

## Chapter 2

# The Haustorium and the Life Cycles of Parasitic Orobanchaceae

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### 2.1 How Do We Define the Haustorium in the Orobanchaceae?

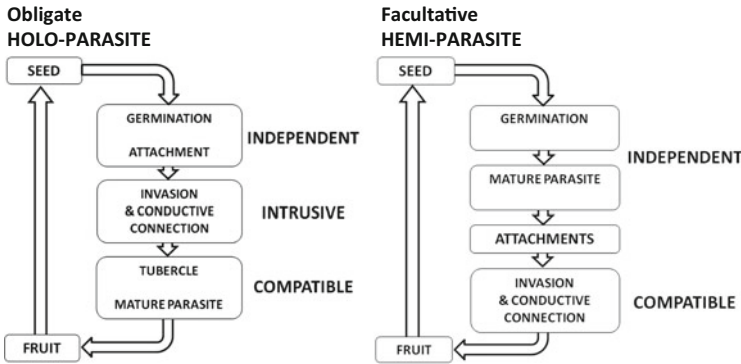
The haustorium is the special organ of all parasitic plants, which connects them to a living host plant and provides them with the ability to extract water and nutrient from their hosts. The term haustorium was originally defined by de Candolle (1813), who took it from the Latin word *haurire* meaning “to draw up” or “to drink,” which points to an active role. While Kuijt (1969) suggested that the haustorium serves as the *bridge* between host and parasite, Fahn’s opinion (1982) that the haustorium is a “specialized plant organ that *draws* nutrients from other organs or tissues” resembles the original meaning of the term haustorium, assuming that this organ is an *active* organ and not a *passive* bridge. Interestingly, most definitions of parasite haustoria do not mention their invasive nature, which should be included in the definition of haustoria, as put forward by Riopel and Timko (1995), who used this term for all developmental stages of this infective structure, from initiation through invasion and until the establishment of full vascular connections.

**In this book, the haustorium is defined as the special organ of parasitic plants, which invades host tissues and serves as the structural and physiological bridge that allows the parasites to withdraw water and nutrients from the conductive systems of living host plants.**

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**Fig. 2.1** Life cycles of obligate holoparasitic and facultative hemiparasitic Orobanchaceae

## 2.2 Life Cycles of Facultative and Obligate Orobanchaceae

The life cycle of the majority of the holoparasitic Orobanchaceae includes several key developmental phases (Fig. 2.1). The seedling develops independently for a short while up to the stage when it attaches to a host. This is the independent phase of the parasite development (see Chap. 9). Then comes the intrusive developmental phase, which includes (a) development of a terminal haustorium at the tip of the radicle, (b) invasion of the haustorium into host tissues (see Chap. 5), and (c) development of primary conductive connections with the host (see Sect. 3.9). Finally is the compatible phase in which the parasite development is coordinated with that of the host (see Chap. 6). The development of the haustorium depends on its ability to overcome host resistance mechanisms (see Chap. 7) and to compete with host organs on available host resources (see Chap. 6). The holoparasites can then develop roots carrying lateral haustoria (see Sect. 3.3).

The facultative hemiparasitic Orobanchaceae develop only lateral haustoria (see Sect. 3.3 and Chap. 4) after they have already established autotrophically (Fig. 2.1). Therefore, parasite–host relations in these plants differ from those of holoparasites, and the lateral haustoria face a different set of developmental and physiological challenges. However, the obligate hemiparasites, e.g., *Striga* and *Alectra*, resemble holoparasites in their short independent phase and in the development of a terminal haustorium; they also develop lateral haustoria and are autotrophic in later stages of their compatible phase.

Parasitism in plants cannot be understood until the architecture and mode of operation of the haustorium are known (Kuijt 1969). The next chapters are accordingly dedicated to the structural and developmental aspects of haustoria in the Orobanchaceae. Chapter 3 focuses on the diversity and anatomical structure of mature haustoria, with reference to the possible function of each haustorial tissue; Chap. 4 describes the stimulation and initiation of haustoria, and Chap. 5 deals with the invasion of the developing haustorium into host tissues.

## References

- De Candolle AP (1813) *Théorie élémentaire de la botanique*. Déterville, Paris
- Fahn A (1982) *Plant anatomy*, 3rd edn. Pergamon, Oxford
- Kuijt J (1969) *The biology of parasitic flowering plants*. University of California Press, Berkeley
- Riopel JL, Timko MP (1995) Haustorial initiation and differentiation. In: Press MC, Graves JD (eds) *Parasitic plants*. Chapman & Hall, London, pp 39–79

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