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Biological Agents Limiting the Development of *Sorghum halepense*

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Abstract

Research has been carried out in Northern Italy since 1983 on the phytophagous fauna of *Sorghum halepense*. This has resulted in identification of various arthropods which are harmful to the plant. Most of the phytophagi feed on leaves. Culms were attacked by *Ostrinia nubilalis*, and inflorescences by *Haplotrips aculeatus*, *Contarinia sorghicola* and *Clinodiplosis* sp. No organisms were found in rhizomes. All the phytophagi identified are extremely common and polyphagous.

Introduction

Sorghum halepense (L.) Pers. (Gramineae) is considered to be one of the world's worst weeds. It has spread to agricultural areas in 53 countries, characterized by a hot summer; it affects over 30 different types of cultivates plants (Bertucci 1983).

This weed is extremely damaging to cultivation of maize, cotton, sugar cane, soya, sorghum, coffee, and various arboreal species. It may also cause problems such as: reducing productivity of cultures (Giardini *et al.* 1978, Catizone and Baldoni 1983, Warwick and Black 1983); producing allelopathic responses (Horowitz and Friedman 1971); hosting parasites of animals and cultured plants (Coudriet and Tuttle 1963, Messieha 1967, Dickinson and Laird 1969, Harris 1976, Hogger and Bird 1976, Milinco 1977, Levy and Cohen 1978, Weaver *et al.* 1980, Warwick and Black 1983); cattle poisoning (Warwick and Black 1983); and genetically contaminating seed sorghum (Monaghan 1979).

Control of *S. halepense* is therefore extremely important. Traditional control methods are non-efficient and ineffective (McWorther and Hartwig 1965). Discovery of natural enemies for *S. halepense* would be an environmentally-safe and efficient management option for this weed.

Very little literature is available for natural enemies of *S. halepense* in Northern Italy. This paper reports organisms which feed on *S. halepense* in this region.

Materials and Methods

The research on the phytophagi (mainly insects) which affect *S. halepense* and on their symbionts was conducted in maize and soya fields, uncultured areas, and along roadsides in Northern Italy (Milan, Pavia and Piacenza provinces) beginning in 1983. The study was carried out from late spring, when the plant starts vegetative growth, to autumn. However some field checks were also carried out in winter.

The phytophagous insects found in the field on *S. halepense* were captured and later identified. Notes were made of the type of damage caused and the vegetative part affected. Some plants were uprooted and taken to laboratory to further observe the damage and to allow the identification of internal parasites.

Results and Discussion

Several species were found that developed on different organs and tissues of the weed (Table 1).

Table 1. Phytophagi found on *Sorghum halepense* (L.) Pers. in Northern Italy.

Species	Roots	Leaves	Culms	Inflor.	Kernels
Tetraneura ulmi (L.) (Hemiptera: Pemphigidae)	*				
Tettigella viridis (L.) (Hemiptera: Cicadellidae)		*			
Philaenus spumarius (L.) (Hemiptera: Aphrophoridae)		*			
Sitobion avenae (F.) (Hemiptera: Aphididae)		*		*	
Chaetocnema conducta (Motsch.) (Coleoptera: Chrysomelidae)		*			
C. tibialis (Ill.)		*			
Haltica sp. (Coleoptera: Chrysomelidae)		*			
Lema melanopus (L.) (Coleoptera: Chrysomelidae)		*			
Luperus leonardii (Fogato) (Coleoptera: Chrysomelidae)		*			
Smaragdina flavicollis (Charp.) (Coleoptera: Chrysomelidae)		*			
Tetranychus urticae (Koch) (Acari: Tetranychidae)		*			
Unidentified grasshoppers (Orthoptera: Ensifera and Celifera)		*			
Unidentified leaf miners (Diptera: Agromyzidae)		*			
Unidentified caterpillars (Lepidoptera: Geometridae)		*			
Ostrinia nubilalis (Hb.) (Lepidoptera: Pyraustidae)			*		
Lygus rugulipennis (Popp.) (Hemiptera: Miridae)				*	
Adelphocoris vandalicus (Rossi) (Hemiptera: Miridae)				*	
Haplothrips aculeatus (F.) (Thysanoptera: Phlaeothripidae)				*	
Contarinia sorghicola (Coquillet) (Diptera: Cecidomyiidae)					*
Clinodiplosis sp. (Diptera: Cecidomyiidae)					*

Root-Attackers

Tetraneura ulmi *(L.) (Hemiptera: Pemphigidae).* This species was found in colonies of various dimensions (approximately one to a few dozen specimens) made of wingless agamic females in different development stages, on the roots of specimens of *S. halepense* grown on the fringe area of crop fields or in wild areas. In the latter case the colonies were represented by a larger number of specimens.

Leaf-Attackers

Tettigella (= Cicadella) viridis *(L.) (Hemiptera: Cicadellidae).* The first attacks by wingless nymphs of this species were observed in May. Nymphs and adults were also found on the plant from spring (June), feeding on the plant's sap.

Philaenus spumarius *(L.) (Hemiptera: Aphrophoridae).* Nymphs were found May to June on the leaves and stems, immersed in the typical masses of white froth. Damage is similar to that caused by *T. viridis*.

Sitobion (= Macrosiphum) avenae *(F.) (Hemiptera: Aphididae).* Attack was first found on leaves; subsequently inflorescences were also affected. Colonies were always attacked by predators, particularly fly larvae (Diptera: Syrphidae), adult coccinellids and various hymenopterous parasites.

Various chrysomelids. Adults of *Chaetocnema conducta* (Motsch.) and *C. tibialis* (Ill.), *Haltica* sp., *Lema melanopus* (L.), *Luperus leonardii* (Fogato) and *Smaragdina flavicollis* (Charp.) were found starting in May. Feeding causes length-wise scars on leaves, parallel to the nerves, sometimes spearing one of the two epiderms.

Tetranychus urticae (Koch) (Acari: Tetranychidae). This mite species is found in highly populated colonies generally on the lower leaf surface. Leaves which are punctured by the mite develop red-straining on the underside, then show wide unpigmented zones, and eventually dry up.

Miscellaneous insects. Grasshoppers and unidentified geometrid larvae occasionally cause significant damage. Some agromyzid (probably) leaf-miners were also found, inside of which were empty black puparia.

Organisms Attacking Culms

Ostrinia (= Pyrausta) nubialis *(Hb.) (Lepidoptera: Pyraustidae).* Attack by this species, the European corn borer, on *S. halepense* was only occasionally observed in very tall culms which have an above-average diameter. Larvae create tunnels in culms, about 10 cm long and almost the whole diameter of the culm in width. From the outside a small hole was visible, from which frass was visible. Both generations of this species attacked culms.

Organisms Attacking Inflorescences

Lygus rugulipennis *(Popp.) and* Adelphocoris vandalicus *(Rossi) (Hemiptera: Miridae).* Small groups of these species were found on *S. halepense* flowers. They feed by puncturing inflorescences; often before blooming, halting flower development causing atrophy of flowers and spikelets to become whitish in colour. Affected parts dry up completely.

Organisms Attacking Ovaries and Kernels

Haplothrips aculeatus *(F.) (Thysanoptera: Phlaeothripidae).* This insect completes its entire cycle on *S. halepense* flowers. It deposits eggs, singularly or in groups of two or three, either inside or outside the spikelet. When eggs are deposited externally, they are found on the higher glume, whereas when they are deposited internally, they are found at the apex of the palea and of the lema or even between the palea and the ovary. Post-embryonic development occurs inside the spikelet; the nymphs feed by puncturing the glumes and the ovary, which may atrophy after being punctured. Punctured kernels develop whitish spots, surrounded by a brown-reddish halo. Adults remain on the inflorescence, where with nymphs, they feed until the end of September.

Contarinia sorghicola *(Coquillet) and* Clinodiplosis *sp. (Diptera: Cecidomyiidae).* *Clinodiplosis* sp. is much more mobile and slender than *C. sorghicola*, and are found in non-fertilized spikelets where blooming has not occurred, or in spikelets having the kernel whitened and atrophied. Development of *C. sorghicola* occurs completely inside the spikelet. Pupae move to the apex of the spikelets, and adults emerge between the two glumes, leaving the chrysalis ecdysis attached. *Clinodiplosis* sp. pupae were not found inside spikelets, and adults have not been seen to emerge from the inflorescences.

Damage by these species to kernels causes colour changes of glumes (light beige rather than the typical bright brown-purple colour of the mature kernel. Also, transverse dimensions are slightly smaller than the healthy spikelets, which makes them easily recognized.

Summary of Damage by the S. halepense *Organisms*

The endemic and introduced distributions of *S. halepense* should be compared to appreciate the role of the organisms.

None of the organisms found are host-specific: they are, for the most part, polyphagous. Furthermore due to their own natural enemies, they do not damage significantly *S. halepense*.

O. nubilalis and *T. urticae* were the most damaging organisms (attacking culms and leaves). *H. aculeatus*, the mirids and the cecidomyiids reduce seed production.

Larval *Clinodiplosis* sp. were always found on atrophied and dried kernels. Thus, it may only be an inquiline and not primarily phytophagous; the genus *Clinodiplosis* includes many saprophagous and mycophagous species.

No organisms were found on rhizomes, which is the most important plant part, being resistant to herbicides and other control techniques. If there were organisms able to affect the rhizome, they would be able to limit its spread, and they would also be very selective with respect to the varieties of sorghum which lack rhizomes (Gerling and Kugler 1973).

In conclusion, the organisms found on *S. halepense* in Northern Italy are not sufficiently host-specific or damaging to allow their use as classical biological control agents.

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