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AGROCHEMICAL ACTIVITY AND ISOLATION OF *N*-(4′-BROMOPHENYL)-2,2-DIPHENYLACETANILIDE FROM THE THAI PLANT *ARUNDO DONAX*

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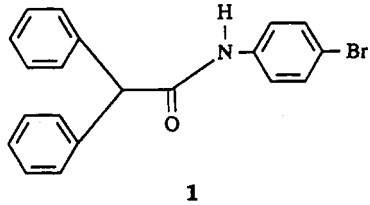
ABSTRACT.—The $CHCl_3$ extract of the whole plant of *Arundo donax* yielded *N*-(4′-bromophenyl)-2,2-diphenylacetanilide [**1**]. The structure was determined on the basis of chemical, spectroscopic, and X-ray crystallographic data. Compound **1** has not been previously reported as a natural product and showed inhibition of feeding for boll weevils.

Arundo donax L. (Gramineae) is called O-luang in Thai (1). Additional names are the giant reed, Georgia cane, and reed grass. *A. donax* is a native of the Mediterranean region and is now naturalized in many warm weather countries. It is commonly cultivated for ornamental or screening purposes and sometimes is used for erosion control (2,3). The stems are used for many purposes such as reeds of bagpipes, clarinets, and organs and for making screens, lattices, mats, and fishing poles as well as for light construction. Decoctions of its rhizomes have been used as emollients and diuretics and are said to stimulate menstrual discharge and diminish secretion of milk (4). Donaxarine was isolated from the plant by Madinaveita (5). Dutta and Ghosal (4) reported the presence of 5-indole-3-alkylamines. Chaudhuri and Ghosal (6) isolated triacontane ($C_{30}H_{62}$) from the leaves. Also isolated were triacontanol ($C_{30}H_{62}O$), β-sitosterol, stigmasterol, β-amyrin acetate, friedelin, and campesterol. Ghosal *et al.* (7) reported the presence of several alkaloids in the flowers. In addition, donaxaridine was isolated by Ubaidullaev *et al.* (8).

This paper reports the presence of *N*-(4′-bromophenyl)-2,2-diphenylacetanilide [**1**] in *A. donax*. This is the first report of **1** from nature and of its activity as a boll weevil antifeedant; however, syntheses have been previously reported (9,10). The EtOH extract of *A. donax* showed 97% and 89% inhibition of cotton boll weevils, using the Hedin method (11). Compound **1** was recrystallized from 10% EtOAc in hexane as colorless needles (mp 199–200°). The hrms showed $[M]^+$ and $[M+2]^+$ peaks at *m/z* 365.0413 and 367.0392, which suggested the molecular formulas of $C_{20}H_{16}NOBr^{79}$ (calcd 365.0415) and $C_{20}H_{16}NOBr^{81}$ (calcd 367.0395), respectively. The molecular formula indicated 13 degrees of unsaturation. The ir spectrum exhibited bands at 3100 cm^{-1} (characteristic of the C-H stretching of aromatic protons), at 3350 cm^{-1} (for N-H stretching), at 1685 cm^{-1} (strong and



1

characteristic of C=O stretching of an amide), and at 1600, 1550, 1480, and 690 cm^{-1}, which are characteristic of an aromatic ring. The ^1H nmr displayed a singlet of one proton at δ 5.88 and a multiplet of 14 protons at δ 7.20–7.40 corresponding to one disubstituted and two monosubstituted benzene rings. The final confirmation of structure **1** was provided by single crystal X-ray diffraction analysis (Figure 1). Atomic coordinates are presented in Table 1.

Compound **1** demonstrated boll weevil antifeedant activity with inhibition levels of 75, 85, and 88% at dose levels of 1, 3, and 5 mg, respectively. Also, this is the first report of compound **1** as a natural product and its structural confirmation by X-ray crystallography. To our knowledge, this is the first report of this structural type from natural sources.

The unusual nature of structure **1** may prompt one to believe that it is present as an artifact since syntheses have been previously reported (9,10). However, to our knowledge no contamination of samples occurred since clean glassware and pure solvents were always utilized. The only other possibility of contamination is before collection in Thailand. There is no reason to believe that significant amounts of this compound would have been present from external sources in the marshes of Thailand.

EXPERIMENTAL

PLANT MATERIAL.—The whole plant of *A. donax* was collected in Laxsi Bangkhen, Bangkok, Thailand, in March 1985 and identified by Pipat Patana-Ponbaiboon, Department of Botany, Chulalongkorn University, Bangkok, Thailand. A voucher specimen (number 46403) was deposited in the Herbarium of the Royal Forest Department, Flora of Thailand.

EXTRACTION AND ISOLATION.—Air-dried plant material (whole plant, 10 kg) was milled and extracted several times with 10 liters of 95% EtOH at room temperature. The solvent was removed in vacuo to yield 254 g of crude extract. The crude EtOH extract was further extracted by equilibrating in H_2O-$CHCl_3$-MeOH (1:2:1). The organic layer was separated and dried over anhydrous $MgSO_4$. The solvent was then removed in vacuo to give 173 g of crude material. This material was further separated into five fractions by flash cc using hexane, hexane-$CHCl_3$ (1:1), $CHCl_3$, $CHCl_3$-MeOH (1:1), and MeOH as eluting solvents.

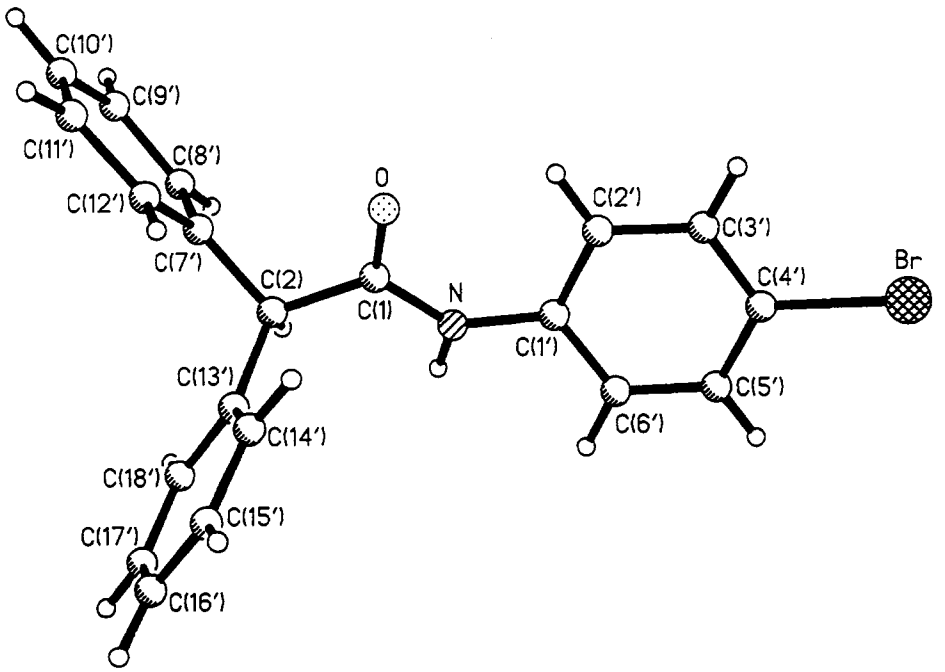


FIGURE 1. *N*-(4′-Bromophenyl)-2,2-diphenylacetanilide [**1**] from the Thai plant *Arundo donax*.

TABLE 1. Fractional Atomic Coordinates ($\times 10^4$) and Equivalent Isotropic Displacement Coefficients ($Å^2 \times 10^3$) of Compound **1**.

Atom	x	y	z	U (eq)[a]
Br	8042 (2)	4760 (1)	10000	126 (1)
O	12591 (9)	7472 (6)	8508 (9)	69 (4)
N	11762 (9)	7288 (6)	10668 (8)	49 (4)
C-1	12567 (11)	7631 (7)	9743 (13)	45 (4)
C-2	13469 (9)	8208 (6)	10359 (11)	43 (4)
C-1′	10897 (10)	6707 (6)	10443 (11)	43 (4)
C-2′	10422 (11)	6514 (8)	9130 (12)	48 (5)
C-3′	9587 (14)	5925 (9)	9012 (13)	66 (5)
C-4′	9207 (11)	5555 (6)	10183 (19)	69 (6)
C-5′	9631 (15)	5753 (9)	11486 (16)	75 (7)
C-6′	10498 (12)	6317 (8)	11612 (13)	59 (5)
C-7′	13793 (12)	8745 (9)	9244 (14)	55 (6)
C-8′	13138 (18)	9365 (12)	9269 (15)	88 (8)
C-9′	13365 (21)	9894 (10)	8256 (29)	117 (10)
C-10′	14303 (25)	9777 (12)	7272 (24)	113 (11)
C-11′	15010 (18)	9170 (13)	7220 (18)	96 (8)
C-12′	14758 (13)	8638 (8)	8205 (14)	69 (6)
C-13′	14766 (11)	7894 (7)	11011 (11)	51 (4)
C-14′	15390 (13)	7319 (8)	10473 (12)	68 (5)
C-15′	16609 (14)	7055 (9)	11043 (17)	82 (6)
C-16′	17158 (15)	7397 (11)	12186 (20)	86 (8)
C-17′	16529 (17)	7947 (11)	12725 (17)	91 (8)
C-18′	15357 (14)	8214 (8)	12168 (15)	69 (6)

[a]Equivalent isotropic U defined as one third of the trace of the orthogonalized U_{ij} tensor.

These fractions were labeled A1, A2, A3, A4, and A5, respectively. The boll weevil antifeedant bioassay of these fractions showed 0/0/0, 26/66/76, 43/76/85, 63/92/98, and 71/82/88 (% inhibition, three replications) in doses of 3/10/30 mg each of the fractions, respectively. Fraction A4 (20 g) was chromatographed over Si gel using hexane containing increasing amounts of $CHCl_3$. Fractions containing **1**, as indicated by tlc, were combined and further purified by preparative tlc in hexane-EtOAc (7:3).

N-(4′-Bromophenyl)-2,2-diphenylacetanilide [**1**].—Compound **1** (80 mg): colorless needles; mp 199–200; ir ν max (pellet) 3100–3500, 1600, 1550, 1480; ^{1}H nmr (200 MHz, $CDCl_3$) δ 5.88 (1H, s, N-H), 7.20–7.40 (14H, m, Ar-H); hrms *m/z* (% rel. int.) $[M+2]^+$ 367.0392 (calcd for $C_{20}H_{16}NOBr^{81}$, 367.0395), $[M]^+$ 365.0413 (calcd for $C_{20}H_{16}Br^{79}$, 365.0415), 194 (8), 183 (7), 167 (100), 152 (19). Crystal data[1] for $C_{20}H_{16}ONBr$ (A4): Mr=366.2, orthorhombic *Pca2*$_1$, *a*=9.807 (5), *b*=18.924 (5), *c*=9.516 (10) Å, V=1766 (2) Å^3, Z=4, D_c=1.378 g·cm^{-3}, μ (CuKα)=32.01 cm^{-1}. The intensity data were measured on a Nicolet R3m/V diffractometer using graphite-monochromated CuKα radiation (λ=1.5418 Å) in a range of $0° \leq 2\theta \leq 112.0°$. A total of 877 unique reflection were collected and 719 reflections with $|Fo| > 3\sigma|Fo|$ were considered observed. The structure was solved by heavy-atom Patterson methods and refined by full matrix least squares using SHELX programs (12). The refinements with anisotropic thermal parameters for non-hydrogen atoms and isotropic for hydrogen atoms theoretically calculated converged at R=0.045, wR=0.059 ($w^1=\sigma^2 f 0.0021\ F^2$). The final atomic coordinates are listed in Table 1.

[1]Atomic coordinates for compound **1** have been deposited at the Cambridge Crystallographic Data Centre and can be obtained on request from Dr. Olga Kennard, University Chemical Laboratory, 12 Union Road, Cambridge CB2 1EZ, UK.

ACKNOWLEDGMENTS

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LITERATURE CITED

1. T. Smitinand, "Thai Plant Names," Funny, Bangkok, Thailand, 1980, p. 36.
2. R.K. Godfrey and J.W. Wooten, "Aquatic and Wetland Plants of South Eastern United States," The University of Georgia, Athens, 1979, p. 227.
3. T.H. Everett, "The New York Botanical

Garden Illustrated Encyclopedia of Horticulture," Garland, New York, 1980, p. 264.
4. S.K. Dutta and S. Ghosal, *Chem. Ind.*, 2046 (1976).
5. M. Madinaveita, *J. Chem. Soc.*, 1927 (1937).
6. R.K. Chaudhuri and S. Ghosal, *Phytochemistry*, **9**, 1895 (1970).
7. S. Ghosal, R.K. Chaudhuri, and S.K. Dutta, *Phytochemistry*, **10**, 2852 (1971).
8. K.A. Ubaidullaev, R. Shakivor, and S.Y. Yunusov, *Khim. Prir. Soedin.*, **4**, 553 (1976).
9. C.L. Stevens and G.H. Singhal, *J. Org. Chem.*, **29**, 34 (1964).
10. F. El-Zahraa, S. El-Bosil, M. El-Sayed, K.M. Goheim, and M. Khalifa, *Pharmazie*, **34**, 12 (1979).
11. P.A. Hedin, A.C. Thompson, and J.P. Mintard, *J. Econ. Entomol.*, **59**, 181 (1966).
12. G.M. Sheldrick, "SHELXTL Crystallographic Computing System," Nicolet Instruments Division, Madison, Wisconsin, 1986.

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