LABORATORY STUDY ON THE LONG-TERM REPELLENCY OF DILL SEED EXTRACT TO CONFUSED FLOUR BEETLES[1]

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(Accepted for publication October 27, 1986)

ABSTRACT

Dill seed extract has strong and persistent repellency to confused flour beetle, *Tribolium confusum* Jacquelin du Val. Laboratory evaluation of repellency by the treated paper method at concentrations of 680 to 85 $\mu g/cm^2$ was continued for two years. The repellency decreased at a faster rate up to 5 mo, then slowed down gradually. After two years, still over 50% of the original repellency remained at treating concentrations of 680, 340, and 170 $\mu g/cm^2$, and about 35% for the 85 $\mu g/cm^2$ concentration.

Key Words: Dill, *Anethum graveolens*, repellency, confused flour beetle, *Tribolium confusum*.

J. Entomol. Sci. 22(1): 70-72 (January 1987)

INTRODUCTION

Seed of dill (*Anethum graveolens* L.) is used in cooking and pickling. The seed oil contains the main volatile component of d-carvone, 2-methyl-5-(1-methylethenyl)-2-cyclohexen-1-one. The insecticidal and synergistic properties of the dill plant were reported by Lichtenstein et al. (1974), and the active constituents were identified to be myristicin [4-methoxy-6-(2-propenyl)-1,3-benzodioxole], apiole [4,7-dimethoxy-5-(2-propenyl)-1,3-benzodioxole], and dill apiole [4,5-dimethoxy-6-(2-propenyl)-1,3-benzodioxole]. The intravenous toxicity of myristicin and apiole to mice was also reported.

Besides toxic and synergistic properties, dill seed and its acetone extract were found to be repellent to stored-product insects on treated paper (Su 1985). The repellency of a material to insects depends on its volatility (Mathlein 1967); therefore, the strong repellency of dill seed extract warrants further investigation of its long-term effect. This paper reports the results of studies made with paper that had been treated with an acetone extract in a previous study (Su 1985). The current study determined the repellency of dill seed to confused flour beetles, *Tribolium confusum* Jacquelin du Val, up to 24 months after the paper had been treated.

MATERIALS AND METHODS

The extract was prepared as described by Su (1985). Confused flour beetle adults, reared at $27 \pm 1°C$ and $60 \pm 5\%$ RH at the Stored-Product Insects Research and Development Laboratory, Savannah, GA, were used as the test insects. They were 7 - 14 days old.

[1] Mention of a commercial or proprietary product does not constitute a recommendation or an endorsement by the USDA.

Table 1. Repellency of *Anethum graveolens* seed acetone extract to *Tribolium confusum* adults using the treated paper method.

Rate of application ($\mu g/cm^2$)	Avg % repellency* at indicated period after treatment								Overall Avg % ± SE†‡
	1 wk	1 mo	2 mo	5 mo	8 mo	12 mo	18 mo	24 mo	
680	80.25	77.50	72.50	61.00	57.25	61.00	46.25	41.00	62.09 ± 4.99 a
340	73.75	68.25	71.75	52.25	45.00	55.50	34.75	45.25	55.81 ± 5.03 a
170	66.50	57.25	43.00	41.50	54.75	55.25	31.00	36.25	48.19 ± 4.27 ab
85	64.50	47.00	38.75	30.75	44.75	47.25	26.75	22.75	40.31 ± 4.79 b

* Average value from four replicates, 10 insects per replicate.

† Average value of 1 wk, 1 mo, 2 mo, 5 mo, 8 mo, 12 mo, 18 mo, and 24 mo.

‡ Values followed by the same letter within a column are not significantly different at the 0.05 level according to Duncan's multiple range test.

The acetone extract was evaluated for its repellency against the confused flour beetles using the method described by Laudani et al. (1955) and McDonald et al. (1970). Strips of aluminum foil laminated to 40-lb kraft paper were treated on the paper side with acetone solutions of the extract at concentrations of 680, 340, 170, and 85 $\mu g/cm^2$ as described by Su (1985). The treated papers were stored in aluminum foil folders at $27 \pm 1°C$ and $60 \pm 5\%$ RH, and repellency tests were conducted after the treatments had aged for 5, 8, 12, 18, and 24 months.

Data were anlayzed by using analysis of variance, and Duncan's multiple range test (Duncan 1955).

RESULTS AND DISCUSSION

Results of the repellency studies conducted after the treatments had aged for 5, 8, 12, 18, and 24 months are compared in Table 1 with those obtained after 1 wk, 1 mo, and 2 mo. The first two months' repellency of dill seed acetone extract on treated paper deteriorated slowly at concentrations of 680 and 340 $\mu g/cm^2$, but deteriorated at a faster rate at lower concentrations of 170 and 85 $\mu g/cm^2$. For 24 mo, the decrease of repellency varied at different rates with the 4 concentrations. For the 3 higher concentrations, the materials retained over 50% of their original repellency, but at 85 $\mu g/cm^2$, only about 35% of the original repellency remained.

The rate of decrease in repellency fluctuated from test period to test period. However, paper treated at the higher concentration always showed higher repellency than the paper treated at the lower concentration except in two cases, one was at 8 mo where the 170 $\mu g/cm^2$ dosage gave a higher repellency than the 340 μg dosage and again at 24 mo where the 340 $\mu g/cm^2$ dosage produced a slightly higher repellency than the 680 μg dosage. This could be due to the loss of some volatile component (Mathlein 1967) or various unstable components present in the acetone extract of the seeds.

The persistent repellency of the dill seed extract to confused flour beetles suggests that it be considered for further development as a protectant for grain in storage.

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