
OHIO PLANTS WITH EXTRA-FLORAL NECTARIES AND OTHER GLANDS.*

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The existence of glands and nectaries outside of the flower or inflorescence has been a subject of much interest to biologists. Delpino, Darwin, Trelease, and many others have given a large amount of information in regard to the occurrence and nature of these organs; yet much is still obscure and any one so inclined may at least obtain considerable pleasure by making observations along this line.

Various views have been held as to the cause and use of extra-floral glands and their secretions. Delpino considered that the power to secrete nectar by any extra-floral organ has been specially gained in every case for the sake of attracting ants and wasps as a body-guard, or as defenders of the plant against enemies. Darwin while admitting that this may be the case in some plants did not think that all such glands originated in this way. He held that the saccharine matter in nectar was excreted as a waste product of chemical changes in the sap and that this product might then become useful for accomplishing cross-fertilization or for attracting a body-guard, and thus the nectary would become an object for selection. He cites the case of the leaves of certain trees where a saccharine fluid, often called honey-dew, is excreted without the aid of special glands. By some, the special use of extra-floral nectar is supposed to be to divert ants and other insects from visiting flowers which they might otherwise injure. But many plants have nectar long before and long after the flowering period. On *Viburnum opulus*, for example, nectar is still present and abundantly used by ants late in October. Another view has been that certain of these glands act as absorptive

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cups and surfaces for the absorption of rain and dew. In *Euphorbia pulcherrima*, commonly cultivated in green houses, there are very large cup-shaped nectar glands, one on the involucre of each cyathium. There are also stipular glands and glands on top of the petiole at the base of the blade. Ants visit the large glands very extensively and one might be inclined to believe that in such cases the foliar glands are guides to the more abundant sweets to be found higher up when the plant is in bloom. In the case of submerged water plants, as for example in certain species of *Potamogeton* with glands on the leaves, the entire question of a relationship between insects and glands in general is eliminated.

Besides nectar there are various other secretions; important among which are those with a digestive function and those of a sticky nature to prevent crawling insects from passing certain parts or for holding them fast while they die and decay.

During the past summer, the writer spent some time in studying the glands which appear on the blades, petioles, stipules, and other parts of our native and cultivated plants. The mode of occurrence and the character of these organs is quite erratic. A species may have highly developed glands while its near relatives have none whatever. Even on a given individual, some leaves may have the glands while others have none and rarely is the number constant.

Very common among plants is the presence of glandular hairs or pubescence, like on *Petunia violacea*, *Martynia louisiana*, *Polanisia graveolens*, *Silene virginica*, and *Cypripedium acaule*. Punctate glands in the leaf blade and other parts are also abundant as in *Xanthoxylum americanum*, *Polygonum punctatum*, *Amorpha fruticosa*, *Hypericum perforatum*, and *Boebera papposa*. The latter has comparatively large, yellow, oval glands which are very conspicuous under a hand lens. Various plants also have glutinous leaves especially when young, but these will not be considered here.

Of plants which have glandular surfaces with digestive secretions especially concerned in capturing and absorbing other organisms as food, we have the following :

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| 1. <i>Sarracenia purpurea</i> . | 6. <i>Utricularia intermedia</i> . |
| 2. <i>Drosera rotundifolia</i> . | 7. <i>Utricularia minor</i> . |
| 3. <i>Drosera intermedia</i> . | 8. <i>Utricularia gibba</i> . |
| 4. <i>Utricularia cornuta</i> . | 9. <i>Dipsacus sylvestris</i> . |
| 5. <i>Utricularia vulgaris</i> . | 10. <i>Silphium perfoliatum</i> . |

In this group probably belong such plants like *Silene antirrhina* with glutinous bands around the stem and *Carduus undulatus*, a western species, in which the outer surface of the involucre bracts are very glutinous and catch large numbers of ants which attempt to reach the flowers above, as well as small flying insects. It seems reasonable to suppose that the debris from these decaying

insects may serve as food to the captor. Some of the Ohio thistles also have glandular involucre bracts.

Various plants have gland tipped teeth or serrations, as species of *Salix*, *Populus*, *Prunus*, and other genera. In some plants the stipules have prominent nectar glands or are reduced to nectaries. Other gland-like stipules however do not appear to secrete nectar. Among the genera which contain species with glandular or gland-like stipules, the following may be mentioned: *Reseda*, *Linum*, *Euphorbia*, *Isnardia*, and *Circaea*.

The more important glands of special interest are those which secrete nectar or those which have attained considerable morphological development. Although it is not easy to make a classification of extra-floral glands because of the indefiniteness of these structures, an arbitrary arrangement will be given below to indicate in a general way their origin and position. Some of the special types I have not yet found on Ohio plants as for example the pit-like nectar glands on the lower surface of the midribs of the leaves of *Gossypium herbaceum* and other plants. The following types are known to occur in Ohio:

1. Glands which appear on the margin at the base of the blade or on the top or the sides of the petiole and evidently representing highly specialized glandular teeth or serrations; as in *Populus* and *Amygdalus*.

2. Highly developed glands under the lobes or teeth of the blade; as in *Ailanthus*.

3. Special patches of tooth-like glands appearing like modified hairs or eruptions either at the upper or lower end of the petiole or at both; as in *Asclepiodora* and *Asclepias*.

4. Patches of pit-like nectaries on the upper side at the lower end of the petiole; as in *Tecoma*.

5. Single or few nectaries on the petiole not apparently originating from hairs, serrations, leaflets, or stipules; as in *Cassia* and *Ricinus*.

6. A series of nectaries on the rachis between the successive pairs of leaflets or divisions; as in *Acuan*.

7. Glands on the under side of the leaf in the axils of the veins or on the rachis at the base of the divisions; as in *Catalpa* and *Pteridium*.

8. Glands on the rachis apparently representing modified leaflets or stipules; as in *Sambucus*.

9. Glands on the stipules or representing highly modified stipules; as in *Vicia* and *Circaea*.

10. Glands on the calyx or peduncle not showing any evident relation to pollination; as in *Tecoma*, *Paeonia*, and *Ricinus*.

11. Glands on submerged water plants; as in certain species of *Potamogeton* which have two glands at the base of the leaf blade.

During the past summer ants were found abundantly on the following plants, working at the nectar and crawling over the leaves and branches :

Cassia marylandica.	Amygdalus persica.
Cassia chamaecrista.	Tecoma radicans.
Acuan illinoensis.	Ricinus communis.
Prunus avium.	Viburnum opulus.

Some of the foliar glands are also visited by bees and may thus be important in the production of honey, as the large nectariferous glands on the leaves of Catalpa.

Extra-floral nectaries make an interesting object lesson well suited for advanced nature study and for elementary botany. The subject is no less important because the reason for the phenomenon is not so very evident and because the teacher is not able to give a conclusive answer so easily. In winter one may readily obtain material for study by sprouting sweet potatoes (*Ipomoea batatas*) in a dish with moist sphagnum and sawdust. The large foliar glands of the first leaves secrete an abundance of nectar.

Below is given a partial list of the native and cultivated Ohio plants with glands, together with numbers referring to the eleven types indicated above.

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| 1. <i>Pteridium aquilinum</i> , 7. | 33. <i>Acuan illinoensis</i> , 6. |
| 2. <i>Potamogeton hillii</i> , 11. | 34. <i>Cassia nictitans</i> , 5. |
| 3. " <i>obtusifolius</i> , 11. | 35. " <i>chamaecrista</i> , 5. |
| 4. " <i>friesii</i> , 11. | 36. " <i>marylandica</i> , 5. |
| 5. " <i>pusillus</i> , 11. | 37. <i>Vicia sativa</i> , 9. |
| 6. <i>Sporobolus heterolepis</i> , 10. | 38. " <i>angustifolia</i> , 9. |
| 7. <i>Populus heterophylla</i> , 1. | 39. <i>Vigna sinensis</i> , 10. |
| 8. " <i>candicans</i> , 1. | 40. <i>Ailanthus glandulosa</i> , 2. |
| 9. " <i>balsamifera</i> , 1. | 41. <i>Acalypha ostraefolia</i> , 3(?). |
| 10. " <i>dilatata</i> , 1. | 42. " <i>virginica</i> , 3(?). |
| 11. " <i>deltoides</i> , 1. | 43. " <i>gracilens</i> , 3(?). |
| 12. " <i>grandidentata</i> , 1. | 44. <i>Ricinus communis</i> , 5, 10. |
| 13. " <i>tremuloides</i> , 1. | 45. <i>Euphorbia dentata</i> , 9. |
| 14. <i>Salix nigra</i> , 1. | 46. <i>Impatiens biflora</i> , 1. |
| 15. " <i>amygdaloides</i> , 1. | 47. " <i>aurea</i> , 1. |
| 16. " <i>lucida</i> , 1. | 48. <i>Circaea lutetiana</i> , 9. |
| 17. " <i>fragilis</i> , 1. | 49. " <i>alpina</i> , 9. |
| 18. " <i>alba</i> , 1. | 50. <i>Asclepias incarnata</i> , 3. |
| 19. " <i>babylonica</i> , 1. | 51. " <i>sullivantii</i> , 3. |
| 20. <i>Crataegus coccinea</i> , 1. | 52. " <i>plexicaulis</i> , 3. |
| 21. " <i>rotundifolia</i> , 1. | 53. " <i>variegata</i> , 3. |
| 22. " <i>macrantha</i> , 1. | 54. " <i>syriaca</i> , 3. |
| 23. <i>Prunus armeniaca</i> , 1. | 55. <i>Ipomoea batatas</i> , 7. |
| 24. " <i>americana</i> , 1. | 56. <i>Tecoma radicans</i> , 4, 10. |
| 25. " <i>pumila</i> , 1. | 57. <i>Catalpa catalpa</i> , 7. |
| 26. " <i>cerasus</i> , 1. | 58. " <i>speciosa</i> , 7. |
| 27. " <i>avium</i> , 1. | 59. <i>Sambucus canadensis</i> , 8, 9. |
| 28. " <i>pennsylvanica</i> , 1. | 60. " <i>pubens</i> , 8; 9. |
| 29. " <i>mahaleb</i> , 1. | 61. <i>Viburnum opulus</i> , 1, 9. |
| 30. " <i>virginiana</i> , 1. | 62. " <i>lentago</i> , 1. |
| 31. " <i>serotina</i> , 1. | 63. <i>Viburnum prunifolium</i> , 1. |
| 32. <i>Amygdalus persica</i> , 1. | |