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PECULIARITIES OF ONTOGENESIS OF THE OROBANCHE CUMANA WALLR., PARASITIZING SUNFLOWER ROOTS (HELIANTHUS ANNUUS L.)

Individual development of representatives of the broomrapes family, as well as those of other highly specialized taxons of parasitic angiospermous plants, considerably differs from the ontogenesis of autotrophic plants. Broomrape sporophyte is marked by metamorphic development expressed in a change from unipolar development of the seedling in the period of its search of the plant-host to a bipolar development after the shift to parasitic feeding.

Our studies of the ontogenesis of different genera of the broomrapes family and of different species of the genus Orobanche have shown that individual development of these plants is characterized by considerable variability within the general form of metamorphic development. We consider these differences to be of importance when developing the means of protecting cultivated plants, sunflower in particular.

Mature seeds of O. cumana and sunflower were collected in the Kilie district of the Odessa region. Seed were germinated according to K. Kodry and H. Tewfic (1956) with subsequent visual observations of the development of the plant-parasite. Anatomical studies of seeds and seedlings were carried out too. Seeds and seedlings were fixated in mixtures of Carnois and FAA. Permanent samples were prepared according to ordinary cytological methods and were died with hematoxyline according to Geidengain with addition of alcyane blue, hencyane violet with orange G and with procionic dyes with addition of alcyane blue.

Mature seed of O. cumana has a structure characteristic for the broomrapes. The reduced

embryo is represented by a globular proembryo; it is surrounded by cellular endosperm and is situated close to the micropilar pole of the seed. The rate of differentiation of the formed embryo corresponds to that of the highly specialized representatives of the broomrape family.

Embryos were stimulated to develop by natural sap of the roots of the host-plant. The action of this sap is effective as a rule at a distance of few millimeters of the growing root. Between the stimulation and the beginning of germination a latent period is observed. Its exact determination was rendered difficult by the seeds' reading to the sap in different periods of time.

The seedling in the period of search of the host-plant shows unipolar development due to morphogenetic activity of the basal (radicular) pole of the embryo. The root sap of the host-plant not only initiates germination but also orients the development of the seedling in the soil. The general pattern of invasion of the seedling's basal apex, which is developed into houstorium, into the tissues of roots of the host-plant corresponds to that of previously studied species of the broomrape family (E.S. Teryokhin, Z.I. Nikiticheva, 1968). The pattern of invasion of broomrape haustorium into the root of the host-plant has so far been poorly studied. However, anatomical patterns of this process suggest the presence at its base of specific chemical relationships. Distribution of haustorial tissues of broomrape in sunflower roots corresponds to the previously described patterns (A. Ya. Panchenko, T.S. Antonova, 1974).

Over the site of invasion of the haustorium of broomrape seedling into the root of the host-plant a specific formation is developed - "a nodule", characteristic for highly specialized representatives of certain families of estoparasitic plants. Nodule formation by parenchyme cells is a necessary stage of preparation for

vegetation of parasitic plant. The nodule is an energetical and structural base of metamorphosis in the development of sporophyte of the parasite in representatives of orobanchoid form of parasitism of floral plants. In the process of evolutionary adaptation to the parasitic way of life the broomrapes have developed such an ontogenesis in which morphogenetic possibilities of reduced embryos during the initial stage of germination are primarily aimed at the search of nutritive substrate (host-plant) and invasion into its tissues. As these plants show heterotrophic type of metabolism, there is no need for the bipolar development of seedling which is characteristic for autotrophic plants. In broomrape embryos the epycotyle is completely reduced, and the cells of the terminal region of the seedling only fulfil the function of extracting nutritive substances from the endosperm during the process of germination (E.S. Teryokhin, 1968).

In the previously studied broomrape species (O. crenata, O. pallidiflora) the whole terminal part of the seedling up to the site of nodule formation dies out on having completed the haustorial function in the endosperm. The return of unipolarly developing seedlings to the bipolar organization and development is due to the secondary endogenic formation of the seedling apex in the terminal region of the nodule. The apex is formed by re-arranging the totality of cells in the nodule's terminal region. At the same time the first protective scales of the seedling are formed and secondary haustorial structures - organs of vegetative multiplication are developing also by re-arranging. The process of seedling apex formation is going through redifferentiation of a whole set of cells in the terminal zone of the nodule.

The difference of ontogenesis of O. cumana from that of the previously studied species is that besides the endogenic formation of the seedling apex in the tissue of the nodule, the exogenic formation also takes place in some

seedlings. When the seed of O. cumana is close to the root of the host-plant, the unipolar stage in the seedling's development becomes sharply shortened and the morphogenetic zone of re-differentiation or re-arrangement during seedling apex formation is located in the group of cells of the terminal pole of the seedling, that is, in the zone where the epicotyle of the autotrophic plants embryos is formed. However, in this case too, the formation and development of seedling apex and of the first scales show the pattern characteristic of apical structures based endogenically. This fact is an evidence that exogenic formation of seedling apex in some seedlings of O. cumana is a secondary result of the ontogenetic evolution of the broomrape family.

Seedlings of O. cumana, in contrast to those of other broomrape species, show a poor development of organs of vegetative multiplication (secondary haustoria). This may be related to their adaptation to parasitism on annual cultivated plants.

Thus, in the ontogenesis of O. cumana some peculiarities are observed which can be regarded as secondary results of evolution towards improvement of parasitism; these results may also be caused by adaptation to parasitism, especially on representatives of cultivated flora.

To develop effective means of controlling broomrapes it is advisable to deepen the studies of the ecological and biochemical features of chemo-induction of germination, of chemo-orientation of seedling growth, and of delicate features of the mechanism of the seedling invasion into the root tissues of host-plants. Apparently, these peculiarities in the broomrape's individual development are most susceptible to goal-oriented action.