한국농약과학회지 제2권 제3호(1998)
The Korean Journal of Pesticide Science
Vol. 2, No. 3, pp.147~150(1998)

< 단보 >

Synthesis and herbicidal activity of new benzenesulfonylurea derivatives possessing α-diketone or α-keto ester moiety

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Abstract : A series of new benzenesulfonylurea derivatives possessing α-diketone or α-keto ester moiety as an ortho substituent were synthesized by employing new methodology starting from 2-bromophenyl methoxymethyl sulfide and some of them were found to have good herbicidal activity at foliar application.(Received September 21, 1998, accepted December 1, 1988)

Key words : benzenesulfonylurea, α-diketone or α-keto ester moiety, foliar application.

Sulfonylurea has been developed as an important class of herbicides, which acts through inhibition of acetolactate synthase (Brown and Cotterman, 1994). Since the first discovery of sulfonylurea by Levitt in 1975 (Levitt, 1991), a number of products have been commercialized and under development (Brown *et al.*, 1995). The main reasons for the rapid development of sulfonylurea herbicides lie in their exceptionally low application rate, broad weed control spectra, good selectivity between crop and weeds, and favorable toxicological and environmental properties.

Up to now, many synthetic methods have been developed for the synthesis of sulfonylurea herbicides (Gee and Hay, 1994). Among them, introduction of the desired ortho substituent into an aromatic ring possessing a sulfonamide precursor constitutes one of the important synthetic methods for the structural diversity of sulfonylurea herbicide. During our research program for the synthesis of new sulfonylurea herbicides, we have developed a new and facile method for the synthesis of sulfonyl chlorides possessing various functional groups, which could be utilized for the general synthesis of a variety of sulfonylureas (Kim *et al.*, 1992).

As an application of the methodology we want to describe the synthesis of new benzenesulfonylurea derivatives possessing α-diketone or α-keto ester moiety and their herbicidal activity.

Synthesis of sulfonylurea compounds is as follows. (Scheme 1)

α-Keto ester **2** was prepared from 2-bromophenyl methoxymethyl (MOM) sulfide **1** by metal-halogen exchange reaction at -78°C followed by treatment with dimethyl oxalate. To avoid cyclization during amination, the carbonyl group of keto ester **2** was protected by ketal with TMSCl/MeOH to provide ketal ester **3**, which could afford sulfonamide **4** possessing α-keto ester moiety by chlorination and amination. On the other hands, reaction of ketal ester **3** with MeLi at -78°C afforded ketal ketone **5** which could be easily converted to sulfonamide **6** by chlorination and amination. Finally, sulfonamide **4** or **6** was coupled with several carbamate **7** employing DBU as a base to give the corresponding sulfonylureas **8a-h**. The structures of new sulfonylureas **8a-h** was assigned by spectroscopy (^{1}H NMR, IR, Mass).

The herbicidal activities of new sulfonylurea **8a-h** were examined in greenhouse. The results are summarized in Table 1.

Of the analogs tested, compound **8c** with 4-methoxy-6-methyltriazine showed good post emergence herbicidal activity in wheat, which can be anticipated from the fact

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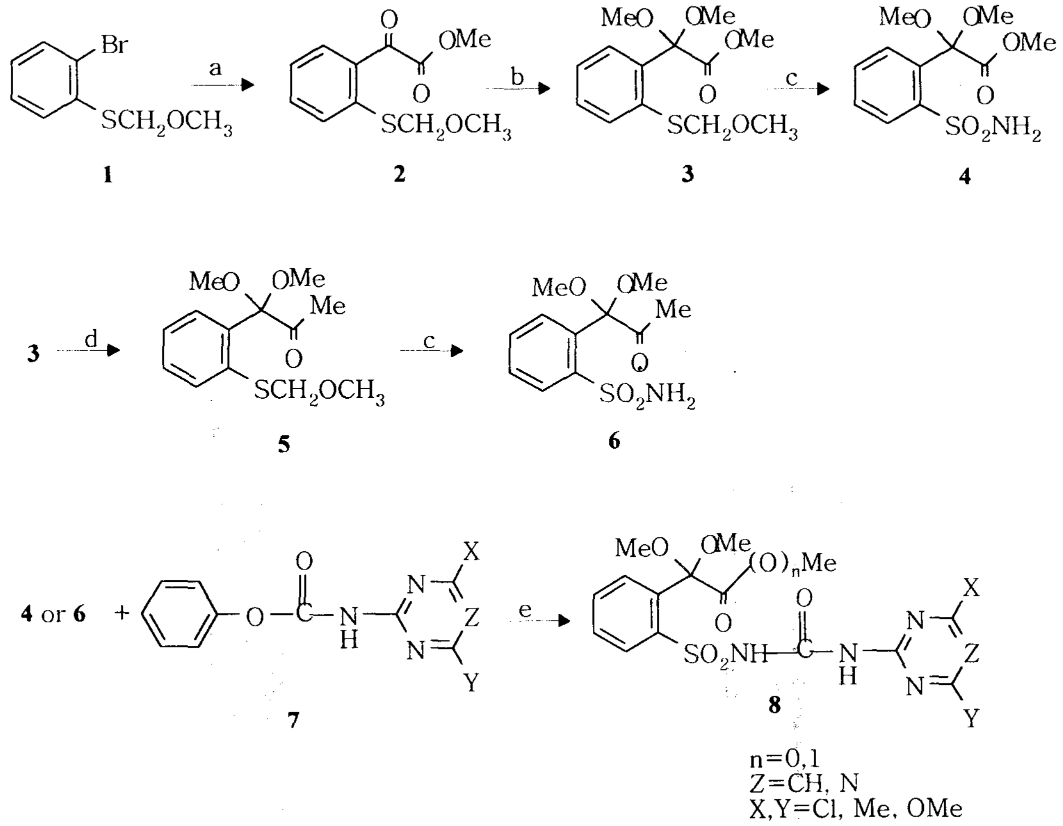
that most of commercialized wheat sulfonylurea herbicides have 4-methoxy-6-methyltriazine heterocycle (Brown and Cotterman, 1994), and was selected for further testing.

Compound **8d** with 4-chloro-6-methylpyrimidine heterocycle showed very poor herbicidal activity at 0.25 kg/ha application rate. Other derivatives had fair to good herbicidal activities but was not safe to wheat at 0.25 kg/ha. Table 2 shows a dose response herbicidal activity of



a. i) n-BuLi/THF, -78°C ii) MeO_2CCO_2Me b. TMSCl/MeOH, reflux c. i) Cl_2/CH_2Cl_2-H_2O ii) NH_4OH/EtOAc d. MeLi/THF, -78°C e. DBU/CH_3CN, r.t.

Table 1. Herbicidal activity of several sulfonylurea compounds at 0.25 kg/ha of foliar application

Compounds	n	X	Y	Z	TRZAW	DACGL	RUMJA	POLHY	AESIN
8a	0	Me	Me	CH	60	100	80	100	15
8b	0	Me	OMe	CH	80	100	90	95	65
8c	0	Me	OMe	N	20	90	100	100	100
8d	1	OMe	OMe	CH	90	75	75	95	100
8e	1	Cl	Me	CH	0	10	0	20	0
8f	1	Cl	OMe	CH	10	65	55	75	40
8g	1	Me	Me	CH	90	100	85	90	100
8h	1	OMe	OMe	N	10	45	65	70	60

TRZAW: *Trirticum aestivum* L. (Wheat), DACGL: *Dactylis glomerata* L. (Orchard grass), RUMJA: *Rumex japonicus* Houtt (Curled dock), POLHY: *Polygonum hydropiper* L. (Smartweed), AESIN : *Aeschynomene indica* L. (Indian jointvetch)
0 : no effect, 100 : complete kill

compound **8c** against several weeds.

It was safe to wheat and effective for the control of broadleaf weeds such as curled dock, lambsquarters, bog starwort, and giant chickweed but shows poor control against grass at 12-100 g/ha.

In conclusion, we synthesized several new sulfonylurea herbicides possessing α-diketone or α-keto ester moiety and evaluated their herbicidal activities. Among them **8c** indicated potential as a candidate for post emergence wheat herbicide. Further synthesis of analogues possessing α-diketone or α-keto ester moiety and evaluation of their herbicidal activity will be reported in due course.

Spectral Data for Compound 8a-h

8a : ^{1}H NMR(200MHz, $CDCl_3$) δ 2.17(s, 3H), 2.53(s, 6H), 3.06(s, 6H), 6.78(s, 1H), 7.40(br s, 1H), 7.45-8.50 (m, 4H), 13.1(br s, 1H); IR(Cm^{-1}) 1730, 1700 (C=O); Mass(FD) m/z 423(M$^+$+1)

8b : ^{1}H NMR(200MHz, $CDCl_3$) δ 2.13(s, 3H), 2.51(s, H), 3.11(s, 6H), 4.10(s, 3H), 6.26(s, 1H), 7.40-8.50(m, 5H), 13.5(br s, 1H); IR(Cm^{-1}) 1725, 1701(C=O);Mass (FD) m/z 439(M$^+$+1)

8c : ^{1}H NMR(200MHz, $CDCl_3$) δ 2.17(s, 3H), 2.56(s, 3H), 3.12(s, 6H), 4.06(s, 3H), 7.45-8.50(m, 5H), 12.1(br s, 1H); IR(Cm^{-1}) 1730, 1698(C=O); Mass(FD) m/z 440(M$^+$+1)

8d : ^{1}H NMR(200MHz, $CDCl_3$) δ 3.10(s, 6H), 3.69(s, 3H), 4.06(s, 6H), 5.80(s, 1H), 7.20(br s, 1H), 7.45-8.45 (m, 4H), 12.5(br s, 1H); IR(Cm^{-1}) 1763, 1707(C=O);Mass (FD) m/z 470(M$^+$)

8e : ^{1}H NMR(200MHz, $CDCl_3$) δ 2.66(s, 3H), 3.11(s, 6H), 3.72(s, 3H), 6.96(s, 1H), 7.42(br s, 1H), 7.45-8.44 (m, 4H), 12.0(br s, 1H); IR(Cm^{-1}) 1763, 1698(C=O);Mass (FD) m/z 459(M$^+$+1)

8f : ^{1}H NMR(200MHz, $CDCl_3$) δ 3.11(s, 6H), 3.67(s, 3H), 4.27(s, 3H), 6.51(s, 1H), 7.41(br s, 1H), 7.50-8.45 (m, 4H), 12.0(br s, 1H); IR(Cm^{-1}) 1760, 1704(C=O);Mass (FD) m/z 475(M$^+$+1)

8g : ^{1}H NMR(200MHz, $CDCl_3$) δ 2.53(s, 6H), 3.09(s, 6H), 3.72(s, 3H), 6.78(s, 1H), 7.42(br s, 1H), 7.50-8.45(m, 4H), 13.1(br s, 1H); IR(Cm^{-1}) 1765, 1698(C=O);Mass (FD) m/z 439(M$^+$+1)

8h : ^{1}H NMR(200MHz, $CDCl_3$) δ 3.13(s, 6H), 3.68(s, 3H), 4.17(s, 6H), 7.41(br s, 1H), 7.50-8.44(m, 4H), 12.1(br s, 1H); IR(Cm^{-1}) 1762, 1730 (C=O);Mass(FD) m/z 472(M$^+$+1)

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Table 2. Herbicidal efficacy of compound 8c at foliar application

Dosage(g/ha)	TRZAW	SETVI	DIGSA	RUMJA	CHEAL	STEAU	STEAQ
12	0	0	0	70	80	100	100
25	0	0	0	80	100	100	100
50	0	20	30	90	100	100	100
100	0	50	70	90	100	100	100

TRZAW: *Trirticum aestivum* L (Wheat), SETVI: *Setaria viridis* P. Beauv (Green foxtail),
DIGSA: *Digitaria sanguinalis* (L.) Scop. (Large crabgrass), RUMJA: *Rumex japonicus* Houtt (Curled dock), CHEAL: *Chenmopodium album* L.(Lambsquarters), STEAU: *Stellaria alsine* Grimm var. *undulata* Ohwi (Bog starwort), STEAQ: *Stellaria aquatica* Scop (Giant chickweed)
0 : no effect, 100 : complete kill

Weeds, 3:1443~1152.

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α-Diketone 또는 α-keto ester기를 포함하는 신규 벤젠술포닐우레아 유도체의 합성 및 제초활성

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요약 : Ortho치환체로서 α-diketone 또는 α-keto ester기를 포함하는 신규한 벤젠 술포닐우레아 유도체들을 2-bromophenyl methoxymethyl sulfide를 출발물질로 하는 새로운 합성방법을 이용하여 합성하였으며, 이 화합물들은 특히 경엽처리에서 흥미있는 제초활성을 나타내었다.

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