris at ground level after the hay making. The *Tyrophagus putrescentiae* (Schrank, 1781) was observed in small numbers in freshly stored hay.

After a few months of conservation the situation was completely different. In Table 1 there are listed the 15 species collected, along with their distribution and number in the 8 sites. Seven of the species collected belong to the Astigmata order, 3 to the Prostigmata, 1 to Mesostigmata and 4 to Oribatida (or Cryptostigmata).

Finally, as results from Table 2, a rich and characteristic mite-fauna was present also in the material collected from the ground of the barns, including many of the above mentioned species plus other 2 Mesostigmata (1 Laelaptidae and 1 Haemogamasidae) and 2 Prostigmata (1 Cunaxidae and 1 Tydeidae).

On the bases of these findings no important differences were noted between hay from Northern and Southern Italy, which emphasizes the fact that the mite-fauna of hay in our country is completely independent of the local conditions.

A further confirmation can be seen by comparing the species found in our study with those of Armanelli (1887), limited to the province of Padua alone. After having clarified the synonymities it can be clearly seen that all the most important species are always present in the hay, in particular *Lepidoglyphus destructor* (Schrank, 1781), *Ctenoglyphus plumiger* (Koch, 1835), *Ctenoglyphus canestrinii* (Armanelli, 1887), *Acarus siro* L., 1758, *Cheyletus eruditus* (Schrank, 1781) e *Cheletomorpha lepidopterorum* (Shaw, 1794).

The only important difference is given by Oribatida, found only in our

Table 2 - Quantitative and qualitative distribution of mite species present in samples of debris collected from the ground of the barn.

Species	Lombardy		Emilia-Romagna		Apulia			
	Abbate-grasso (MI)	Monte-sciano (PV)	Piacenza (South)	Piacenza (North)	Sannicandro Garganico (FG)	Apricena (FG)	Lesina (FG)	Cagnano Varano (FG)
<i>Eulaelaps</i> sp.	*	—	—	*	—	*	—	—
<i>Androlaelaps casalis casalis</i>	*	*	*	*	*	*	—	*
Laelaptidae sp.	*	—	—	—	*	—	—	*
<i>Tectocephus velatus</i>	*	*	*	*	—	*	*	*
<i>Zygoribatula cognata</i>	*	*	—	*	*	*	—	—
<i>Phauloppia lucorum</i>	—	*	—	—	—	—	—	—
<i>Trichoribates trimaculatus</i>	*	*	*	*	—	—	—	—
<i>Acarus farris</i>	—	—	—	*	—	*	—	—
<i>A. siro</i>	—	*	—	*	—	—	*	*
<i>Tyrophagus longior</i>	*	*	*	*	*	*	*	*
<i>T. putrescentiae</i>	—	*	*	—	—	—	*	—
<i>Lepidoglyphus destructor</i>	**	*	**	*	**	*	*	*
<i>Ctenoglyphus canestrinii</i>	—	*	—	*	—	*	—	—
<i>C. plumiger</i>	—	*	—	**	—	**	—	—
<i>Cheyletus eruditus</i>	*	*	*	*	*	*	*	—
<i>Cheletomorpha lepidopterorum</i>	*	*	*	*	—	—	*	*
<i>Tarsonemus granarius</i>	*	*	*	*	*	*	*	*
<i>Tydeus</i> sp.	*	—	*	—	—	*	*	—
<i>Cunaxa setirostris</i>	*	*	—	*	*	—	—	—

— Species not present,
* Secondary species ($\leq 35\%$ of the total number of mites of the sample),
** Dominant species ($> 35\%$ of the total number of mites of the sample).

study. The presence of mites of this order is infact caused by the modern techniques of hay-making. the Oribatida are inhabitants of the top-soil and are collected along with the fodder by the mechanical parts of the modern machinery. In the past, on the other hand, the use of hay-sickle, of wooden rake, to make the paths, and of hay-fork, to load the hay onto the cart, eliminated these typical inhabitants of the soil.

Table 3 - *Acarocoenosis of hay observed in Europe.*

Species	Armanelli 1887	Griffiths 1960	Hallas 1981	Terho et al. 1982	Hallas & Solberg 1989	Lozzia et al. 1993
MESOSTIGMATA						
Laelaptidae						
<i>Eulaelaps stabularis</i> (Koch, 1836)	+	+	-	-	-	-
<i>Eulaelaps</i> sp.	-	-	-	-	-	+
<i>Androlaelaps casalis casalis</i> (Berl., 1887)	-	+	+	-	+	+
<i>Proctolaelaps pygmaeus</i> (Müller, 1859)	-	-	-	-	+	-
<i>Laelaptidae</i> sp.	-	-	-	-	-	+
Eviphidae						
<i>Alliphis halleri</i> (G. & R. Can., 1881)	-	+	-	-	-	-
Ameroseiidae						
<i>Kleemannia plumigera</i> (Oud., 1930)	-	+	+	-	+	-
<i>K. plumosa</i> (Oud., 1902)	-	+	-	-	-	-
Ascidae						
<i>Melichares agilis</i> Hering, 1838	-	+	-	-	-	-
ORIBATIDA						
<i>Oribatida</i> gen. sp.	-	+	+	-	+	-
Tectocephidae						
<i>Tectocephus velatus</i> (Michael, 1880)	-	-	-	-	-	+
Oribatulidae						
<i>Zygoribatula cognata</i> (Oudemans, 1902)	-	-	-	-	-	+
<i>Phauloppia lucorum</i> (C.L. Koch, 1841)	-	-	-	-	-	+
Ceratozetidae						
<i>Trichoribates trimaculatus</i> (C.L. Koch, 1836)	-	-	-	-	-	+
ASTIGMATA						
Acaridae						
<i>Acarus farris</i> (Oud., 1905)	-	-	+	+	+	+
<i>A. siro</i> L., 1758	+	-	-	+	-	+
<i>Tyrophagus longior</i> (Gervais, 1844)	-	+	-	-	+	+
<i>T. palmarum</i> Oud., 1924	-	+	-	-	-	-
<i>T. putrescentiae</i> (Schränk, 1781)	-	-	-	-	-	+
<i>T. similis</i> Volgin, 1949	-	-	+	-	+	-
<i>Mycetoglyphus fungivorus</i> Oud., 1932	-	+	-	-	-	-
Glycyphagidae						
<i>Glycyphagus domesticus</i> (De Geer, 1778)	+	+	-	+	+	-
<i>Lepidoglyphus destructor</i> (Schränk, 1781)	+	+	+	+	+	+
<i>Blomia freemani</i> Hughes, 1948	-	+	-	-	-	-
<i>Ctenoglyphus canestrinii</i> (Armanelli, 1887)	+	+	-	-	-	+
<i>C. palmifer</i> (Fumouze & Robin, 1868)	+	-	-	-	-	-
<i>C. plumiger</i> (Koch, 1835)	+	+	+	-	-	+
Chortoglyphidae						
<i>Chortoglyphus arcuatus</i> (Troupeau, 1879)	-	-	-	-	-	+

(Table 3 continued)

Species	Arma- nelli 1887	Grif- fiths 1960	Hallas 1981	Terho et al. 1982	Hallas & Solberg 1989	Lozzia et al. 1993
PROSTIGMATA						
Cheyletidae						
<i>Cheyletus eruditus</i> (Schränk, 1781)	+	+	+	+	+	+
<i>C. trouessarti</i> Oud., 1903	-	+	-	-	-	-
<i>Cheletomorpha lepidopterorum</i> (Shaw, 1794)	+	+	-	-	-	+
Tarsonemidae						
<i>Tarsonemus granarius</i> Lindquist, 1972	-	-	-	-	-	+
<i>Tarsonemus</i> spp.	-	+	+	+	+	-
Ereynetidae						
<i>Ereynetes ministralis</i> (Koch, 1838)	-	-	-	-	-	-
Tydeidae						
<i>Tydeus croceus</i> L.	+	-	-	-	-	-
<i>T. interruptus</i> Sig Thor, 1932	-	-	+	-	-	-
<i>T. velox</i> Coch, 1835	+	-	-	-	-	-
<i>Tydeus</i> spp.	-	+	-	+	+	+
<i>Microtydeus fenilis</i> (Can., 1886)	+	-	-	-	-	-
<i>Pronematus bonatii</i> (Can., 1886)	+	-	-	-	-	-
<i>Coccotydeus</i> sp.	-	-	-	-	+	-
Cunaxidae						
<i>Cunaxa setirostris</i> (Hermann, 1804)	+	-	-	-	-	+
Raphignathidae						
<i>Caligonus longimanus</i> Koch, 1842	+	-	-	-	-	-

After examining the results of the foreign authors mentioned previously, it is possible to point out some characteristic situations in the hay ecosystem, despite the enormous climatic difference; passing from the 40° latitude (Apulia) to the Arctic Circle (Iceland) (Table 3).

The Astigmata make up the numerical dominant species, being constantly present and characterizing the mite-fauna of the hay. During the drying stage the hay goes mouldy, and various mycophagous species settle and proliferate on the moulds such as *Acarus farris* Oudemans, 1905; *A. siro*; *Tyrophagus longior* Gervais, 1844; *T. putrescentiae*; *L. destructor*; *Glycyphagus domesticus* (De Geer, 1778); *C. plumiger*; *C. canestrinii* and some Tarsonemidae (Prostigmata). The primary species are invariably accompanied by predator mites of which the most important are *Androlaelaps casalis casalis* Berlese, 1886; *Cheyletus eruditus* and *Cheletomorpha lepidopterorum*.

This combination of species is typical of the barn environment. It is interesting to note that the hay has the same level of humidity, 12-14%, that the cereals and other stored food-stuffs, which constitute also the other typical habitats of this group of species (Griffiths, 1960; Sinha, 1964; Rota, 1972).

The other species found do not seem to be typical of the hay, but to come

from the outside environment (vegetation or soil), and even if they are mycophagous, detriticolous or predators, they rarely find the conditions suitable for a permanent colonization of the barn. These factors explain the variability of the species present and the scarce numeric consistency in their population.

CONCLUSIONS

The present work confirms the existence of a specific association of mite-species in hay, very similar to that of stored food-stuffs in general. The most important species result in being *Lepidoglyphus destructor*, *Ctenoglyphus plumiger* and *Tyrophagus longior*, which can be considered both primary and mainly tertiary. *Androlaelaps casalis casalis*, *Cheyletus eruditus* and *Cheletomorpha lepidopterorum* can be noted among the predatory mites.

These species can cause depreciation of the hay and some of these, principally *Acarus siro*, can also cause nutritional problems in animals which are fed with this hay. *L. destructor*, *Glycyphagus domesticus*, *A. siro* and *Tyrophagus putrescentiae* can cause medical problems such allergies, in hay workers.

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