STUDIES IN HEPTAPTERA (UMBELLIFERAE) I: A BIOSYSTEMATIC STUDY OF HEPTAPTERA IN ISRAEL

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ABSTRACT. Eleven populations and several single plants of *Heptaptera* were studied in their native habitats in Israel. In 5 populations in which the chromosome number was studied, it was found to be 2n = 22. The variability of characters of leaves, inflorescences and fruits within and between populations was analysed. Some correlation was found between features of inflorescences, fruits and leaves and the altitude of the habitat. As, for the most part, variation of characters proved to be continuous, all the plants in the area under investigation are considered as one species, *H. anisoptera* (DC.) Tutin. Within this species it is proposed to include *H. alata* (Boiss.) Tutin, *H. microcarpa* (Boiss.) Tutin and *H. crenata* (Fenzl) Tutin. These 3 species were originally described on the basis of traits which proved to fall within the range of variation of *H. anisoptera*. This study may provide criteria for the evaluation of diagnostic characters in the genus in general.

INTRODUCTION

A study of herbarium specimens of the small and neglected genus *Heptaptera* showed that the main diagnostic characters on which the delimitation of species is usually based, i.e. the shape of the leaves and the mericarps, are very variable. One of the problems with which we were therefore faced, was the evaluation of diagnostic characters. As in most genera of the Umbelliferae, this is a matter of some difficulty.

In order to estimate the trends of variation and the value of different characters for the delimitation of species, the authors studied morphological characters in representative native populations of *Heptaptera*.

Heptaptera is rather widespread in Israel and its vicinity. It grows mainly on hilly terrain, from 150 to 800 m above sea level, forming numerous, usually small populations (fig. 1). Until recently, species of *Heptaptera* have been known either as *Colladonia* or *Prangos* and have been listed under either name.

De Candolle (1830) described *Prangos anisoptera* from a plant collected in Tiberias (near locality 8, fig. 1). Boissier (1872) based his description of the same species on a specimen collected in Samaria (= Nablus) (near localities 5 and 6 on fig. 1). Post (1896), Dinsmore (1932) and Bornmueller (1936) referred collections from the area of the present study to two species: *Colladonia anisoptera* (DC.) Boiss. (from the vicinity of localities 1, 2, 4 and 8 on fig. 1) and *C. crenata* (Fenzl) Boiss. (near localities 1, 2 and 7 on fig. 1). Zohary (1941) and Eig, Zohary & Feinbrun (1948), considered local plants as belonging to two species: *C. anatolica* (Boiss.) Boiss. (near localities 4, 10) and *C. crenata* (including *C. anisoptera*) (near localities 5, 6, 7); whereas Zohary (in press) considers them as one species = *H. crenata* (Fenzl) Tutin—with two varieties, one of them synonymous with *H. anatolica*.

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Material and Methods

Eleven populations of *Heptaptera* were studied *in situ*. Figure 1 gives a map of the localities; the numbers correspond with those in table 1, which provides some data for each population; sites from which single specimens of *Heptaptera* were collected are also indicated in fig. 1.

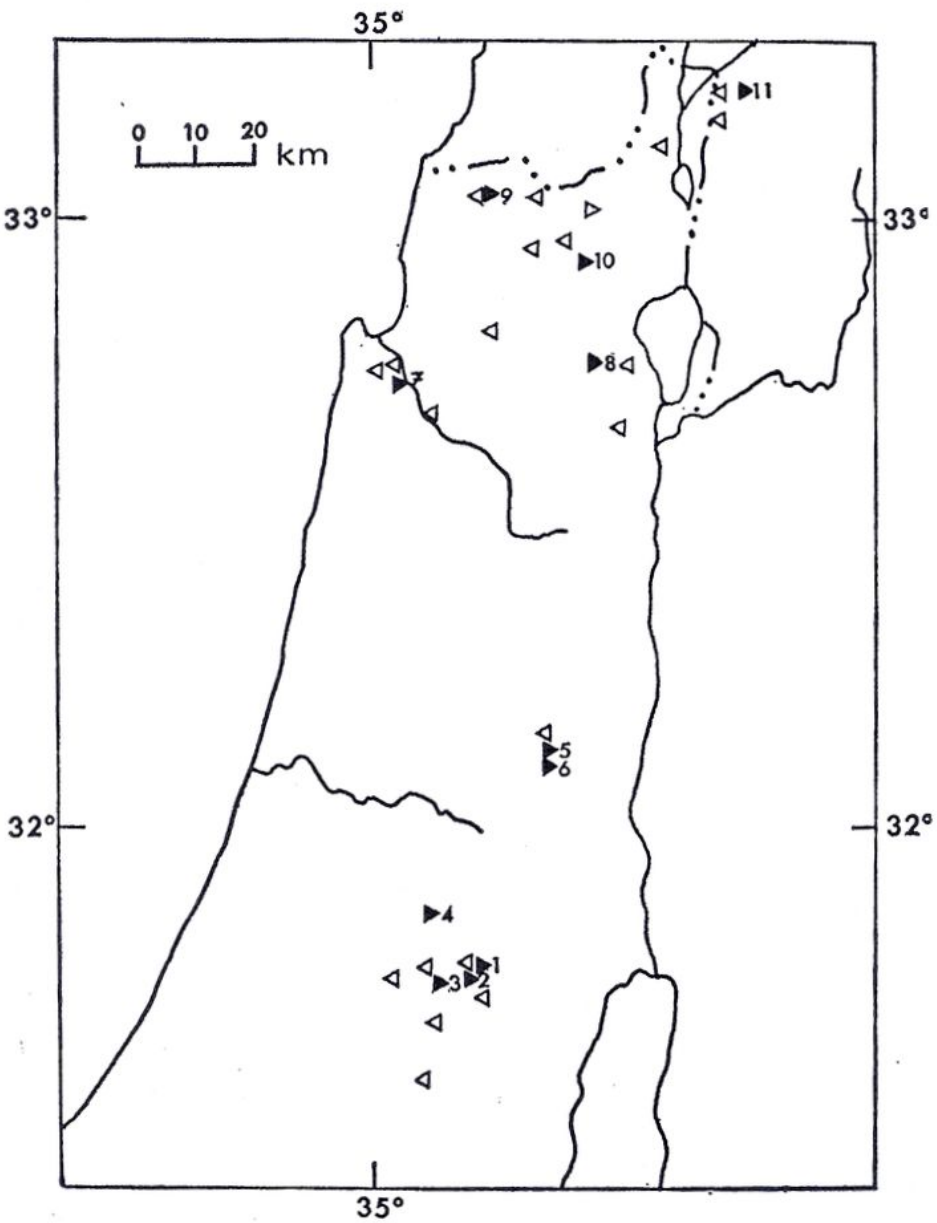

FIG. 1. The distribution of *Heptaptera* in Israel and neighbouring areas; populations studied are marked ▲ and by numbers corresponding to those in tables 1 and 2. Single plants observed are marked △.

TABLE I

List of populations of *Heptaptera*

Population No.	*Locality*	*Altitude* (m)
1	Judean Mts., Jerusalem 1	750
2	Judean Mts., Jerusalem 2	750
3	Judean Mts., Bet Zayit	650
4	Judean Mts., Qiryath Anavim	770
5	Shomron, betw. Ramallah and Nablus 1	700
6	Shomron, betw. Ramallah and Nablus 2	700
7	Mt. Carmel, Wadi Shomria	400
8	Lower Galilee, Mizpah (near Tiberias)	100
9	Western Galilee, Elon	300
10	Upper Galilee, betw. Bet Gan and Miron	900
11	Golan Heights, Kala'at Nimrod	700

In each population about 5–15 plants were studied in the field; additional material was collected for documentation and further studies. Special attention was paid to individual plants with characters deviating from the norm. Most localities were visited twice, once in early spring for study of basal leaves and again in summer for study of fruits.

The following characters were found to be variable (see table 2 and figs. 2–4). *Leaf* (fig. 2)—number of pairs of segments; development of petiolule of the first segment; the extent of dissection. *Fruits* (see figs. 3 and 4) —overall size and shape; length of seed in relation to length of mericarp; development of dorsal wings; degree of suberization. *Inflorescence*—length of rays; length of pedicels in relation to length of fruits.

Chromosomes were studied in five populations. In four, mitotic metaphase was investigated in roots of seedlings pre-treated with paradichloro-benzene; squashes were made in 2% aceto-orcein. In one population meiosis of PMC was studied in 2% aceto-carmine smears.

Results

Leaves and fruits vary to a considerable extent between populations as well as within populations (figs. 2–4). The combinations of characters within the 11 populations studied and the chromosome counts are recorded in table 2.

Leaves. The leaves of *Heptaptera* are 1–4 times pinnatisect, not always to the same degree in any single plant; basal leaves may be less dissected than the lower cauline leaves by one degree (very rarely the basal leaf is simple) and may have a smaller number of segment pairs.

In some populations (e.g. 2 and 8), the extent of dissection of the basal leaves varies greatly between individual plants. In other populations the basal leaves of all plants are more or less uniformly dissected (e.g. 1, 6 or 10—with slightly dissected, 7 and 9—with strongly dissected leaves).

There seems to be some correlation between leaf type and locality, and stronger dissection of basal leaves is usually correlated with an increase in segment pairs. Those populations which include at least some plants with 1- to 2-pinnatisect leaves of type A and B (fig. 2) and with not more than 4 pairs of segments, are confined to higher elevations, between 650–950 m alt. (populations 1–4, 10). On the other hand, at elevations between

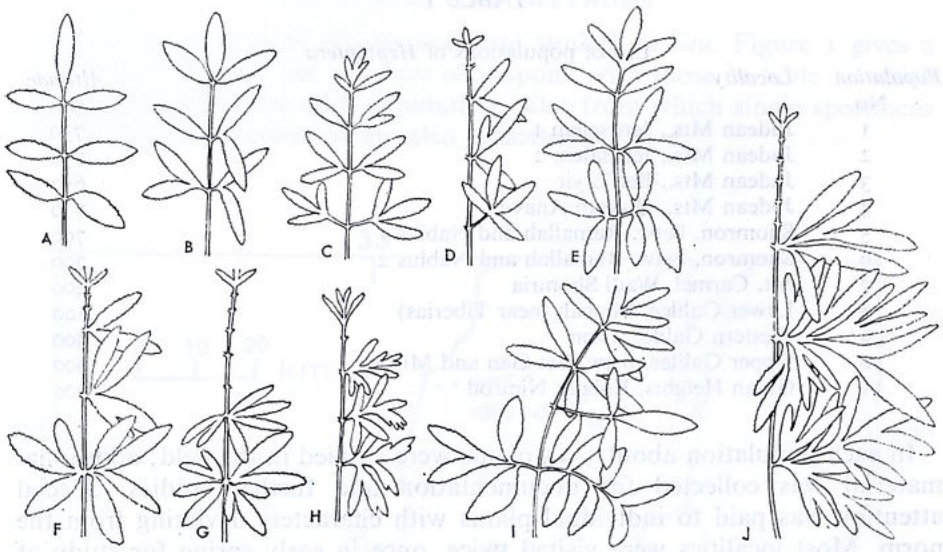

FIG. 2. Different types of leaves found in *Heptaptera* in Israel. See table 2 for explanation.

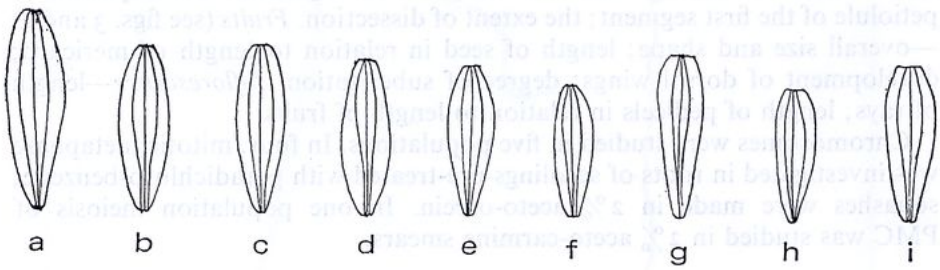

FIG. 3. Different outlines of mericarps found in *Heptaptera* in Israel.

150–400 m, the basal leaves are more dissected and have 5–8 pairs of segments (populations 7–9, 11). In this connection, the case of populations 5 and 6 from two neighbouring localities, 10 km S of Nablus, is of interest: whereas in one population (5), the leaves are of the type characteristic of the higher elevations, in population 6 they are of the type occurring at a lower elevation.

Fruits. All fruits of *Heptaptera* from our region are more or less uniform and have ellipsoid to narrowly obovoid mericarps. The seed usually reaches about half the length of the mericarp, only exceptionally attaining two thirds. The outline of the mericarps varies within the limits shown in fig. 3. The width of the dorsal wings gradually decreases from the base of the seed downwards. Though variation of mericarps between individual plants in any population may be considerable, some populations show characteristic trends. The length of individual fruits may vary considerably in any single population. In the extreme case of population 11 it varies between 15 and 25 mm. It seems impossible to correlate trends of variation of the fruit with those of the leaves.

TABLE 2

Distribution of characters in populations of *Heptaptera*

Population	*Basal leaves* type[1]	number of segment pairs	*Inflorescence* *Rays* number	*Rays* length (cm)	*Pedicels* length (mm)	*Fruit* type[2]	length (mm)	suberized	2*n*
1	A B C	3–4	7–13	7–10	20–25	a b c d e f	15–18(–20)	—	22
2	A B C D H	3–4	10–12	7	20–25	d f j	15–18	—	—
3[3]	A C D E	—	—	—	—	—	—	—	—
4[4]	A B C	3–4	12	8	20	a b e	20–22	—	—
5	A C	3–4	8–12	9–12	15–22	a d f	17–22	—	—
6	E I	5–8	8–12	9–12	15–22	a d f	17–22	—	—
7	F G	5–8	13	7–8	15	c g h	15–18	+	22 (n = 11, p.m.c.)
8	C D E G	5–8	14–22	9–13	10–15(–18)	c d g i j	18–20	+	22
9	E G J	5–8	11–18	12–15	15–20	c g h	18–20	+	22
10	A C	3–4	8–9	7–10	20–37	a d	18–25	—	—
11	—	5–8	6–9	(7–)10–14	15	c g h	15–25	+	22

(1) The letters refer to illustrations in Fig. 2. (2) The letters refer to illustrations in Fig. 3. (3) Only young plants seen. (4) Some plants growing near this population had entire basal leaves.

All fruits seen were asymmetrical: usually both mericarps have uniformly developed lateral wings; the dorsal ribs are, however, asymmetrically developed in one fruit with the median rib winged in one mericarp and the two submedian ribs winged in its counterpart. In certain populations a different distribution of dorsal wings was observed in some fruits (see fig. 4 for an analysis of fruit types in one population).

The rare combination of 2, or even 3, winged dorsal ribs on both mericarps of a single fruit was noted by Boissier in some fruits of a collection of *Aucher* 3667 from an unknown locality in Syria. Boissier named this plant *Meliocarpus alatus* (Boissier, 1844) and subsequently included it in *Colladonia* (Boissier, 1872). As the same collection and even the same plant also has some typically asymmetrical fruits, we do not accept *Colladonia alata* as a separate species.

Fruits of different populations show a different degree of suberization. Suberized mericarps have a more ovoid shape than others. The most strongly suberized fruits were found in populations 7, 8, 9, 11, which also showed a higher degree of leaf dissection.

Inflorescences. The number of rays varies greatly between populations as well as within populations and is confined in the majority of populations to a range between 6–13. Populations 8 and 9 are exceptional with 14–22 and 11–18 rays respectively. No strict correlation between the number of rays and other morphological characters could be detected, though in the populations with greater dissection of leaves there is a trend towards an increase in the number of rays and a trend towards the development of longer rays.

The ratio pedicel/fruit shows a different distribution in individual populations. Plants from lower elevations usually have pedicels which are shorter than or as long as the fruit. In plants from higher elevations the pedicels are often longer but never shorter than the fruit.

Chromosomes. In the populations in which chromosomes were studied (see table 2), identical chromosome numbers were found—in one population (no. 7) $n = 11$, in 4 populations (nos. 1, 8, 9, 11) $2n = 22$. The idiogram in fig. 5A shows the metaphase plate of a plant from population 1. It seems that all the karyotypes studied are identical and have 3 pairs of short acrocentric and 8 pairs of longer acrocentric to submetacentric chromosomes (fig. 5 A–C). No chromosomes with satellites were seen.

Discussion and Conclusions

The analysis of table 2 points towards the existence of two groups with a fair number of correlated characters.

As a rule, plants of *Heptaptera* from the higher elevations are different from plants of lower elevations. In each of the populations of the first group, the leaves have 3–4 segment pairs per leaf and at least some plants have only once dissected leaves (see fig. 2, A); shorter and fewer rays in the inflorescence are more frequent in this group, as well as scarcely suberized fruits on pedicels which are sometimes as long as, but more often longer than the fruits.

In plants of lower elevations the leaves have 5–8 segment pairs and are more times dissected (see fig. 2, E–J); rays are usually longer and more

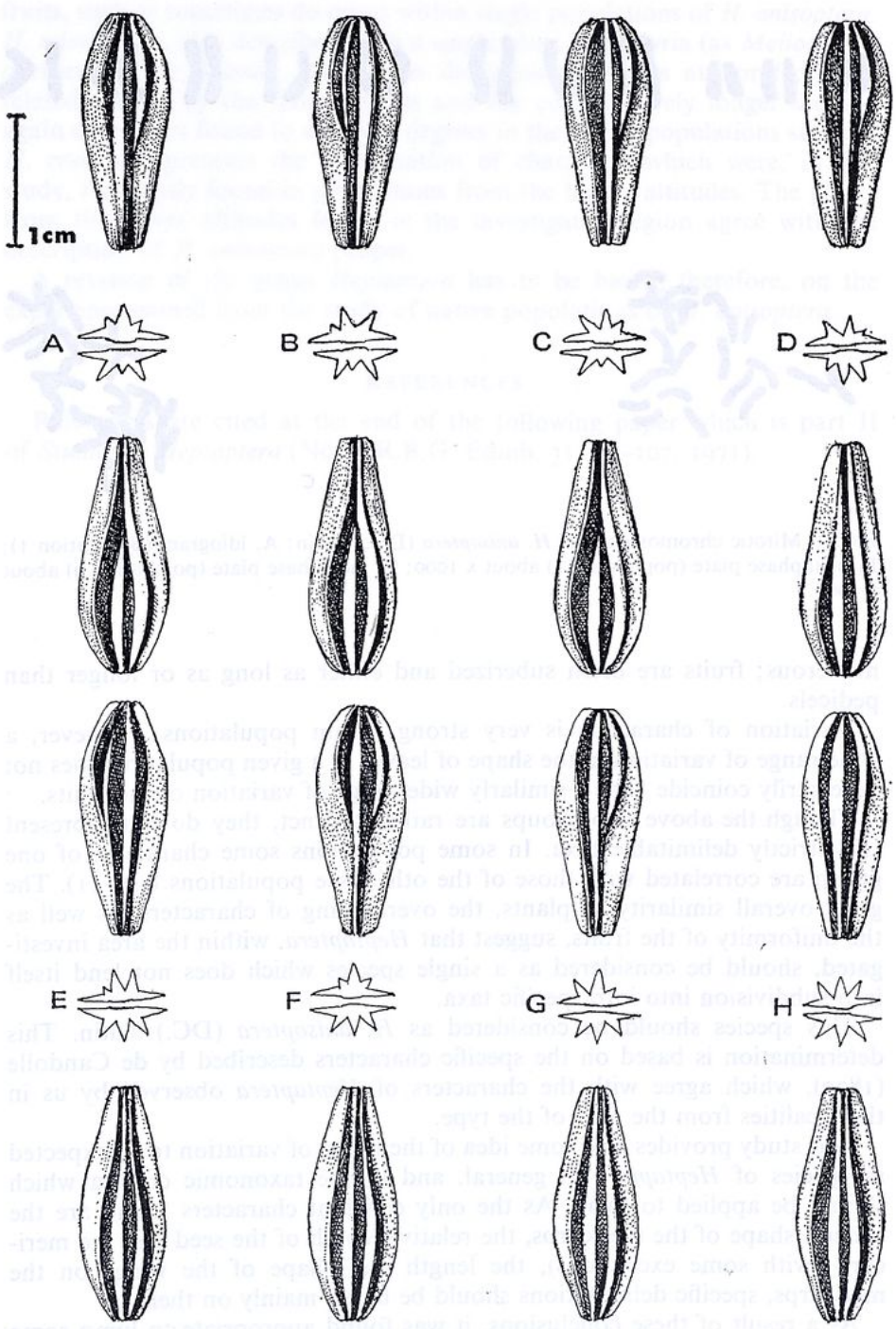

FIG. 4. Different combinations of wing development on the two mericarps within a single population of *Heptaptera* (population no 1). See table 2 for explanation.

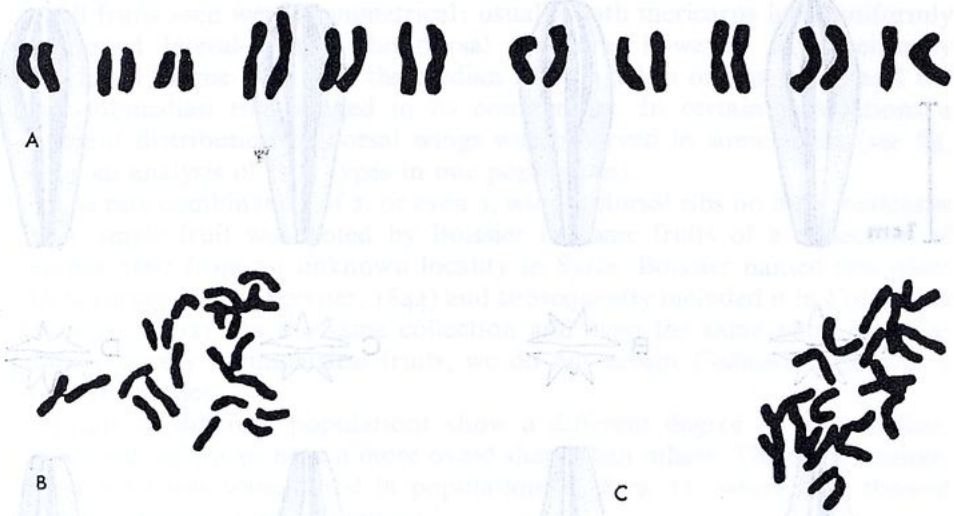

FIG. 5. Mitotic chromosomes of *H. anisoptera* (DC.) Tutin: A, idiogram (population 1); B, metaphase plate (population 1) about x 1000; C, metaphase plate (population 9) about x 1000.

numerous; fruits are often suberized and either as long as or longer than pedicels.

Variation of characters is very strong within populations. However, a wide range of variation in the shape of leaves in a given population does not necessarily coincide with a similarly wide range of variation of the fruits.

Though the above two groups are rather distinct, they do not represent two strictly delimitable taxa. In some populations some characters of one group are correlated with those of the other (see populations 8 or 11). The great overall similarity of plants, the overlapping of characters, as well as the uniformity of the fruits, suggest that *Heptaptera*, within the area investigated, should be considered as a single species which does not lend itself into subdivision into infraspecific taxa.

This species should be considered as *H. anisoptera* (DC.) Tutin. This determination is based on the specific characters described by de Candolle (1830), which agree with the characters of *Heptaptera* observed by us in the localities from the area of the type.

This study provides also some idea of the range of variation to be expected in species of *Heptaptera* in general, and of the taxonomic criteria which should be applied to them. As the only constant characters found are the general shape of the mericarps, the relative length of the seed and the mericarp (with some exceptions), the length and shape of the wings on the mericarps, specific delimitations should be based mainly on them.

As a result of these conclusions, it was found appropriate to lump some of the forms earlier described as species—often on the basis of a single specimen.

In *H. anisoptera*, as understood here, we included *H. alata* (Boiss.) Tutin, *H. microcarpa* (Boiss.) Tutin and *H. crenata* (Fenzl) Tutin. As explained above, *H. alata* was described from a single plant with some symmetric

fruits, such as sometimes do occur within single populations of *H. anisoptera*. *H. microcarpa*, also described from a single plant from Syria (as *Meliocarpus microcarpus* by Boissier, 1849), was distinguished by its author from the related species by the shorter fruits and the comparatively longer seeds—again characters found to different degrees in the native populations studied. *H. crenata* represents the combination of characters which were, in this study, frequently found in populations from the higher altitudes. The plants from the lower altitudes found in the investigated region agree with the description of *H. anisoptera* proper.

A revision of the genus *Heptaptera* has to be based, therefore, on the experience gained from the study of native populations of *H. anisoptera*.

References

References are cited at the end of the following paper which is part II of *Studies in Heptaptera* (Notes R.B.G. Edinb. 31: 91–107, 1971).