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NEW TETRAPLOID <u>SOLANUM</u> SPECIES FROM BOLIVIA:

<u>S. HOOPESII</u> AND <u>S. UGENTII</u>

J.G. Hawkes and K.A. Okada

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Although Bolivia has been very well explored for wild potatoes, recent expeditions have revealed the presence of two more hitherto unknown species. These were discovered during the 1986 and 1987 US-funded expeditions by Dr. R. Hoopes, Dr. K.A. Okada, Israel Aviles, Jaime Herbas and Ricardo La Fuente. We thank Dr. Hanneman, Director of the Potato Introduction Station at Sturgeon Bay, Wisconsin for obtaining the funding for these expeditions and for growing the materials on which the descriptions are based. We are grateful also to Dr. R. Hoopes for permission to publish the descriptions and to him and Dr. D. Ugent for allowing us to name the species after them. We thank J.P. Hjerting of the Copenhagen Botanic Gardens for cooperation in making the descriptions, and Mr. Mr. D. Costa of Birmingham University for checking the Latin concordances.

<u>S. hoopesii</u> Hawkes & Okada, sp. nov. (Series Tuberosa)

<u>Caulis</u> usque ad 50 cm altus vel altior, infra ramosissimus, angustissime alatus, pilis brevibus, appressis sparsissimis tectus.

<u>Folium</u> 10-15(-19) cm longum x 5-7(-13) cm latum, (2-)3(-4) -jugatum, foliolis interjectis 0-2(-5) -jugatis minutissimis sessilibus, rotundis usque ad ovata; foliola lateralia 3-4 cm longa x 1.5-2.5 cm lata, late ovata usque ad ovato-lanceolata, foliolorum lateralium duo juga summa magnitudine fere aequalia, infimum minutissimum, apice acuto ad leviter acuminatum atque basi rotunda usque ad truncatam; petioluli 3-7(-10) mm longi; foliolum terminale quam lateralia plerumque latius, apice acuminato atque basi rotundata usque ad truncatam; foliorum superficies superior pilis aliquantum frequentibus paulo brevibus appressis obtecta, infra minus frequentibus.

<u>Inflorescentia</u> generaliter multiflora; pedunculus supra furcatus (nonnumquam bis), pars inferior brevis, 3-4(-7) cm longa, furcae 5-14 cm longae usque ad pedicellum ultimum, pedicelli 20-30 mm longi, articulati in vel prope medium; pedunculus et pedicelli pilis brevissimis sparsissimis appressis tecti, supra leviter frequentioribus.

Calyx atropurpureus, 6-7 mm longus, acuminibus 1-2 mm, pilis modice densis brevissimis appressis tectus.

Corolla rotata, speciosissima vivide atropurpurea, 20-30 mm diametro, lobis rotundatis vel humeris similibus, 7-10 mm longis, acumine 2.5-3 mm incluso.

Antherae 7 mm longae, manifeste decrescentes supra; filamenta 1-1.5 mm longa.

Stylus circa 10-11 mm longus, exsertus 3(-4) mm supra columnam antherarum, supra expansus in stigma breviter capitatum.

Baccae sphaericae, diametro ignoto

Stem about 50 cm or more, much branched below, 3-5 mm diam, very narrowly winged, with very sparse short appressed hairs.

Leaf 10-15(-19) cm long x 5-7 (-13) cm broad, (2-)3(-4)-jugate with 0-2(-5) pairs of very small sessile rotund to ovate interjected leaflets; lateral leaflets 3-4 cm long x 1.5-2.5 cm broad, broad ovate to ovate-lanceolate, the two upper pairs + the same size, the lowest very small, with acute to slightly acuminate apex and rounded to truncate base; petiolules 3-7(-10) mm long; terminal leaflet generally broader than the laterals, with acuminate apex and rounded to truncate base; upper leaf surface covered with rather frequent fairly short appressed hairs, less frequent below.

Inflorescence generally many-flowered; peduncle forked above (sometimes twice), the lower part short, 3-4(-7) cm long, the forks from 5 to 14 cm long to the last pedicel; pedicels 20-30 mmlong, articulated at or near the centre; peduncle and pedicels provided with very sparse very short appressed hairs, slightly more frequent above.

Calyx dark purple, 6 - 7 mm long, with 1-2 mm acumens, provided with medium dense very short appressed hairs.

Corolla rotate, very showy, deep rich purple, 20-30 mm diam; lobes rounded or shouldered, 7-10 mm long including the 2.5-3 mm acumen.

Anthers 7 mm long, clearly tapering above; filaments 1-1.5 mm long.

Style about 10-11 mm long, exserted 3(-4) mm above the anther column, expanded above into the shortly capitate stigma.

Berry spherical, diameter unknown.

Chromosome number: 2n = 48.

TYPE: BOLIVIA, dept. Chuquisaca, prov. Azurduy, 26 km from Abra Kasa (85 km from Azurduy) on the road to Tarabuco, 5 km before Cruz Kasa. Alt. 3200 m. 1 April, 1986. Growing by a stone wall. Hoopes, Aviles and Okada 160 (K - HOLOTYPE).

BOLIVIA, dept. Chuquisaca, prov. Azurduy, 11 km from Abra Kasa on the way to Tarabuco, 20 km before Cruz Kasa. Alt. 2500 m 1 April. 1986. Roadside under bushes. Hoopes, Avilés and Okada 157 (K-PARATYPE).

Description made from 160 and 157).

This species is named in honour of Dr. R.V. Hoopes, the leader of both expeditions. It is chiefly distinguished by its rather sparse short pubescence, poorly dissected leaves with 0 - few small interjected leaflets, 3-jugate leaves with the lowest pair much smaller than the uppermost two, very long peduncle branches, large showy corolla with rounded shoulders, and style expanded above into a short capitate stigma.

The tetraploid chromosome number is noteworthy for a species in Series Tuberosa.

S. ugentii Hawkes & Okada sp. nov. (Series Tuberosa)

Caulis usque ad 50 cm altus vel altior, ramosissimus, ad 6 mm diam, angustissime alatus, pilis frequentibus appressis.

Folium 14-19 cm longum x 8-13 cm latum, 5-6(-7)- jugatum; foliola lateralia 3-4 x 1.3-2(-2.5) cm, ovata, apice acuta atque basi cuneata saepe obliqua; petioluli 5-15(-25) mm longi; foliolum terminale leviter latius atque interdum brevius quam foliola lateralia; foliola interjecta frequentissima, usque ad circa 20 juga, saepe acroscopica, basiscopica et semi-basiscopica, nonnumquam ad 30 mm longa; pubescentia pilorum frequentium appressorum medio-longorum infra breviorum et solum in venis.

Inflorescentia aliquantum multiflora; pedunculus supra furcatus, infra furcam 3-6 cm longus, supra furcam 3-5(-8)cm longus; pedicelli 20-35 mm longi articulati in medio vel supra; pubescentia pilorum brevium appressorum a sparsis ad frequentes variantium in ramis omnibus inflorescentibus.

Calyx atropurpureus, 7-8 mm longus, acuminibus 2-3 mm atque pilis frequentibus appressis brevibus.

Corolla rotata, vivide atropurpurea, 25-30 mm diametro; lobis circa 7 mm longis, 3 mm acuminibus inclusis.

Antherae 5-6 mm longae; filamenta 1-2 mm longa.

Stylus 10 mm longus, exsertus circa 4 mm supra columnam antherarum, supra expansus in stigma grande capitatum.

Baccae sphaericae, viridae, sine maculis albis.

Stem up to 50 cm or more, much branched, up to 6 mm diam, very narrowly winged, with frequent appressed hairs.

Leaf 14-19 cm long x 8-13 cm broad, 5-6(-7)-jugate; lateral leaflets 3-4 x 1.3-2(-2.5) cm, ovate, with acute apex and cuneate often oblique base; petiolules 5-15 (-25) mm long; terminal slightly broader and sometimes shorter than the laterals; interjected leaflets very frequent, often acroscopic, basiscopic and semi-basiscopic, up to about 20 pairs, sometimes up to 30 mm long; pubescence of frequent medium-lengthed appressed hairs, shorter below and on veins only.

Inflorescence with rather frequent flowers, forked above, 3-6 cm below the fork, 3-5(-8) cm long above the fork; pedicels 20-35 mm long with articulation at or above the centre; pubescence of short appressed hairs varying from sparse to frequent on all inflorescence branches.

Calyx dark purple, 7-8 mm long with 2-3 mm acumens and frequent appressed short hairs.

Corolla deep rich purple, rotate, 25-30 mm diameter; lobes about 7 mm long including the 3 mm acumens.

Anthers 5-6 mm long; filaments 1-2 mm long.

Style 10 mm long, exserted about 4 mm above the anther column, expanded above into a large capitate stigma.

Berries spherical, green, without white spots.

Chromosome number: $2n = 48$.

TYPE: BOLIVIA, dept. Chuquisaca, prov. Azurduy, road from Tarabuco to Azurduy, 30 km beyond the Torre Pampa junction and 20 km before Cruz Kasa. Alt. 3730 m. 6 April 1987. At the base of cliffs 200 m above the road. Hoopes, Okada, Herbas and La Fuente 288 (K - HOLOTYPE).

PARATYPE: BOLIVIA, dept. Chuquisaca, prov. Azurduy, about 22 km beyond Torre Pampa junction on the way to Azurduy. Alt. 3730 m. 6 April 1987. Base of cliff. Hoopes, Okada, Herbas and La Fuente 290 (K-PARATYPE).

This species is named in honour of Professor Donald Ugent, who has collected potatoes in Mexico, Peru and Bolivia and who has worked for many years on the taxonomy of this group of plants.

The main distinguishing features of this species are the highly dissected leaves with long petiolules and very many interjected leaflets which attain a large size, often with acroscopic, basiscopic and semi-basiscopic leaflets; also noteworthy are the peduncles that are generally short below the fork and longer above, the rotate deep rich purple corolla, the large capitate stigma and the tetraploid chromosome number.

These two species can be easily distinguished by the leaf, which in S. hoopesii is typically 3-jugate with very few pairs of interjected leaflets, whilst S. ugentii has a highly dissected, 5-7-jugate leaf, with very frequent interjected leaflets, up to 20 pairs. They both differ from the tetraploid S. sucrense in the rotate corolla with short acumens, whilst that of S. sucrense is rotate-pentagonal with well-marked acumens (5 mm long).

GIGANTONOCLEA IN THE LOWER PERMIAN OF TEXAS

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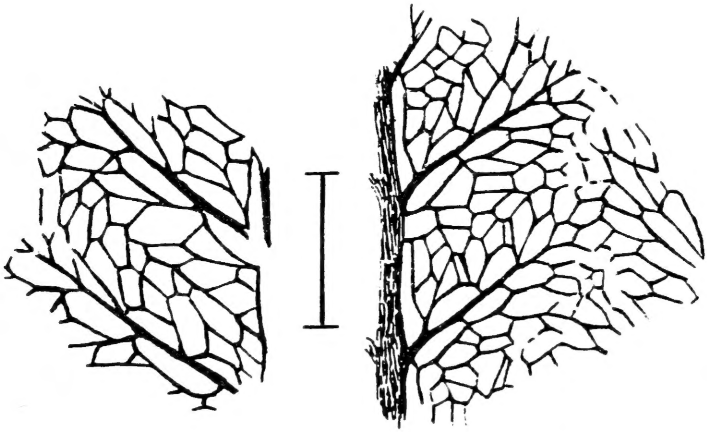
Following publication of the description of the gigantopterid genus Delnortea from Leonardian (Lower Permian) strata in western Texas (Mamay, Miller, Rohr, and Stein, 1986), it was shown (Mamay, 1986) that two Asiatic gigantopterid genera, Cathaysiopteris Koidzumi and Zeilleropteris Koidzumi, also occur in the Texas Permian, along with a second American gigantopterid, Gigantopteridium Koidzumi. Subsequent reexamination of unpublished material that I had collected in 1967 indicates the presence of yet another Asiatic gigantopterid taxon in Texas. K. Asama examined the specimens in 1970 and tentatively identified them as Bicoemplectopteris hallei Asama. Asama's valuable opinion has bolstered my convictions in regard to the similarities between the Permian floras of Asia and North America.

The material was collected at the "Emily Irish" site southeast of Seymour in Baylor County, Texas. The fossiliferous beds lie in the Belle Plains Formation, of Leonardian (Lower Permian) age; details of the occurrence were published earlier (Mamay, 1968). The locality is known as a rich source of Gigantopteridium americanum (White) Koidzumi and the only known American occurrence of Russellites taeniata (Darrah) Mamay. Russellites is otherwise known only in China.

The gigantopterid material consists of 4 small leaf fragments (USNM 422403-422406), 2 of which are illustrated here (Fig. 1). The largest (Fig 1B) is slightly less than 1 cm in its greatest dimension and contains a stout dominant vein at the left, from which two distinct lateral veins and the base of a third depart to the right; remnants of 2 equivalent veins appear on the left. From each side of the lateral veins arise thin ultimate veins at regular intervals; a few also arise directly from the main vein. As they proceed away from the main vein, the laterals lose identity through diffusion of their distal portions into ultimate veins. The ultimate veins form a closed system of small polygonal meshes with no blind-ending veinlets. The meshes are mostly elongate, with a greatest length of about 2.0 mm; most are much smaller, however. The smallest meshes are trigonal; the largest are penta- or rarely sexagonal. The largest meshes generally are those that lie directly against the main vein or the laterals, with all others gradually diminishing in size so that the smallest meshes are about midway between the laterals, where meshes from adjacent laterals merge with their opposing counterparts.

Although it shows nothing of its margin, this specimen is clearly part of a leaf with at least 3 orders of veins, with the laterals



A B

Fig. 1. Tracings of photographs of leaf fragments of *Gigantonoclea* sp., showing 3 vein orders and ultimate reticulations. A: USNM 422403; B: USNM 422404. Scale equals 3 mm.

of secondary rank and the ultimate veins tertiary. However, the arrangement of meshes suggests a more complex system of venation, i.e., one with 4 orders. Those meshes at the right of Fig. 1B and beyond the diffused ends of the lateral veins are predominantly aligned perpendicularly to the alignment of the meshes adjacent to the laterals. This is clear indication that the meshes at the right of Fig. 1B are the ultimate derivatives of an adjacent, equivalent set of penultimate and lower-order veins. Thus the "main vein" of Fig. 1B is of at least secondary rank; accordingly the ultimate veins are at least quaternary.

The specimen seen in Fig. 1A also lacks evidence of the leaf margin, showing only parts of 2 penultimate veins within the surrounding meshwork of ultimate veins. However, the precise angularity of its meshes and their orientation relative to the penultimate veins duplicate those features of Fig. 1B. The chief difference between the two specimens is one of relative sizes: the intercostal distance in Fig. 1A (3.0 mm) is greater than that of Fig. 1B (2.5 mm), and the largest meshes in Fig. 1A are proportionately longer. These minor quantitative differences are possibly of specific significance, but a taxonomic differentiation requires more extensive material.

The unimpressive appearance of these small fragments belies their paleobotanical importance, for the presence of a reticulate pattern of ultimate veins arising from parallel penultimate veins is in itself sufficient to distinguish a taxon of Gigantopteridaceae. That combination of foliar characteristics appears in no other group of Paleozoic plants.

Because of their distally diffuse penultimate veins, their polygonal meshes, and the lack of sutural veins, these specimens are readily distinguished from the 4 other gigantopterid genera now known in North America: Cathaysiopteris, Gigantopteridium, Delnortea, and Zeilleropteris (Mamay et al., 1988). The same set of characters denotes close relationship with specimens designated by Gu et Zhi (1974, Fig. 103, 2-3) as Gigantonoclea lagrelii (Halle) Koidzumi and G. hallei (Asama) Gu et Zhi; both taxa are from the Permian of China (the latter is Bicoemplectopteris hallei of Asama, 1959). Although comparisons of gross architecture cannot be made between the Chinese and American material, the known resemblances between the two sets (Gu et Zhi, Fig. 103, 2, and present Fig. 1A; Gu et Zhi, Fig. 103, 3, and present Fig. 1B) are so exact that congenericity is reasonably assumed. I therefore refer the Texas specimens to the genus Gigantonoclea, sensu Gu et Zhi, 1974, but defer specific designation until clarification of such questions as number of vein orders and laminar division becomes possible through additional material.

Acknowledgement: I am grateful to James P. Ferrigno for preparing the photographs from which the drawings in Fig. 1 were made.

REFERENCES CITED

Asama, K. 1959. Systematic study of so-called Gigantopteris. Tohoku Univ. Japan. 2nd Ser. (Geol.) 32(1): 1-72. pl. 1-20.

Institute of Geology and Palaeontology, Academia Sinica and Institute of Botany, Academia Sinica (Gu et Zhi, eds.), 1974. Paleozoic plants from China. Science Press, Beijing (in Chinese).

Mamay, S.H. 1968. Russellites, new genus, a problematical plant from the Lower Permian of Texas. U.S. Geol. Survey Prof. Paper 575-C: C120-126.

_________. 1986. New species of Gigantopteridaceae from the Lower Permian of Texas. Phytologia 61: 311-315.

_________, Miller, J.M., Rohr, D.M., and Stein, W.E., Jr. 1986. Delnortea, a new genus of Permian plants from West Texas. Phytologia 60(5): 545-546.

____. 1988. Foliar morphology and anatomy of the gigantopterid plant Delnortea abbottii, from the Lower Permian of West Texas. Amer. J. Bot. (in press).

A NEW COMBINATION IN MYRCIANTHES (MYRTACEAE)

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Myrcianthes rigidissima (Cufodontis) W. D. Stevens, comb. nov.
Eugenia rigidissima Cufodontis, Arch. Bot. Sist. 9: 198. 1933.

In McVaugh's synopsis of *Myrcianthes* (Fieldiana, Bot. 29: 473-497. 1963), this species is treated but without the combination being made; he had not seen the type but had seen a specimen from Panamá (*Allen 1563*) which matched the original description. I have seen three additional collections (*Schmalzel & Todzia 2040* from Panamá and *Lent 1909* and *Wilbur 16716* from Costa Rica) and recently compared them with the type (*Porsch 758*, W). There is no doubt that this species corresponds to the concept of *Myrcianthes*, and seems to be quite distinct, as already noted by McVaugh.

NEW NAMES AND COMBINATIONS IN APOCYNACEAE, ASCLEPIADOIDEAE

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Cynanchum densiflorum W. D. Stevens, nom. nov.
Orthosia ecuadorensis Schlechter, Bot. Jahrb. Syst. 37: 618. 1906, not *Cynanchum ecuadorensis* Schlechter, Bot. Jahrb. Syst. 34 (Beibl. 78): 15. 1904.

It is not at all clear how the genera related to *Cynanchum* might be separated, but while the genus continues to be recognized in the New World this species must belong to it.

Cynanchum longirostrum (K. Schumann) W. D. Stevens, comb. nov.
Diplolepis longirostrum K. Schumann, Bot. Jahrb. Syst. 25: 725. 1898.

This is apparently a rare species belonging to a distinctive group within *Cynanchum* exemplified by the more common *C. formosum*

N. E. Brown and C. tarmense Schlechter, but no other species of that alliance has a rostrate style apex. The never-formally-published name "Doumetia ecuadorensis" Fournier was based on a specimen of this species, also from Ecuador, and the species has recently been collected in Peru.

Gonolobus denticulatus (Vahl) W. D. Stevens, comb. nov.
Cynanchum denticulatum Vahl, Eclog. Am. 2: 23. 1796.
Matelea denticulata (Vahl) Fontella & Schwarz, Bol. Mus. Bot. Munic. 46: 4. 1981.

Until recently this species went under the name Matelea viridiflora (G. Meyer) Woodson, the basionym of which was both an illegitimate later homonym and younger than the above basionym. The nearest relatives of this species have been kept in the genus Gonolobus and it has the only two characters currently used to separate Gonolobus from Matelea.

Matelea cumanensis (Willdenow ex Schultes) W. D. Stevens, comb. nov.
Apocynum cumanense Willdenow ex Schultes in Roemer & Schultes, Syst. Veg. 4: 796. 1819 (March-June).
Cynanchum fimbriatum H.B.K., Nov. Gen. Sp. 3(10): t. 234. 1819 (8 February), 3(11): 158 (fol.), 203 (qu.). 1819 (9 July).
Metaplexis fimbriatum (H.B.K.) Sprengel, Syst. Veg. 1: 854. 1824.
Cynoctonum fimbriatum (H.B.K.) Decaisne in de Candolle, Prodr. 8: 531. 1844.
Ibatia fimbriata (H.B.K.) Karsten, Fl. Columb. 2: 113, t. 160, f. 2. 1865.
Vincetoxicum fimbriatum (H.B.K.) O. Kuntze, Revis. Gen. Pl. 2: 424. 1891.
Matelea fimbriata (H.B.K.) Dugand, Caldasia 9: 436. 1966.

As discussed by McVaugh (Taxon 4: 78-86, 1955), the Humboldt and Bonpland collections from tropical America were often named independently and at times almost simultaneously from the sets at Paris and at Berlin. The pair of names Apocynum cumanense and Cynanchum fimbriatum were based on probably the same collection, certainly the same collector, locality, and species. The identity of the two names was noted by Kunth (Nov. Gen. Sp. 3: 453 (qu.), 1820 and Syn. Pl. 2: 282. 1823) and McVaugh listed this case among a few others where the apparent priority was opposite that of normal usage. The actual dates of publication of the two names have been refined somewhat since McVaugh's analysis, but the priority remains the same. Although the "fimbriatum" version of the name has been placed in six different genera, it has not to my knowledge been used on any but the type specimen. The rarity of this type of specimen improves the probability that the types of the two names are duplicates of the same collection. However, as already pointed out by Morillo (Ernstia 18: 3-4, 1983), this is probably nothing more than an unusual form of a more common plant, currently going by the name Matelea albiflora (Karsten) Dugand. This name, along with its suite of homotypic synonyms, would then fall into the synonymy of the proposed combination.

Metastelma infimicola (L. O. Williams) W. D. Stevens, comb. nov.
Cynanchum infimicola L. O. Williams, Ann. Missouri Bot. Gard. 55: 48. 1968.

Metastelma miserum (L. O. Williams) W. D. Stevens, comb. nov.
Cynanchum miserum L. O. Williams, Fieldiana, Bot. 32: 38. 1968

Metastelma rubens (L. O. Williams) W. D. Stevens, comb. nov.
Cynanchum rubens L. O. Williams, Fieldiana, Bot. 32: 39. 1968.

Metastelma sepium (Decaisne) W. D. Stevens, comb. nov.
Vincetoxicum sepium Decaisne in de Candolle, Prodr. 8: 526. 1844.
Cynanchum sepium (Decaisne) Standley, Contr. U. S. Natl. Herb. 23: 1177. 1924.

Metastelma stenomeres (Standley & Steyermark) W. D. Stevens, comb. nov.
Cynanchum stenomeres Standley & Steyermark, Publ. Field Mus. Nat. Hist., Bot. Ser. 23: 224. 1947.

Metastelma trichophyllum (L. O. Williams) W. D. Stevens, comb. nov.
Cynanchum trichophyllum L. O. Williams, Fieldiana, Bot. 32: 41. 1968.

Woodson (Ann. Missouri Bot. Gard. 28: 208-215. 1941) placed Metastelma in the synonomy of Cynanchum. This usage has been accepted only in a few floristic treatments, particularly in Central America and the West Indies. Over the years, a number of Metastelma species have been published as Cynanchum. Of those from Central America, at least the above six seem to be good species.

Tassadia berterianum (Sprengel) W. D. Stevens, comb. nov.
Oxypetalum berterianum Sprengel, Syst. Veg. 1: 854. 1825.
Metastelma berterianum (Sprengel) Decaisne in de Candolle, Prodr. 8: 515. 1844.

This species has little superficial similarity to typical Tassadia. The floral details, however, match quite well and the inflorescence differs only in that the cymes are distinctly pedunculate and the so-called thyrses upon which they are borne are strongly reduced. Several groups of South American milkweeds tend toward the loss of leaves on the flowering branches, the end result of which are apparently axillary inflorescences, but the ultimate cymes are probably always extra-axillary.

THREE NEW COMBINATIONS IN BOMBACACEAE

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Three new combinations are needed to provide a uniform nomenclature for Bombacaceae in the upcoming "Checklist of the Chocó Flora." The authors of that checklist (A. Gentry and E. Forero) have chosen to follow Stevens (Taxon 36: 458-464. 1987) in adopting the name Pochota Ramírez Goyena over Bombacopsis Pittier, necessitating the first two combinations. Gentry and Forero also prefer to treat Quararibea in the broad sense which includes Matisia, requiring the third combination. To insure that these names are available for the checklist, they are here proposed.

Pochota speciosa (Triana & Planchon) Montiel, comb. nov.
Pachira speciosa Triana & Planchon, Ann. Sci. Nat. Bot., ser. 4. 17: 319. 1862.
Bombacopsis speciosa (Triana & Planchon) Robyns, Bull. Jard. Bot. Etat 33: 219. 1963.

Pochota squamigera (Cuatrec.) Montiel, comb. nov.
Pseudobombax squamigerum Cuatrec., Phytologia 4: 471. 1954.
Bombacopsis squamigera (Cuatrec.) Robyns, Bull. Jard. Bot. Etat 33: 230. 1963.

Quararibea longipes (Little) Montiel, comb. nov.
Matisia longipes Little, Phytologia 18: 200. 1969.

COMMENTS UPON, AND NEW COMBINATIONS IN, HELIOPSIS (ASTERACEAE, HELIANTHEAE)

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Fisher (1957) rendered a taxonomic treatment of the genus Heliopsis in which he recognized 13 species. Two of these, H. rubra (= H. anomala) and H. parvifolia, are closely related congeners. The former was said to have red pales (hence its specific name), and was thought to be restricted to Baja California. Numerous subsequent collections have shown that the key character used by Fisher to distinguish H. rubra from H. parvifolia breaks down repeatedly and that yellow-paled populations of H. rubra also occur in Sonora along the coast line. Nevertheless, I concur with Fisher that H. rubra is a "good" species and that there is a syndrome of characters that distinguish it from H. parvifolia. Fisher listed several characters which distinguish between them, the most noteworthy being the large pubescent ray-achenes of H. rubra (5-8 mm long, vs 3-5 mm in H. parvifolia) and the densely tomentulose leaf axils (vs sparingly pubescent to glabrous in H. parvifolia).

Wiggins (1964), however, reduced H. rubra to varietal rank under H. parvifolia, restricting this to Baja California. He presumably would retain the coastal populations of Sonora (as shown in Fig. 1) in var. parvifolia. But the latter populations differ in no significant way from the Baja California populations, except that the pales are yellow and not reddish. It is likely that Wiggins looked upon these populations as somewhat intermediate to the Peninsula populations; this might account for his nomenclature.

In any case, I cannot distinguish between the coastal Sonoran plants and those from the Peninsula, but I do find a number of distinctions between these two populational sets and those from the montane regions of northcentral Mexico and the adjacent U.S.A., as shown in Fig 1.

Most of the characters which distinguish H. rubra from H. parvifolia, listed by Fisher in his original discription of the former, do tend to hold. To the 5 characters which he listed I would add the following:

H. rubra (=H. anomala)	H. parvifolia
1. Sprawling suffruticose, brittle-stemmed, shrublets	1. Erect, perennial herbs
2. Peduncles mostly 20-40 cm long	2. Peduncles mostly 10-20 cm long
3. Inner receptacular pales rounded to obtuse	3. Inner receptacular pales mostly acute

So far as known, the two taxa appear to be cleanly allopatric and among the several hundred specimens examined by me, I detected not a single intermediate, although the occasional character or two might appear intermediate. Because of this I intend to recognize both as valid species in my treatment of the genus for Mexico. My views as to what might or might not constitute a variety are elaborated upon below.

Fisher (1957) was apparantly unaware that his newly described species, H rubra, had been described earlier as a species of Encelia, although this was pointed out by Blake (1945) who showed that E. anomala M.E. Jones was "in fact Heliopsis parvifolia A. Gray". Unfortunately, Blake did not make critical comparisons of Jones' type material (Blake selected the lectotype, POM, which was collected at Arroyo Undo Ranch, Loreto, Baja Calif. Sur) with H. parvifolia, noting that "the selection of a type is a matter of no great importance, since all three sheets [examined by Jones] are clearly conspecific..." Subsequently, however, Fisher has shown the populations to differ specifically, but he should have applied the earlier name, H. anomala, to these.

HELIOPSIS ANOMALA (M.E. Jones) B. Turner, comb. nov.-

Based upon Encelia anomala M.E. Jones, Extracts from Contr. 18: 82. 1933. TYPE: MEXICO. BAJA CALIF. SUR: Arroyo Undo Ranch, Loreto, 26 Oct 1930, M. E. Jones 27715; lectotype, POM; isolectotype LL, as selected by Blake (1945).

Heliopsis rubra Fisher, Madrono 12: 152. 1954.

Heliopsis parvifolia var. rubra (Fisher) Wiggins, in Shreve & Wiggins, Vegetation Fl. Sonoran Desert 2: 1529. 1964.

HELIOPSIS HELIANTHOIDES var. OCCIDENTALIS (Fisher) B. Turner, comb. nov.

Based upon Heliopsis helianthoides supsp. occidentalis Fisher, Ohio J. Sci. 57: 190. 1957.

Fisher did not recognize varietal taxa in his treatment of Heliopsis. His subsp. occidentalis from the northcentral and western U.S.A. intergrades extensively with the more southern var. scabra (Dun.) Fern. [= subsp. scabra (Dun.) Fisher], as may be ascertained from the examination of specimens from regions of periphery and as well-noted by Fisher himself (1958). I use the varietal category as a regional populational unit which intergrades (over a restricted zone) with peripheral morphogeographic units. By simple populational reasoning, one cannot expect two varieties to occur at a given site, rather one can expect to find populations that are variously intermediate, any individual from which might possess one or more characters of the two taxa concerned.

I use the term subspecies for clustering purposes or to call to the fore more divergent populational systems which do not normally intergrade. Because subspecies occidentalis, sensu Fisher, fulfills my definition of a variety, I have reduced it here.

ACKNOWLEDGEMENTS

I am grateful to the following institution for the loan of herbarium materials in connection with this study (ARIZ, ASU, F, GH, LL, TEX). These form the basis for Fig 1.

LITERATURE CITED

Blake, S.F. 1945. Asteraceae described from Mexico and the southwestern United States by M.E. Jones, 1908-1935. Contr. U.S. Natl. Herb. 29: 117-137.

Fisher, T.R. 1957. Taxonomy of the genus Heliopsis (Compositae). Ohio J. Sci. 57: 171-191.

____________.1958. Variation in Heliopsis helianthoides (L.) Sweet (Compositae). Ohio J. Sci. 58: 97-107.

Wiggins, L.L. 1986. Heliopsis, in Shreve and Wiggins, Vegetation Fl. Sonoran Desert 2: 1528-1529.

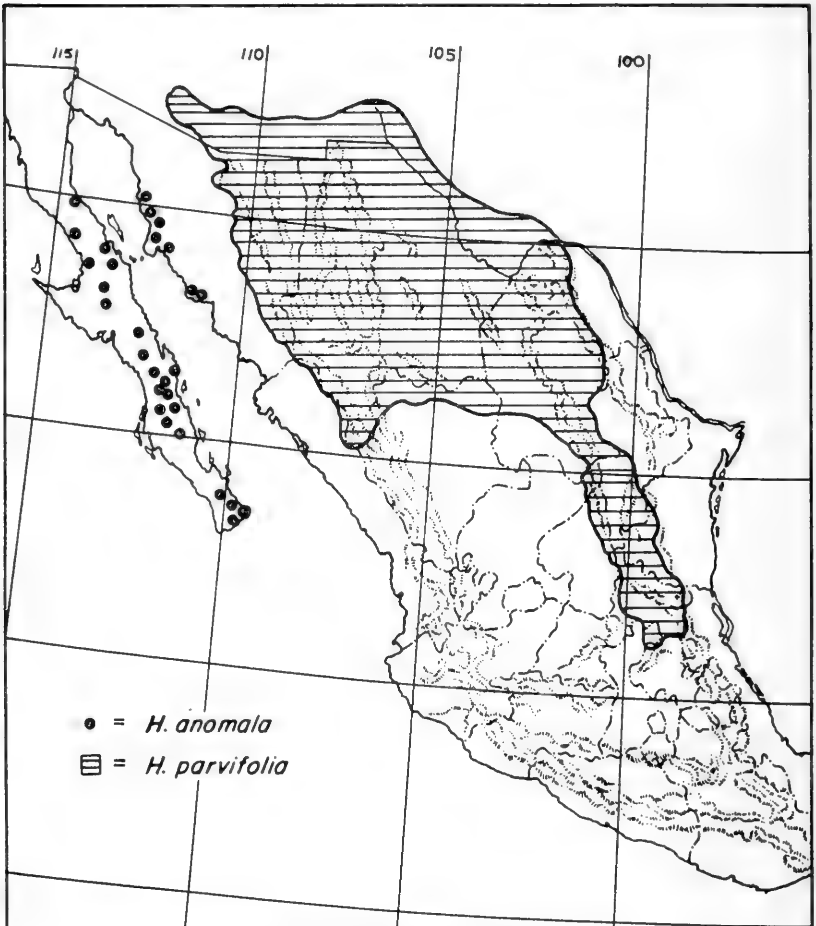

Fig. 1. Distribution of *Heliopsis anomala* and *H. parvifolia*

A NEW VARIETY OF SCLEROCARPUS UNISERIALIS (ASTERACEAE, HELIANTHEAE) FROM SOUTHERNMOST TEXAS

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Feddema (1972) treated Sclerocarpus uniserialis (Hook.) Benth. & Hook. as comprised of three varieties: 1) var. uniserialis, confined to Texas; 2) var. frutescens, widespread from northeastern Mexico to Guatemala; and 3) var. rubridiscus from the Pacific slopes of Mexico (Michoacan to Chiapas). The latter two varieties appear to intergrade extensively in central Oaxaca.

The type of the species was first collected near San Felipe, Texas (Austin Co.) by Drummond, and described in 1837 by Hooker. As noted above, Feddema (1972) treated the var. uniserialis as endemic to Texas, noting that "The Texas populations are well isolated from those in Mexico" and that "the nearest Mexican plants of the species [var. frutescens] have been found near Monterrey [Nuevo Leon]." He does comment, however, that two distinct color forms of var. uniserialis occur in Texas, forms with yellow disk corollas (representing the type species), and forms with reddish or purplish-brown disk corollas. He correctly notes that the latter are known only from southermost Texas from the counties shown in outline in Fig 1.

In connection with my treatment of Sclerocarpus for Mexico, I have had occasion to sort out the geographical variation found in S. uniserialis. I was surprized to find that the specimens of southernmost Texas with purplish disk corollas made up a coherent group, and were largely confined to dune soils and that the several characters given in the description below tended to cohere, with little evidence of intergradation with the allopatric yellow-disked populations, which largely occupy calcareous or mixed sandy-calcareous soils of south-central Texas (Fig 1). Indeed, the distinction between these two populational "forms", as judged by herbarium sheets, were more marked than between the varieties frutescens and rubridiscus, both of which were proposed and maintained by Feddema (1972). I have little hesitation, then, in proposing the following varietal novelty:

SCLEROCARPUS UNISERIALIS VAR. AUSTROTEXANUS, B. Turner, var. nov.

A var. uniserialis vestimento foliorum densiore flavovirenti, capitulis grandioribus, corollis disci longioribus (10-12 mm longis) numerosioribus limbis purpurascentibus differt.

TYPE: UNITED STATES. TEXAS. KENEDY CO.: just S of Armstrong, dune area, off U.S. highway 77, 25 Sep 1958, C.L. Lundell & D.S. Correll 15227 (holotype, LL).

Additional specimens examined: TEXAS. BROOKS CO.: 5 mi N of Encino, 31 Jul 1961, Feddema 1468 (TEX); King Ranch, 21 Nov 1954, Gould & Morrow 6759 (TEX); between Encino and United Carbon Black Plant, 16 Apr 1954, Johnston 54505; S of Falfurrias, 15 Sep 1942, C.L. Lundell & A.A. Lundell 11946 (LL); Falfurrias, 16 Jul 1925, Tharp 3836 (TEX). DUVAL CO.: 3 mi W of San Isidro, 9 Oct 1954, Tharp & Johnston 541861 (TEX). KENEDY CO.: Near Rudolph, 3 Jan 1963, Correll 26920 (LL); King Ranch, 23 Jul 1953, Johnston 5328040 (TEX); King Ranch, 27 Sep 1953, Johnston 5328042 (TEX); King Ranch, 24 Nov 1953, Johnston 5328043 (TEX); STARR CO.: 25 mi above Rio Grande City, 16 Jun 1928, Tharp s.n. (TEX) WILLACY CO.: 2.4 mi S of Yturria, 6 Jul 1954, Johnston 541090 (TEX); Yturria Station, 8 May 1937, Runyon 1686 (TEX).

The var. austrotexanus has not been collected in Mexico as yet, but is to be expected in sandy soils along the Rio Grande, since the taxon has been collected relatively close to the Rio Grande in Starr and Hidalgo counties.

It should be noted that the only other collections of S. uniserialis with purple limbs examined by me in this study have been the following: MEXICO. CHIHUAHUA: 3 km S of Rancho La Gloria (27° 18' 30" N, 104° 13' W), 1450 m, 29 Aug 1972, Chiang et al. 8993 (LL), and COAHUILA: 25 air mi NW of Esmaralda (27° 34' N x 103° 59' W), 20 Sep 1971, Henrickson 6980 (LL). Both collections are near each other and far out of the range of the two varieties discussed above. These appear to be populational forms of S. uniserialis var frutescens, possessing most of the vegetative characters of that variety.

ACKNOWLEDGEMENTS

I am grateful to Dr. Guy Nesom for the Latin diagnosis.

LITERATURE CITED

Feddema, C. 1972. Sclerocarpus uniserialis (Compositae) in Texas and Mexico. Phytologia 23: 201-209.

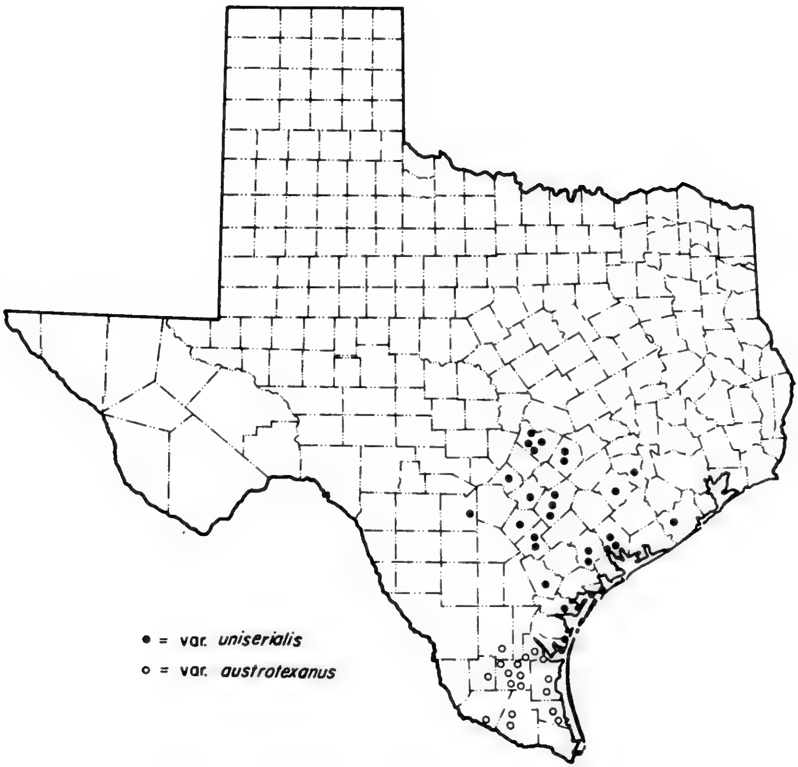

Fig. I. Distribution of *Sclerocarpus uniserialis*

A NEW SPECIES OF VERBESINA (ASTERACEAE-HELIANTHEAE) FROM VERACRUZ MEXICO

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Routine identifications of Mexican Asteraceae has revealed the following novelty:

VERBESINA XICOANA B. TURNER, sp. nov.

V. seatonii S.F. Blake simile sed habitu fruticoso usque ad 1.4 m alto, foliis plerumque oppositis, et acheniorum setis pappi 1.5-3.0 mm longis differt.

Suffruticose perennial herb or shrub, 1.0-1.4 m high; stems terete, wingless, densely pubescent with appressed or spreading, tawny, hairs; leaves mostly opposite, but a few leaves alternate above, 3-7 cm long, 1.4-1.8 cm wide, sessile, or nearly so, ovate-elliptical, widest at or near the middle, hirsutulous above, densely appressed pubescent beneath with soft hairs, the margins entire or sometimes serrulate; heads radiate, arranged 2-5 in terminal lax cymules, the ultimate peduncles 3-9 cm long; involucres hemispheric, 6-8 mm high, 2-3 seriate, the bracts subequal, hirsutulous, blackish-green; receptacle conical, ca 2.5 mm wide, ca 2 mm high, the pales lanceolate, 5-6 mm long; ray florets 11-15, pistillate, fertile, the ligules yellow, 6-9 nervate, 12-16 mm long, 3-4 mm wide; disk florets numerous, the corollas yellow, pubescent, 3.7-4.0 mm long, the tube ca 1 mm, the throat tubular with lobes ca 0.5 mm long; anthers brown, the appendages ca 0.3 mm long; style branches with short, acute, appendages; achenes black, wingless, ca 2.5 mm long, 1.5 mm wide, the pappus of 2 readily deciduous awns, 1.5-3.0 mm long.

TYPE: MEXICO. VERACRUZ: Mcpio. Xico, Barranca El Caracol, 1 km S of de Tembladeras, pine forest, 2900 m, 17 Aug 1983, Hector Narave F. 964 (holotype TEX; isotypes XAL)

Additional specimens examined: VERACRUZ: Mcpio. Xico, Barranca El Caracol, 3000 m, 17 Aug 1983, H. Narave F. 961 (TEX, XAL).

Verbesena xicoana, because of its shrubby habit, superficially resembles V. robinsonii Fern. but differs in having sessile, mostly opposite leaves and small, wingless, achenes. It appears closest to the perennial herb, V. seatonii S.F. Blake, which differs in having mostly alternate leaves, larger heads and wingless, but pappose, achenes. Both V. xicoana and V. seatonii possess sessile leaves which are densely, but softly, appressed pubescent beneath, and both have conical receptacles with quite similar pales. The latter species occurs along the upper western slopes of Mount Orizaba (Puebla) eastward to Morelos and Mexico State in pine forests from 2800-3000 meters; V. xicoana occurs in similar habitats on the eastern upper slopes of Pico de Perote, Veracruz.

NOVITATES ANTILLANAE. XIV.

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Some new species from the island of Hispaniola and some new combinations, together with a new record for Puerto Rico have to be reported as a result of my studies in the Caribbean Flora.

ASCLEPIADACEAE

Cynanchum calcicolum Alain, sp. nov.

Volubilis; rami teretes, hornotini pilis brevibus bifariam pilosi; petioli 1-3 mm longi; folia linearia 1.5-2.7 cm longa, 1-3.5 mm lata, apice rotundata vel acuta, basi obtusa vel acuta, nervo medio supra prominulo subtus applanato, lateralibus obsoletis, in juventute nervo medio sparse pilosulo, ciliata, mox glabra, supra viridia subtus pallidiora, membranacea, margine integra; umbellae 3-6-florae, pedunculi 2-4 mm longi subglabri; bracteae ovatae 0.7 mm longae obtusae; pedicelli 2-3 mm longi glabri; sepala ovata 1 mm longa et lata, glabra, margine hyalina; corolla brunneo-viridis, 2 mm longa, tubo brevissimo; lobi lanceolato-oblongi, extus glabri, intus as apicem dense barbati, basi tomentulosi; squamae coronae lineares 1 mm longae acuminatae; gynostegium sessile corona duplo brevius; ratinacula ellipsoidea, pollinia ovata 0.3 mm longa; follicula anguste filiformia, 3 cm longa, 2.5-3 mm lata, minute striata; semina brunnea, linearia 6-7 mm longa, vix 0.4 mm lata, pilis albidis obsita.

HAITI: On limestone cliff, 1,000 m alt., Presqu'île du Nord-Ouest, Montagnes Terreneuve, Oct. 9, 1925, E. L. Ekman 5039, (Holotypus, S.).

This taxon is outstanding by its narrow leaves, the corona scales lanceolate about twice as long as the gynostegium; it is near to Cynanchum stenoglossum (Schltr.) Jiménez; this last species has ovate-lanceolate leaves, the corolla lobes are glabrous; by its leaves, it resembles Cynanchum savannarum Alain, which has corona scales half as long as the gynostegium; finally, C. angustifolium Pers., with linear leaves, has glabrous corolla lobes.

Gonolobus stipitatus Alain, sp. nov.

Volubilis; rami et ramuli striati bifariam breviter retrorse pilosuli; petioli 1-1.5 cm longi, glabrescentes; folia ovata, 3-4.5 cm longa, 1-2.5 cm lata, apice acuminata mucronata, basi late rotundata vel subtruncata, nervo medio supra vix prominulo, subtus prominulo, lateralibus utroque latere 2-3, supra obsoleti, subtus vix obviis, glabra, in juventute minute punctata, subtus pallida, margine integra; flores fasciculati 2-5 in axillis; pedicelli 6-8 mm longi puberuli; sepala lanceolata 2.5 mm longa, 1 mm lata acuminata glabra, margine sparse ciliata; corolla campanulata, viridis, 5 mm longa, usque ad madium lobata, lobi ovati apice obtusi, venosi, intus pulverulenti; corona annularis breve cupuliformis, 0.7 mm alta integra; gynostegium 5-angulare, apice applanatum 2 mm latum, filamenta in columna conica 1.5 mm alta at basim 1.5 mm lata connata; pollinia obovoidea 0.6 mm longa, translatores brevissimi, retinaculum brunneum, 0.3 mm longum; follicula non visa.

HAITI: On hard limestone, Massif du Nord, St. Louis du Nord, on top of Morne Baron, July 20, 1925, E. L. Ekman 4693 (Holotypus, S).

This taxon is distinguished by its conical staminal column 1.5 mm high, its ovate, acuminate and basally truncate leaves. It is distinguished from Gonolobus membranaceus Schltr., the latter having elliptic, obtuse leaves, the calyx segments obtuse, the crown lobed.

Matelea linearipetala Alain, sp. nov.

Volubilis; rami et ramuli bifariam pilis brevibus patentibus vel retrorsis pilosuli; petioli usque ad 1.5 cm longi, pilosuli; folia elliptica vel elliptico-oblonga, 2-4.5 cm longa, 1-2.3 cm lata, apice rotundata vel truncata, nervo medio supra leviter impresso, subtus prominente, lateralibus 2 basalibus, caetera utroque latere 2-3, venis tenuissimis, supra viridia subtus pallidiora, utroque superficie minute punctata, glabra, margine integra; flores in axillis solitarii, pedicelli usque 5 mm longi tomentulosi; sepala lanceolata, acuminata 1 mm longa glabra, nervosa; corolla rotata, fere ad basim 5-fida, lobi lineari 6-7 mm longi 0.8 mm lati, in sicco brunnei, glabri; corona annularis 2.5 mm diam.; gynostegium apice applanatum; pollinia oblique ovoidea 0.8 mm longa, translatoribus filiformibus, retinaculo brunneo 0.3 mm longo; folliculi oblongo-lineares, 3.8 cm longi, 1.5 cm lati, lutei (ex Ekman), tuberculis carnosis 1-2 mm longis obsiti.

HAITI: On oligostene limestone, 200 m alt., Massif des Matheux, Thomazeau, Morne à Cabrits, Oct. 24, 1926, E. L. Ekman 7136 (Holotypus, S).

Similar to M. annulata Alain; this last species has oblong-lanceolate leaves, acuminate at apex, not punctate; the corolla lobes are ovate, rounded at apex, the calyx lobes are ciliate.

BORAGINACEAE

Cordia ignea Urb. & Ekm. var. aurantiaca Alain, var. nov.

A var. ignea differt: Hornotini glabri, vel in novelli puberuli; folia oblonga 4-6 cm longa, 2-3.5 cm lata, apice obtusa vel rotundata, basi inaequilatera subcordata, supra nitida nervis applanatis, subtus in sicco pallida brunnea nervis prominulis; calycis lobi 0.5 mm longi, corolla aurantiaca 3 cm longa.

DOMINCAN REPUBLIC: On dog-tooth limestone, Cabo Rojo, Pedernales, near sea level, 10 Feb. 1969, A. H. Liogier 13735 (Holotypus, NY).

LABIATAE

Salvia lavendula Alain, sp. nov.

Frutex 2.5 m altus; rami nigrescentes, ramuli obtuse quadranguli glabri, dense et minute glandulosi; folia petiolis gracilibus 8-12 mm longis supra sulcatis, lamina lanceolata 5-9 cm longa, 1-2 cm lata, apice longe acuminata, base cuneata, nervo medio supra impresso, subtus prominente, lateralibus utroque latere ca. 8, sub angulo 50°-60° abeuntibus, supra vix impressis, subtus prominulis, supra glabra et minute glandulosa, subtus foveolata et pilis minutis in foveolis munita, margine serrulata, supra obscure viridia, subtus pallida subcoriacea; inflorescentiae in ramulis terminales spiciformes 8-10 cm longae, paniculam formantes, 1-2 cm longe pedunculatis, rachis retrorso-pilosus; bracteae deciduae ovato-subulatae 4 mm longae, 2 mm latae extus patenti-pilosae; verticillastri 6-9-flori, pedicelli subnulli; calyx subcylindraceus, sub anthesi 6 mm longus, patenti-pilosus et minute glandulosus, lavendulus, tubus 9-nervis, labia subaequilonga 1.5 mm longa, posticum ovatum breviter apiculatum, 3-nervium, anticum bilobum lobis triangularibus apiculatis; corolla lavendula, inferne glabra, superne pilis multicellularibus hirsuta, 1.5 cm longa, tubus campanulatus, labium posticum erectum explanatum breviter rectangulare-ovatum, emarginatum, anticum patens 3-4 mm longum, 3-lobum, lobis triangularibus acutis; stamina sub ore corollae inserta, filamenta usque 8 mm longa glabra, exserta, antherae 1.5 mm longae; stylus 15 mm longus, glaber, apice inaequaliter bifidus, ramulo altero 1 mm longo, altero 0.2 mm longo; nuculae non visae.

DOMINICAN REPUBLIC: Along Bao river, upper Bao Valley, at the base of La Pelona, Cordillera Central, alt. 1,650 m, in pine forest, common, 1-7 Oct., 1968, A. H. Liogier 12911 (Holotypus: NY; Isotypi: US, H).

This species is outstanding by the color of its flowers, the calyx included, and by its narrow lanceolate leaves, glabrous above and with minute hairs in the foveolae beneath; it can be compared with S. densiflora Benth., with ovate, acute or obtuse and pubescent leaves, smaller blue flowers in dense spikes; S. arborescens Urb. & Ekm. has smaller (less than 1 cm long) white flowers, leaves densely puberulous beneath.

RUBIACEAE

The reduction of Borreria to Spermacoce makes necessary the following new combinations for our area:

Spermacoce densiflora (DC.) Alain, comb. nov.

Borreria densiflora DC., Prodr. 4: 542. 1830.

Borreria spinosa of authors, not Spermacoce spinosa L.

Spermacoce litoralis (Urb.) Alain, comb. nov.
  Borreria litoralis Urb., Repert. Spec. Nov. 20: 352. 1924.

Spermacoce rosea (Urb.) Alain, comb. nov.
  Borreria rosea Urb., Symb. Ant. 7: 414. 1912.

Spermacoce sintenisii (Urb.) Alain, comb. nov.
  Borreria laevis var. sintenisii Urb., Symb. Ant. 4: 607. 1911.
  Borreria brachysepala Urb., Symb. Ant. 7: 415. 1912.

COMPOSITAE

Baccharis myrsinites (Lam.) Pers., Syn. 2: 424. 1807. (Conyza myrsinites Lam.).

PUERTO RICO: Pico del Este, Luquillo Mts., Aug. 3, 1982, A. H. Liogier & al. 33310; Oct., 1986, A. H. Liogier 36159, coll. by P. Vives. A new record for Puerto Rico; previously known from the island of Hispaniola.

PATCH STUDIES IN THE STABILITY OF NON-DIVERSITY: DENNSTAEDTIA, SOLIDAGO, SPIRAEA, KALMIA

John P. Anderson Jr., and Frank E. Egler

Key Words: Dennstaedtia, Solidago, Spiraea, Kalmia, patches, northwest Connecticut, stability

Introduction

This paper is a Progress Report on the relative stabilities of four one-species-predominant "Patches" of a fern, a forb, a low shrub and a tall shrub, of Dennstaedtia punctilobula, Solidago rugosa, Spiraea latifolia, and Kalmia latifolia -- not on the stability of a complex Vegetation composed of many plant-communities. It is based on both observations and experimentation that go back for several decades. The study is part of the long-term low-tech low-cost research at Aton Forest, an 1100-acre area in the beech-birch-maple-hemlock Zone of northwestern Connecticut; and does not emulate the ecolometric overkill now fashionable in ecological journals ("Physics Envy in Ecology" Ecol. Soc. of Amer. Bull. 67(3):233-234. 1986). Furthermore, the study goes beyond the successional "patch dynamics" that seems to be currently emerging, which current approach is a rediscovery of the Cover Type coincidences, fully understood by Henry A. Gleason, Carl O. Sauer and others seven decades ago, subsequently lost under several epistomologic enthusiasms. This present Patch study focuses upon specific small areas up to 10 m. across, that play their partial roles in the complex wholes of total Vegetation, an example of top-down ecosystemic research, from wholes to parts (not the reverse). (The Latin nomenclature is that of Gleason's 3-volume "Illustrated Flora of the Northwestern United States and Adjacent Canada", 1952.

I. Basic Conceptualization. In the philosophy of the science, this study aims:

- To reduce where feasible the known, multi-species plant-community in nature to predominantly one-species "parts" or "Patches" by top-down thinking;
- To observe, monitor, describe, study and experiment with these one-species-predominant parts; for their stability, their peripheral expansion into other plant-communities or other one-species Patches (which expansion is clearly non-stability on the part of the invaded community, the combination of the two communities being one expression of "diversity); or for the instability of the Patch by peripheral contraction (as by invasion of other plants); or by autotoxicity, forming "fairy rings"; or by overall

invasion (Relay Floristics) by other plant-communities or by one-species populations;

- To evaluate the role of allelopathy, with or without competition for space and nutrients;
- To accept interferences and accidents of nature, which are thus turned into "natural experiments", which may or may not require readjustments in the study;
- To integrate, lastly, the knowledge of a one-species-predominant community into a better understanding of the nature of many-species plant-communities, bio-communities and ecosystems.

II. History of the Idea. While working for his doctorate under George E. Nichols in 1934-36, Egler came in one day after sitting thinking and dozing in a large Patch of overmature Rhus typhina near Yale, and excitedly told his professor that the community under the Rhus was precisely the same set of herbs as in the open weedy field outside the Patch, that there was no Rhus-correlated invasion by young "pioneer" trees; and that where the Rhus was deteriorating from old age, this supposedly later Rhus-shrub stage was actually being "succeeded" by the "younger" old-field stage! Nichols' dogmatic reply was one that did not accept either such exceptional successional behavior, or further such student observations.

Two decades later, Egler visited the Audubon Nature Center, Greenwich, Conn., met their summer staff member William A. Niering, and saw a patch of Viburnum lentago. The end result was "A shrub community of Viburnum lentago, stable for twenty-five years" (Ecology 36(2):356-360. 1955). A fifth-decade update, by William A. Niering, Glen Dreyer, John P. Anderson Jr., and Frank E. Egler has been completed (Ecology 113(1):23-27. 1986).

At Aton Forest, over one hundred plant taxa occurring in Patches are under long-term observation. Some are not proving significantly stable, especially under recent heavy deer-grazing, but mice and rabbits are also critical factors. (Amongst other related publications, see "Botanical studies in the stability of non-diversity: Cornus racemosa", Conn. Bot. Soc. Newsletter 10(3):1. 1982. And "Botanical studies in the stability of non-diversity: Taxus canadensis", Third Intern. Symposium on Environmental Concerns in Rights-of-way Management, Feb. 15-18, 1982, San Diego. 1984 [Miss. State Univ., 39762].) The subject is obviously of great practical importance in silviculture, range management, naturalistic landscaping, and R/W Vegetation Management, as well as in academic Ecosystem Science.

III. Methodology. If research in long-stable Patches appears to have been neglected, it is understandable if not excusable. The study is not amenable to the short-term quickie research of Mr. Grant Swinger. The methods are not rigid and elegant, but flaccid yet risible with attractive and unexpected opportunities.

- Pick a small area, a good "sample" in the judgment of an experienced field person, young or old (but not of a just-graduated technician).
- Interpret the area with regard to its origins:
  - A. The species: clonal, seedlings, root age, past browsing, etc.
  - B. The non-Patch species: are they
    1. Antecedents (older than the Patch species)?
    2. Concomitants (same age as the Patch species)?
    3. Subsequents (younger than the Patch species)?
- "Purify" the Patch, by <u>root</u>killing or otherwise removing all the species you arbitrarily decide are "alien" to your intents. (Remember that the herbicide industry sells chemicals as "control", and sells more if they do <u>not</u> rootkill -- a kind of planned obsolescence of the treatment, like using a cheap paint on a house.) This purification itself may take several years.
- Sample the Patch for detailed data on composition and abundance, by permanent plots, transects, or lines. There is no single standard methodology, suited for all species in all areas.
- Monitor the Patch thru the years and decades as to overall expansion (in decimeters, not millimeters), contraction, overall invasion (change, not Clementsian "succession"), internal decay (fairy rings), autotoxicity, etc.
- Manage or not-manage the Patch thru the years as unanticipated events arise, and ad hoc decisions must be made, e.g.:
  1. If overridden by a dense vine, like grape or Japanese honeysuckle.
  2. If affected by fire, flood, drouth, wind, insects.
  3. If grazed out, as by deer, or a neighbor's cow, or if a well-meaning person interferes.
  4. If an adjacent tree overshades it, or a rootsuckering shrub or tree invades from below.

IV. <u>Prepare Reports</u>. At initiation of the project, and at suitable intervals thereafter, indicate changes or non-changes involving:

- Composition (minor and accessory species that may be present).
- Structure with respect to height, type of branching, etc.
- Peripheral behavior with adjacent plant-communities, and with species of them (always pointing to further research) on the physico-chemical nature of the phenomena observed, especially with respect to competition for space and nutrients, and to allelopathy).

- Internal behavior, as regards newly invading taxa. Herein lies the very essence of Patch Stability, or Instability.

I. DENNSTAEDTIA PUNCTILOBULA 1946-1987

Dennstaedtia punctilobula, the non-evergreen Hay-scented Fern, is and is increasingly, an important component of our regional vegetation in New England, New York and Pennsylvania. It commonly covers significant portions of land, either mixed with other plant species, or more frequently as a single-species patch.

At Aton Forest, Dennstaedtia cover in the forested areas is now estimated at up to 25% of the local (50-acre units) vegetation cover; it is less important in the non-forested managed Herblands and Shrublands, to 5% of the cover, but it is increasing even there. Due to its clonal nature, this native fern tends to form a dense rhizomatous sod.

The fern has increased tremendously within the last twenty-five years, in full sunlight and under hardwoods and pine. It is absent under Hemlock. In the total vegetation it seems destined to increase still more. The increase is related to its unpalatability to deer, its aggressiveness in the browse-outs by deer, and to its apparent allelopathy which seems to prevent invasion by all other potential predominants, herbs shrubs and trees (except Rubus idaeus, thinly appearing in a few sunny areas). In 40 years, no clone has been observed to decay or disintegrate.

Elsewhere on Aton Forest, a few large down and decaying tree trunks may be playing a significant role in the future plant-community complex. All small tree trunks (to 45 cm., ca. 18 in., in dm.) are submerged in Dennstaedtia fronds almost year-round. A few larger trunks remain free of such a cover, and after suitable decay, ca. 25 years, may become a seed bed for trees. Paper Birch, Yellow Birch, Black Birch, Red Maple and White Ash have been found in such a microsite. Other species can be expected. Such large down-trunks are rare in Connecticut forests that are lumbered and fuelwood-collected; and thus this significant silvicultural factor in forest regeneration is likely to go unnoticed. Approximately 70 such prostrate tree trunks are under long-term study at Aton Forest.

Location and History. The Patch is located at the north edge of the field called Far North, in Lot C-47 (1757 Town Map), and was originally part of the brushy border of the hayfield. The field was mowed from 1926 thru 1944. It was not mowed from then on, but has been kept free of trees and tall shrubs since 1946 by the selective spot-use of herbicides.

Creation and Enlargement of the Patch. In 1946 there was a 4 m. wide strip of dense shrubs and young trees immediately south of the bounding E-W stone wall. It contained the usual mixture of species: Red Oak, Sugar Maple, Red Maple, Striped Maple, White Ash, Black Cherry, Paper Gray and Black Birches, a few White Pines and Hemlocks; Tall Blueberry, Low Blueberry, Winterberry, Lyonia, Arrowwood, Low Juniper, and perhaps others. In 1946, 1947 and 1948 this brush was treated to spot-spraying with chlorophenoxy herbicides. (See various publications by FEE.) By that time not only had the woody plants been rootkilled, but the herbicide-resistant probably-allelopathic Dennstaedtia was observed as becoming predominant at this spot. It was decided to make it a study Patch.

To mark the Patch, a line of 15 stones was laid down by FEE, ca. one m. apart and 23 m. long, on May 31, 1949. Remeasurements were taken on March 30, 1973, by FEE and Happy Kitchel Egler, with no new stone-line (data on file), showing that the entire Patch had not only remained compositionally stable, but had moved southward from 2.7 to 3.6 m. (aver. 3.2 m.), averaging 0.13 m./yr. Both 1949 and 1973 lines were "wavy" in the sense that each seemed to consist of the fronts of two circular clones that had already merged. If so, there was no apparent phenotypic difference between the two clones. This phenomenon occurs commonly at Aton Forest and elsewhere in northwest Connecticut.

A second line of bordering stones was laid down on May 10, 1981, by JPA and FEE. Again the entire Patch had remained stable, and the line had moved southward from 1.22 m. to 2.5 m. (aver. 1.7 m.), averaging 0.22 m./yr.

The Patch was restudied by JPA and FEE on June 18, 1985. By this time, Dennstaedtia clones had consolidated in the forest north of the stone wall and westward for ca. 60 m., carpeting the forest floor. Fifteen 1949-1981 transects were again measured, and shown to have moved southward (into further sunlight) from 1981 to 1985 from 0.6 m. to 1.14 m. (aver. 0.84 m.), averaging 0.21 m./yr. There was no 1985 line of stones.

Also on June 18, 1985, data on: composition and structure, behavior, and the adjacent herbaceous communities were taken (now on file), from which the following summaries are drawn.

According to policy, as the clonal Patch has moved southward, any established trees and shrubs that seemed destined to be Antecedents to the Patch have been rootkilled, since it is the primary intention of the research to test for newly invading "subsequent" woody plants. From 1946 to 1965 this rootkill was accomplished by spot-spraying with phenoxy herbicides. In 1965, use of phenoxy was stopped because certain species always had been resistant to it. From 1965 to 1979 such plants were cut close to the ground with a pruning shears, with the assumption that competition and allelopathy would be effective. It was, if one so pruned two or three times a year. In 1979, stub-spraying with picloram was initiated; and the few remaining such woody plants now occurring in the Dennstaedtia are considered to be "misses", related to previous deer- or rodent-browsing. To date, there has been no obvious invasion by new tree or shrub seedlings, tho such seedlings do occur in adjacent non-Dennstaedtia communities.

Composition and Structure. The Dennstaedtia Patch, as a plant community, appears physiognomically as a pure single-species population. There are no other herbaceous species that are apparent, even as one stands only a few feet away. Nonetheless the fern occupies only 95 to 99% of the total mass, the few other species being small, low, and of no functional dominance. No sporeling ferns have been found.

In the section of the Patch studied and measured between 1949 and 1981, the most common (i.e., occurred in at least 25% of the transects) species found (still comprising 1% or less of the Cover) were: Carex spp. (2 sterile unidentified taxa), Rumex acetosella, Potentilla canadensis, Rubus flagellaris, grasses (small, sterile, unidentified), Maianthemum canadense (the most frequent), Rubus hispidus, and Solidago rugosa. Woody plant species (not yet rootkilled) occurred in only 8 out of 15 transects (75.4 m. of total length), for a total of 14 stems: Acer saccharum (5 stems), Quercus borealis (4), Carpinus caroliniana (2), Acer rubrum (1), Fagus grandifolia (1), and Amelanchier arborea (1).

The Marginal Belt. In autumn it has been noticed that all the fronds at the margin of the Patch bend away from the Patch and seemingly blanket out the adjacent low herbs of the Herbland. In spring after growth has started, there is an obvious 15-25 cm. band where the low herbs appear weakened and depauperate. It can be assumed that such an effect facilitates the extension of the Dennstaedtia rhizomes into this band.

Furthermore, in that new part of the Patch dating only from 1981-1985, there is a distinctly greater, but still minor amount of the Herbland plants, implying that it takes 5 years or more for the overrolling Dennstaedtia to eliminate them. The most common such species (still comprising 5% or less of the total Cover) were: Rubus hispidus, Rubus flagellaris, Potentilla canadensis, Carex spp., Rumex acetosella, and Quercus borealis. Other forbs occurred in 8 out of 15 transects (12.8 m. total length) for a total of 12 stems: Acer saccharum (3), Acer rubrum (3), Quercus borealis (2), Betula papyrifera (2), Prunus serotina (1), and Viburnum recognitum (1). Heavy fern growth would probably kill the small plants.

This poor survival and decline of woody species and the sudden reduction in other species Coverage which occurs immediately at the advancing edge of the fern suggests not only that Dennstaedtia punctilobula is a strong competitor in our regional vegetation, but is likely to be allelopathic, as various other studies have indicated.

Behavior. A conspicuous deer trail crossed the Patch at one place from 1981 to 1984. In the winter of 1980-81 about 10% of the area had been chewed up by mice, and short sections of the fern stipes could be raked together using one's hand. Several holes 8 inches deep had been dug (skunks?). Within the fern Patch over the years Whitetail Deer have occasionally pawed at the fern in early and late winter. Over the three years of 1983-85, this pawing has increased and intensified. In spring 1985, such scratches occurred in 13 of 15 transects between the 1949 and 1981 stone-lines. (None occurred between the 1981 and 1985 stone-lines), covering 18% of those transects, which seemed a fair approximation for this entire section of the patch. These scratches, which are oval-shaped, vary from 1.0 to 2.0 sq. m. in size, and are usually bare soil, with nearby piles of fern duff several inches deep. By summer new fern fronds were seen in some, but often where spots have been deeply scratched down to the soil, grasses sedges or Potentilla seeded in sparingly. In the 1985-86 and 1986-87 winters, no pawing occurred. By July 1986, in walking thru the dense fern fronds, no bare soil whatever was seen. In April 1987 new fern fronds were unrolling in almost all the pawed places. Neither these nor other animal effects have yet altered or permanently changed the continuity or stability of the Dennstaedtia Patch.

In a different Dennstaedtia Patch in northern Lot C-46, about 100 ft. in dm., Rubus strigosus (wild Red Raspberry) was first noticed in 1975, occupying less than 5% coverage. Since then, it has maintained this status, neither decreasing nor increasing in Coverage.

Adjacent Vegetation. The old-field vegetation beyond the 1985 Patch boundary was inventoried for plant species and abundance in a two-meter strip parallel to the Patch. Abundant species were: Anthoxanthum odoratum, Solidago rugosa, Lycopodium obscurum, Vaccinium angustifolium, Rubus flagellaris, Rubus hispidus, and Potentilla canadensis. Few or rare species included: Anaphalis margaritacea, Rumex acetosella, Festuca ovina, Panicum sp. (sterile), Quercus borealis, Carpinus caroliniana, Acer rubrum, Amelanchier arborea, Acer pensylvanicum, Acer saccharum, and Viburnum recognitum. Trees and a few shrubs can and do invade this Herbland, but not the shrubland of V. angustifolium. Such woody plants have from time to time been cut and treated with herbicides since 1946, in another project.

Future Trends. There is no indication as yet, after 38 years, that any seedplant or other fern does or can invade the Patch, either peripherally by vegetative means or scatteringly by isolated propagules. It can be assumed that some rhizomatous or rootsuckering plant might invade, but none has been observed so far.

As a stable spreading clone that, helped by deer, outcompetes adjacent herbaceous species and communities, and in terms of the multi-community vegetational mosaic of Aton Forest, this Patch can be said to be contributing to an inter-community instability of that total Vegetation.

Conclusions. Dennstaedtia is high in esthetic appeal, excellent in preventing soil erosion, probably cannot withstand trampling by livestock, without forage or edible-fruit value for wildlife, with unknown insect populations, and forms a cover which prevents the development of seedling forest reproduction. Dennstaedtia is one plant that exemplifies the principle that in small-scale natural one-species predominant community-level non-diversity, there can be a significant stability.

II. SOLIDAGO RUGOSA

The strongly rhizomatous Solidago rugosa, best called the Rugose-leaved Goldenrod, is one of the easier to recognize in spring and summer in its vegetative state. It is also one of the most abundant thruout the northeastern states in Zones "below" spruce and fir, in sunlight forming solid stands, with other herbs taking very minor roles. It gives every evidence of being a relatively stable one-species-predominant herbaceous community. If young trees are also part of the Initial Floristic Composition (IFC), these soon overtop, and thin out the Solidago. On the other hand, this goldenrod is not part of the typical forest understory of the beech-birch-maple-hemlock Zone.

In the entire acreage of Aton Forest, it is estimated that Solidago rugosa (SR) occurs in 1-5% of its herb stratum. For 1926, the species is not recollected as being of vegetational significance in mowed fields and pastures. From 1946 to the mid-1950s, this plant was sprayed with phenoxy herbicides (in order to maintain a "grassland"). That treatment produced a kill-to-ground in spring. When the foliage "hardened" by midsummer, the spraying merely twisted the leaves. Thru those years, the total amount of SR was increasing by rhizomatous spread. In the 1960s, an intensive effort was made to remove it by "pulling". A steady tug would pull up a section of the horizontal rhizome. Later in the season there would be a satisfying addition of 5-8 new radiating rhizomes of 3-6 in. lengths. By count, thousands of such stems were pulled, in an effort completely to eradicate SR from about

4 acres, plus other smaller infestations. Obviously, pieces of rhizomes were always left in the soil, for the next year's growth was always plentiful. Within 2-3 years, the stand would become solid again. It was noticed however, that nowhere in the fields were SR <u>seedlings</u> found (tho they did occur in an experimental Bare Soil Project). Then it was decided to "live with it". Then it was found (by 1985) that SR does not appear to extend uphill on dry infertile thinly covered Upper Slopes, nor does it invade already existing Spiraea, Dennstaedtia, Vaccinium angustifolium, Onoclea, or Festuca turf (where developed on lower moister areas). It also does not invade areas that are mowed in a thrice-a-year, 5-foot-wide, mile-long transect (begun in 1947). SR will also dominate where shaded much of the day by tall adjacent forest.

<u>Creation of the Patch</u>. For reasons indicated above, and in order to concentrate attention at one particular spot, a study Patch was established June 19, 1985, partially under the crown of an isolated large Red Oak (which blew down in hurricane Gloria September 27, 1985), in the Aton Forest research area of C-46, known as Headquarters, section Eta. This area had been pastured until 1926; mowed until 1945; then treated with phenoxy herbicides until 1965, and with picloram since 1978. The Patch boundaries are located by four permanent field-stone markers, one at the base of the above-mentioned oak. Two transects were laid out (40 cm. wide), perpendicular to each other (E. 25 deg. N. and N. 25 deg. W.), dividing the elliptical Patch into quarters.

The Patch diameters are 6.45 and 3.70 m. The transects extended 0.6 m. beyond the Patch, into Herbland on three sides. The circumference is smooth and broadly elliptical. Altho this area has been under observation for many years, this is the first time that detailed measurements and other data have been collected. Ash and oak seedlings had previously been abundant.

<u>Composition and Structure</u>. The Patch is 99% Solidago rugosa. There is an abundance of Maianthemum canadense under the Solidago, which is the only truly associated species. There remained in 1985 several suppressed-and-browsed Quercus borealis and Fraxinus americana stems, shorter than the Solidago, scattered thruout the Patch.

The 6.45 m. transect contained: Maianthemum canadense, Gentiana andrewsii, Asters simplex var. simplex, lateriflorus, sagittifolius, and undulatus (all frequent in the surrounding herblands), Narcissus 'King Alfred', Aralia nudicaulis, Fraxinus, Quercus, Prunus serotina, and a large Kalmia latifolia at the tree-end of the transect.

The 3.70 m. transect contained: Maianthemum canadense, Convallaria majalis, Narcissus 'King Alfred', Aster undulatus, Rubus flagellaris, Quercus, Prunus serotina, Prunus virginiana, and Fraxinus.

A marginal not-dense Solidago belt occurs around the Patch, varying from 0.3 to 0.8 m. in width (except for 20% of the Patch edge at the east, which abuts another Patch of Solidago). SR is still dominant, but other species include: Achillea millefolium, Potentilla canadensis, Rubus flagellaris, Anthoxanthum odoratum, Solidago graminifolia, Fragaria virginiana, Asters simplex var. simplex, laterifolius, sagittifolius, and undulatus, Rumex acetosella, Carex sp. (sterile, small), Gentiana andrewsii, Quercus and Fraxinus. This marginal belt is viewed as the most recent expansion of the clone into the "thinner" plant-community of section Eta. It is interesting to note the occurrence of a few species more common at the forest edge, particularly Aralia, Gentiana, and Convallaria (which spreads by seedlings and rhizomes), which herbs are rarely in the surrounding sunny mixed non-SR herbland. This is a situation implying an ecosystemic affinity of the dense and shady SR vegetation with the Forest Edge, rather than with large open sunny areas.

Adjacent Vegetation. Beyond the Patch, Solidago is spotty, or rare. Other species vary considerably in coverage from place to place. The most abundant are: Anthoxanthum odoratum with Agrostis alba, Agropyron repens, Dactylis glomerata, Carex spp., Uvularia perfoliata, Poa pratensis, Maianthemum canadense, Potentilla canadensis, Achillea millefolium, Aster spp. (as above), Solidago graminifolia, Rubus flagellaris, and browsed Fraxinus, Quercus and Prunus.

Future Trends. On the basis of past experience with SR elsewhere on Aton Forest, no retreat of the Patch boundaries is expected, nor any decadence within a Patch. Gradual enlargement is possible, barring unusual drouths. On the other hand, an unanticipated critical event has already occurred, with the hurricane-felling of the tree that partially shaded the area. This event will significantly change the mixture of herb and leaf litter on the ground, as well as the concomitant moisture, light and chemical conditions.

Conclusion. The small oaks and ashes still remaining within this Patch are considered to be Antecedent to the dense SR, not yet rootkilled. They will be closely watched to see if they die thru competition/allelopathy/browsing. If the rise above the Solidago, they will be rootkilled. The blowdown left a snag 7 feet tall. The tree was already weakened by Polyporus sulfureus. The Patch will thus be deprived of future falls of acorns directly upon it. The autumns of 1985, 1986, and 1987 were exceptionally heavy acorn-years, and the moist spring of 1986 an exceptionally successful germination year, yet no new seedlings appeared either in the Patch or in the vicinity from other trees (tho seedlings were abundant on the roadsides where covered by road sand). By the spring of 1987, deer and rodents had eaten most of the acorns. A large oak grows 50 feet to the northeast, and a large ash 50 feet to the north, so that invasions by fruits of both are expected. The Patch is ideally located to test for the stability or instability of an essentially pure colony of this densely growing goldenrod, especially under an invasion of tree fruits that are well supplied with initial food for substantial seedling growth.

III. SPIRAEA LATIFOLIA

Spiraea latifolia (SL), the native Meadowsweet, is one of the most common and aggressive shrubs of the original pre-1926 hayfields of Aton Forest, growing eventually to 2-2.5 m. in height, rhizomatous, with woody pencil-sized rhizomes, ca. 6-8 cm. below the surface, and up to 1 m. or more in length. It does best in full sunlight; becomes rare in open young forests, and is totally absent under the full canopy of Beech, Yellow Birch, Sugar Maple, Hemlock, Black Cherry and White Ash. In de-shrubbed and de-treed old-fields, it becomes increasingly abundant. Most of the increase seems to be due to the slow increase of distant vegetative sprouts, competing with the herbs and animals, tho Spiraea is only very lightly browsed by deer. New SL seedlings in the Herbland have not been identified (another project). They are however, known to occur on bare soil (another project). Eventually (after 30-40 years), and if "concomitant" and "antecedent" woody plants are <u>root</u>killed, Spiraea becomes a dense cluster of whipstem shoots, from which one-species-predominant community most other species have disappeared. To date, no invading (Clementsian) Relay of any tree or taller shrub has been observed. The present project was designed to test the long-term stability, and the expansion (i.e., an <u>in</u>stability at the multi-community level) of one specific Spiraea Patch, as supplemented by observations of many other such stands at Aton Forest.

<u>Location and History</u>. The Spiraea Patch is located on a Midslope of Woodchuck Hill, in 1926 a 7-acre hayfield in Lot C-47 (of the original Proprietor's Map of the Town of Norfolk, 1757). The field was mowed from 1927 thru 1944. From 1946 thru 1965, undesired trees and shrubs were spot-treated with chlorophenoxy herbicides, followed by a very large new incursion of the herbicide-resistant Red Maple. From 1966 thru 1978 various physical methods of removal were unsuccessfully tried. Stub treatments with picloram (liquid and pellets) were effectively begun in 1978, and are continuing. Certain seedling trees and shrubs do newly invade, but not according to the ecological literature. Spiraea latifolia and Vaccinium angustifolium are the two chief shrubby invaders of the Herbland under recent management practices. Observations on many acres since 1946 already indicate

that physiognomically pure stands of Spiraea are remarkably stable, with no internal die-back as yet.

Creation of the Patch. In the southern part of Woodchuck Hill, Spiraea is predominant on about one acre. From this material a spot was subjectively chosen that appeared to be a single circular clone, of tall dense old growth, with no trees and other shrubs, surrounded by less tall and less dense Spiraea. Other spots in the field are similarly tall and dense.

On June 20, 1985, a circular surrounding "trench", 0.6 m. wide, was cut with a pruning shears; and the ca. 500 stubs (mostly Spiraea) treated (2 hrs.) with picloram. (See Phytologia 57(3):177-181, and citations in it.) Results of this treatment are awaited. Personal "misses" will be stub-treated. By September 1987, no movement thru and by the soil-solution has affected nearby plants. Once the bio-effects of Tordon have ceased (sometimes up to 4 years), continuing studies will be initiated on the original clone, and on its extensions outward, if any, into the Herbland.

Composition and Structure. Data taken by JPA and FEE on May 6, 1986, provide the following information:

In gross vertical and horizontal structure of stems and foliage, the Spiraea is distinctive. The stems are clearly clumped, with many stems in small areas 10-30 cm. across, and very few stems in between the clumps. Vertically, the foliage is dense in the upper third. In the middle third, the stems are relatively bare of foliage. The lower third reveals another surge of leafy shoots. These could probably perpetuate the Patch in the event of such as mowing, are probably supported by photosynthates produced in the upper foliage, but doubtfully produce enough photosynthates in that lower shade to justify their present existence.

The Patch is essentially circular, with 4 diameters of 5.9, 6.1, 6.8 and 6.8 m. respectively. It is crossed by two 20-cm.-wide transects, extending N-center-south, and W-center-E, providing four radii or spokes for separate data-gathering. There was an obvious segregation between (a) a central uniform core, and (b) a marginal perimetric belt 0.0 to 1.0 meter wide (as in the Dennstaedtia and Solidago Patches) transitional to the outside Herbland (see section below).

(a) The Central Core was 99%-plus Spiraea (119 stems in the 4 plots) in terms of stem density, biomass, coverage, and other measurable parameters. Accessory species were limited to Steironema ciliatum (48 stems in the 4 plots) and one very depauperate Lycopodium clavatum. There were no other woody plants.

(b) The Perimetric Belt (looked upon as a relatively recent centrifugal clonal expansion) showed a decided admixture of old-field plants. Spiraea maintains its status with 90-99% of the mass. Other plants comprise a total of 1 to 10% (usually closer to 1%). Listed alphabetically: Achillea millefolium, Agropyron repens, Agrostis alba, Anaphalis margaritacea, Anthoxanthum odoratum, Aster sagittifolius, Carex spp. (sterile), Danthonia spicata, Festuca rubra, Polytrichum commune, Potentilla canadensis, Rubus flagellaris (rooted outside the Patch), Rubus hispidus, Solidago graminifolia.

Behavior. Spiraea latifolia is a low-shrub growing densely in clonally spreading patches, or as sparsely scattered stems from old rootstocks. Dense grass covers or Festuca and Agrostis seem to retard the proliferation of Spiraea for at least one or two decades. The solid clumps are apparently topping out at heights of 2 m. or slightly more. The flowering tops rise some 15-30 cm. above the general foliage level, and thus become conspicuous in their season. The entire clone is slightly dome-shaped, with no flowering stalks at the outer margins. The doming may be in part due to the younger age of peripheral stems, and in part to light deer-browsing. Deer do no enter into the center of the clone.

The Adjacent Herbland. The surrounding Midslope Herbland (a separate project) by data from this Patch study, is an admixture of all the herbs mentioned above. Among the graminoids, Agrostis has been the most abundant, but Anthoxanthum and Danthonia are increasing. Carex spp. occur in small amounts. Potentilla and Rubus flagellaris are seasonally flowering aspects. Anaphalis, with its fairy rings forming and breaking thru the years, is conspicuous. Pinus, Juniperus, Amelanchiers arborea and laevis, Vacciniums augustifolium and corymbosum, and Prunus serotina seedlings do occur, but rarely, and need be removed, so far, at 10 or more year intervals.

Future Trends. Altho stands of Spiraea appeared in this field soon after the last mowing in 1944, they must have been mowed for many years previously. They were mixed with 75 kinds of woody plants, which Vegetation Management practices eventually removed. There is no evidence whatsoever at this time of any invading autogenic (Clementsian) Relay of another shrub, or any tree, under the Spiraea of this patch. The Patch, and surrounding areas, will be watched closely for evidence of any trend to another community.

Conclusion. Development of one-species-predominant dense clones of Spiraea latifolia seems to be a natural situation in sunny areas when and where trees and other shrubs do not occur, by coincidence or by human management. There is no vertical layering in the community, except for a few small herbs. After almost 40 years of extensive observation, there is no evidence of any invading Relay of another woody species.

IV. KALMIA LATIFOLIA

Kalmia latifolia, the Mountain Laurel, is the most common single-shrub species in the once-pastured landscape of Aton Forest. It was present in the original pre-1750 forests of Indian times, tho in unknown but undoubtedly variable, quantities. It was probably less abundant in the Midslope forests than just below the hickory-covered "southern" Summits, with their ground cover of Carex pensylvanica. It does not occur under old hemlock stands. (neither does anything else.)

The next 200 years can be referred to as the Cattle Era, with or without sheep. Laurel is unpalatable to cows, and becomes increasingly abundant, eventually crowding out the cattle, who graze out most other trees shrubs and herbs (but not White Pine, Pasture Juniper and Hemlock, hence those common Cover Types of this Zone on the face of New England until recently). In the late 1920s, the laurel pasture was one of the commonest plant-communities, dominating on ca. 50% of the present Aton Forest, both as open pastures and as an understory under non-hemlock forests, being the accumulations of maybe two centuries, for laurel resprouts after cutting by the farmer. In those times Visibility was often not more than 30 feet and trail-cutting thru it was a laborious exercise.

By 1965, a remarkable change was first noticed, a change which is still continuing. Visibility is increasing. Today one can see thru the trees for 300 feet, where before there was an impassable laurel tangle from the ground up. Laurel foliage has largely disappeared at mid-heights from 18" aboveground, up to 7 feet, above which the original dense foliage remains. (In northeastern Maryland we have seen the entire lower foliage of laurel lost, apparently in correlation with the extreme shade of the upper laurel canopy, but that is not the critical factor here.

In the forest, Laurel is a layering species, forming sprawling clones, helped by falling trunks and weighted ice- and snow-covered branches. In the open, Laurel is a single shrub, neither layering nor clonally spreading. Seedlings are known to occur, even abundantly, in the crevices of open new rocky slopes (southeastern Connecticut) or on the abandonment of run-down hayfields. Today the total Laurel stratum at Aton Forest varies from 5% to 20% per 50-acre "Lot". In 1925, it had been 20-40% or much more.

Location and History. The Kalmia latifolia Patch here studied is located in the northwest section of Aton Forest, in the southeast part of Lot C-16-2, in an area which we believe to have been pastured (never ploughed) almost continuously since the early 1800s, and not abandoned until the early 1970s. It is now mostly forested, with a mixture of northern hardwoods, Hemlock and White Pine, of Beech, Yellow Birch, Sugar Maple, Red Maple, White Ash, Black Cherry and Red Oak, with an unusually dense and almost continuous understory of Kalmia.

Creation of the Patch. There are many places that had been considered suitable for a permanent Kalmia Patch, areas of 20 or more meters across, and covered with uniformly dense tall laurel. On the other hand, it now appears that deer-browsing has affected and will be affecting all such areas more extensively in the near future, with remaining tall slender stems themselves then vulnerable to snow-weight and ice-weight damage, so that special consideration is essential.

The present Patch was found and chosen by JPA because it included one unusual single non-layering 11-stem shrub, probably over 100 years old, which for some reason was left uncut when the pasture was last rejuvenated by shrub-cutting. It is 7 m. tall, 7.5 to 9.1 m. in diameter, with essentially no understory foliage, thru which one can walk with ease (contrary to much of the adjacent laurel). The ground is 95% covered with oak leaves, with 5% low herbs, with a few small tree seedlings.

This single shrub is surrounded on 3 sides by other tall high-canopied Laurels, forming a Patch 12.8 x 17 m. in size, with no concomitant trees (which would have been removed in this 1985-creation of the Patch), with very few associated tall shrubs, no low-shrub layer, almost no ground cover, and no (Clementsian) Relay of invading trees, even tho a complete canopy of trees surrounds the Patch. The land has not been pastured since. The Patch is judged to be a one-species-predominant shrub community, that has already resisted tree invasion for an estimated 100 years.

Composition and Structure. On June 25, 1985, JPA and FEE charted and gathered data on this Patch (on file). Every laurel stem was located and measured. All other woody plants were similarly treated. Ground cover was also detailed. The major trees of the adjacent forest were located and diameters taken. Laurel formed essentially a complete canopy. Other tall shrubs formed less than 5% of the coverage of that layer, including only Amelanchier arborea/laevis, Viburnum recognitum, and Vaccinium corymbosum. There was one 5-cm.-dm. dead ash.

There was no low-shrub layer. The 5% ground cover included the following: Arisaema triphyllum, Dennstaedtia punctilobula (barely invading the Patch on the east), Lycopodia annotinum complanatum and obscurum, Mitchella repens, Polytrichum commune, and Trientalis americana. Among shrubs, only a few small

Vaccinium corymbosum were present. Several small Red Maples, Red Oaks, and Black Cherries gave no evidence of growing into trees. A few small Laurel seedlings occurred in a moss patch. About 50% of the Patch was overshadowed by the high branches of surrounding trees.

Adjacent Forest. This forest, extending in all directions, is composed of the customary beech-birch-maple-hemlock-pine, with Red Oak, White Ash, Black, Yellow and Paper Birches. Adjacent to the Kalmia Patch were one oak, 5 Red Maples, and 2 pines. Laurel formed essentially a complete tall-shrub cover above 3 m.; about 50% coverage at 2-3 m. height; 15% coverage at 1-2 m. and below 1 m. less than 5%. Visibility varied to distances of 3-5 m. Dennstaedtia was predominant locally. Other common plants were Vaccinium corymbosum, Vaccinium angustifolium, Hamamelis virginiana, Acer pensylvanicum, and Osmunda claytoniana (not here a moist-soil species).

Conclusions. Kalmia latifolia is a native evergreen, attractively flowering State-protected species that has greatly increased during the last two centuries due to cattle-grazing; and that is now decreasing due to increased deer-browsing. It can be, and in the landscape can produce, tall dense Patches (akin to chaparral, maquis, et al.) which restrict the growth of other plants, hinders advance tree reproduction of importance to timber-harvesting and fuelwood-production, provides no fruits or nuts for wildlife, tho it does provide cover. Academically, it provides a challenging and fascinating opportunity to study the stability of non-diversity, with respect to one essentially pure shrub-cover, which may have started by chance and coincidence and not by paradigmatic edapho-climatic determinism.

The present Patch, established in 1985, is considered to have started a century ago, and will be reported upon periodically in the future. As with current legal easements for preserving open-space recognized by the Internal Revenue Service, these study-Patches are considered to be established "in perpetuity", in the public interest, for study of developmental changes on the site.

SPECIES NOVAE VENEZUELAE GENERIS OURATEA AUBLET (OCHNACEAE)

par Claude SASTRE

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Ouratea guaiquinimensis Sastre sp.nov.

A O. ptaritepuiensis Steyermark, inflorescencia axillare, nervis secundaris et tertiaris subparallelis, alabastra 3mm longa, differt.

Frutex 0,5-2 m alta, ramis glabris. Folia petiolo 3-5 mm longo, lamina coriacea 2-4 x 1,5-3 cm, ovata, basi rotundata vel subcordata, margine integerrima cum dentis sparsis, apice rotundata, nervo principali pagine inferiore proeminenti, nervis secundaris subparallelis adscendentiis, nervis tertiaris horizontalis subparallelis. Inflorescentia axillaris 3-4 cm longa, flores pedunculis 4 mm longis, sepala 5, 3 x 2 mm, petala 5, 4 x 3 mm, stamina 10 subsessilia 3 mm longa, carpello 5, stylo 3 mm longo. Fructus ex 1 (2) carpello oblongo 5 x 2 mm, carpophoro conico vel arcuato 8-10 mm alto.

TIPUS : VENEZUELA, Est. Bolivar, cerro Guaiquinima, cumbre, la extension mas septentrional del cerro en el sector NE : la parte pedregosa, abierta y plana con vegetacion baja 6°N, 63°28'W, E del rio Paragua, alt. 1650 m, leg. Steyermark & Dunsterville 117967, 9 IV 1979 (holo. P, iso. F, VEN), fl. Paratipus : Ibid., cerca de la roca escarpada del lado NE, alt. 1560 m, leg. Steyermark & Dunsterville 113504, 26 I 1977 (P, VEN), fr. Ibid., sector SW, alt. 950 m, leg. Steyermark & al. s.n. 26 V 1978 (F). Ibid., sector NE, alt. 1490-1500 m, leg. Steyermark & al. 117367, 25 V 1978 (F, U, VEN). Cerro Guanacoco, cumbre, porcion NE, 4°46'N, 63°55'W, alt. 1450 m, leg. Steyermark & al. 109719, 3 III 1974 (P, VEN).

Ouratea davidsii Sastre sp. nov.

A O. ptaritepuiensis Steyermark, arbor 10-25 m alta, ramis pilosis, margine foliorum plana, stamina pedunculata, pedunculo 0,5 mm longo, differt.

Arbor 10-25 m alta, ramis pilosis. Folia petiolo canaliculato 2-3 mm longo, lamina 1,5-3,5 x 1,5-3 cm ovata, basi rotundata vel subcordata, margine sub-integerrima undulato-dentata, apice rotundata vel truncata, nervo principali pagine inferiore proeminenti, nervis secundaris anastomosis pagine superiore immersi et pagine inferiore proeminenti. Inflorescentia racemosa terminalis 3-9 cm longa. Flores pedunculis sparsis pilosis 4-5 mm longis, sepala pilosa 5, 5 x 2-3 mm, | exteriore coriacea, 2 interiores marginibus membranaceus, 1 mm lata, 2 intermediores cucullatae, petala 5 membranacea subtriangularia 8 mm alta, 8 mm lata, stamina 10 pedunculata, arcuata 5,5 mm longa, carpello 5, stilo 4-4,5 mm longo. Fructus ignotus.

TIPUS : VENEZUELA, Est. Apure, distr. San Fernando, banks of the rio Arauca, 5 Km ESE of Güirimita 66°46'W, 7°22'N, alt. 35 m; gallery forest, leg. Davidse & Gonzalez 13260, 16-17 V 1977 (holo. P, iso. MO, VEN).
Paratipus : Ibid., 5 Km SW of El Faro, alt. 35 m, leg. Davidse & Gonzalez 13449, 18-19 V 1977 (MO, P, VEN). Est. Bolivar, Caicara, en la orilla del Medio Orinoco, alt. 100 m, leg. Williams 13287, 12 VI 1940 (F).

Ouratea liesnerii Sastre sp. nov.

A O. inundata Spruce ex Engler, ramis, petiolo et pedunculo pilosis, sepala 5-6 mm longa, carpophoro spherico (nec clavato) differt.

Frutex 3-4 m alta, ramis pilosis. Folia petiolo piloso 10-12 mm longo, lamina subcoriacea velutina pagine inferiore, 6-10 x 2-5 cm, ovata vel oblonga, basi obtusis, margine angusto revoluto integerrima, apice acuta, nervo principali pagine inferiore proeminenti, nervis lateralibus horizontalibus, adscendentibus prope marginem paullum prominulis. Panicula terminalis 6-10 cm longa, ramulis pilosis. Flores pedunculis pilosis, 6-8 mm longis, sepala 5 acuminata, 5 mm longa, 2 exteriores coriaceae, 2 mm lata, 2 interiores marginibus membranaceus 1 mm lata, partibus centralibus coriacibus 0,5 mm lata, 1 sepala intermediore, partibus coriaceus 1,5 mm lata, partibus membranaceus 1 mm lata, petala 5 membranacea, subtriangularia, 6-7 mm alta, 5 mm lata, stamina 10 sessilia 5 mm longa, carpello 5, stilo 5 mm longo. Fructus : carpophoro spherico 3 mm diam., carpello 1 spherico 5 mm diam.

TIPUS : VENEZUELA, Terr. Fed. Amazonas, Dep. Rio Negro, rock outcrop and forest around it. Mamurividi. Zona 10 estacion climatologica of Ministerio del Ambiente on rio Pasimoni, alt. 125 m 01°32'N, 66°32'W, leg. Liesner 17174, 3 IV 1984 (holo. p, iso MO, VEN).
Paratipus : Ibid., rio Pasimoni, between its mouth and its junction with the rio Baria and the rio Yatua, alt. 80 m, leg. Davidse 27760, 23-25 VII 1984 (MO, P, VEN).

CHANGES IN AMINO ACID AND SUGAR CONTENT OF BROAD BEAN LEAVES FOLLOWING INFECTION WITH Botrytis fabae

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ABSTRACT

Amino acid and sugar contents of healthy and Botrytis-inoculated bean leaves were determined. Glycine, proline, glutamic acid, DL-valine and histidine were detected in the leaves of the three bean varieties. Cystine and cystiene were detected in the leaves of the varieties "Rebaia 40" and "Giza 1". Aspartic acid, tyrosine and phenylalanine were detected only in the leaf extract of "Rabaia 40" leaves. Regarding the sugar pattern of the three broad bean varieties, sucrose, glucose, and galactose were present in appreciable amounts in the leaves of both "Rebaia 40"and "Giza 3" varieties relative to that present in "Giza 1" variety. Certain qualitative as well as quantitative changes have been detected as a result of plant infection with Botrytis fabae.

Leaf extracts from the three bean varieties and their individual components (except sorbose), stimulated separately the spore germination of the fungus. Leaf extract of "Rebaia 40" variety has the superior stimulatory effect followed by "Giza 3" and then "Giza 1" varieties.

INTRODUCTION

Recently it has been established that the infection of host plants with certain phytopathogenic fungi induced both qualitative and quantitative changes in their nutrient composition (Wallace et al., 1962; McCombs and Winstead, 1964; Tu and Ford,1970, Youssef &Youssef, 1971, Naik & Powell, 1973; Borah et al., (1978).

McCombs and Winstead (1964) reported qualitative as well as quantitative changes in sugars, amino acids and amides induced in cucumber fruit during the first four days of infection by pythium aphanidermatum.

Tu and Ford (1970) reported that the individual amino acids of soybean (Glycine max) were decreased after infection with soybean mosaic virus or bean pod mottle virus.

On the other hand, higher levels of amino acids, amides and soluble sugars were detected in tea leaves after infection with red rust alga Cephaleuros parasiticus Karst, (Borah et al., 1978).

These findings stimulated our interest to identify the amino acids and sugars in the leaves of Vicia faba L. and the parasite Botrytis fabae sardina, aiming to determine whether there were any changes in these components due to infection. Furthermore, the effect of these nutrients on spore germination of the fungus was determined to elucidate the role of them, if any, in disease development.

MATERIAL AND METHODS

Three varieties of broad bean (Vicia faba L.) namely "Rebaia 40" "Giza 3" and "Giza 1" were used in the present study. Seeds of these varieties were kindly supplied by the plant Breeding Department. Ministry of Agriculture,Giza, Egypt. Botrytis fabae culture was obtained by isolation from typically diseased broad bean leaves and plant inoculation experiments were carried out as previously described (Abu Shady et al., (1988).

Extraction and analysis of amino acids and sugars from broad bean leaves:

Amino acids:

The free amino acids were extracted from plant leaves with 80% ethanol (Thompson & Morris, 1959). Samples of 25 gm fresh leaflets from each plant set were comminuted in 100 ml ethanol for three minutes in an electric blender. The slurry was shaken for 4 hours and filtered through sintered glass, and the residue washed with four 25 ml aliquots of 80% ethanol. Extracts were stored at – 20°C until processed for chromatography.

Portions of extract were concentrated under reduced pressure at 35°C and centrifuged at 4500 g for 15 minutes. The supernatant solutions were desalted with Dowex 50 W-X resin, according to the procedure of Thompson & Morris (1959) except that the eluates were dried under pressure at 35°C. The extracted and dried amino acids were recovered and stored at 4°C in 10 % isopropanol so that 1 ml of the solution should be equivalent to 2 gm of fresh plant leaves. two dimensional chromatography on Whatman No. I paper was employed with butanol-acetic acid-water (4:1:5 v/v/v). Ordinarily 40 ul of the sample were applied to the paper.

A standard amino acid mixture, prepared according to the method of Block and Weiss (1966) was used for comparison in each test. The dried chromatograms were sprayed with 0.2% ninhydrin in acetone and then heated to 45°C for 1 hour, after which full colour was allowed to develop in a darkened chamber for 18-20 hours.

Sugars:

Samples of leaves were soaked in boiling 96% ethanol to give (with the moisture in the tissues) a final strength of 80% (10 gm F.W.+ 50 ml 96% ethanol). After boiling for 5 minutes the tissues were blended in the alcohol for 5 minutes and the macerate was then filtered. The residue was transferred to a soxhlet apparatus and extracted until no further colour appeared in the alcohol dropping down. This took nearly 4 hours as no sugars were detected in a further extraction. All the ethanolic extracts were combined and neutralized with N/10 NaOH. The extracts were then reduced to 50 ml under reduced pressure and subjected to paper chromatography. The solvent pyridine-ethylacetate-water in a ratio (20:80:10 v/v/v) was used. The chromatograms were then sprayed with aniline hydrogen phethalate reagent. A known mixture of authentic sugars was spotted for comparison on the chromatograms.

Extraction and analysis of amino acids and sugars of Botrytis fabae mycelium:

Erlenmayer flasks(500 ml) containing 50 ml liquid medium were inoculated with Botrytis spore suspension. The culture medium has the following composition: glucose 40 gm; peptone, 10 gm; potassium nitrate, 0.1 gm; potassium dihydrogen phosphate, 6.8 gm, magnesium sulphate, 2.5 gm; calcium chloride 0.1 gm; and ferric chloride, 20 mg per one litre tap water. Cultures were incubated for two weeks at 21°C and the mycelium was then filtered and washed several times with warm distilled water and then subjected to extraction and analysis.

Effect of broad bean leaf extract on Botrytis spore germination:

Spore suspension of Botrytis fabae (2 X 10^7 spores/ml distilled water) was prepared from 10 day old culture; 0.2 ml of this spore suspension were added to an equal amount of Sietz filtered leaf extract in small test tubes and incubated at 21°C for 24 hours (Buxton, 1962). The germinating spores were counted using a haemocytometer. Amino acids and sugars identified in the leaf extracts of the three broad bean varieties were similarly tested for their effect on Botrytis spore germination. Different concentrations of these components (10, 50, 100 and 500 ppm) were used. The percentage of spore germination in distilled water was used as control.

RESULTS

Amino acids determinations:

Results presented in (Table 1) demonstrate the identity and relative abundance of amino acids in the extracts of 3-week-old bean leaves of the three broad bean varieties ("Rebaia 40" "Giza 3" and "Giza 1"). It indicates that the free amino acids glycine, proline, glutamic acid, DL-valine and histidine were detected in the leaves of "Rebaia 40" "Giza 3" and "Giza 1" Cystine and cystiene were in the leaves of "Rebaia 40" and "Giza 1". Aspartic acid, tyrosine and phenylalanine were detected only in the extracts of "Rebaia 40" leaves. Tryptophan was only detected in the extract of "Giza 3" leaves. Arginine and serine were detected in the extracts of "Giza 3" and "Giza 1" plants while L-leucine was detected in "Rebaia 40" and "Giza 3" extracts.

Analysis of the amino acid content of either inoculated or uninoculated leaf extracts of 6 -week-old bean leaves (Table 2) showed that certain qualitative as well as quantitative changes in the amino acid content have occurred as a result of plant infection.

Results presented in (Table 2) have showed that threonine, ornithine, methionine, phenylalanine and L-leucine were detected only in the extract of Botrytis-inoculated "Rebaia 40" plants (the most susceptible variety). On the other hand glycine, DL-valine and traces of cystiene were only detected in the uninoculated plants of the same variety. Cystine histidine, aspartic acid, glutamic acid, proline and tyrosine were present in the extracts of both inoculated and uninoculated "Rebaia 40" plants.

Table 1. Identity and relative abundance of the amino acids and sugars spotted in extracts from healthy leaves of 3-week-old broad bean varieties.

Amino acids and sugars	Broad Bean varieties "Rebaia 40"	"Giza 3"	"Giza 1"
Amino acids			
Cystine	+	–	+
Cystiene	traces	–	+++
Histidine	+++	+++	traces
Arginine	–	++++	++
Aspartic acid	++++	–	–
Serine	–	++++	++
Glycine	+++	++++	+++
Glutamic acid	++++	++++	++++
Proline	++	++	+
Tryptophane	–	++	–
DL-valine	++	++	++
Phenylalanine	++	–	–
Isoleucine	–	++	++
L-leucine	++	++	–
Tyrosine	+	–	–
Sugars			
Galactose	+	+	–
Fructose	+	+	–
Xylose	–	–	+
Maltose	++	++	++

– absent.
+ present.
++ present in appreciable amount.
+++ present in high amount.
++++ present in very high amount.

Furthermore, the infection of the plant with the fungus Botrytis caused qualitative changes in certain amino acids (i.e glutamic acid, histidine and proline to certain extent).

Concerning the pattern of amino acids in the inoculated and uninocualted "Giza 1" variety, the results presented in (Table 2) indicated that arginine, serine, glycine, tryptophane and isoleucine were detected in the uninocualted plants. On the other hand ornithine, aspartic acid, methionine, phenylalanine, L-leucine and traces of tyrosine were present in the inoculated ones. Furthermore, it is also indicated that cystiene, cystine, histidine, glutamic acid and proline were detected in both inoculated and uninoculated "Giza 1" plants.

Results concerned with the differences in the amino acid pattern of "Giza 3" (the moderately susceptible variety) are also expressed in (Table 2). It is clear from these results that arginine, serine, glycine and tryptophane were spotted in the uninocualted "Giza 3" seedlings. On the other hand aspartic acid, L-leucine and traces of tyrosine and methionine were detected in the inoculated ones. Results also indicated that ornithine, histidine, glutamic acid and proline were present in both inoculated and uninoculated "Giza 3" plants. Quantitative changes were also observed (Table 2).

These results revealed that the amino acid pattern of the three varieties showed both qualitative and quantitative changes. The most striking changes are the presence of appreciable amounts of cystine and cystiene in the uninoculated "Giza 1" plant, compared with traces of these amino acids detected in the uninoculated "Rebaia 40" and their complete absence in the uninoculated "Giza 3" seedlings. Another interesting result was the detection of relatively great amounts of glutamic acid and histidine in the extracts of both "Rebaia 40" and "Giza 3" plants compared with their very small amounts in extract of the uninoculated "Giza 1" plant.

Analysis of the amino acids of the fungus (Table 2) show that Botrytis mycelium contained the amino acids namely: cystine, lysine, arginine, threonine, glutamic acid, DL-alanine, proline, tyrosine, tryptophane, DL-valine, phenylalanine and L-leucine.

Sugar determination:

Galactose, fructose and maltose were detected in the leaves of uninoculated 3-week-old "Rebaia 40" and "Giza 3" broad bean varieties. On the other hand, in the leaves of "Giza 1" variety, only maltose and xylose were detected (Table 1).

Concerning the sugar content of the noninoculated and inoculated 6-week-old seedlings, the results indicated that sucrose, galactose, sorbose, arabinose, fructose and maltose constitute the sugar

Table 2. Identity and relative abundance of amino acids and sugars spotted in extracts from Botrytis mycelium and leaves of 6- week-old healthy or infected bean varieties.

Amino acids and sugars	Broad Bean Varieties "Rebaia 40" (N)	"Rebaia 40" (I)	"Giza 3" (N)	"Giza 3" (I)	"Giza 1" (N)	"Giza 1" (I)	Botrytis mycelium
Amino acids							
Cystine	+	+	–	–	++	+	+
cystiene	tr	–	–	–	+++	++	–
DL-Ornithine	–	++	++	++	–	++	–
Histidine	++++	++	+++	+	tr	+	–
Arginine	+	–	+++	–	+++	–	+
Aspartic acid	+++	++++	–	+++	–	+++	–
Serine	–	–	++++	–	++	–	–
Glycine	+++	–	++++	–	++	–	–
Threonine	–	++	–	–	–	–	++
Glutamic acid	+++	++++	+++	+++	tr	+++	+++
Proline	++	+++	++	+	+	+	+
Tyrosine	++	tr	–	tr	–	tr	+
Tryptophane	–	–	++	–	+	–	+
Methionine	–	+	–	tr	–	++	–
DL-valine	++	–	–	–	–	–	+
Phenylalanine	–	+	–	–	–	+	+
Isoleucine	–	–	–	–	+	–	–
L-leucine	–	+	–	+	–	+	+
Lysine	–	–	–	–	–	–	++
Sugars							
Sucrose	+++	+++	+++	++	++	++	–
Galactose	+++	+++	++	++	++	++	++
Sorbose	+	+	+	+	++	++	+
Arabinose	+++	–	++	–	–	–	–
Fructose	++	–	+	–	–	–	–
Xylose	–	–	++	–	++	++	–
Maltose	++	+	++	+	++	++	–
Glucose	–	++	–	++	–	+	–

– absent
+ present
++ present in appreciable amount
+++ present in high amount
++++ present in very high amount
tr traces

pattern of the noninoculated "Rebaia 40" and "Giza 3" bean leaves (Table 2). The sugars of "Giza 1" variety were the same except that arabinose and fructose are completely absent. Xylose was detected in "Giza 3" and "Giza 1" bean leaves but not in "Rebaia 40" variety.

The sugars of Botrytis-inoculated bean showed more or less the same pattern except that arabinose and fructose were absent after leaf inoculation of the varieties "Rebaia 40" and "Giza 3" Furthermore, results (Table 2) indicated that glucose was detected among the sugars in the inoculated leaves of the three broad bean varieties. Similarly xylose was completely absent from the sugars of Botrytis-inoculated "Giza 3" bean leaves. On the other hand, galactose and sorbose were the only 2 sugars detected in the fungal mycelium (Table 2).

Effect of broad bean leaf extract on Botrytis spore germination:

The leaf extracts of the three bean varieties showed a stimulatory effect on the percentage of Botrytis spore germination. the percentage was 77 for "Rebaia 40" followed by 48 for "Giza 3" then 35 for "Giza 1".

Effect of the individual amino and sugars of broad bean leaf extracts on Botrytis spore germination:

The data presented in (Table 3) show that all the concentrations used (10,50,100 and 250 ppm) of amino acids and sugars (with the exception of sorbose) had a stimulatory effect on fungal spore germination, but to differing extents. Amino acids that have the superior effect were methionine, tyrosine, phenylalanine and glutamic acid in a descending order. Concerning the effect of sugars, glucose was superior followed by galactose, and then xylose and sucrose.

DISCUSSION

Although changes in host constituents have frequently been associated with disease development, interpretations of changes are usually difficult. With fungus diseases, interpretations of chemical changes must take into account additive effects of mycelium present in host tissue. In the present study, certain aspects are quite clear, others can only be speculative. Evidently most of the amino

Table 3. Effect of amino acids and sugars detected in broad bean leaf extracts on Botrytis spore germination.

Conc. of amino acids and sugars (ppm).	Spore germination after 24 hours(%)			
	10	50	100	250
Amino acids				
Cystine	25	25	27	27
Cystiene	27	32	30	32
Histidine	29	32	35	35
Aspartic acid	27	29	32	30
Arginine	30	37	32	32
Serine	25	27	25	27
Tyrosine	35	45	54	45
Tryptophane	27	27	28	27
Phenylalanine	41	48	50	45
Glutamic acid	32	37	40	38
Glycine	25	25	27	27
Proline	30	35	37	37
DL-Ornithine	27	27	30	28
Threonine	25	25	24	29
Methionine	40	62	65	63
DL-Valine	27	30	35	35
Isoleucine	29	32	37	37
L-leucine	26	26	28	28
Sugars				
Sucrose	27	38	40	29
Galactose	27	42	57	55
Glucose	30	45	60	65
Fructose	25	30	32	30
Sorbose	22	19	20	19
Arabinose	25	38	38	40
Xylose	28	40	45	45
Maltose	27	30	32	30

Distilled water 25% (Control)
Data are means of 4 replicates, 10 microscopic field each.

acids are utilized by the pathogen, as only reduced amounts were present in diseased leaves, however, some amino acids (e.g., DL-ornithine, threonine, glutamic acid, proline, methionine and phenylalanine) were detected in larger amounts than those in noninoculated ones. These could arise from several sources. Contributions to the free amino acid pool may come from proteolysis of the host proteins catalyzed by normal host or fungal enzymes. Aminc acids synthesized by the fungus also would be present. Preferential utilization of particular amino acids by the fungus in protein synthesis could account for accumulation of some amino acids in diseased leaves.

Among 18 amino acids detected and identified in the leaf extract of bean seedlings, methionine and tyrosine were superior in stimulating spore germination of the fungus. The rest of the amino acids were stimulatory or have no detrimental effect. This finding was in agreement with those of Deverall and Wood (1961b), McCombs and Winstead (1964) and Deverall (1967).

Similarly, sugars are rapidly utilized by the pathogen. However, the results in the present work did not sharply indicate this criterion since no marked differences in sugar content of inoculated and noninoculated plants were detected.

Of much interest is the absence of glucose from the sugars extracted and identified from the leaf extracts of 3-week-old bean varieties. On the other hand, glucose was detected in the leaf extract of 6-week-old bean varieties. Furthermore, glucose accomplished the most stimulatory effect on spore germination of the pathogen. These findings could explain why old leaves were more susceptible to fungal infection. That sugar was similarly reported to stimulate spore germination of fungi by Kosuge & Hewitt (1964) and Barash et al., (1964).

Conversely, we found that sorbose exerts an inhibitory effect on spore germination of Botrytis fabae to that previously reported by Deverall (1961a).

The stimulation of spore germination of the pathogen by the whole leaf extract of 6-week-old bean varieties recorded here was identical to our field observation which showed that "Rebaia 40" was the most susceptible variety followed by "Giza 3" and the least susceptible variety was "Giza 1".

REFERENCES

Abu Shady, M.R., El Beih, F.M., Youssef, Kh. A. and Abdel Kader. A.I. 1988. Lipids in healthy and Botrytis infected broad bean leaves and their role in disease development. Phytologia (to be published).

Barash, I. Klisiewicz, J.M., and Kosuge T. 1964. Biochemical factors affecting pathogenicity of Botrytis cinerea on safflower. Phytopath. 54: 923.

Block, R.J. and Weiss, K.W. 1966. Amino acid handbook. Charles Thomas, springfield.

Borah, R.C., Bojaj, K.L. and Bhatia I.S. 1978. Biochemical changes in tea leaves after infection with red rust (Cephaleuros parasiticus). Phytopath. Z. 93: 208.

Buxton, E.W. 1962 Root exudates from banana and their relationship to strains of the Fusarium causing banana wilt. Ann. Appl. Biol. 50: 269.

Deverall, B.J., 1967. Biochemical changes in infection droplets containing spores of Botrytis spp. incubated in the seed cavities of pods of bean (Vicia faba L.). Ann. Appl. Biol. 59:375.

Deverall, B.J. and Wood, R.K.S. 1961a. Infection of bean plants (Vicia faba L.) with Botrytis cinerea and B. fabae. Ann. Appl. Biol. 49: 461.

Deverall, B.J. and Wood, R.K.S. 1961b. Chocolate spot of beans (Vicia faba L.) interactions between phenolase of host and pectic enzymes of the pathogen. Ann. Appl. Biol. 49: 473.

Kosuge, T. and Hewitt, W.B. 1964. Exudates of grape berries and their effect on germination of conidia of Botrytis cinerea. Phytopath. 54:167.

McCombs C.L. and Winstead, N.N. 1964. Changes in sugars and amino acids of Cucumber fruits infected with Pythium aphanidermatum. Phytopath. 54:233.

Naik, R.a and Powell, D.1973. Changes in protein and isozyme content of apple fruit following infection by Monochaetia mali. Phytopath. 63:851.

Thompson, J.F., C.J., Morris 1959. Determination of amino acids from plants by paper chromatography. Anal. Chem. 31: 1031-1037.

Tu, J.C. and Ford, K.E. 1970. Free amino acids in soybeans infected with soybean mosaic virus, bean pod mottle virus, or both. Phytopath. 60:660.

Wallace, J., Kuc, J. and Draudt, H.N. 1962. Biochemical changes in the water insoluble material of maturing apple fruit and their possible relationship to disease resistance. Phytopath. 52:1023.

Youssef, Y.A. and Youssef, Kh. A. 1971. Studies on *Fusarium* wilt of cotton. V-Differences in contents of free amino acids and sugars of seedlings of susceptible and resistant cotton varieties raised in *Fusarium* inoculated or uninoculated U.A.R.J. Phytopath. 3:33.

LIPIDS IN HEALTHY AND BOTRYTIS - INFECTED BROAD BEAN LEAVES AND THEIR ROLE IN DISEASE DEVELOPMENT

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ABSTRACT

The lipids of three varieties of broad bean (*Vicia faba* L.) and the mycelium of the fungus *Botrytis fabae* sardina the cause of chocolate spot disease of beans were determined. The lipid pattern of 3-week-old leaves of the three bean varieties and the fungal mycelium were composed of phospholipids, free sterols, triglycerides, methyl esters of fatty acids and squalenes. Steryl esters of fatty acids were detected only in 6-week-old leaves of "Rebaia 40" and "Giza 3" bean varieties but not in "Giza 1" bean variety. The total lipids of the fungal mycelium were similarly devoid of the steryl esters of fatty acids. Phospholipid fatty acids 6-week-old healthy leaves of the three bean varieties are constituted of mono, di, and tri-unsaturated fatty acids. Poly-unsaturated fatty acids were not detected. Inoculation of bean seedlings with *Botrytis fabae* resulted in a marked decrease in most lipid groups. The role of steryl esters and lipids in general in the process of pathogenesis and disease resistance was discussed.

INTRODUCTION

It has been recently reported that lipids play a role in the process of pathogenesis and disease resistance (Hendrix 1970; Gottlieb, 1971, Hoppe and Heitefuss, 1974b & c, 1975 and Mondy & Koch, 1978).

Hoppe and Heitefuss (1975) determined the phospholipids and phospholipid fatty acids in healthy and rust-infected leaves of resistant and susceptiple bean varieties to *Uromyces phaseoli*. They found that infection of bean leaves resulted in the increase of phosphatidyl serine and a decrease in phosphatidyl glycerol content. At the same time, the phosphatidyl ethanolamine and phosphatidyl choline detected in the infected leaves contained higher amounts of unsaturated fatty acids than those from healthy leaves. Similarly, changes in other membrane lipids of *Phaseolus vulgaris* infected with *Uromyces phaseoli* were observed (Hoppe and Heitefuss, 1974 b & c).

On the other hand, lipids were recently reported to exert potent biological effects on fungi. They stimulate growth and many of the physiological activities of fungi and share in the structure and function of biological membranes (Hendrix, 1964, 1965; Wardle and Schisler, 1969; Lloyd et al., 1971 and Abu Shady, 1971 & 1979).

Therefore, it was of interest to determine the lipid pattern in healthy and Botrytis - infected broad bean leaves as well as in the mycelium of the fungus itself, aiming to throw some light on the role played by lipids in the process of pathogenesis.

MATERIAL AND METHODS

Three varieties of broad bean (Vicia faba L.) namely "Rebaia 40" (R_{40}) "Giza 3" (G_3) and "Giza 1" (G_1) were used in the present study. Seeds of these varieties were kindly provided by the Plant Breeding Department, Ministry of Agriculture, Giza, A.R. Egypt. Botrytis fabae sardina was isolated from broad bean leaves that showed typical symptoms of chocolate spot disease. Single spore culture of the fungus was prepared, and stored at 5°C for artificial infection of bean plant.

Artificial infection of four-week-old healthy broad bean seedlings was done by inoculation with Botrytis spore suspension. Spore suspension ($2X10^7$ spores/ml distilled water) was prepared from representative slants and sprayed by an atomizer. Seedlings of the three bean varieties were first sprayed with sterile water before the application of the fungal spore suspension. They were then kept under humid conditions in the green house. Characteristic chocolate spots were developed 10 days after inoculation. For each particular broad bean variety extraction and analysis of lipids were done from healthy leaves of 3-week-old seedlings as well as from infected and healthy leaves of 6-week-old seedling.

Extraction and analysis of lipids from bean leaves:

Total lipids of leaves were extracted by chloroform-methanol (2:1 v/v) and purified by washing with 0.7% saline solution (Folch et al.,1957). The lipids were analyzed by thin layer chromatography on silica gel G (E. Merck, Darmstadt, W. Germany). The plates were activated for 2-3 hours at 110°C prior to use. Total lipids were fractionated using the solvent hexane-diethyl ether-acetic acid (90:10:1 v/v/v) (Mangold & Malins, 1960). For the fractionation of polar lipids the solvent system chloroform-methanol-water(65:25:4 v/v/v) was used (Wagner et al., 1961). To analyze the phospholipid fatty acids a direct methanolysis on the plate was carried out (Kaufmann et al., 1966). Two dimensional chromatograms were used to separate the phospholipid fatty acids from the total lipids. All processes of lipid extraction and analysis were carried out under carbon dioxide atmosphere. The lipid fractions were detected by spraying the plates with 5% phosphomolybdic acid in 95% ethanol and heating at 110°C, or by charring after spraying the plates with 50% aqueous sulphuric acid. The fractions were identified by comparing their migration rates to those of standard samples and by the reactions with specific spray reagents (Dittmer & Lester, 1964).

Extraction and analysis of lipids from *Botrytis fabae* mycelium:

For lipid extraction and analysis, stationary cultures of the fungus were grown in 500 ml Erlenmayer flasks containing 50 ml liquid medium with the following constitution per one litre tap water: glucose, 40 gm; peptone, 10 gm; potassium nitrate, 0.1 gm; potassium dihydrogen phosphate, 6.8 gm; magnesium sulphate, 2.5 gm; calcium chloride, 0.1 gm; and ferric chloride, 20 mg. The medium was sterilized by autoclaving and inoculated with fungal spore suspension, then incubated at 21°C for two weeks. Flasks were then filtered and the mycelium was washed 3 times with distilled water, then dried under vacuum in CO_2 atmosphere and then subjected to lipid extraction and analysed as previously described.

Effect of individual lipid components of broad bean leaf extract on *Botrytis* spore germination:

Spores of *Botrytis* were allowed to germinate in different concentrations of lipids identified in the leaf extracts of the three broad bean varieties. The concentrations were 10, 50, 100 and 250 ppm. Freshly egg phospholipids were prepared according to (Folch et al., 1957) and directly emulsified in distilled water to make stock solution from which the proper concentrations were prepared.

Other lipids were first emulsified in tween 80 and then dissolved in distilled water. Controls prepared were distilled water and distilled water containing tween 80. The percentage of spore germination in each treatment and controls was measured after 24 hours.

RESULTS

Lipid determinations:
a. Total lipids:

The total lipids of 3-week-old seedlings of the three broad bean varieties showed more or less the same pattern, with the exception of the presence of trace amount of methyl esters of fatty acids detected in the extract of "Giza 1" variety as compared with appreciable amounts of this lipid fraction detected in the extracts of "Rebaia 40" and "Giza 3" varieties (Table 1). The lipid pattern of the bean varieties was composed of phospholipids, free sterols, free fatty acids, triglycerides, methyl esters of fatty acids and squalenes.

A common observation is the absence of steryl esters of fatty acids from the lipid extract of the 3-week-old samples of the 3 broad bean varieties. The most striking result (Table 2) is the detection of steryl esters in the lipid extract from six-week-old "Rebaia 40" and "Giza 3" varieties.

Table 1. Identity and relative abundance of total lipids in extracts from 3-week-old "Rebaia 40", "Giza 3" and "Giza 1" broad bean varieties.

	Broad Bean Varieties		
Lipids	"Rebaia 40"	"Giza 3"	"GIza 1"
Phospholipids	++	++	++
Free sterols	++	++	++
Free fatty acids	+++	+++	+++
Triglycerides	+	+	+
Methyl esters of fatty acids	++	++	traces
Squalenes	++	++	++

The lipid extract of the 6-week-old leaves of "Giza 1" variety showed the absence of this fraction and the presence of traces of methyl esters of fatty acids. On the other hand, the results presented in (Table 2) indicate that the total lipid extracts of the noninoculated and inoculated bean leaves of the

Table 2. Identity and relative abundance of the total lipids in extracts from either inoculated or noninoculated leaves of 6-week-old bean varieties and those of Botrytis fabae mycelium.

Lipdis	Broad Bean Varieties "Rebaia 40" (N)	(I)	"Giza 3" (N)	(I)	"Giza 1" (N)	(I)	Botrytis mycelium
Phospholipids	++	++	++	++	++	++	+++
Free sterols	++	+	++	+	++	++	++
Free fatty acids	+++	+	+++	+	+++	+	+++
Triglycerides	+	+	+	+	+	+	+
Methyl esters of fatty acids	++	++	++	++	t	t	++
Steryl esters	+++	t	+++	t	-	-	-
Squalenes	++	++	++	++	++	++	+++

- absent ++ Present in appreciable amount
+ present +++ Present in high amount
t traces

three varieties (6-week-old) showed more or less the same lipid pattern detected in the extracts of leaves from 3-week-old plants. The total lipid content of the leaves is composed of phosholipids, free sterols, free fatty acids, triglycerides, methyl esters of fatty acids and squalenes.

Furthermore a marked quantitative change in the lipid patterns of non-inoculated and inoculated bean leaves has been observed. A general observation is the decrease of most lipid groups in the extracts of Botrytis-inoculated seedlings. In this respect, steryl esters were detected in appreciable amounts in the healthy "Rebaia 40" and "Giza 3" bean leaves in contrast to only traces detected in the inoculated seedlings. (Table 2).

Analysis of the total lipid extract of Botrytis fabae mycelium shows that lipid content of the mycelium is composed of phospholipids, free sterols, free fatty acids, triglycerides, methyl esters of fatty acids and squalenes. A striking result is the complete absence of steryl esters from the lipid extract of the fungus.

b. Phospholipid fatty acids:

Analysis of the lipid extracts of the three bean varieties (3-week-old) (Table 3) showed that the phospholipid fatty acids are composed of saturated, mono-, and di-unsaturated fatty acids. Furthermore, traces of tri-unsaturated fatty acids (trienoic) were detected in the lipid extracts of "Rebaia 40" (R_{40}) and "Giza 3" (G_3) bean leaves. Polyunsaturated fatty acids were absent from the lipid extracts of the three broad bean varieties.

The phospholipid fatty acids of 6-week-old healthy bean leaves are composed of saturated, mono-,di-,and tri-unsaturated fatty acids. Polyunsaturated fatty acids were absent. Furthermore, it is evident (Table 4) that phospholipid fatty acids disappeared from the lipid extracts of the inoculated "Rebaia 40" and "Giza 3" bean leaves. Conversely neither qualitative nor quantitative changes were detected in the phospholipid fatty acids of inoculated and non-inocualted "Giza 1" bean leaves.

Table 3. Identity and relative abundance of phospholipid fatty acids in extracts from 3-week-old leaves of the three broad bean varieties.

Phospholipid fatty acids	Broad Bean Varieties "R 40"	"G 3"	"G 1"
Saturated	++	++	++
Monoenoic	+++	+++	++
Dienoic	+	+	+
Trienoic	traces	traces	−

Table 4. Identity and relative abundance of phospholipid fatty acids in extracts from either inoculated or non-inoculated leaves of 6-week-old bean varieties and those of *Botrytis fabae* mycelium.

Phospholipid fatty acids	Broad Bean Varieties "Rebaia 40" (N)	(I)	"Giza 3" (N)	(I)	"Giza 1" (N)	(I)	Botrytis mycelium
Saturated	+++	−	+++	−	+++	+++	++
Monoenoic	+++	−	+++	−	+++	+++	traces
Dienoic	++	−	++	−	++	++	−
Trienoic	+	−	+	−	+	+	−

− Absent ++ Present in appreciable amount
+ Present +++ Present in high amount

The phospholipid fatty acids of *Botrytis* mycelium contained only saturated fatty acids and traces of mono-unsaturated fatty acids (monoenoic) (Table 4).

Effects of lipid detected in broad bean leaf extracts on Botrytis spore germination:

The results presented in (Table 5) indicate that all the classes of lipids at all the tested concentrations stimulated spore germination of the fungus. However, steryl esters of fatty acids were superior in their stimulatory effect.

Table 5. Effect of lipids detected in broad bean leaf extracts on Botrytis spore germination.

Conc. of lipids (ppm)	Spore germination after 24 hr%			
	10	50	100	250
Lipids:				
Phospholipids	35	48	48	35
Free sterols	30	50	50	37
Free fatty acids	27	32	38	32
Triglycerides	30	35	35	35
Methyl esters of fatty acids	30	38	39	29
Steryl esters	28	55	68	45
Squalenes	31	35	38	30

Distilled water 25% (Control 1).
Tween 80 18% (Control II).
Data are means of 4 replicates, 10 microscopic field each.

DISCUSSION

Infection of broad bean leaves with Botrytis fabae resulted in several distinguishable alterations in the physiology of the host. The observed changes in lipids conform to the results reported for different host pathogen interactions.

The most interesting finding in the present work was the complete absence of steryl esters of fatty acids from the lipid extracts of all three broad bean varieties at the plant age of 3 weeks and from the fungal mycelium. On the other hand, steryl esters were detected in the leaf extracts of 6-week-old bean varieties, of "Rebaia 40" and "Giza 3" but not in "Giza 1" variety. Furthermore, the results indicate that the degree of susceptibility of the three broad bean varieties may be correlated in part to the presence of steryl esters in the leaf extracts of bean seedlings. In this respect it could be suggested that steryl esters of fatty acids may play a role in the infection and development of the chocolate spot disease by Botrytis fabae. Also, it is worthy of mention caused here that the detection of steryl esters in the leaf extract of bean leaves may be correlated to their age. This suggestion explains why the older leaves were more susceptible than the younger ones and why the "Giza 1" variety was the least susceptible variety toward infection with Botrytis fabae.

Furthermore, steryl esters were superior in stimulating spore germination of Botrytis fabae. This finding supports the above suggestion that Steryl esters may play a role in the infection development of chocolate spot disease. The absence of steryl esters from the lipid extract of the fungus Botrytis fabae and the presence of traces of this lipid fraction in the lipid extract of infected broad bean leaves of "Rebaia 40" and "Giza 3" varieties compared with large amounts of steryl esters detected in non-infected ones is a result which indicates that steryl esters were completely utilized by the fungus. This finding confirms that steryl esters may play a role in disease development.

Concerning the effect of other lipid groups on spore germination of the fungus detected in leaf extracts, phospholipids and free sterols, free fatty acids and triglycerides, squalenes and methyl esters of fatty acids could be arranged in a descending order with respect to their stimulatory effect. In this respect, it was reported that lipids stimulate the spore germination of fungi and have a role in the sporulation and physiological aging of some micro-organisms (Hendrix, 1964 & 1965; Haskins et al., 1964; Leal et al., 1964; Chee & Turner 1965; Lloyd et al., 1971). Growth of fungi was also stimulated by lipids (Wardle and Schisler, 1969 and Smith 1970).

On the other hand, the decrease of lipids detected in the two infected varieties of Vicia faba seedlings namely, "Rebaia 40" and "Giza 3", could be attributed to the enhanced degradation of plant cell membranes. An increased membrane degradation in the infected tissue might be of great importance for cell permeability which undoubtedly plays a part in the nutrient supply available to the invading pathogen (Hoppe and Heitefuss, 1974a). In this respect, it is known that membrane lipids can determine the barrier properties of a membrane (Van Deenen 1969). Accordingly, the absence of steryl esters from leaves of the variety "Giza 1" could explain its resistance.

REFERENCES

Abu Shady, M.R. 1971. Effect of some lipids on physiological and biochemical activities of certain microorganisms Ph.D. Thesis, Faculty of Science, Ain Shams University Cairo-Egypt.

Abu Shady, M.R. 1979. Citric acid production in relation to lipids internally synthesized and externally added by a locally isolated strain of Aspergillus niger. J. Fac. Sci. Riyadh Univ. 10:15.

Chee, K. H and Turner, N.A. 1965. A steroid factor in pea (Pisum sativum L.) influencing growth and sporulation of phytophthora cinnamomi Rands N.Z.J. Agric. Res. 8: 104.

Dittmer, J.C. and Lester R.L. 1964. A simple specific spray for the detection of phospholipids on thin layer chromatogram. J. Lipid Res. 5: 126.

Folch, J., Lees, M. and Sloane-Stanely, G.H. 1957. A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem. 226: 497.

Gottlieb, D. 1971. Function of sterols in fungi. In morphological and biochemical events in plant parasite interaction Ed. by S. Akai & S. Ouchi. The phytopathological Society of Japan Tokyo. 153-179.

Haskins, R.H., Tulloch, A.P. and Micetich,R.G. 1964. Steroid and the stimulation of sexual reproduction of species of Pythium. Can. J. Microbiol. 10: 187.

Hendrix, J.A. 1964. Sterol induction of reproduction and stimulation of growth of pythium and Phytophthora. Science, N.Y.144: 1028.

Hendrix, J.A. 1965. Influence of sterols on growth and reproduction of Pythium and phytophthora spp. Phytopathology. 55:790.

Hendrix, J.A. 1970. Sterols in growth and reproduction of fungi. Annual Review of Phytopathology. 8: 11.

Hoppe, H.H and Heitefuss, R. 1974a. Permeability and membrane lipid metabolism of Phaseolus vulgaris infected with Uromyces phaseoli 1- Changes in the efflux of cell constituents. Physiological plant pathology. 4:5.

Hoppe, H.H. and Heitefuss, R. 1974b. Permeability and membrane lipid metabolism of Phaseolus vulgaris infected with Uromyces Phaseoli II- Changes in lipid concentrations and ^{32}P-incorporation into phospholipids. Physiological plant pathology, 4:11.

Hoppe, H.H and heitefuss, R. 1974c. Permeability and membrane lipid metabolism of Phaseolus vulgaris infected with Uromyces phaseoli. III-changes in relative concentration of lipid bound fatty acids and phospholipase activity. Physiological plant pathology. 4: 25.

Hoppe, H.H. and Heitefuss, R. 1975. Permeability and membrane lipid metabolism of Phaseolus vulgaris infected with Uromyces phaseoli. IV. Phospholipids and Phospholipids fatty acids in healthy and rustinfected bean leaves resistant and susceptible to Uromyces phaseoli. Physiological plant Pathology. 5: 263.

Kaufmann, H.P., Radwan, S.S. and Abd El kader S.A. 1966. Pro and anti-oxidants in the field of fats. XX-Lipid of yeast cells in different stages of growth. Fette Seifen Anstrichm. 68(12) 1010.

Leal, J.A., Friend, J. and Holliday P. 1964. A factor controlling sexual reproduction in Phytophthora. Nature. 203: 545.

Lloyd, G.L. Morris, E.O. and Smith J.E. 1971. A study of the esterases and their function in Candida lipolytica Aspergillus niger and a yeast-like fungus. J. Gen. Microbiol. 63:141.

Mangold, H.K. and Malins, D.C. 1960. Fractionation of fats oils and waxes on thin-layers of silicic acid. J. Amer. Oil Chem. Soc. 37:383.

Mondy, N.I.a and koch R.L., 1978. Effect of potato virus X on enzymatic darkening and lipid content of potatoes. J. Food Science. 43:703

Smith, R.F 1970. Fatty acid requirements of human cutaneous lipophilic Corynebacteria. J. Gen Microbiol. 60: 259.

Van Deenen, L.L.M. 1969. Membrane lipids and lipophilic proteins In the molecular basis of membrane function. Ed. by D.c. Testeson prentice-Hall. Inc. Englewood Cliffs, New Jersey. 47-78.

Wagner, H., Horgammer, L. and Wolff, P. 1961. Thin layer chromatography of phosphatides and glycolipids. Biochem. Zeit. 334,175.

Wardle, K.S. and Schisler, L.C. 1969. The effect of various lipids on growth of mycelium of Agaricus bisporus. Mycologia. 61(2), 305.

CHROMOSOME COUNTS OF ANGIOSPERMS FROM NEW MEXICO AND ADJACENT AREAS

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The following 124 chromosome number determinations are from flowering plants of New Mexico, southeastern Arizona and adjacent areas. These determinations are part of a continuing project to expand the cytogeographic knowledge of the region from the southern Rocky Mountains to the northern Sierra Madre Occidental. All counts in this listing are derived from chromosome configurations seen in pollen mother cells during various stages of meiosis. A count believed to be the first for a taxon is designated by (**) and a new ploidal-level report by (++) before the relevant epithet. After review of the standard indices and western floras, we find that counts listed for 2 genera, 20 species and 6 varieties are first reports. Codes for collectors are S = Richard Spellenberg and W = Darrell Ward. Cytological material was stained in Snow's hydrochloric-acid-carmine stain (Snow, 1963). Voucher specimens are deposited at NMC, and duplicates of many are at NY and RSA.

APIACEAE: *Cicuta maculata* L. var. (**)*angustifolia* Hook. n=11. NM, Lincoln Co., White Mts., 5.5 km WNW of Alto, *W 81-436*.

APOCYNACEAE: *Apocynum androsaemifolium* L. var. *androsaemifolium*. n=11. NM, Otero Co., Sacramento Mts., La Luz Canyon, 5 km N of Cloudcroft, *W & S 87-006*.

ASTERACEAE: *Artemisia* (**)*neomexicana* Greene ex Rydb. n=9. NM, Grant Co., 9 km SW of Emory Pass, *W 80-017*. This count was first published in Ward, 1983 as *A. ludoviciana* var. *mexicana*. The proper identification was provided by Elisabeth Bol of the University of Oklahoma.

Aster hesperius Gray var. (**)*wootonii* Greene. n=32. NM, Otero Co., USFS Road-63, 1.5 km S of High Rolls, *W 84-032*.

Baccharis brachyphylla Gray. n=9. NM, Hidalgo Co., Peloncillo Mts., US Hwy-80, 17 km S of Road Forks and IH-10, *W 81-561*.

Baccharis (**)*thesioides* H.B.K. n=9 + 3-4 supernumeraries. AZ, Cochise Co., Chiricahua Mts., Herb

Martyr CG, 10 air km WSW of Portal, W 86-049.

Bahia woodhousei Gray. n=12. NM, Cibola Co., 50 km NNW of Pietown, 17 km N of Catron Co. line, W 81-521.

Brickellia betonicaefolia Gray. n=9. AZ, Cochise Co., Chiricahua Mts., CG at S Fork of Cave Cr. Canyon, W 86-008a; Turkey Cr., 11 km W of Portal, W 86-040.

Chrysopsis villosa (Pursh) Nutt. n=9. NM, Cibola Co., Grant Malpais, NM Hwy-117, W & S 81-514.

Chrysothamnus greenei (Gray) Greene var. linifolius (Rydb.) H.& C. n=9. NM, Cibola Co., NM Hwy-117, 13 km SSE of Grants, W 81-503.

Chrysothamnus nauseosus (Pall.) Britt. subsp. bigelovii (Gray) Hall. n=9. NM, McKinley Co., US Hwy-666, 51 km N of Gallup, W 81-490.

Cirsium (**)pallidum W.& S. n=17. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-427.

Cirsium parryi (Gray) Petrak. n=17. NM, Sacramento Mts., La Luz Canyon, USFS Road-162, W & S 87-013.

Cirsium undulatum (Nutt.) Spreng. n=13. NM, Lincoln Co., White Mts., USFS Road-117, 2 km W of Alto, W 81-469.

Conyza canadensis (L.) Cronq. n=9. NM, Lincoln Co., White Mts., 6 km WNW of Alto, Eagle Cr., W 81-524.

Cosmos parviflorus (Jacq.) H.B.K. n=12. AZ, Cochise Co., Chiricahua Mts., Turkey Cr., 11 air km W of Portal, W 86-037; NM, Lincoln Co., White Mts., N fork of Eagle Cr., 6 km WNW of Alto, W 81-528.

Erigeron divergens T.& G. 2n=27 (triploid). NM, Hidalgo Co., NM Hwy-338 highway, 1.5 km S of IH-10, W 86-068; NM, McKinley Co., NM Hwy-400, 3 km S of Ft. Wingate village, W & S 81-499; Otero Co., Sacramento Mts., US Hwy-82, 1.5 km W of High Rolls, W 81-532.

Erigeron (**)lepidopodus (Rob. & Fern.) Nesom. n=9. MEX, Chihuahua, 32 km W of Tomochic on road to Basaseachic, S 8414.

Erigeron platyphyllus Greene. n=9. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-419.

Eupatorium pycnocephalum Less. n=10. AZ, Cochise Co., Chiricahua Mts., S Fork of Cave Cr., W 86-013.

Gaillardia pinnatifida Torrey. n=17. NM, Otero Co., Sacramento Mts., 6 km S of High Rolls, USFS Road-90, W 81-543.

Helianthella quinquenervis (Hook.) Gray. n=15. NM, Otero Co., Sacramento Mts., 5 km N of Cloudcroft, W & S 87-007.

Hymenopappus flavescens Gray var. (**)cano-tomentosus Gray. n=17. NM, Cibola Co., Grant Malpais, NM Hwy-117, W & S 81-516.

Hymenopappus newberryi (Gray) Johnston. n=17. NM, Otero Co., Sacramento Mts., USFS Road-90, 10 km S of High Rolls, W & S 87-002.

Lactuca ludoviciana (Nutt.) DC. n=17. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-445.

Lactuca pulchella (Pursh) DC. n=9. NM, Lincoln Co., SE Ruidoso, Paradise Canyon Rd., W 81-458.

Leucelene ericoides (Torrey) Greene. n=16. NM, Eddy Co., US Hwy-82, 3 km E of Otero Co. line, W 84-003.

Machaeranthera asteroides (Torrey) Greene var. asteroides. n=4. Otero Co., Sacramento Mts., USFS Road-90, 10 km S of High Rolls, W & S 87-003. This collection and S 6323, reported in Ward and Spellenberg (1984), are identifiable as M. tephrodes (Gray) Greene. This has been relegated to synonymy under M. asteroides by B.L. Turner according to recent annotations of specimens.

Machaeranthera parviflora Gray. n=4. NM, Otero Co., US Hwy-70/82, saline lake, 24 km WSW of Alamogordo, W & S 87-020.

Machaeranthera riparia (Knuth) A. Jones. n=5. NM, Hidalgo Co., NM Hwy-338, 4.5 km S of IH-10, W 86-068; SE corner of the intersection of NM Hwy-338 and IH-10, W 86-072. One large bivalent and four smaller ones were observed as reported by Turner et al. (1975). During Anaphase I, the large bivalent was extremely late in separating. W 86-068 was of the annual form usually associated with the species. W 86-072 was a very large, sprawling, highly-branched plant.

Machaeranthera tagetina Greene. n=4. NM, Otero Co., US Hwy-70/82, saline lake, 24 km WSW of Alamogordo, W & S 87-021.

Machaeranthera tenuis (Wats.) Turner & Horne. n=9. TX, Jeff Davis Co., Davis Mts., Madera Canyon, W 81-306.

Pectis filipes Gray. n=12. AZ, Cochise Co., Peloncillo Mts., S Fork of Skeleton Canyon, 1.5 km W of NM-state boundary, W 81-570a.

Perityle staurophylla (Barneby) Shinners. n=17. NM, Otero Co., Sacramento Mts., USFS Road-90, 5.5 km S of High Rolls, W 81-540a.

Porophyllum ruderale (Jacq.) Cass. subsp. macrocephalum (DC.) R.R. Johnson. n=11. AZ, Cochise Co., Peloncillo Mts., Skeleton Canyon, 2 km W of NM-state boundary. W 81-563.

Senecio eremophilus Richards var. macdougalii (Heller) Cronq. n=20. AZ, Cochise Co., Chiricahua Mts., 5 air km W of Portal, W 86-027a; NM, Lincoln Co., White Mts., 5.5 km WNW of Alto, W 81-429.

Solidago canadensis L. var. scabra T.& G. n=27. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-440; TX, Culberson Co., Guadalupe Mts. National Park, McKittrick Canyon, W 84-029.

Solidago missouriensis Nutt. var. fasciculata Holz. n=9. NM, Catron Co., Gila Nat. Forest, USFS Rd-

141/NM Hwy-59, 13 km WNW of Beaverhead, Todsen 82-038.

Solidago parryi (Gray) Greene. n=9. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-425.

Solidago rigida L. var. humilis Porter. n=9. NM, Lincoln Co., US Hwy-70 roadside, 7 km SW of Ruidoso, W 81-454; Otero Co., Sacramento Mts., US Hwy-82, 8 km E of Cloudcroft, W 84-021. W 84-021 was typical of S rigida. Collection W 81-454 has the pubescense, diploidy, and ovate upper leaves of S. rigida var. humilis. It also has 3 parallel, brown veins on most of the phyllaries, with 5 being present on the remainder. The inflorescence, however, resembles the sympatric S. wrightii Gray var. wrightii in being cymose with long pedicels instead of having the tight cyme of typical S. rigida.

Solidago velutina DC. var. nevadensis (Gray) C.& J. Taylor. n=9. NM, Otero Co., US Hwy-24, 12 km E of Cloudcroft, W 81-461.

Solidago wrightii Gray var. adenophora Blake. n=9. NM, Hidalgo Co., Peloncillo Mts., Skeleton Canyon, S 6313.

Thelesperma simplicifolium Gray. n=9. NM, Otero Co., Tularosa Canyon, 19 km S of Mescalero, W 81-459. Previous reports of n= 10, 11, 20 and 22 have been reported for this taxon from stations further east (Strother, 1983).

Viguiera longifolia (Robins.) Blake. n=8. AZ, Cochise Co., Chiricahua Mts., S Fork of Cave Cr., W 86-011a.

Viguiera stenoloba Blake var. chihuahuanensis Butterwick. n=34. NM, Otero Co., Sacramento Mts., 6 km S of High Rolls, W 81-542.

Zinnia acerosa (DC.) Gray. n=10. NM, Hidalgo Co., Playas Valley, 3 km S of NM Hwy-9, W 86-067.

BORAGINACEAE: Hackelia floribunda (Lehm.) I.M. Johnston. n=12. NM, Lincoln Co., White Mts., 5.5 km WNW of Alto, W 81-434.

Heliotropium (**)greggii Torrey. n=14. NM, Doña Ana Co., 15 km NNE of Las Cruces, Jornada Del Muerto Road, W 81-574.

Lithospermum (**)multiflorum Torrey. n=14. NM, Otero Co., Sacramento Mts., USFS Road-90, 18 km S of High Rolls, W & S 87-004.

BRASSICACEAE: Draba helleriana Greene var. (**)patens (Heller) O.E. Schulz. n=8. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-426.

Thelypodiopsis (**)vaseyi (S. Wats.) Rollins. n=10. NM, Otero Co., Sacramento Mts., La Luz Canyon, USFS RD-162, W & S 87-012.

CAPPARACEAE: *Cleome serulata* Pursh. n=16. NM, Cibola Co., Grant Malpais, NM Hwy-117, W & S 81-504.

CARYOPHYLLACEAE: *Arenaria confusa* Rydb. n=20. NM, Lincoln Co., White Mts., US Hwy-70 roadside, 7 km SW of Ruidoso, W 81-451.

Drymaria (**)*tenella* Gray. n=18. AZ, Cochise Co., Chiricahua Mts., 5 air km W of Portal, W 86-028.

CHENOPODIACEAE: (**)*Allenrolfea occidentalis* (Wats.) Kuntze. n=9. NM, Otero Co., US Hwy-70/82, 5 km E of White Sands National Monument, W 81-475.

Suaeda fruticosa (L.) Forsk. n=9. NM, Otero Co., 5 km E of White Sands National Monument, W 81-476.

CUCURBITACEAE: (**)*Echinopepon wrightii* (Gray) Watson. n=12. NM, Grant Co., Black Range, Iron Cr., NM Hwy-90, W 81-558.

FABACEAE: *Astragalus* (**)*albulus* W.& S. n=11. NM, McKinley Co., NM Hwy-400, 3 km S of Ft. Wingate village, W & S 81-494.

Dalea filiformis Gray. n=7. AZ, Cochise Co., Basin Trail (USFS Trail-247), 11 air km W of Portal, W 86-046.

Dalea (**)*ordiae* Gray. n=14. AZ, Cochise Co., Chiricahua Mts., 5 air km W of Portal, W 86-023; Chiricahua Mts, Turkey Cr., 11 air km W of Portal, W 86-039. Both collections of this tetraploid showed a high frequency of 8 bivalents and 3 quadrivalents during Metaphase I. Mature pollen tetrads had a 10% incidence of a fifth, highly reduced cell.

Desmodium (**)*arizonicum* Watson. n=11. AZ, Cochise Co., Chiricahua Mts., CG at S Fork of Cave Cr., W 86-009.

Desmodium (**)*grahami* Gray. n=11. AZ, Cochise Co., Chiricahua Mts., 5 air km W of Portal, W 86-025.

Desmodium (**)*procumbens* (Mill.) Hitchcock. n=11. AZ, Cochise Co., Chiricahua Mts., 5 air km W of Portal, W 86-026.

Desmodium (**)*psilophyllum* Schlecht. n=11. AZ, Cochise Co., Chiricahua Mts., CG at S Fork of Cave Cr., W 86-006.

Lotus oroboides (H.B.K.) Ottley var. *oroboides*. n=7. NM, Lincoln Co., White Mts., 5.5 km WNW of Alto, W 81-447.

Lupinus argenteus Pursh. n=24. NM, Cibola Co., 50 km NNW of Pietown, 17 km N of Catron Co. line, W & S 81-520.

Petalospermum exile Gray. n=7. AZ, Cochise Co., Chiricahua Mts., 5 km W of Portal, W 86-020; Basin Trail (USFS Trail-247), 11 air km W of Portal, W 86-048.

Phaseolus (**)*heterophyllus* Willd. var. *heteropyllus*. n=11. AZ, Cochise Co., Peloncillo Mts., S Fork of Skeleton Canyon, 2 km W of NM-state boundary, *W 81-562*.

HYDROPHYLLACEAE: *Phacelia neomexicana* Thurber var. *alba* (Rybd.) Brand. n=11. NM, Lincoln Co., White Mts., US Hwy-70, 7 km SW of Ruidoso, *W 81-450*.

HYPERICACEAE: *Hypericum formosum* H.B.K. n=8. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, *W 81-438*.

LAMIACEAE: *Monarda menthaefolia* Graham. n=17. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, *W 81-437*.
Monarda punctata L. var. (**)*occidentalis* (Epl.) Palmer & Steyerm. n=12. NM, Cibola Co., Grant Malpais, NM Hwy-117, *W & S 81-515*.
Salvia (**)*lycioides* Gray. n=11 + 1 supernumerary. NM, Otero Co., Sacramento Mts., USFS Road-90, 18 km S of High Rolls, *W & S 87-001*.

LILIACEAE: *Allium cernuum* Roth var. (**)*neomexicanum* (Rydb.) MacBr. n=7. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, *W 81-423*.
Allium cernuum Roth var. *obtusum* Cocker. n=7. NM, McKinley Co., NM Hwy-400, 3 km S of Ft. Wingate village, *W & S 81-493*.
Allium geyeri Watson. n=7. NM, Otero Co., US Hwy-82, Fresnal Canyon, 1.5 km W of High Rolls, *W 81-417*.
Anthericum (**)*torreyi* Baker. n=32. NM, Lincoln Co., White Mts., 2 km W of Alto, *W 81-464*.

LOASACEAE: *Mentzelia rusbyi* Wooton. n=10. NM, Lincoln Co., White Mts., N edge of Ruidoso, *W 81-448*.

MALVACEAE: *Anoda cristata* (L.) Schlecht. var. *cristata*. n=30. NM, Luna Co., Cooke Range, E base of Cooke Peak, *W 81-557*.
Sidalcea candida Gray var. *candida*. n=10. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, *W 81-432*.
Sphaeralcea angustifolia (Cav.) Don var. *cuspidata* (Britt.) Gray. n=5. NM, Otero Co., S edge of High Rolls, USFS Road-63, *W 81-479*.
Sphaeralcea grossulariaefolia (Hook. & Arn.) Rydb. var. (**)*pedata* (Torrey) Kearney. n=10. NM, McKinley Co., NM Hwy-400, 3 km S of Ft. Wingate village, *W & S 81-501*. This contrasts with n=21 for this species reported in Hitchcock et al. (1961, page 431).

Sphaeralcea incana Torr. var. incana. n=10. NM, Cibola Co., 13 km SSE of Grants, W & S 81-502; Luna Co., Cooke Range, at Cooke abandoned town, W & Soreng 81-553.

Sphaeralcea subhastata Coult. var. (**)pumila (W.& S.) Kearney. n=15. NM, Lincoln Co., White Mts., NM Hwy-532, 1 km W of Alto, W 81-472; Otero Co., Sacramento Mts., Fresnal Canyon, 1.5 km W of High Rolls, US Hwy-82, W 81-533.

ONAGRACEAE: Zauschneria latifolia (Hook.) Greene. n=15. AZ, Cochise Co., Chiricahua Mts., CG at S Fork of Cave Cr., W 86-012.

POACEAE: Agrostis semiverticillata (Forsk.) C. Chr. n=14. AZ, Cochise Co., Chiricahua Mts., Herb Martyr CG, Cave Cr. Canyon, 10 km SW of Portal, W 86-056.

Blepharoneuron tricholepis (Torrey) Nash. n=8. AZ, Cochise Co., Chiricahua Mts., Crest Trail, 1.5 km S of Rustler Park Ranger Station, W 86-058.

Bromus lanatipes (Shear) Rydb. n=14. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-422.

Bromus richardsonii Link. n=14. NM, Otero Co., Sacramento Mts., La Luz Canyon, USFS Rd-162, W & S 87-014.

Digitaria sanguinalis (L.) Scop. n=18. AZ, Cochise Co., Chiricahua Mts., Herb Martyr CG, 10 km WSW of Portal, W 86-050.

Echinochloa crusgalli (L.) Beav. var. (**)mutis (Pursh) Peterm. n=27. AZ, Cochise Co., Chiricahua Mts., 5 air km W of Portal, W 86-024.

Eragrostis neomexicana Vasey. n=30. NM, Otero Co., Sacramento Mts., La Luz Canyon, USFS Road-162, W & S 87-017.

Sporobolus contractus Hitchc. n=18. NM, Cibola Co., E edge of Grant Malpais, NM Hwy-117, W & S 81-505.

Sporobolus cryptandrus (Torr.) Gray. n=19. NM, Cibola Co., Grant Malpais, NM Hwy-117, W & S 81-510.

POLEMONIACEAE: Ipomopsis longiflora (Torr.) Grant. n=7. NM, Cibola Co., Grant Malpais, NM Hwy-117, W & S 81-506.

Linanthastrum nutallii (Gray) Ewan subsp. nutallii. n=9. NM, Lincoln Co., US Hwy-70, 7 km SW of Ruidoso, W 81-456.

Polemonium foliosissimum Gray var. molle (Greene) Anway. n=9. NM, Otero Co., Sacramento Mts., 5 km N of Cloudcroft, W & S 87-009.

POLYGALACEAE: Monnina (**)wrightii Gray. n=10. AZ, Cochise Co., Chiricahua Mts., Basin Trail (USFS Trail-247), 11 air km W of Portal, W 86-047.

Polygala scoparioides Chodat. n=17. TX, El Paso Co., N end of Franklin Mts., 11 km E of Anthony, W 86-002a.

POLYGONACEAE: Eriogonum (**)annuum Nutt. n=20. NM, Cibola Co., Grant Malpais, NM Hwy-117, W & S 81-509.
Eriogonum jamesii Benth. var. (**)jamesii. n=20. NM, Otero Co., W edge of High Rolls, US Hwy-82, W 81-478.
Eriogonum (**)polycladon Benth. n=13. NM, Dona Aña Co., US Hwy-70/82, 1 km W of Organ, S & Soreng 6197.

PRIMULACEAE: Androsace septentrionalis Pursh var. puberulenta (Rydb.) Knuth. n=10. AZ, Cochise Co., Chiricahua Mts., Crest Trail, 1.5 km S of Rustler Park Ranger Station, W 86-059.

RANUNCULACEAE: Delphinium novomexicanum Wooton. n=8. NM, Otero Co., Sacramento Mts., La Luz Canyon, USFS Rd-162, S & W 9208.

RHAMANACEAE: Ceanothus integerrimus Hook. & Arn. n=12. AZ, Cochise Co., Chiricahua Mts., beside road to Onion Saddle (USFS Road-42), 11 air km W of Portal, W 86-044.

ROSACEAE: Potentilla norvegica L. n=35. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-431.
Potentilla (++)pennsylvanica L. n=7. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-441.
Potentilla pulcherrima Lehm. n=42. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-433.

SAXIFRAGACEAE: Heuchera parvifolia Nutt. var. parvifolia. n=7 (2n=14 + 1 supernumerary). NM, Lincoln Co., White Mts., Eagle Cr., W 81-443. In about one-fourth of the cells observed, a supernumerary chromosome was present in the metaphase plate and afterwards. It did not divide during Anaphase I, but did migrate to one anaphase pole. The supernumerary was about 1 micrometer in diameter, stained as darkly as the other chromosomes, and exhibited no sign of lagging.
Heuchera rubescens Torrey. n=7. NM, Lincoln Co., White Mts., Eagle Cr., 5.5 km WNW of Alto, W 81-442.

SCROPHULARIACEAE: Cordylanthus wrightii Gray subsp. wrightii. n=13. NM, McKinley Co., NM Hwy-400, 3 km S of Ft. Wingate village, W & S 81-497b. In the observed meiocytes, two of the bivalents were paler staining and noticeably smaller. The base number for this genus is thought to be n=14 (Chuang and

Heckard, 1986).

Mimulus cordatus Greene. n=15. AZ, Cochise Co., Chiricahua Mts., Bootlegger Trail (USFS-257), S of Rustler Park, W 86-062.

VERBENACEAE: Verbena macdougalii Heller. n=7. NM, Lincoln Co., US Hwy-70, 7 km SW of Ruidoso, W 81-452.

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LITERATURE CITED

Chuang, T., and L. Heckard. 1986. Systematics and evolution of Cordylanthus (Scrophulariaceae-Pedicularieae). Syst. Bot. Monog. Vol. 10.

Hitchcock, C., A. Cronquist, M. Ownbey and J. Thompson. 1961. Vascular plants of the Pacific Northwest. Part 3. Univ. Washington Press, Seattle. 614 pp.

Keil, D., and D. Pinkava. 1976. Chromosome counts and taxonomic notes for Compositae from the United States and Mexico. Amer. J. Bot. 63: 1393-1403.

Snow, R. 1963. Alcoholic hydrochloric acid-carmine as a stain for chromosomes in squash preparations. Stain Technol. 38:9-13.

Strother, J.L. More chromosome studies in Compositae. Amer. J. Bot. 70: 1217-1224.

Turner, B.L., J. Bacon and T. Wendt. 1975. Chromosomes and phyletic position of Aster sonorae Gray. (Asteraceae - Section Oxytripolium). Southwestern Naturalist 19: 361-364.

Ward, D. 1983. IN: A. Löve. IOPB Report LXXX. Taxon 32:504-511.

Ward, D., and R. Spellenberg. 1984. Chromosome counts from New Mexico and Mexico. Phytologia 56:55-60.

Ward, D., and R. Spellenberg. 1986. Chromosome counts of angio-sperms of western North America. Phytologia 61(2): 119-125.

UNA NUEVA ESPECIE DE *Unonopsis* R.E. FRIES (ANNONACEAE) PARA COSTA RICA

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Unonopsis theobromifolia Zamora y Poveda, *sp. nov.*

Arbor parva, usque 7 m alta; ramuli teretes, dense ferrugineo-puberuli. Foliae brevi-petiolatae; petiolis brevis, 3-7 mm longis, puberulis; laminae oblongo-lanceolatae usque abovatae vel ovatae, 17.8-43.7 cm longae, 6.9-14.5 cm latae, ápice acuminato usque acuto vel apiculato (acumine 1.3-2.7 cm longo), basi rotundata, obtusa vel late asymetrica, supra glabra, impressinervis, subtus dense pilosa, nervis elevatis, nervis lateralis 13-22. Flores axilarris, solitaris vel jugate (raro 3); pedicelli 4-5 mm longi; sepala 3, extus dense ferrugineo sericea, intus glabra; petala 6, valvata, triangulo-ovata, extus dense ferrugineo sericea, intus glabra; stamina numerosa, 1-1.2 mm longa; styli 7-11 ad 1.5 mm longi. Monocarpi stipitati, (2-) 5-9, globosi, 14-23 mm longi, maturitati rubri; stipites 1.5-4 mm longi; semina 2-4 discoideus, usque 1.16 mm longa.

Arbol pequeño de 4-7 m de altura; tronco derecho; ramas largas horizontales; ramitas jóvenes cilíndricas y densamente ferrugineo-pubescentes. Hojas corto pecioladas; peciolos de 3-7 mm de largo, 2-3.8 mm de ancho, pubescentes, cilíndricos. Lámina de oblongo-lanceolada a abovada u ovada, 17.8-43.7 cm de largo, 6.9-14.5 cm de ancho; ápice de acuminado a agudo o apiculado, el acumen 1.3-2.7 cm de largo; base de redondeada a obtusa o levemente asimétrica; nervios secundarios 13-22 pares, impresos en la haz y prominentes en el envés, membranáceo-cartáceas; haz glabro, excepto el nervio central, o esencialmente glabro cuando maduras; envés densamente piloso. Flores axilares, solitarias o en fascículos de 2 (raras veces 3); pedúnculo ausente o de 1-2 mm de largo, grueso con una bráctea densamente-ferrugíneo Serícea; pedicelo 4-5 mm de largo y hasta 2 mm de ancho articulado en la base y con pequeñas bracteolas arriba y abajo de la articulación, la superior 2-3.5 mm de largo y 2mm de ancho, densamente ferrugíneo serícea. Sépalos 3, 3-4 mm de largo y 3-4 mm de ancho, valvados, triangular-ovados y unidos en la base, ápice redondeado o levemente agudo, densamente ferrugíneo-seríceos externamente y glabros internamente. Pétalos 6, valvados, cóncavos, triangular-ovados y carnosos, los 3 externos 6-7 mm de largo y 5-6 mm de ancho, densamente ferrugíneo-seríceos externamente y glabros internamente, los 3 internos 4-5.5 mm de largo y 4-5 mm de ancho, diminutamente ciliados, glabros excepto en la línea media dorsal; estambres numerosos 1-1.2 mm de largo, pubescentes en la base; pistilos 7-11, hasta de 1.5 mm de largo, argenteo-pubescentes estigmas 0.5 mm de largo, cónico-ovoides. Monocarpos (2) 5-9, de 1.4-2.3 cm de largo y 1.3-1.8 cm de ancho, globosos, glabros o diminuto y esparcidamente seríceos, rojos cuando maduros; estipete 1.4-4 mm de largo, diminuto ferrugíneo-seríceo; semillas 2-4 discoides, hasta 1.16 cm de largo, 1.02 cm de ancho y 0.6 cm de espesor, pardas, brillantes y diminutamente punteadas.

TIPO. COSTA RICA. SAN JOSE, Santa Rosa de Puriscal, Zona Protectora La Cangreja. N. Zamora, M. Grayum, G. Herrera & G. Umaña 1327 (fl. fr.), 400 m. CR. (Isotipos: MO,F, NY).

DISTRIBUCION Y HABITAT: Hasta el momento endémico para Costa Rica, conocido en la parte central y suroeste de la Vertiente del Pacífico, desde la Reserva Biológica Carara y Santa Rosa de Puriscal (Prov. San José) hasta Rincón de Osa (Prov. Puntarenas), 50-700 msnm. En algunos sitios llega a ser común o frecuente, y generalmente forma parte del sotobosque en las formaciones de bosque tropical muy húmedo; creciendo en lugares más o menos planos o laderas con pendientes medias. Se ha observado con frutos en mayo, agosto y setiembre, y flores en marzo, mayo y junio.

Esta especie se distingue del resto de las especies neotropicales por su pubescencia pilosa, densa y persistente en las ramitas jóvenes y el envés de las hojas, además las hojas se asemejan a las de un cacaotero silvestre (*Theobroma* sp.).

OTROS EJEMPLARES EXAMINADOS: COSTA RICA. San José: Santa Rosa de Puriscal, Zona Protectora La Cangreja(400 m) Poveda 491;Zamora & Jiménez 1274 (fr.), 1282 (fr.): Grayum et al. 8305(fl.); Montañas Jamaica, Reserva Biológica Carara (500-600m) Grayum et al. 5484 (fl.), 5835 (fr.). Puntarenas: Cerro Nara, Quepos (700 m) Zamora et al. 1455 (fr.); Rincón de Osa (250-540 m) Croat & Grayum 59868 (fl.).

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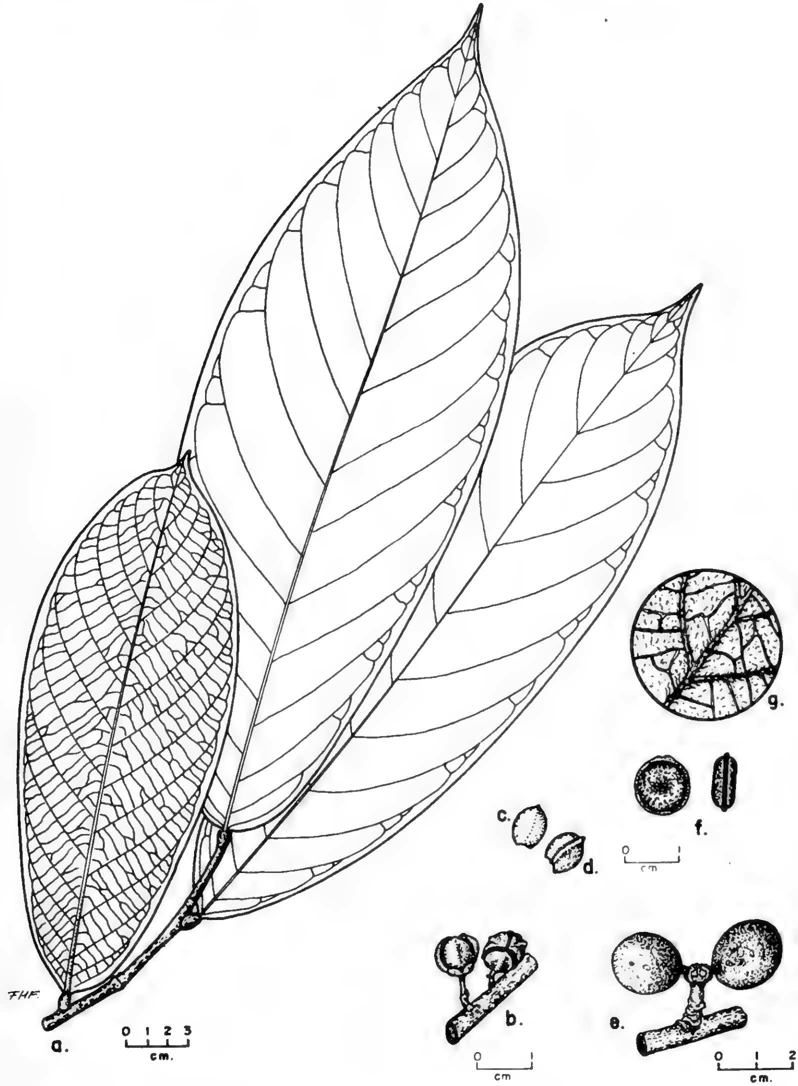
BIBLIOGRAFIA

Fries, R.E. Annonaceae In Flora of Panamá. Ann. Missouri Bot. Gard. 49: 179-213. 1962.

Standley, P.C. and Steyermark, J.A. Flora of Guatemala. Fieldiana Bot. 24(4): 270-294. 1946



Unonopsis theobromifolia Zamora & Poveda. a. Rama; b. Flores; c. Pétalo externo; d. Pétalo interno; e. Frutos; f. Semillas; g. Detalle de tricomas.

PAPPOPHORUM PHILIPPIANUM (GRAMINEAE) NEW TO NORTH AMERICA

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In his Mexican Grasses in the United States National Herbarium, Hitchcock (1913) listed three species of _Pappophorum_. One of these, _P. Wrightii_ S. Wats., is now excluded and assigned to the genus _Enneapogon_, as _E. Desvauxii_ P. Beauv. The other two names are _Pappophorum laguroideum_ Schreb. [= _P. pappiferum_ (Lam.) Kuntze] and _P. vaginatum_ Buckley. Both of these names are current, and apply to species well documented as occurring in Mexico. In the above work there are keys to the genera and species, but no descriptions. The range for each species is given, however, and this is followed by a list of the specimens seen by the author. In the case of _P. vaginatum_, several collections are cited from the states of Durango, Coahuila, Nuevo Lėon, and there is one from Guaymas, Sonora (_Palmer 350_ in 1887).

The Sonoran locality is separated from the others not only by a considerable distance, but also by the Sierra Madre Occidental which might seem to be a formidable barrier. Nevertheless, no one seemed to question Hitchcock's determination of the Palmer gathering until Swallen (1964) redetermined it as _Pappophorum subbulbosum_ Arechavaleta, originally described from Uruguay. Swallen's determination appears to have been accepted by all subsequent botanists. In his revised catalogue of the grasses of Mexico, Beetle (1987) includes this name and lists the locality as Sonora.

Since Sonora borders Arizona, and the floras have many similarities, the ARIZ herbarium is rich in Sonoran collections. Among them are several gatherings of _Pappophorum_, a number of which had been named _P. mucronulatum_. These specimens would key out to _P. subbulbosum_ in Swallen's 1964 treatment. Because we have some familiarity with South America _Pappophorum_, we realized that these Sonoran plants were not good _P. subbulbosum_. Rather, they represent a related species, _P. Philippianum_ L. Parodi, originally described from Mendoza, Argentina, and not previously reported from North America. The diagnostic features of this latter species are the long glumes, mostly 6--10 mm, with awn points 1 mm or more in length, and densely pilose lemmas. Callus hairs are about two-thirds as long as the lemma body, and the interior of the lemma also has prominent hairs on the upper part below the point from which the numerous 7--10 mm long awns diverge.

All specimens of _Pappophorum_ from coastal Sonora which we have seen are referable to _P. Philippianum_. In North America the species appears to be limited to that area. In addition to the Palmer specimen mentioned above, the following collections, all from Sonora, Mexico, represent this species:

Guaymas, 26 January 1927. M. E. Jones 23440. (MO-970023)

Bahia Colorado, vicinity of 28° 18 1/2' N lat., 111° 28' W long. Rocky hill, north side of Morro Colorado. 28--29 December 1966. Felger, R. S. & E. Hamilton 15703. (ARIZ-257056)

Estero Soldado, about 10 km E of Bahia San Carlos; ca 100 m N of inland edge of estero; ecotone between saltscrub and desertscrub. Flat terrain, sandy-silty soil. Tufted perennial, locally common. 22 Oct. 1984. Felger, R. S. et al. 84-202. (ARIZ-252438)

Isla Almagre Chico in Guaymas Bay. 27° 55' N lat., 110° 53' W long. Occasional perennial. Mostly on more level, open sites. 24 April 1985. Burgess, T. L., R. M. Turner & J. E. Bowers 6912. (ARIZ-254841)

Puerto Viejo, 3.5 mi S of El Paredoncito W 109° 54' 30", N 27° 0' 30". Rio Mayo, Shell mantled beach ridge to 8' tall between mangroves, mud flats, and irrigated lands. 29 December 1985. Martin, P. S. & M. K. O'Rourke s.n. (ARIZ-262162)

Dune behind beach at base of Punta Yavaros. Bayside of sand spit near mangroves. Less than 5 m elev. 109° 26'W, 26° 40' 10" N. 28 December 1986. Martin, P. S. & M. K. O'Rourke s.n. (ARIZ-269151)

Pappophorum Philippianum L. Parodi, Revista Mus. La Plata, Secc. Bot. 8(40): 79. 1943.

- P. vaginatum Philippi, Anales Univ. Chile 36: 206. 1870. non Buckley, 1866.
- P. pappiferum (Lam.) Kuntze var. τ mucronulatum (Nees) Kuntze, Rev. Gen. Pl. 3(3): 365. 1898.
- P. mucronulatum Nees var. vaginatum (Phil.) Hackel in Stuckert, Gram. Arg. III, An. Mus. Nac. B. Aires 21: 123. 1911.

LITERATURE CITED

Beetle, A. A. 1987. Noteworthy grasses from Mexico XIII. Phytologia 63: 209--297.

Hitchcock, A. S. 1913. Mexican Grasses in the United States National Herbarium. Contr. U.S. Natl. Herb. 17(3): 181--389 + index.

Swallen, J. R. 1964. Gramineae (1: 237--301) In: Shreve F. & I. L. Wiggins, Vegetation and Flora of the Sonoran Desert. Stanford University Press.

BOOK REVIEWS

Alma L. Moldenke

"AGRICULTURAL INSECT PESTS OF TEMPERATE REGIONS AND THEIR CONTROL" by Dennis S. Hill, ii + 659 pp., 285 black/white fig. & draw., 135 photo., 4 tab., 205 geog. dist. maps, Cambridge University Press, Cambridge & London, U.K. and New York City, N.Y. 10022. 1987. $95.00.

In a previous PHYTOLOGIA 64[3] p. 241 by an oversight the highly appreciative review skipped mentioning the Cambridge Press as the producer and source of this important publication affecting temperate and subtropical crop areas around the whole world. This is the first study with such a scope and yet with so much well organized and detailed information.

"CHARLES DARWIN'S NATURAL SELECTION: Being The Second Part Of His Big Species Book Written From 1856 To 1858" edited by R.C. Stauffer ix + 692 pp., 2 black/white photo. & 6 tab. Cambridge University Press, Cambridge, U.K. & New York, N.Y. 10022. 1987. $29.95. Paperbound.

This book was first published in 1975 in hard cover form and has been well received. This new paperback second printing makes an excellent text for advanced courses on evolution, Darwinism and the like rather than "On the Origin of Species" because it includes the "Origin" and much, much more as helpful resource and matrix. Interested, critically inquiring readers will also appreciate it. The "Origin" was literally only an abstract of some of the manuscript Darwin had originally intended to complete and publish as the formal documented presentation of his views on evolution. This major work which Darwin came to call "my big book" was started in 1850. The "Origin" was hurriedly prepared from this unfinished matrix in answer to the appearance of Wallace's letter with its paralleling but independently derived concept of natural selection. Darwin continued with this major manuscript including all necessary documentation. Stauffer's editing of the massive material is a meticulous performance of great value to science and biography.

Inasmuch as we do no editing, papers accepted for publication *must* be submitted in *exactly* the form that the author wants to have them published. They will then be photographed and printed by photo-offset in exactly the form as submitted except that we will add page numbers and running-heads.

Typescripts should be prepared single-spaced on clean white heavy bond smooth and opaque paper. Elite type is probably the most space-economical. Typescript text must not exceed a rectangle 5⅝ inches wide (horizontal) by 8⅝ inches high (vertical), not including the running-head and page number.

The title of the paper should be typed in all uppercase (capital) letters with 2 blank lines above the title and one beneath; then the name of the author in ordinary upper- and lower-case letters, along with his address (if so desired); followed by 2 blank lines; then the first line of text. It is usually best to leave a blank line between paragraphs.

All scientific plant and animal names and group names should be typed either in italic type (if available) or underscored. Any corrections in the text made by the author must be complete and neat as they will be photographed as they are.

The finished typescript as submitted by the author will be reduced from the 8⅝ x 5⅝ inch size as submitted to 6⅜ x 4 inches by the printer. It is therefore advisable to place a centimeter or millimeter scale on all text figures and plates included.

Use a *new* heavily inked black typewriter ribbon and be sure to *clean* the type on the typewriter after each several pages of typing.

Cost of publication at present is $12.00 US per page, with no subsequent rebates, but this rate may vary depending on inflation and costs, so it is best to inquire as to current rates. The page charges are due *with* the typescript and no paper will be published before payment is received in full. Each author will receive gratis a proportionate share of the printed copies remaining after paid subscriptions are filled, but if separates (reprints or offprints) are desired, these will be charged extra in accord with the current rate for offprints provided by the printer. The cost of all such separates ordered must also be paid for in advance at the time the typescript is sent. No orders for separates will be accepted later, nor can additions or corrections be accepted.

Authors are asked to indicate in light pencil on the *reverse* side of each page of their typescript the page number so that no mistakes in sequence occur.

All manuscripts accepted will be published in the next issue, so that the size of the numbers may vary greatly. A volume will contain 512 pages. The plan insures prompt publication of all accepted manuscript.

Illustrations will be published according to the desires of the authors. No extra charge is made for line drawings, such as are ordinarily reproduced in zinc, or for diagrams, tables, or charts, provided they conform to certain limitations of size and proportion. An extra charge will be made for halftones, depending on their size, as fixed by the engraver.

Articles dealing with research in all lines of botany and plant ecology, in any reasonable length, biographical sketches, and critical reviews and summaries of literature will be considered for publication.