

## Sex abnormalities in the Common Spider Mite (*Tetranychus urticae*) (Acari, Tetranychidae)

by

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In spider mites, males develop parthenogenetically from unfertilized, haploid eggs. Females arise from fertilized eggs, which are diploid. When a female has not mated, her offspring is only male. A fertilized female produces sons and daughters, mostly in a ratio in favour of the females. From genetical data (HELLE & VAN ZON, 1966) it is known that males are normally impaternal (fatherless). This type of reproduction is known as arrhenotokous parthenogenesis.

Sex is extremely well buffered in spider mites. Never before do sex abnormalities seem to have been reported in these frequently studied animals.

A number of inbred lines of the Common or Two-spotted Spider Mite, *Tetranychus urticae* C. L. Koch, 1836, were made by means of sibmating over 7 generations, in order to study the concealed genetic variability (cf. HELLE, 1965).

In one line (no. 23) the inbreeding procedure induced a great number of sex abnormalities. These abnormalities consist of giant males as well as a diversity of sex chimaerae. They were produced only by fertilized females, while unfertilized females gave normal male offspring.

In this paper a description of the aberrant forms of the mentioned line 23 is given by the first author. A study on the inheritance and cytogenetics of the sex abnormalities in *Tetranychus urticae* will be published elsewhere by the second author.

For the giant specimens we can distinguish three categories. They cannot be sharply defined.

- I. Giant males, with a normal appearance and with mainly male characters;
- II. Giant intersexes most of which have an asymmetrical shape and show various male and female characters, but all of which have a well developed aedeagus;
- III. Giant intersexes as II, but with genitalia which combine male and female structures.

I. Giant males. The general aspect is entirely that of a male, but the dimensions are much larger than those of normal males. A few average dimensions are given for comparison:

	normal ♂	giant ♂
length	320 $\mu$	480 $\mu$
width	160 $\mu$	220 $\mu$
leg I	240 $\mu$	310 $\mu$
leg IV	230 $\mu$	330 $\mu$
aedeagus, complete	40 $\mu$	60 $\mu$
dorsal hair on palpal femur	6 $\mu$	10 $\mu$

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Typical male characters are the normally formed dorsal seta on both palpal femora and the clawlike empodium of both tarsi I. Furthermore there is a fully developed aedeagus, usually complete with a cup-shaped invagination (BLAUVELT, 1945 : 31) and a separate ductus ejaculatorius (not mentioned by BLAUVELT).

A female character is that tarsus I bears proximally only four hairs as opposed to 6 hairs in normal males.

In their behaviour these giant males are sexually indifferent. They are not interested in females and do not try to mate. Apart from this it would be doubtful whether a copulation could be effective because of the large dimensions. The female element is also proved by the fact that normal males show much interest for the giant specimens and even try to mate by placing themselves under their body. Such a strong affection has never been observed between normal males.

II. Giant intersexes. In the population these specimens can generally be discovered at once by their asymmetrical shape, though more or less symmetrically built specimens occur as well. Their length is about equal to that of the

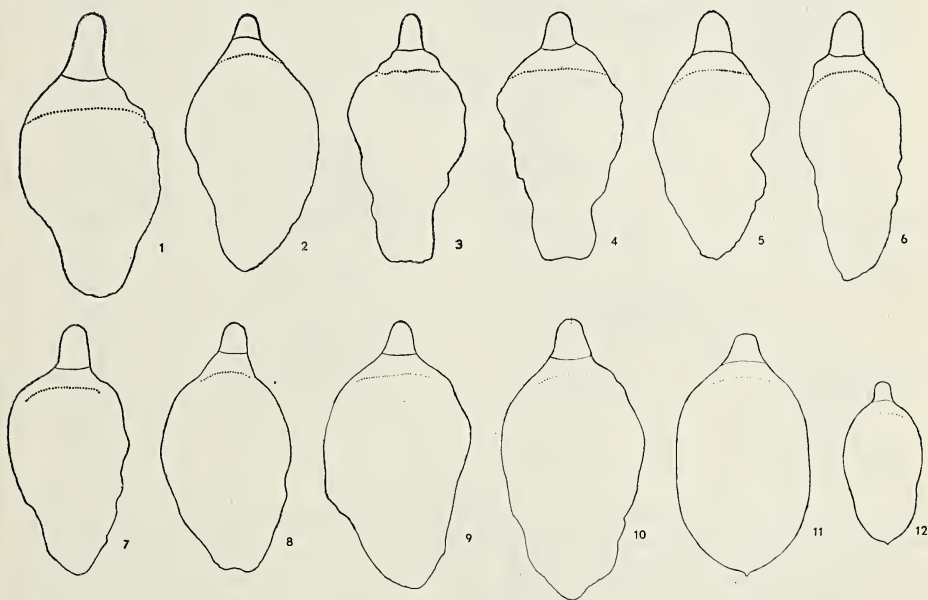


Fig. 1—10, Body outline of 10 different specimens of giant intersexes; fig. 11, Body outline of a normal female; fig. 12, Body outline of a normal male.

giant males. The front half of the idiosoma is broad and therefore of the female type. The hind part suddenly narrows distally and has the male aspect. Figures 1—10 give the body outline of a number of specimens killed in alcohol, but not macerated or mounted. In living specimens the abnormal shape is still more conspicuous.

A general female character of all intersexes is the four proximal hairs on tarsus I, while a male character of all mites of this category is a fully developed aede-

gus, complete as described under I. In some cases the cup-shaped invagination has not been observed in mounted specimens, but it may have become invisible due to maceration and further treatment.

Furthermore a wide variation occurs in some appendages of the palpa and the empodia I, fluctuating between the male and the female form.

1. The main variations of the male dorsal hair on the palpal femur are as follows:
  - a. normal shape (fig. 13)
  - b. spinelike (fig. 14)
  - c. short, but rectangular (fig. 15)
  - d. short, but rounded (fig. 16)
  - e. elongated, club shaped (fig. 17)
  - f. short hair with broad basis (fig. 18)
  - g. long hair (fig. 19)
  - h. entirely lacking as in female
2. The terminal sensillum on the palpal tarsus may be:
  - a. of the more elongated male type
  - b. intermediate
  - c. of the shorter and broader female type

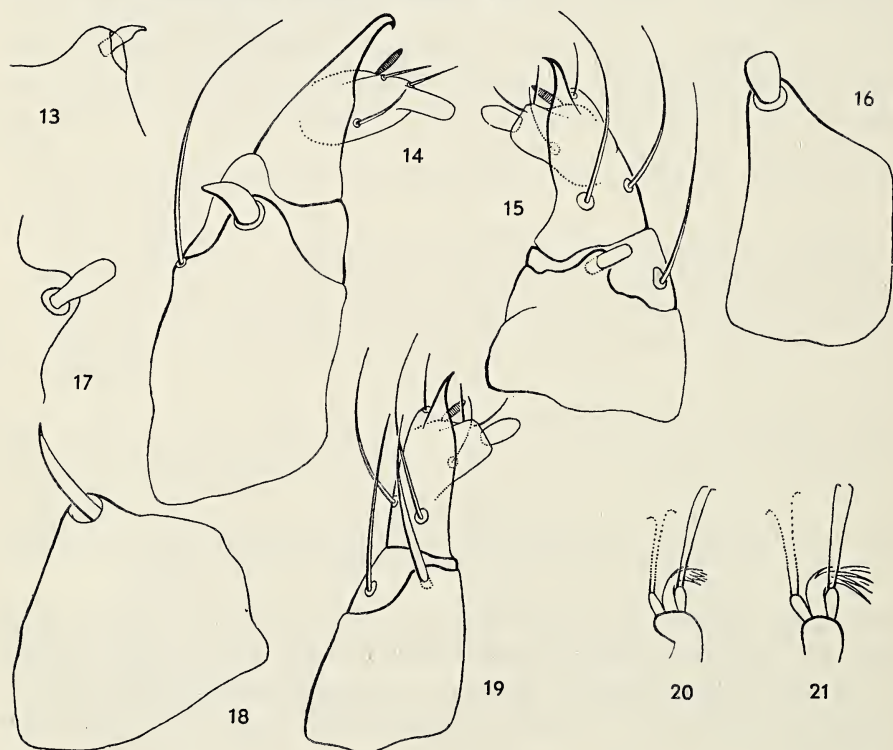


Fig. 13—19, Different shapes of the dorsal hair on the palpal femur (see text); fig. 20—21, Empodium I of the intermediate and of the female type (see text). (B. WEIJDE del.).



3. The empodium I may vary as follows:

- a. the male type, clawlike
- b. intermediate, with short needles (fig. 20)
- c. the female type, with six long needles (fig. 21)

As these modifications do not strictly go together a large number of combinations may occur. It cannot be said that these combinations of characters are strictly longitudinal. Nor does a regular female character, for instance the empodium, necessarily imply that the other characters are all female. Even the left hand and the right hand side of a specimen may be different.

For illustration we shall give a few examples of combinations as observed in our material. The numbers correspond with those of the figures.

		male dorsal hair on palpal femur	terminal sensillum	empodium I
a	left	lacking	intermediate	female
	right	male	intermediate	male
b	left	male	male	female
	right	fig. 19	female	intermediate
c	left	male	male	female
	right	male	male	male
d	left	lacking	female	female
	right	lacking	female	female
e	left	male	male	intermediate
	right	fig. 18	intermediate	intermediate
f	left	fig. 18	male	intermediate
	right	male	intermediate	male
g	left	lacking	intermediate	female
	right	fig. 15	intermediate	intermediate
h	left	fig. 17	male	male
	right	fig. 19	female	intermediate

III. Giant intersexes with intermediate genitalia. The general aspect of these mites is as described above, but instead of a normal aedeagus they have a combination of mutilated male and female genitalia. We think that the figures 22—24 are more instructive to this point than would be a long description. In these cases we have not observed the cup-shaped invagination and the ductus ejaculatorius.

Fig. 22 shows a partly developed female structure and a poorly developed aedeagus with an indication of its stem. The palps and empodia I of this specimen have the female aspect.

Fig. 23 shows a similar female structure and a mutilated aedeagus. The left hand palp is male, the right hand one is female. Both empodia I are female.

Fig. 24 shows a mutilated female structure, but the aedeagus is absent. The left hand palp is of the female type. The right hand palpal femur has a modified hair as fig. 15. The empodia I are female.

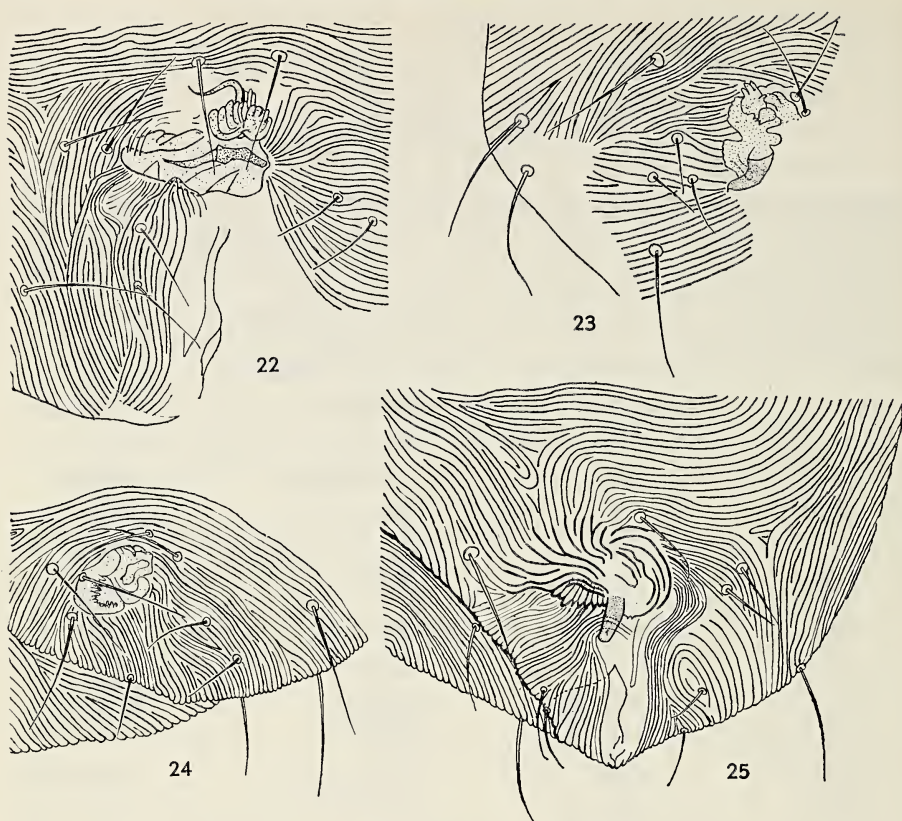


Fig. 22—24, Mutilated genital structures of three giant intersexes (see text);  
fig. 25, Mutilated genital structures of an intersex of normal size (see text).

**Intersexes of normal size.** Occasionally specimens are observed in line 23, which look entirely like a normal female, but which are slow and rather apathic in their reactions.

We have examined one of them. As seen in fig. 25 it possesses incomplete female genitalia, combined with a rather well developed aedeagus. Such females can produce an egg, which we suppose to be haploid as no mating seems to be possible. This egg, however, cannot leave the body, as no sufficiently developed genital opening is present. As a result the mite mostly keeps on sitting quietly. It becomes swollen and seems to suffer from the impossibility of getting rid of the egg.

The palps and empodia I of this specimen are of the female type.

#### References

- BLAUVELT, William Ernest, X.1945, The Internal Morphology of the Common Red Spider Mite (*Tetranychus telarius* Linn.). Cornell Univ., Ithaca, Mem. 270, p. 1—35, Pl. 1—11, fig. 1—51.  
HELLE, W., 1965, Inbreeding depression in an arrhenotokous mite (*Tetranychus urticae* Koch). *Entom. exper. & appl.* 8: 299—304.  
HELLE, W. and A. Q. VAN ZON, 1966, Albinism in two *Tetranychus* species. *Genen en Phaenen*, in the press.