The influence of environmental conditions on the naturalization of the alien millipede species *Spinotarsus caboverdus* Pierrard, 1987 on Cape Verde

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Introduction

Spinotarsus caboverdus belongs to the family Odontopygidae (Order Spirostreptidae). This family is widely spread across tropical Africa with the exception of Madagascar. The genus *Spinotarsus* was introduced to Cape Verde via the African continent (Brito, 1994). *S. caboverdus* was first found on Cape Verde in 1969 (Neves et al., 1993). Mechanical damage leads to losses in plant tissue and can be observed year-round. It is possible to distinguish border and hole feeding in leaves and holes bored in fruit.

Material and Method

S. caboverdus was collected on Santo Antão (Cape Verde) and transferred to Germany. The millipedes were kept in small groups (15/treatment) in terrariums at temperatures of 20, 25, 30 and 35°C, relative humidity of 75% and 12 hours of illumination. Pieces of potato were included as food.
Sick and dead millipedes as well as excrement of potential predators were collected at several times of the year at several sites of the island Santo Antão.
The material was tested for residues, deposited in humid chambers or animals were bred. Parasitic organisms were analysed with a light optical or electron microscope.

Results

1. Abiotic factors

- The temperature on the islands Santo Antão fluctuated between 20 und 30 °C.
- Temperatures up to 30°C are favourable for the viability of females and males.
- The highest levels of egg laying were also attained at these levels (Table 1).

Table 1 Mortality of adults of *S. caboverdus*, number of eggs and number of hatched eggs after 30 days at temperature of 20, 25, 30 and 35°C and 75% humidity

Temperature (°C)	Mortality (%)		Eggs (number)	Hatched eggs (number)
	Females	Males		
20	10	0	33	31
25	10	0	35	29
30	40	70	60	39
35	100	100	6	0

- The eggs and the first three stadia of juveniles require high soil moisture.
- Because of it the egg laying period coincided with the rainfall period in September - October (Fig 1).
- The development to adult takes approximately 7 months and it must be finished till summer.
- The hot and dray summer survive only adults.
- They look for the smallest moisture source like papaya or mango fruits that helps to survive the unfavourable dray season.

2. Parasitic organisms

Fungi

- In the samples collected on the Island of Santo Antão fungi organisms could be detected only to a limited extent (Table 2).
- However, only few of the isolated fungi are known as entomopathogenic until now.

Table 2 Isolated fungi from adults and eggs of *S. caboverdus*

Stadium of *S. caboverdus*	Origin	Genus/species of fungi
Adult	Santo Antão	*Acremonium strictum* Aspergillus sp. Cylindrocladium sp. *Fusarium semitectum* Geotrichum sp. Gliocladium sp. *Paecilomyzes sp.*
Egg	Laboratory	*Doratomyces microsporus* Penicilium sp. *Trichurus spiralis*

3. Predators – toads

- It was observed that habitats of millipedes and toads coincided close to irrigation channels.
- In March/ April found excrements referred to a small population density of the toads. The excrements contained only sporadically residues of the exoskeleton of *S. caboverdus.*
- From June to August the population density was higher as during spring time and in the excrements of the toads numerous residues of millipedes were found.

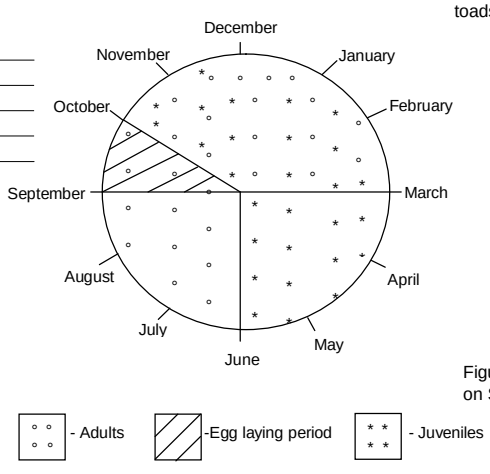

Figure 1 Annual lifecicle of *S. caboverdus* on Santo Antão

Conclusion

It seems that no natural factors can stop population development of *S. caboverdus* on Santo Antão. The millipedes can always find nourishment in fields planted with permanent crops like banana and sugarcane as well as in vegetable crops.
Abiotic factors like temperature vary with small amplitudes (20-30°C) and don't have a negative influence on the reproduction and development of millipedes.
The lifecycle of *S. caboverdus* is adapted to environmental parameters such as rainfall period.

The clarification of the origin of *S. caboverdus* remained unsuccessful. Therefore, we searched for antagonists on site. Predators, which could be of interest, need to be night active and have to stay near irrigation plants. Although these conditions are true for toads, only at a high population density of the toads in summer, millipedes are interesting as food. Therefore, the population regulating influence of toads on *S. caboverdus* remains limited in terms of time and space.
Also, the potential of the entomopathogenic fungi found on Santo Antão does not show a clear function as antagonist.

REFERENCES
Brito, M J, The millipede of Santo Antão, *Spinotarsus caboverdus*: survey for pathogenic microorganisms, biossay tests of fungal pathogens against *S. caboverdus* and *Melanoplus sanguinipes.* – Thesis, Montana State University, Bozeman – Montana, USA, 1994
Neves, A M, van Harten, A, McKillup, S C, The Millipede *Spinotarsus caboverdus* PIERRARD (Diplopoda, Odontopygidae), an Important Pest of Agricultural Crops on the Island of S. Antão. Courier Forschungs- Institut Senckenberg, 159, 1993, 327-334