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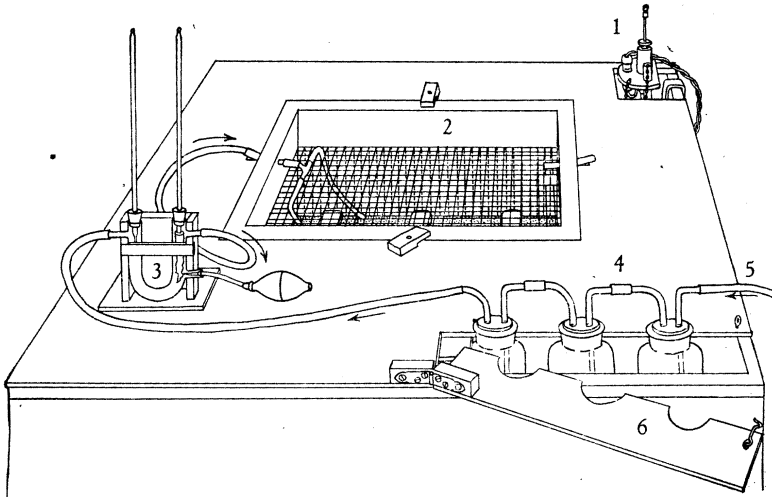
## USE OF A CONSTANT-TEMPERATURE WATER BATH AS A CULTURE CHAMBER

JAMES H. CRAFT

In the course of experiments done at the State University of Iowa on excised leaves of *Bryophyllum calycinum* a need arose for a culture chamber in which light, temperature, and humidity could be controlled simultaneously. The chamber described below met these requirements. It is capable of providing a wide range of environments which should make it useful in the culture of bacteria or other microorganisms and it might be substituted for equipment currently unobtainable. Dimensions given here may be modified as necessary.

The chamber (2), twelve inches wide, seventeen inches long, and eight inches deep, is constructed of 24-gauge galvanized sheet steel and has a one and one-half inch flange around the top. This chamber is inserted through an opening in a three-eighths-inch plywood board covering a 100-gallon Freas constant temperature water bath. The flange supports the chamber on the plywood frame. Another opening in the frame permits insertions of the thermoregulator (1) which controls the heaters and refrigerating coils.

Portions of the chamber with the water of the bath are coated thinly with Rutland roofing cement to prevent rusting. Sections of lead sashweight placed on the floor of the chamber overcome its buoyancy sufficiently to cause the flange to rest lightly on the frame. Coarse galvanized wire screening, with the edges bent down at right angles to make a platform, supports the experimental material and permits free circulation of air about it.



To provide entry and exit for a continuous supply of fresh air a four-inch length of three-eighths-inch copper tubing is soldered into

each end of the chamber as shown, and the incoming air is distributed to both sides of the chamber by rubber hose attached to the inlet by a T-tube.

Temperature and humidity of the incoming air are adjusted by passing it through a series of three 500 ml. bottles containing distilled water or  $H_2SO_4$  solution and immersed in the bath as shown (6). The degree of relative humidity desired determines the concentration of  $H_2SO_4$  necessary (Wilson). When an acid solution is used, the treated air should be passed through a U-tube packed with glass wool to remove corrosive droplets that might otherwise pass into the chamber.

The temperature and humidity of the treated air are indicated by means of a modified Dorochoy (1935) psychrometer (3).

When in operation the chamber is covered by a sheet of plate glass held in place by two wooden thumb latches attached to the frame. The junction between the chamber flange and the glass is sealed with petrolatum.

Illumination within the chamber, when desired, is furnished by a fifteen-watt "Daylight" (6500° Kelvin) fluorescent lamp controlled by a G. E. automatic time switch. The lamp is suspended six inches above the chamber and delivers 110 foot-candles at the surface of the experimental material. Extraneous light is kept out of the chamber by three layers of black sateen draped over the lamp and thence beyond the edges of the chamber cover. If continuous darkness within the chamber is desired, black photographic wrapping paper may be pasted to the inner face of the glass cover.

Once in operation the culture chamber needs no attention beyond keeping the water in the scrubbing bottles at the desired level and making routine checks on switches and valves. If the chamber is to be employed for long periods it is advisable to use a resin-bonded plywood for the frame rather than glued plywood. The plies of the latter tend to separate when exposed to dampness, although this tendency is diminished if the frame is painted with waterproof varnish.

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## OXALIS EUROPAEA AND OXALIS STRICTA IN IOWA

H. S. CONARD AND E. D. HUBBARD

The taxonomy of *Oxalis europaea* Jordan and *Oxalis stricta* L. and their several varieties and formae has been variously interpreted in the past. This paper attempts to follow the genus *Oxalis* through the literature.

Theophrastus (1) on page 159 states "oxya non habit differentias sed"; on page 533 "Humidissima fraxinus, (note, oxya), scissimaque," and on page 538 "Latinus autem ager aquis totus abundat, et plana laurum myrtumque habent (note, oxyan) scissimamque mirabilem: tanta enim longitudine caeditur, ut pro carina Etruscis navibus passit sufficere." On page 171 Joannes Bodaeus a Stapel comments, "Fateor plures communes notas habere cerrum et oxyan: attamen, eandem arbore esse, nego. Oxyes materiem Theophrastus firman, nervosamque ait." The word "Oxalis" is used in connection with "Oxalis" in such a manner as to indicate that they were used as absolute synonyms as the following passage shows: "Apud nos haec reperiuntur acetosae genera. Vulgaris cujus folia aliquando media parte virent, altera vero candida sunt (& idio fortassis Plinius colore betae dixit) aliquando in imo utrimque bifurcata; nonnumquam crispantur. Oxalizm aliam habemus folio amplissimo, quam nescio cur Hispanicam vocent vulgo." The plants described as *Oxalis* are in all cases of the genus *Rumex* as that genus is now understood, while *Oxya* is used to refer to those plants now classified as *Oxalis*. Stapel also quotes Pliny as using the word *Oxalis* in "Natural History" Book 20, Chapter 21. "Plinius loco citato, est autem sylvestre quod alii oxalidem apellunt sativo proximu, foliis acutis, colore betae candidae, radice minima. Nostri vero rumicem, alii lapahtum cantherium"—*Oxalis* a sapore acido dicitur". In this the word "*Oxalis*" is used to refer to members of the Polygonaceae.

Oxys is used by Pliny (2) to refer to *Oxalis* as it is now known: "ex his melancranis sine aliis generibus nascitur, oxys autem et holschoenus eodem caespite" (Bk. 21:113) and "Oxys folia terna habet. datur ad stomachum dissolutum. edunt et qui enterocelen habent." (Bk. 27:112)

Tournefort (3) uses "*Oxalis*" as a synonym for "*Acetosa*." The pictures and description of the *Acetosa* are unmistakably members of the family now known as Polygonaceae, and of the genus *Rumex* as "*Acetosa* foliis crispis, *Oxalis* crispa."

Tournefort (3) describes some members of the genus *Oxalis*, as it is now known, under Oxys and has very good drawings of the flowers and fruit. Tournefort states, "Oxys purpurea, virginiana, radice squamata. 'Oxys purpurea, Virginiana, radici Lillimore nucleata, capitulis postquam defloruerit bulbillis ut in Allio corvino conflatis Pluk. Phytog. Tab. 102. fig 4'" which undoubtedly refers to *Oxalis violacea* L. Again, "Oxys lutea, Americana, erectior. 'Trifolium acetosum, corniculatum, luteum, magus erectum, Indicum seu Virginianum Mor.

Hift. Oxon. part 2, 184'' is supposed to and probably does refer to *Oxalis stricta* L. And lastly, "Oxys flore purpurascencia 'Oxys sive Trifolium acidum, flore purpurascence F. B. 2. 387. Trifolium acetosum, vulgare, flore purpurascence C B. Pin. 330. Alleluis a fleur purpurine'" and is believed to refer to *Oxalis Acetosella* L.

Linnaeus (4) uses "Oxalis" as a synonym for *Rumex* in describing three species of plants now referred to under the family Polygonaceae and the genus *Rumex*. But under genus *Oxalis*, lists thirteen species including *O. violacea*, *O. corniculata*, and *O. stricta*.

Aiton (5) in 1811 lists and describes 58 species of the genus *Oxalis* including those now found in that genus.

Nuttall (6) uses "Oxalis" to refer to six species; *O. Acetosella*, *O. violacea*, *O. Lyoni*, *O. corniculata*, *O. stricta*, and *O. Dillenii* that occur in North America, but states that more than 100 species occur mostly in Europe and America, being peculiarly indigenous to the Cape of Good Hope.

Torrey and Gray (7) in 1838 in "Flora of North America" use *Oxalis* to refer to the group of plants now known by that name including *O. Acetosella* Linn., *O. Oregana* Nutt! mss., *O. trilliifolia* Hook., *O. violacea* Linn., *O. corniculata* Linn., *O. stricta* Linn. Gray in his "Manual of Botany of the Northern United States" names and describes *O. Acetosella* L., *O. violacea* L., and *O. stricta* L. in the first edition (8) in 1848, the second edition (9) in 1856, the third edition (10) in 1858 and the fourth edition (11) in 1865. In the fifth edition (13) he adds *O. corniculata* L. In the sixth edition (14) Gray lists and describes *O. Acetosella*, L., *O. violacea*, L., *O. corniculata*, L., *O. corniculata* var. *stricta*, Sav., and *O. recurva*, Ell.

Small (15) split the genus *Oxalis* as described by Gray (16) into *Oxalis* L., *Ionoxalis* Small, and *Xanthoxalis* Small. Small also included *Bolboxalis* Small, and *Lotoxalis* Small in the Oxalidaceae, Lindl. He included *stricta* L., *corniculata* L., *Bushii* Small, and *cymosa* Small in *Xanthoxalis*. Small saw fit to make *Bushii* Small and *cymosa* Small species of the genus *Xanthoxalis* Small.

In the seventh edition (16) Gray lists and describes *O. Acetosella* L., *O. violacea* L., *O. Priceae* Small, *O. grandis* Small, *O. stricta* L., *O. filipes* Small, *O. corniculata* L., and *O. repens* Thunb.

Britton and Brown (18) follow Small's classification.

In 1925 Wiegand (19) monographed this group in a manner that seems to us to take care of all the yellow flowered *Oxalis* we have examined from Iowa. Wiegand (19) describes *O. corniculata* as having stems (not rootstocks) creeping, generally brownish, from slender roots; stipules usually broad and brownish or purplish, subscurious, while *O. europaea* and *O. stricta* have stems not truly creeping, but stems that are either erect or decumbent, often with creeping rootstocks; umbels and seeds various; stipules oblong, narrowly oblong, or obsolete.

Deam (20) uses Wiegand's classification of the yellow flowered *Oxalis* and does not list *O. corniculata*.

*O. stricta* is easily differentiated from *O. europaea* by the examination of the capsules. The capsules of *O. europaea* always have glandu-

lar hairs with no appressed hairs. The capsules of *O. stricta* always have appressed hairs that give the capsule a whitish appearance. The differentiation of *O. stricta* and *O. stricta*, var. *piletocarpa* is based on the presence of some loose subvillous viscid hairs on the capsule of *O. stricta* and all hairs of the capsule of *O. stricta*, var. *piletocarpa* appressed and non-viscid.

*O. europaea* can easily be split into *O. europaea* and *O. europaea*, var. *Bushii*. The upper surface of the leaves of *O. europaea* are always glabrous while the upper surface of the leaves of *O. europaea*, var. *Bushii* always have scattered hairs. This characteristic is very clean cut. Small (15) made *Bushii* a species. The above characteristics seem to warrant this action.

The differentiation of *O. europaea* var. *Bushii*, *O. europaea*, var. *Bushii*, f. *subglabrata*, and *O. europaea*, var. *Bushii* f. *vestita* is based on the character of the hairs of the stems and pedicels. The stems may be glabrate to provided with ascending hairs, or have spreading hairs. The pedicels may have spreading hairs or ascending hairs. The type of hairs on the stems and pedicels varies from one extreme to the other.

Distinguishing between *O. europaea*, *O. europaea* f. *pilosella*, *O. europaea*, f. *cymosa*, and *O. europaea*, f. *villicaulis* has been very difficult for us. There seems to be no definite line of demarkation between this species and the three forms and this difficulty warrants ranking these doubtful entities as forms. The hairs of the pedicels may be appressed and scarcely viscid, or spreading and usually viscid. The stems may be nearly or quite glabrous, with ascending hairs or glabrate, or villous. In most cases the character of the hairs on the pedicels and type of hairs on the stems, or the fact that the stems are glabrate, clearly places the specimen as an *europaea* or one of the three forms. However some specimens are intermediate as in *Bushii* and the forms of *Bushii*.

We have examined four hundred ninety-four specimens that were sufficiently complete for us to identify them. Of these, one hundred fifty-four were in the herbarium of the State University of Iowa; twenty-one were in the herbarium of Grinnell College, and eighty-four were in the herbarium of Iowa State College. We have identified two hundred thirty-five specimens that we personally collected. Two hundred four of these latter were collected at a time when we recorded as accurately as possible the nature of the surroundings of each specimen. The compilation of the data from all these specimens is included in the following list:

#### OXALIS EUROPEA JORDAN

(*O. corniculata* Gray)

This species was found in both sunny and shady places, always in damp or moist ground, on loam or soil containing at least some humus and in lawns, fields or thickets. We identified specimens from Cerro Gordo, Clay, Clayton, Dallas, Davis, Dickinson, Emmet, Fayette, Hamilton, Iowa, Jasper, Johnson, Lee, Louisa, Lyon, Monona, Muscatine, Palo Alto, Polk, Poweshiek, Ringgold, Scott, Story, Van Buren, Wapello, Warren, and Winnebago counties.

**OXALIS EUROPAEA JORDAN, F. PILOSELLA WIEG.**

This forma was found in both sunny and shady places, always in damp or moist ground, on loam or soil containing at least some humus and in lawns or at the edge of thickets. We identified specimens from Boone, Calhoun, Chickasaw, Clay, Clayton, Decatur, Dickinson, Emmet, Fayette, Fremont, Hardin, Harrison, Henry, Howard, Iowa, Jasper, Johnson, Keokuk, Lyon, Marion, Monona, O'Brien, Palo Alto, Polk, Pottawattamie, Poweshiek, Shelby, Story, Van Buren, Webster, and Winneshiek counties.

**OXALIS EUROPAEA JORDAN, F. CYMOSA (SMALL) WIEG.**

*Oxalis cymosa* Small

*Xanthoxalis cymosa* (Small) Small

This forma was found in sunny places, always in damp or moist ground, on loamy soil and in lawns or fields. We identified specimens from Iowa, Muscatine, Poweshiek, and Story counties.

**OXALIS EUROPAEA JORDAN, F. VILICAULIS WIEG.**

This forma was found in sunny, damp, loamy lawns or fields. We identified specimens from Appanoose, Clayton, Davis, Floyd, Henry, Iowa, Jones, Madison, Poweshiek, Story, Van Buren, and Webster counties.

**OXALIS EUROPAEA JORDAN, VAR. BUSHII (SMALL) WIEG.**

This variety was found in shady, dry, loamy ground in a woods. We identified specimens from Cherokee, Clayton, Dubuque, Harrison, Linn, Muscatine, Story, Tama, and Winneshiek counties.

**OXALIS EUROPEA JORDAN, VAR. BUSHII (SMALL) WIEG.**

**F. SUBLABRATA WIEG.**

This forma was found in both sunny and shady places, in both dry or moist ground, in sandy loamy or humus soil, and in fields, woods or thickets. We identified specimens from Appanoose, Boone, Cerro Gordo, Clinton, Delaware, Floyd, Iowa, Jasper, Poweshiek, and Van Buren counties.

**OXALIS EUROPEA JORDAN, VAR. BUSHII (SMALL) WIEG.,**

**F. VESTITA WIEG.**

This forma was found in shady, dry or moist, loamy woods or thickets. We identified specimens from Boone, Davis, Dubuque, Hardin, Jasper, Palo Alto, Poweshiek, and Story counties.

**OXALIS STRICTA L.**

*Oxalis corniculata*, var. *stricta* Sav.

*Xanthoxalis stricta* (L) Small

We collected two specimens from a sunny wet loamy lawn. We identified specimens from Allamakee, Black Hawk, Cerro Gordo, Davis, Iowa, Lee, and Poweshiek counties.

**OXALIS STRICTA L., VAR. PILETOCARPA WIEG.**

This variety was found in both sunny and shady places, in dry or moist ground, under all types of soil conditions including one on a rock. We found it very common in lawns and occasionally in fields

or woods. We identified specimens from Adams, Allamakee, Black Hawk, Boone, Buchanan, Carroll, Cerro Gordo, Chickasaw, Clay, Davis, Delaware, Dickinson, Emmet, Fremont, Hamilton, Hardin, Harrison, Iowa, Johnson, Lee, Linn, Louisa, Lucas, Lyon, Madison, Monona, Muscatine, Plymouth, Poweshiek, Story, Taylor, Union, Van Buren, Wapello, and Webster counties.

## SYNONYMS

- |              |   |
|--------------|---|
| Small (15)   | <i>Ionoxalis violacea</i> (L.) Small.   |
| Gray (16)    | <i>Oxalis violacea</i> L.   |
| Deam (20)    | <i>Oxalis violacea</i> L.   |
| Deam (20)    | <i>Oxalis violacea</i> L., var. <i>trichophora</i> Fassett.                                   |
| Small (15)   | <i>Xanthoxalis corniculata</i> (L.) Small   |
| Gray (16)    | <i>Oxalis repens</i> Thunb.   |
| Wiegand (19) | <i>Oxalis corniculata</i> L.  |
| Deam (20)    | <i>Oxalis repens</i> Thunb.   |
| Gray (16)    | <i>Oxalis repens</i> Thunb.   |
| Wiegand (19) | <i>Oxalis corniculata</i> L., var. <i>viscidula</i> Wieg.                                     |
| Small (15)   | <i>Xanthoxalis Langloisii</i> Small   |
| Gray (16)    | <i>Oxalis repens</i> Thunb.   |
| Wiegand (19) | <i>Oxalis corniculata</i> L., var. <i>Langloisii</i> (Small) Wieg                             |
| Gray (16)    | <i>Oxalis corniculata</i> L.  |
| Wiegand (19) | <i>Oxalis europaea</i> Jord.  |
| Deam (20)    | <i>Oxalis europaea</i> Jord.  |
| Gray (16)    | <i>Oxalis corniculata</i> L.  |
| Wiegand (19) | <i>Oxalis europaea</i> Jord., f. <i>pilosella</i> Wieg.                                       |
| Gray (16)    | <i>Oxalis corniculata</i> L.  |
| Wiegand (19) | <i>Oxalis europaea</i> Jord., f. <i>villicaulis</i> Wieg.                                     |
| Deam (20)    | <i>Oxalis europaea</i> Jord., f. <i>villicaulis</i> Wieg.                                     |
| Small (15)   | <i>Xanthoxalis cymosa</i> Small   |
| Gray (16)    | <i>Oxalis corniculata</i> L.  |
| Wiegand (19) | <i>Oxalis europaea</i> Jord., f. <i>cymosa</i> (Small) Wieg.                                  |
| Deam (20)    | <i>Oxalis europaea</i> Jord., f. <i>cymosa</i> (Small) Wieg.                                  |
| Small (15)   | <i>Xanthoxalis Bushii</i> Small   |
| Gray (16)    | <i>Oxalis corniculata</i> L.  |
| Wiegand (19) | <i>Oxalis europaea</i> Jord., var. <i>Bushii</i> (Small) Wieg.                                |
| Small (15)   | <i>Xanthoxalis interior</i> Small   |
| Gray (16)    | <i>Oxalis corniculata</i> L.  |
| Wiegand (19) | <i>Oxalis europaea</i> Jord., var. <i>Bushii</i> (Small) Wieg.                                |
| Gray (16)    | <i>Oxalis corniculata</i> L.  |
| Wiegand (19) | <i>Oxalis europaea</i> Jord., var. <i>Bushii</i> (Small) Wieg.<br>f. <i>subglabrata</i> Wieg. |
| Deam (20)    | <i>Oxalis europaea</i> Jord., var. <i>Bushii</i> (Small) Wieg.<br>f. <i>subglabrata</i> Wieg. |
| Gray (16)    | <i>Oxalis corniculata</i> L.  |
| Wiegand (19) | <i>Oxalis europaea</i> Jord., var. <i>Bushii</i> (Small) Wieg.<br>f. <i>vestita</i> Wieg.     |
| Deam (20)    | <i>Oxalis europaea</i> Jord., var. <i>Bushii</i> (Small) Wieg.<br>f. <i>vestita</i> Wieg.     |



Small (15)	<i>Xanthoxalis stricta</i> (L.) Small
Gray (16)	<i>Oxalis stricta</i> L.
Wiegand (19)	<i>Oxalis stricta</i> L.
Deam (20)	<i>Oxalis stricta</i> L.
Small (15)	<i>Xanthoxalis stricta</i> (L.) Small
Gray (16)	<i>Oxalis stricta</i> L.
Deam (20)	<i>Oxalis stricta</i> L., f. <i>viridiflora</i> (Hus.) Fern.
Small (15)	<i>Xanthoxalis stricta</i> (L.) Small
Gray (16)	<i>Oxalis stricta</i> L.
Wiegand (19)	<i>Oxalis stricta</i> L., var. <i>piletocarpa</i> Wieg.
Deam (20)	<i>Oxalis stricta</i> L., var. <i>piletocarpa</i> Wieg.

KEY

These were identified by the following key, which was taken from Wiegand and Deam with variations to accommodate it to our use.

- |   |   |
|---|---|
| 1. Hairs of capsule all or nearly all spreading and viscid                        | 3   |
| 1. Hairs of capsule all or nearly all appressed and all or nearly all non-viscid  | 2   |
| 2. Hairs of capsule appressed and non-viscid with some spreading and viscid hairs | <i>O. stricta</i>   |
| 2. Hairs of capsule appressed, non-viscid   | <i>O. stricta</i> , var. <i>piletocarpa</i>                   |
| 3. Upper surface of leaflets glabrous   | <i>O. europaea</i> 4  |
| 3. Upper surface of leaves pubescent  | <i>O. europaea</i> , var. <i>Bushii</i> 7                     |
| 4. Hairs of pedicel appressed, non-viscid   | 5   |
| 4. Hairs of pedicel spreading, viscid   | 6   |
| 5. Hairs of stem ascending or stem glabrate                                       | <i>O. europaea</i>  |
| 5. Stem villous   | <i>O. europaea</i> , f. <i>pilosella</i>                      |
| 6. Stem villous   | <i>O. europaea</i> , f. <i>villicaulis</i>                    |
| 6. Stem glabrous  | <i>O. europaea</i> f. <i>cymosa</i>                           |
| 7. Hairs of pedicel spreading; stem villous                                       | <i>O. europaea</i> , var. <i>Bushii</i> f. <i>vestita</i>     |
| 7. Hairs of pedicel appressed   | 8   |
| 8. Stem villous   | <i>O. europaea</i> , var. <i>Bushii</i>                       |
| 8. Hairs of stem ascending or stem glabrate                                       | <i>O. europaea</i> , var. <i>Bushii</i> f. <i>subglabrata</i> |

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