tained were almost all haploid, as shown by their chromosome number studied cytologically. Only on two occasions among many crosses were a few gynogenetic diploid individuals found. The percentage of developing eggs in such crosses was always high, usually greater than that of the control group inseminated with sperm of its own species. Serial sections of the inseminated eggs show that the sperm head lies along the first cleavage spindle, but does not fuse with the female pronucleus. It is eliminated after the first division. A study of the chromosomes of the spade-foot toad shows that they are smaller in size than either those of *R. pipiens* or *P. nigrita triseriata*, and their diploid number is 26. The chromosome number of *R. pipiens* is 26, whereas that of *P. nigrita triseriata* is 24.

The above method is very convenient and requires little time to prepare the material when a large number of gynogenetic haploid embryos of *R. pipiens* or *P. nigrita triseriata* is needed for study. The toad can be kept alive in the laboratory in a container filled with damp loose soil for 2–3 months without feeding. A pair of adult testes is enough to inseminate several hundred eggs.

References

1. Hertwig, G. *Arch. mikroskop. Anat.*, **81**, Abt. II, 87 (1913).
2. Hertwig, O. *Ibid.* **77**, Abt. II, 1 (1911).
3. *Ibid.* **82**, Abt. II, 1 (1913).
4. Hertwig, G. *Anat. Anz.*, **58**, Erg. Heft, 223 (1924).
5. Dalcq, A. *Arch. Biol.*, **43**, 343 (1932).
6. Hertwig, G. *Arch. mikroskop. Anat.*, **91**, Abt. II, 203 (1918).
7. Tchou-Su. *Arch. d'anat. micr.*, **27**, 1 (1931).

Studies on Algal Epiphytes

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Studies have been undertaken to determine if certain algal epiphytes possess parasitic characteristics. Light on this problem can only be obtained through a careful study of the physiology of the host and the epiphyte, as well as a careful study of the histology of their attachment areas.

Obligate epiphytes and mild or partial parasites among the algae have been observed and discussed by many writers and investigators (*1–8*), but the literature does not contain thorough reports concerning their physiology and morphology. Many investigators postulated that some of these algae were parasitic simply because they showed preference for certain hosts. Knight (*3, 4*), in describing *Pylaiella* on *Fucus vesiculosus*, stated that the epiphyte shows exclusive preference for fucoids. This, she pointed out, suggests selective epiphytism or a parasitic relationship not of the obligate type. Chapman (*1*) pointed out that, since *Ectocarpus siliculosus* often penetrates the host tissue, the relationship is possibly an example of mild parasitism. Kylin (*5, 6*), as well as Fritsch (*2*), also mentioned similar conditions among the algae. In all cases, however, the writers and investigators have shown some doubt about the physiological and histological relationship between the epiphyte and the plant upon which it lives.

TABLE 1

Summary of Algae Studied

Symbiotic relationships	Degree of penetration
Polysophonia lanosa on *Ascophyllum nodosum*	+++
Elachistea fucicola on *A. nodosum*	+
E. fucicola on *Fucus vesiculosus*	+
Spermothamnion turneri on *Chondrus crispus*	++
S. turneri on *F. vesiculosus*	–
Calothrix sp. on *Fucus* sp.	–
Calothrix sp. on *Cystoclonium* sp.	+
Acrochaetium moniliforme on *Dasya pedicellata*	+
Ceramium rubrum on *Chondrus crispus*	–
Ectocarpus siliculosus on *Laminaria agardhii*	–
E. siliculosus on *Zostera marina*	++
Polysiphonia variegata on *Chorda filum*	+
Lithothamnion turneri on *F. vesiculosus*	–
Bangia ciliaris on *Gelidium crinale*	–
Erythrotricia sp. on *Cladophora* sp.	–
Acrochaetium sp. on *Grinnellia* sp.	+++

+++ Cells of epiphyte penetrate deeply into tissue of host.
++ Cells of epiphyte penetrate just below the superficial cells of host.
– Cells of epiphyte do not penetrate tissue of host. host.
– Cells of epiphyte do not penetrate tissue of host.

During the summer of 1949 a number of algae epiphytes were collected in the vicinity of Woods Hole, Massachusetts, specifically on Penikese Island, Nobska Point, Martha's Vineyard, No Mans Land, and the Elizabeth Islands. Many microslides of the attachment areas of these epiphytes were made, and some of the slides were prepared by freehand sectioning, thereby making it possible to observe the living cells. Most of the slides, however, were prepared by the paraffin method, which made possible a more careful histological study.

Of the algae studied thus far, the attachment areas fall into four categories: those in which the cells of the epiphyte deeply penetrate the host; those in which they penetrate just below the superficial cells of the host; those in which they are wedged between the superficial cells of the host but go no further; and those in which they do not enter the host. At the present stage of this investigation, it is not the intention of the writer to imply conclusively that the degree of penetration of the epiphyte correlates with the degree of parasitism. Before such a conclusion can be drawn, studies must be made to determine whether the attachment areas observed represent a stage in the growth of the epiphyte or its ultimate growth.

Sufficient data have been obtained, however, to suggest that many of these so-called algal epiphytes may be symbionts of a nutritive antagonistic type, or of a nutritive reciprocal type. It can be observed from Table 1 that some of the algae deeply penetrated the tissues of the plant upon which they were growing. One that is of particular interest is *Polysiphonia lanosa* on *Ascophyllum* *nodosum*. The hyphalike cells of *P. lanosa* penetrated well into the medulla of *A. nodosum,* thereby disturbing the latter's general histological pattern and producing a necrotic appearance. In living sections the red cells of *P. lanosa* produced a good natural contrast with the greenish-brown cells of *A. nodosum*. As *P. lanosa* pushed its way in, many cells of the host appeared to have become crushed or dissolved. Although cells of *P. lanosa* did not appear to be intracellular in relationship to the host, it is believed that there could be an exchange of elaborated foods similar to that reported in *Cuscuta* sp. (*9*). Further reports will be made on this problem as soon as more data are obtained.

References

1. CHAPMAN, V. J. *J. Linnaean Soc. London, Botany,* 1937, **51**, 205.
2. FRITSCH, F. E. *The structure and reproduction of the algae.* New York: Macmillan, 1948. Vol. II.
3. KNIGHT, M. *Trans. Roy. Soc. Edinburgh,* 1923, **53**, (2), 343.
4. *Ibid.,* 1929, **56**, (2), 307.
5. KYLIN, H. *Botan. Notiser,* 1927, 275.
6. ———. *Botan. Rev.,* 1935, **1**, (4), 138.
7. PAPENFUSS, G. F. *Science,* 1933, **77**, 39.
8. ———. *Botan. Notiser,* 1934, 437.
9. THODAY, M. G. *Ann. Botany,* 1911, 655.

The Control of Storage Sprouting in Onions by Preharvest Foliage Sprays of Maleic Hydrazide[1]

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Chemicals such as the methyl ester of α-naphthalene-acetic acid (*1*) and 2,4,5-trichlorophenoxyacetic acid (*2*), which have markedly retarded the growth of sprouts in stored potatoes and, under some conditions, in vegetable root crops, have had no apparent inhibiting effect upon sprouting of onions. A possible explanation may be that the growing points in the onion are so firmly enclosed and protected by layers of leaf bases that the chemicals fail to penetrate to the meristems. It is well known from numerous herbicide tests that substituted phenoxy acids, in general, have little effect on monocotyledonous plants. In studies concerned with means of prolonging the storage life of onions, various growth substances were applied as preharvest foliage sprays. It was hoped that the intact growing plant might translocate the chemical or stimulus to the meristematic regions, making possible a penetration of the growth substance thus far not realized by postharvest treatments. There would be a possible added advantage in that the food product is treated only indirectly. Standard field spray equipment could also be utilized, thus eliminating many of the present difficulties incurred with treating produce after harvest.

[1] Journal Article No. 1157 of the Michigan Agricultural Experiment Station.

TABLE 1

EFFECT OF PREHARVEST FOLIAGE SPRAYS OF GROWTH REGULATORS ON SUBSEQUENT SPROUTING AND BREAKDOWN OF YELLOW SWEET SPANISH ONIONS IN STORAGE

Treatments	Concentration (ppm)	Weight of sprouts (g/40 bulbs)	Percentage of storage loss from	
			Sprouting	Breakdown
Sodium salt of α-naphthalene acetic acid	1,000	64.7	23	38
	5,000	36.8	22	40
2,4,5-trichlorophenoxyacetic acid	10	67.4	23	35
	50	68.1	28	46
Sodium salt of β-naphthoxyacetic acid	500	22.2	19	48
	2,500	45.3	14	49
Benzo-thiazol-2-oxyacetic acid	500	40.4	20	48
	2,500	53.6	30	44
Maleic hydrazide*	100	31.7	26	40
	500	3.9	10	21
	2,500	0.0	0	15
"Barsprout"—controls		28.8	26	69
No treatment—controls		40.5	19	26
Differences necessary for significance between treatments	5% Level	24.4	13	23
	1% "	34.3	18	33

* Formulated as the water soluble diethanolamine salt of 1,2 dihydro 3,6 pyridazinedione, and supplied by the U. S. Rubber Company, Naugatuck Division, Naugatuck, Conn. Concentrations are expressed as ppm of active ingredient.

Yellow sweet Spanish onions were started from greenhouse-grown plants, seeded March 1, and transplanted into a field of productive mineral soil the second week in May. On August 15, when the tops were still green and approximately one-third of them were down, water solutions of various growth substances (Table 1) were sprayed on the foliage of four 20-ft row replicates. Triton B-1956 at a concentration of 0.1% was used as a wetting agent. The chemical solutions were applied at the rate of 75 gal per acre by means of 3-gal hand sprayers. One week following treatment the remainder of the tops were turned down. The onions were harvested August 29. After the bulbs were cured for 2 weeks at a temperature of 85° F and a relative humidity of $50 \pm 7\%$, they were placed in replicated lots of 20 bulbs in kraft paper bags and removed to a cold storage room (35° F) for 30 days, following which they were held at a temperature of $55° \pm 3°$ F and a relative humidity ranging from 65 to 85%. Two control comparisons were used (Table 1): nontreated lots, and a postharvest application in commercial dust form of the methyl ester of α-naphthalene-acetic acid equivalent to 0.9 g active ingredient per bu.[2]

Observations were made March 2 after the onions had been held in storage for 5 months. No sprouting was evident on bulbs that had been harvested from plants the tops of which had been sprayed with 2,500 ppm of maleic hydrazide (1,2 dihydro 3,6 pyridazinedione), and there was a significant reduction in sprouting with 500 ppm. Some decrease in loss from storage breakdown

[2] Formulated as "Barsprout" by the American Cyanamid Company, New York City.