

# 1 Introduction to the Genus *Coryphantha*

*Coryphanthas* are small to medium-sized globose to short-columnar tubercled cacti from Mexico and the south of the USA, which grow in dry regions and deserts between the Sierra Madre Oriental and the Sierra Madre Occidental. The plant bodies are not partitioned into ribs as e.g., in *Ferocactus*, *Thelocactus* etc., but into tubercles as in the closely related genus *Mammillaria*.

The name *Coryphantha* originates from the Greek *koryphe* = apex and *anthos* = flower and means “flowering from the apex”. The flowers are quite large (3–10 cm diameter) and arise from the new growth, which is in the centre of the plant, contrary to e.g. *Mammillarias*, which flower around the top from the growth of the year before. The flowers often are yellow, but also white or pink. The fruits are green and juicy, with attached flower remnants, the seeds are mostly reniform, brown, with reticulate testa structure.

The tubercles of *Coryphanthas* have a groove on their upper surface which usually reaches from the spine-bearing areole to the axil. The flowers originate from this groove, from which the plants may also sprout. Different types of areole development exist, which gives hints about the possible developmental history of the genus (phylogenesis).

In some species in these grooves and/or the axils, so-called nectary glands are produced which are mostly yellow, orange or red and which produce a sugar-containing sap. This sap may serve to attract ants, which, by their marking, keep plant- and mainly bud-eating animals from the plant.

The genus is characterised by the following three features, which should be present in adult plants:

1. Flowers in the apex of the plant.
2. Flowering tubercles grooved.
3. Seed testa reticulate.

Each cactus with tubercles showing these three features belongs to the genus *Coryphantha*. Moreover, all *Coryphanthas* have the potency to produce extrafloral nectary glands.

Following this definition and mainly due to the seed morphology, the following species have to be separated from *Coryphantha*: all species of the genus *Escobaria* which show foveolate testa cells and *Cumarinia*, with channelled anticlinal boundaries.

*Coryphanthas* belong to the slow-growing cacti and often are floriferous only after 8–10 years. Formation of a tubercle groove indicates that a plant has become floriferous. Many species pass through several stages, in which they change their appearance repeatedly. In nature, slow growers are heavily influenced by the microclimate at their individual location and, therefore, are surprisingly variable. These are also the main reasons, why up to now, more than 300 supposedly different species or combinations have been published which, as a result of our studies, must be reduced to 43 species and 11 subspecies.

For a better understanding of the genus *Coryphantha*, in addition to their great variability in nature, three particularities must be considered:

**1. Many *Coryphantha* species continuously change their appearance during their development from young to adult plants.**

Sometimes this change is so marked that, in consequence, floriferous plants of different ages are difficult to identify as belonging to the same species if one does not know their stages of development. Note the following examples: *C. echinus* (whose early form has pure radial spination only and was described as *C. pectinata*), *C. salinensis*, *C. difficilis*, *C. wohlschlageri*, *C. echinoidea* (see Plate 1).

**2. Several *Coryphantha* species occur, even as adult plants, either with or without a central spine.**

These variants do not depend on the location. They can be found altogether at one and the same location. Here are some examples: *C. compacta*, *C. nickelsiae*, *C. delicata*, *C. cornifera*, *C. pallida*, *C. erecta*. Repeatedly, plants of the same species with and without a central spine have been described as different species (examples: *C. compacta*/*C. palmeri*, *C. cornifera*/*C. radians*, *C. pallida*/*C. pseudoradians*) (see Plate 3).

**3. Extrafloral nectary glands**

All *Coryphanthas* have the potential to produce extrafloral nectary glands. Two different types must be differentiated (see Plate 2, photos 1–4):

- Species in which nectary glands are always present, either in the areolar groove and/or in the axil (subgenus *Neocoryphantha*)
- Species with optional nectary glands around the flowering period only, and directly behind the spine-bearing areole only and, moreover, on singular areoles only (subgenus *Coryphantha*). Among them, there are species which were counted among the obligatory gland-bearing *Coryphanthas* by earlier authors (BACKEBERG 1961, H. BRAVO 1991; e.g. *C. pseudechinus* ssp. *pseudechinus*, *C. pulleineana* etc.) as well as other species which until today have been regarded as glandless (e.g. *C. pseudechinus* ssp. *laui*, *C. maiz-tablasensis* etc.).

The differentiation between obligatory and optionally gland-bearing *Coryphanthas* can already be observed in a seedling only a few weeks old, because the species mainly of the series *Clavatae* and section *Otonis*, which will be gland-bearing later on, show strikingly “inflated” and flattened, snow-white small spines, while the first spines of the non-glandular species are much thinner, roundish and yellow-brown (see Plate 4).

Only when considering these three points mentioned above can plants of this genus be judged and classified correctly. Disregard of these points has led to wrong diagnoses in the past and contributed to the general systematic chaos.

## 2 Ecology of *Coryphantha* spp.

### 2.1 Geographical Distribution

The 43 *Coryphantha* species are plants of the Mexican highlands, their main distribution area extends from the Sierra Madre Oriental to the Sierra Madre Occidental and to the Sierra Madre del Sur. Six species (*C. sulcata*, *C. ramillosa*, *C. recurvata*, *C. robustispina*, *C. echinus* and *C. macromeris*) also occur on the other side of the Rio Grande in the southernmost states of the USA (Texas, New Mexico and Arizona).

The only species which occurs in some places south of the Sierra Madre del Sur, mainly along the Rio Balsas and South of Oaxaca, is *C. elephantidens* with its ssp. *bumamma*.

The Sierra Madre Oriental is more habitable for *Coryphantha* spp. thanks to the large river valleys towards the Gulf of Mexico. Here, again, it is *C. elephantidens* with its ssp. *greenwoodii*, which has an isolated habitat on the eastern slopes of Puerto del Aire near Acultzingo VER. To the north of the distribution area, *C. macromeris* ssp. *runyonii* reaches the coastal plains along the Rio Grande. In the region in between, in the states of Tamaulipas and Nuevo León, there are two species whose distribution area is exclusively restricted to the eastern slopes of the Sierra and the plains extending below it: *C. salinensis* and *C. nickelsiae*.

The distribution maps are shown on colour Plates 5 and 9–13.

### 2.2 Climate

The geographical distribution area is identical to the drier zones of Mexico with a maximum precipitation of up to 1000 mm/year. These precipitations, however, are very unequally distributed over the year and mainly occur in the four summer months as heavy thunder showers. The rest of the year is dry. The majority of *Coryphantha* spp. grow in regions with less than 600 mm/year precipitation, i.e. dry and very dry zones, but the marginal areas of distribution are located in moderately humid regions.

Summer in the whole distribution area is very hot, but in the wintertime short cold periods and nightly frosts are not unusual, mainly in the north.

The climatic conditions are shown in Plate 5.

*Coryphantha* spp. are very well adapted to these conditions of climate. In winter they stop growing in order to withstand the dryness and cold. Growth begins again in spring shortly before or with the first rainfall.

In order to reproduce, *Coryphantha* spp. have two main strategies: either they flower very early in spring or summer so the fruits ripen within the same rainy period (a typical representative of these early flowerers: *C. clavata*). Or they flower in fall only, and the fruits remain dormant and ripen in the following spring when the seeds have a complete rainy season for germination (typical representative of these late flowerers: *C. elephantidens*).

Many *Coryphantha* spp. make use of both strategies and flower several times during the whole summer. In this case, some of the fruits ripen in the same summer, others towards spring.

## 2.3 Geology

Mexico can roughly be divided into two geological zones: The eastern zone with the Sierra Madre Oriental, which mainly consists of calcareous sedimentation and the western and southern zones with the Sierras Madre Occidental and del Sur which are of volcanic material. *Coryphantha* spp. grow in both zones, but the species are specialised either for lava soils or for calcareous soils. An exception is *C. clavata* which is known to grow on volcanic stone in one location, while otherwise this species grows on calcareous ground.

*Coryphantha* spp. are not extreme endemites, which occur on strictly defined soil or ground only. Usually, a few main parameters like lava/lime, exposition, incline etc. are sufficient for the occurrence of a species. Most probably, the limits of distribution of the species are caused by climatic factors. This would also explain the rather huge distribution area of certain species like *C. elephantioides* (in this case from southern Oaxaca and Veracruz up to Zacatecas), which can be found wherever their specific demands for a location are fulfilled.

A few species are specialised for special soils:

*C. gracilis* grows on very characteristic conglomerate soils only, or *C. jalpanensis*, which grows on raw humus on calcareous rocks only. For other species with very limited areas, like *C. pulleineana* or *C. vogtherriana*, the reason for their limited distribution is not known, but it is certainly not caused by geological conditions.

## 2.4 Habitats

Since many *Coryphantha* spp. are widely distributed, they are practically part of the "basic outfit" of certain floras. Some species, like *C. cornifera* or *C. delicata* occur in masses, while others like *C. hinoniorum* are very scattered over large areas. There are few habitats which are not settled by *Coryphantha* spp.: the highest mountainous regions with pine forests as well as naked rock walls and gypsum hills, but also steep and unstable ground where *Coryphantha* spp. as slow-growing plants can hardly establish themselves.

The classical habitat of a *Coryphantha* is the foot of a hill or a ridge of stony gravel with loose vegetation, or on lava with grass. There, the plants grow partly in the open or slightly to completely protected between or under bushes.

Some species grow in specialised habitats. Among them, *C. macromeris* and *C. maiztablasensis*, both group-forming plants which occur in sandy gypsum, usually dry, nearly bare lagoons only; or *C. pseudochinus* and *C. durangensis*, which form large clusters on quite steep slopes with rocks, and *C. vaupeiana*, which grows on gravel plains. *C. poselgeriana*, *C. pycnacantha* and *C. hintoniorum* occur on flat plains only.

A special form of growth habit is shown by *C. pulleineana* which needs the proximity of a *Hechtia* or *Agave* to support the long, thin sprout.

It is not known yet how *Coryphantha* spp. settle in areas and how they came to be so widely distributed. Moreover, due to its green berry and the fact that, unlike certain *Mammillaria* spp., they are never found on trees, birds as the main distributors of seeds can be excluded with great certainty.

## 2.5 Conservation Status

The main threat for *Coryphantha* spp. is the fast growth of the population of Mexico and the consequent activities such as construction of settlements and roads, expansion of areas used by agriculture, intensified use of natural resources, deforestation and clearing by fire. Fortunately, most species are only marginally affected by these changes, thanks to their wide distribution and their remote and unfruitful habitats.

However, some *Coryphantha* species are extremely and acutely endangered. The most endangered species is *C. vogtherriana*, of which one single location remains which is extremely threatened by erosion due to deforestation and overpasturing. There are only a few hundred adult plants left and seedlings are never observed.

All those species which need plain, deep soils are heavily threatened by the extension of agriculture. This is true mainly for *C. pycnacantha*, *C. hintoniorum* and *C. maiz-*

*tablasensis*, but also to a somewhat lesser degree, for *C. elephantidens* and *C. ottonis*. Today, *C. pycnacantha* can only be found in pitiful remnants of habitats between the fields and the roads or near railroad banks.

Certain species suffer from a permanent loss of individuals by the “clearing” of pastures either by burning off the dry vegetation or by intentional removal of the plants, because they are regarded as a source of injury to cattle, as observed for *C. elephantidens* and *C. ottonis*.

Again and again, some habitats are completely destroyed unintentionally or through ignorance. This happened to the only known location of *C. maiz-tablasensis* outside the lagoon of Las Tablas near Matehuala, which was almost completely destroyed by the construction of the new highway. At the location of *C. sulcata* near Monclova COAH, which is right in the centre of a fast-growing industrial zone with continuous construction, there was one single plant left when we last visited (2001).



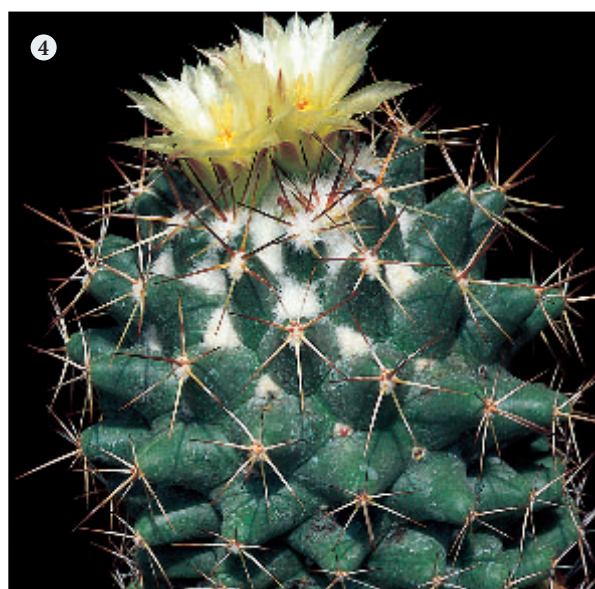


Plate 7. Examples of areole types. 1 *Macromeris* type: *C. macromeris* ssp. *macromeris*; 2 *Protocoryphantha* type: *C. robustispina* subsp. *robustispina* (photo L. Moore); 3 *Protomammillaria* type: *C. vaupeliana*; 4 *Ortegocactus* type: *C. georgii*; 5. *Escobaria* type: *C. elephantidens* ssp. *elephantidens*

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