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NOTE

Preparation and Activity Study of a New Organophosphate Insecticidals

CHUNHUA YANG and DEQUN SUN*

Marine College, Shandong University at Weihai, Weihai 264209, P.R. China

*Corresponding author: E-mail: dequn.sun@sdu.edu.cn

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A new organophosphorus pesticide, compound **2** was prepared. The laboratory evaluations against *Plutella xylostella* L larva was performed. This compound showed the similar toxicity with corresponding pesticides but with higher insecticidal activity.

Key Words: Pesticide, Preparation, Insecticidal activity, Toxicity.

Synthetic insecticides have played an essential role not only in modern agricultural pest management but also in the control of infectious diseases transmitted by insect vectors and microorganisms[1,2]. The introduction of chiral centre or asymmetric factor into the molecular usually changes the pesticidal activity[3]. Because enantiomers of the same chiral compound can degrade at significantly different rates[4-12] and have different toxicological characteristics in the environment[4,5,8-15]. Sometimes, the chiral organophosphate pesticides have not only the high selectivity and bioactivity, but also the low possibility to cause cross resistance of pesticides while compared with common or traditional pesticides. The compounds with chiral phosphorus centre showed the similar toxicity with corresponding pesticides but with higher laboratory insecticidal activity[16]. Therefore, it is considerably necessary to develop chiral organophosphate pesticides, especially based on current used pesticides since this strategy is very efficient.

Triazophos (Fig. 1) is an important organophosphate pesticide has been used for long time. As the long period of time to use it, the resistance is becoming more and more obviously. To avoid such problem, we introduced asymmetric phosphorus centre into the molecule by utilizing the important intermediate, O-methyl-O-ethyl-thiophosphoryl chloride **1** starting from thiophosphoryl trichloride[17] to prepare firstly the racemic O-methyl-O-ethyl-O-(1-phenyl-1*H*-[1,2,4]triazol-3-yl)-phosphorothioate **2** (Fig. 2). We present here about the preparation and bioactivity study of compound **2** as new organophosphate pesticide candidate. The toxicity assay was evaluated using triazophos as comparison. Laboratory evaluation of compound **2** against *Plutella xylostella* L larva was performed. It was found that the target compound **2** exhibited similar toxicity with triazophos. However, with higher insecticidal activity than triazophos, this result indicated that compound **2** might be the better pesticide candidate.

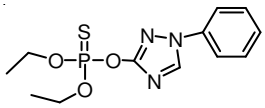

Fig. 1. Structure of triazophos

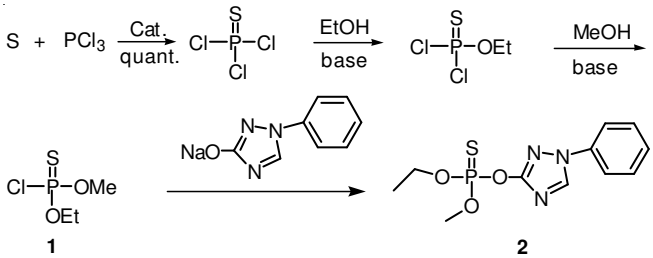

Fig. 2. Synthesis of intermediate **1** and title compound **2**

Melting points were determined with an electrothermal digital melting point apparatus and were uncorrected. ^{1}HNMR was run either on Bruker-200 and Bruker-300 or on Varian-400; ^{13}C NMR was given by Bruker-200. All raw materials were purchased from commercial sources.

General procedure of intermediate (1): Compound **1** was prepared according to the method reported in literature[17,18].

Preparation of O-methyl-O-ethyl-O-(1-phenyl-1*H*-[1,2,4]triazol-3-yl)-phospho-rothioate (2): To a mixture of sodium 1-phenyl-1*H*[1,2,4]triazol-32-olate (1.83 g, 10 mmol), 4-dimethyl-amino-pyridine (0.44 g, 3.6 mmol), benzyl-trimethyl-ammonium chloride (0.43 g, 2.3 mmol) and sodium

hydroxide (0.064 g, 1.6 mmol) in water (25 mL) was added dropwise O-methyl-O-ethyl-thiophosphoryl chloride (1.89 g, 10.8 mmol), then the reaction was kept stirring at 55-60 ºC for 3.5 h. The reaction was cooled to room temperature and organic layer was seperated, which was concentrated under vaccum to give product **2**, 2.39 g, yield 80 % and purity 85 % by HPLC. ^{1}H NMR δ_H ($CDCl_3$, main isomer): 1.36 (3H, m, CH_3), 4.15 (3H, m, CH_3O), 4.13 (2H, m, CH_2O), 7.41 (m, 1H, *p*-ArH), 7.50 (m, 2H, m-ArH), 7.64 (m, 2H, i-ArH). ^{13}C NMR δ_C ($CDCl_3$): 161.9, 140.2, 136.5, 129.7, 128.3, 77.0, 65.9, 55.5, 15.8.

Biological assays

SD big mouse acute oral toxicity evaluation method: The method for detecting and evaluating reproductive toxicity of compounds **2** includes using SD big mouse as test animal and contaminating it by orally force taking compound which was dissolved in salad oil, observing mouse mortality and calculating mortality rates after 48 h to give medium lethal dose (LD_{50}). Each treatment had three repetitions (Table-1).

TABLE-1
TOXICITY OF COMPOUNDS **2** TO SD BIG MOUSE COMPARED WITH TRIAZOPHOS

Compd.	Triazophos		Compound **2**	
	Female	Male	Female	Male
LD_{50}	58.4 mg/kg[18]	68.1 mg/kg[18]	200 mg/kg	79.4 mg/kg

Evaluation of insecticidal activity of triazophos and compound 2 in laboratory: The bioassay was performed on representative test organisms reared in the laboratory. The bioassay was repeated at 26 ºC according to statistical requirements. The test compounds were dissolved in acetone (AP, Shanghai Chemical Reagent Co., Ltd., Shanghai, China) and diluted with distilled water containing Tuwen 80 (0.1 %) to obtain series concentrations. For comparative purposes, triazophos and compound **2** were tested under the same conditions at the same time.

The activities of insecticidal compounds for *Plutella xylostella* L larva were tested by insect dipping method. The larva of *Plutella xylostella* L were dipped in diluted solutions of the chemicals and the excess dilution was sucked out with filter paper and exposed to dry. The insects were placed in Petri dishes with fresh cabbage leaf in the conditioned room. The mortality rates were evaluated different period after treatment to give medium lethal concentration (LC_{50}). Each treatment had four repetitions. The revised death rate was calculated by the Abbott formula. The insecticidal activity was summarized in Table-2.

TABLE-2
INSECTICIDAL ACTIVITIES OF TRIAZOPHOS AND COMPOUND **2**

Pest specices	Time after treatment (h)	LC_{50} (mg/L) of triazophos (μg/g)	LC_{50} (mg/L) of compd. **2** (μg/g)
Plutella xylostella L larva	6	719.686	322.927
	12	296.597	257.121
	24	305.863	201.219
	48	266.887	166.499

Toxicity: Compound **2** has the similar LD_{50} value with triazophos, which indicated that substitution of ethyl group by methyl group in 2 could not affect toxicity obviously.

Comparison of insecticidal activity of triazophos and compound 2: As summarized in Table-2, compound **2** was two fold more active than triazophos against *Plutella xylostella* L larva, which implied that compound **2** exhibited much higher laboratory insecticidal activities toward to the insect. The compound **2** was 2-fold more active than triazophos against *Plutella xylostella* L larva after 6 h and with almost the same activity as triazophos after 24 h, which indicate that compound **2** displayed quick activity against *Plutella xylostella* L larva.

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