VARIABILITY OF THE OSMOTIC STRENGTH OF THE SAP OF *CUSCUTA REFLEXA*, ROXB.

BY

P. PARIJA, M.A. (CANTAB.), B.Sc., I.E.S.,
Professor of Botany, Ravenshaw College, Cuttack

AND

A. B. SARAN, M.Sc.,
Government Research Scholar, Ravenshaw College, Cuttack.

Introduction.

Cuscuta reflexa, Roxb. grows commonly in Orissa on various hosts. No doubt there must be a definite osmotic relation between the host and the parasite in order to enable the latter to obtain nourishment from the former. In the case of a plurivorous parasite like *Cuscuta*, either (*a*) the parasite selects hosts which possess saps of a definite osmotic strength or (*b*) it is capable of adjusting the strength of its own sap in order to grow on a host which has sap of higher osmotic strength to begin with. Even when the parasite selects hosts having lower osmotic strength than its own, it must be capable of adjusting its osmotic strength when the strength of the host-sap changes, especially when it becomes stronger. It was considered worth while to find out the extent to which the osmotic strength of the sap of a plurivorous parasite like *Cuscuta reflexa*, Roxb. changes under artificial conditions. The osmotic strength of the host was changed by introducing glucose solution under pressure into the host. Then the osmotic strength of both the host and the parasite was measured by plasmolysis. The results are set out in this short account.

In the literature consulted, a list of which appears at the end of this paper, we find that J. A. Harris alone deals with the osmotic strength of the tissue fluid of *Cuscuta*. He finds by a single set of determinations that the osmotic strength of the sap of *Cuscuta*, growing on *Impatiens* in saturated soil, is higher than that of the host, while *Cuscuta salina*, growing on a halophyte, *Alleurolfea occidentalis*, has a lower sap strength than the host. He is dealing with two different species and the range of variation of the sap strength is from 5.36 atmospheres to 27 atmospheres. There does not seem to be any record of the variation of the sap strength of the same species.

Material and Method.

Cuscuta reflexa, Roxb. was growing in our laboratory garden on several plants of *Duranta plumieri*, Jacq. All the materials used during the period of this investigation, were taken from these plants. The materials, where the parasite was growing on other hosts, were collected from different localities of Cuttack.

For injecting sugar, only such leafy branches were selected, on which the parasite had sent in 4, 5 or more haustoria

The following method was adopted for injecting the host and the parasite with sugar solutions. A long glass tube (T in Fig. 1) (30"–36") of wide bore (.8–1.2 cm.) was taken. At one end of this tube a pressure tubing (R in Fig. 1) was slipped on. Into the free end of the rubber tubing the cut portion of the host, with the parasite on, was inserted and the connections were made water-tight. The whole tube along with the rubber tubing was immediately filled with the sugar solution of the desired strength. The glass tube and the host (with the parasite) so treated were kept upright, the rubber tubing forming a short loop. The whole arrangement was left in this condition for twenty-four hours. Three different concentrations of the sugar solution i e 0.4 %, 0.6 % and 0.8 % were used for this artificial feeding.

The concentrations of the cell sap of the host and the parasite were determined before and after sugar-injection by plasmolytic method Potassium nitrate was used as the plasmolysing medium. Sections of the host and the parasite were cut and were directly transferred to the different plasmolysing solutions. For moistening the razor and the material and for mounting the sections the same plasmolysing solution was used with which the sections were to be treated in order to determine their sap concentrations. The sections were kept in the plasmolysing solutions for about five minutes.

The results are set out in the table on the opposite page.

It will be seen that the osmotic strength of *Cuscuta* growing on all the hosts examined (seven genera representing four families) is always higher than that of the host. This varies from 0.40 to 0.45 in terms of mols. of KNO_3.

In the *Cuscuta reflexa*, Roxb. growing on *Duranta plumieri*, the osmotic strength is equivalent to 0.43 mols. of KNO_3. It was possible to raise this strength by injecting glucose solution into the host under pressure. But it will be seen from the table that there is a limit beyond which the osmotic strength could not be raised, although that of the host was raised higher than that of the parasite.

In the case of lower concentrations of sugar used in injecting the host, the parasite was quite fresh but in higher concentration such as

Name of Host.	Experimental			Control		Remarks
	Concentration of glucose in feeding the host.	Os. St. Host. (Mols KNO_3)	Os. St. Parasite	Os. St. Host.	Os. St. Parasite	
Duranta plumieri, Roxb.	0.4 %	0.43	0.44	0.42	0.43	
" "	0.4 %	0.43	0.44	0.42	0.43	
" "	0.4 %	0.43	0.44	0.42	0.43	
" "	0.6 %	0.44	0.45	0.42	0.43	
" "	0.6 %	0.44	0.45	0.42	0.43	
" "	0.6 %	0.44	0.45	0.42	0.43	
" "	0.8 %	0.46	0.45	0.42	0.43	
" "	0.8 %	0.46	0.45	0.42	0.43	
" "	0.8 %	0.46	0.45	0.41	0.42	
" "	0.8 %	0.46	0.45	0.42	0.43	
Euphorbia sp. ...	...	0.43	0.44	...	...	
Euphorbia sp. ...	...	0.43	0.44	...	...	
Phyllanthus reticulatus ...	...	0.42	0.43	...	...	
Tinospora ...	...	0.41	0.42	...	...	The parasite was growing on the peduncle of the fruit.
Daemia extensa ...	...	0.39	0.40	...	...	
Lantana camara ...	...	...	0.43	...	...	The parasite was growing on a young twig.

0.6 % and 0.8 % the cells of the parasite contain more starch grains than before and in the last case there were signs of wilting noticeable. This indicates that under the conditions of experiment the osmotic strength of the cell sap of *Cuscuta reflexa*, Roxb. growing on *Duranta plumieri*, Jacq. could be varied from 0.43 mols. of KNO_3 upto a maximum of 0.45 mols. beyond which the excess sugar if injected is converted into starch.

As already noted, *Cuscuta reflexa*, Roxb. growing on seven different genera representing four families were examined and the osmotic strength of the cell sap lay within the range of variability noted in *Cuscuta reflexa*, Roxb. growing on *Duranta plumieri*, Jacq.

It must, however, be noted here that 24 hours may not be long enough for the parasite to adapt itself to the changed osmotic condition of the host. In nature the parasite could perhaps be educated to adapt itself to hosts having higher osmotic conditions. The case of *Cuscuta salina* observed by Harris and referred to above, may find an explanation in such gradual adaptation.

Summary.

With a view to finding out the extent to which osmotic strength of the sap of a plurivorous parasite like *Cuscuta* could vary, twigs of the host were supplied with various concentrations of grapesugar thus raising the osmotic strength of the sap of the host. Consequent on this, the sap of the parasite rose in strength but up to a maximum. If the strength of the host-sap was raised further, the parasite-sap showed no further rise but the quantity of starch in the cells of the parasite increased. The range of variation was about 10 % below the maximum.

The sap strength of all the available hosts (7 genera representing 4 families) falls within this range.

References.

1. Griazev, N. D.—Life history, Parasitism and Control of Dodder on flax: Bull. Appl. Bot. and Plant Breed, 18 (1), 1927, 1938.
2. Harris, J. A.—The Tissue Fluids of Cuscuta: Bulletin of the Torrey Botanical Club, Vol. 51, 1924.
3. Harris, J. A. and Lawrence, J. V.—On the Osmotic Pressure of the Tissue Fluid of Jamaica Loranthaceae Parasitic on Various Hosts: Amer. Jour. Bot., Vol. 3, 1916.

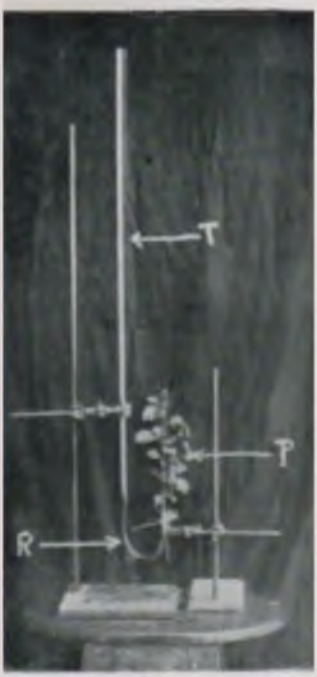

Fig. 1.—Device for injecting Sugar into the host and parasite.
T, glass tube; R, rubber tubing;
P, host with parasite.

4. HARRIS, J. A. and others.—Maximum Values of Osmotic Concentration in Plant Fluids: Proc. Soc. Exper. and Med. 18, 1921.
5. MELHARDT, HELENE.—The Relation of Phanerogamic Parasite to the Nutrition of the Host: Bot. Archiv. 13 (516): 1926.
6. MOSS, E. M.—The Haustorium of Cuscuta gronovii. Phytopath, 18 (5) 1928.
7. PEIRCE, G. J.—A Contribution to the Physiology of the Genus Cuscuta: Ann. Bot. 1894.
8. THOMPSON, JOHN.—Studies in Irregular Nutrition No. 1. The Parasitism of Cuscuta reflexa: Trans. Roy.