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香根草地上部分的挥发性成分及对二化螟的诱集作用

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摘　要:香根草作为诱杀植物在农田螟虫的综合防治中被广泛应用。植物挥发物在寄主植物和它的植食性害虫的相互作用中发挥着重要的作用。实验通过气相色谱和气质联用对香根草地上部分的挥发物进行了分析,鉴定得到27种化合物。趋性实验显示樟脑和杜烯两种成分对二化螟的雌成虫具有一定的诱集作用。该项研究首次报道了香根草地上部分挥发物的成分以及其对二化螟的诱集作用。

关键词:香根草;挥发物;固相微萃取-气质联用;诱集作用;二化螟

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Volatile Constituents from Aerial Parts of *Vetiveria zizanioides* (L.) Nash and Their Behavior Regulating Effects on *Chilo suppressalis*

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Abstract: *Vetiveria zizanioides* is well known as a dead-end trap crop in habitat management strategy for *Chilo partellus*. Plant volatiles play an important role in the relationship of host plants and their phytophagous pests. Volatile constituents from aerial parts of *V. zizanioides* from china was analyzed by gas chromatography mass spectrometry (GC-MS) and gas chromatography (GC). Twenty-seven compounds were identified. Camphor and durene exhibited potent attractive effects on *C. suppressalis* female. This is the first report on volatile constituents and their attractive activity from aerial parts of this plant.

Key words: *Vetiveria zizanioides*; volatile constituent; SPME-GCMS; attractive effects; *Chilo Suppressalis*

Introduction

Vetiveria zizanioides (L.) Nash, belonging to the family Poaceae, is a perennial grass with thick fibrous adventitious roots [1]. It is native of Indian subcontinent and has been introduced in many tropical countries [2]. The plant is used in Indian folk medicine because of its digestive, carminative stomachic, constipating, haematinic, expectorant, antispasmodic, antiasthmatic, antifungal and diuretic activities [3,4]. *V. zizanioides* is also well known as an eco-friendly plant that prevents soil erosion and is useful in the rehabilitation of metalliferous polluted land [5]. It is also the major source of Vetiver oil, which is already used in treatment of several diseases, including fever, headache, and inflammation, and perfumery [6,7]. Therefore many research were focused on Vetiver oil [7-9]. Recent research on *V. zizanioides* show that this plant is not infected by pest and disease [10], and also is used as dead-end trap crop in habitat management strategy for *Chilo partellus*[11,12]. As we know, plant volatile constituents play a decisive role in the plant-insect chemical communication, and regulating insect behaviors. There is no investigation on the volatile constituents from the aerial parts of this plant. Herein we communicate results from an analysis of volatile constituents from aerial parts of this plant, and

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three compounds were tested for its behavior regulating effects on *C. suppressalis* female.

Materials and Methods

Plants, insects and reference substances

Aerial parts of the plant were collected from Hangzhou, Zhejiang Province, China in July 2011. *C. suppressalis* were reared with artificial diet in climatic chamber (28 ℃ ±1 ℃, 60%-80% RH, and a photoperiod of 14 L: 10D). Newly emerged female adults of *C. suppressalis* were collected daily and used for experiment. Reference substances, including camphor, durene, α-pinene were purchased from shanghai Xiyu company.

Volatile collection

Aerial parts of *V. zizanioides* were cut off at soil level, and the cut parts of the stem were wrapped in pieces of moist cotton to avoid desiccation. The plant were placed in a glass cylinder (5 cm diam × 30 cm), which was covered by a glass lid (5 cm diam) with two holes (1 mm diam) through which the SPME fibers were inserted for odor collection. The SPME fiber (polydimethysiloxane coating silica fiber, Supelco Co., 100 μm) was desorbed in a GC injector at 250 ℃ for 15 min before use. The desorbed fibers were exposed in the headspace of the sample for 60 min, then they were introduced into the GC and GC-MS injector for thermal desorption of the analytes at 250 ℃ for 1 min separately.

GC and GCMS analysis

GC analysis was conducted using a Shimadzu GC-17A gas chromatograph equipped with an FID detector and a Rtx-5MS fused silica column (30 m × 0.25 mm × 0.25 μm). The column temperature was kept at 40 ℃ for 2 min and programmed to 150 ℃ at a rate of 8 ℃ / min, and then programmed to 250 ℃ at a rate of 3 ℃ / min, then kept constant at 250 ℃ for 5 min; Injector and detector temperatures were set at 250 ℃; Helium carrier gas had a flow rate 1mL/min. The other sample was analyzed by Shimadzu GC-MS QP2010 Ultra, equipped with a Rtx-5MS fused silica column (30 m × 0.25 mm × 0.25 μm), in the same chromatographic conditions as described above. The MS operating parameters were as follows: electron impact ionization mode; ionization potential 70 eV; interface temperature 250 ℃; ion source temperature 200 ℃; acquisition mass range 45-500 Da.

Identification of the components was made by comparison of their mass spectra with those in the NIST08. L and NIST08s. L libraries or with authentic compounds, and confirmed by comparison of their retention indices (RI) with authentic compounds or those reported in literature [13]. The relative percentage compositions were determined on electronic integration measurements using flame ionization detection.

Two-choice bioassay

A two-choice bioassay was done in a behavior observing device[14]. *C. suppressalis* females were released to make a choice between two odor sources (rice-hexane and rice-hexane-sample). Each odor comparison was repeated 3-4 days with 30 females per day. The quantities of females which had made choices were recorded. In this research three compounds (camphor, durene and α-pinene) were tested. The data were analysis by software SPSS 13.0 and Microsoft Excel 2003.

Results and Discussion

Twenty-seven compounds were obtained from the aerial parts of *V. zizanioides*. The structures were elucidated by comparison of their mass spectra with those in the NIST08. L and NIST08s. L libraries and RI. The results showed that the volatile constituents were mainly terpene and aliphatic hydrocarbon compounds. Two choice bioassay show Camphor ($P = 0.001$) and Durene ($P = 0.007$) have potent attractive effects on *C. Suppressalis* female. Moreover, the volatile constituents nonanal and naphthalene were also reported to be attractants for stem borers[15]. Those attractive volatile compounds may be the reason why this plant was used as dead-end trap crop in habitat management strategy for *C. partellus*. This analysis could be significant for the research

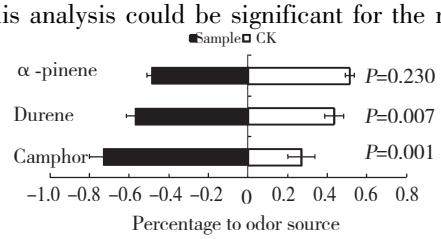

Fig. 1 Behavior regulating effect of volatile compounds on *C. suppressalis* females

Table 1 Volatile constituents from aerial parts of *V. zizanioides*

Name of compounds	RI[a]	%[b]	Name of compounds	RI[a]	%[b]
α-pinene	942	4.88	(1-Hydroxy-2,4,4-trimethylpentan-3-yl) 2-methylpropanoate	1411	4.65
2-ethylhexanol	995	2.21	Tetradecane	1433	4.35
Nonanal	1104	0.80	(+)-longifolene	1462	1.78
Isodurene	1059	0.37	α-cedrene	1468	10.24
Durene	1101	1.32	β-cedrene	1483	3.21
7-pentadecanone	1104	0.40	Pentadecane	1500	6.71
Camphor	1146	0.53	3,7,11,15-*tetramethyl*-1-*hexadecanol*	1517	1.41
Allo-ocimene	1120	0.32	Hexadecane	1600	13.05
Menthol	1191	0.42	(2*E*,6*E*)-farnesol	1608	1.93
Naphthalene	1201	2.63	Cedrol	1618	8.86
Decanal	1208	0.45	Heptadecane	1700	2.97
3,6-dimethyloctane	1301	0.88	3,7,11-trimethyl-1-dodecanol	1708	0.80
1-methyl naphthalene	1322	3.81	Norphytane	1716	4.23
2-methylnaphthalene	1395	1.09	Total		84.3

[a] The retention indices of compounds relative to C_6-C_{40} *n*-alkanes on Rtx-5MS column were determined.
[b] Percentage of each compound is calculated as (peak area of analyte/peak area of total ion chromatogram) × 100.

on the ecological relationship between *V. zizanioides* and herbivores or plant pathogens from a chemical point of view.

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(下转第 23 页)