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LABORATORY INVESTIGATIONS ON THE REPELLENCY OF SOME PLANT OILS TO RED FLOUR BEETLE, *TRIBOLIUM CASTANEUM* HERBST

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Seventeen locally available plant oils were tested for their repellent activity against red flour beetle, *Tribolium castaneum*. The studies have shown that the seed oil of iple iple, *Intsia bijuga* (Coteber) Kuntze. can be favourably compared with neem oil. Both these oils showed class V repellency. Vegetable oils from *Ocimum basilicum* L. *Allium sativum* L., *Tagetes errecta* L., *Momordica charantia* L., *Apium graveolens* L., showed repellent activity of class IV while oils from *Cuminum cyminum* L., *Lagenaria vulgaris* Seringe, *Brassica juncea* L. exhibited repellent activity of class III.

Key words: Repellency, *Tribolium castaneum*, Iple iple oil.

INTRODUCTION

In recent years attention has been directed at controlling stored-grain pests with vegetable oils [1-5], essential oils [6-10] and mineral oils. Krishnarajah [11] and Abraham *et al.* [12] investigated the repellent and narcotic properties of some plant extracts to *Sitotroga cerealella* (Oliver). Krishnarajah *et al.* [10] studied the toxicity and repellency of several plant products both singly and in combination against major pest of stored paddy. Su [13] has evaluated the toxicity and repellency of coriander seeds to four species of stored-product insects.

The present study summarizes the repellent activity of some locally available plants against a stored grain pest in the hope that some of them may be used to control the infestation of grains stored for domestic use.

MATERIALS AND METHODS

Extraction method. (i) *Essential oils.* They were obtained by hydro-distillation of the following plant materials: (1) *Allium sativum*, (2) *Ocimum basilicum*, (3) *Apium graveolens*, (4) *Cuminum cyminum*, (5) *Cymbopogon citratus*, (6) *Foeniculum vulgare* and (7) *Eucalyptus globulus*.

(ii) *Fixed oils* (non-volatile): The seed-kernels of the following plants were crushed and extracted with *n*-hexane. The solvent was removed under reduced pressure.

(1) *Intsia bijuga*, (2) *Azadirachta indica* (3) *Momordica charantia*, (4) *Lagenaria vulgaris*, (5) *Annona squamosa*, (6) *Jatropha curcas*, (7) *Ricinus communis* and (8) *Brassica juncea*.

Culturing procedure. The culture of the test insect, *Tribolium castaneum* Herbst., was maintained on wheat flour with 5 % yeast at 29 ± 1° and 60 ± 5 % R.H. in glass bottles.

Repellency method. The repellency of oils was evaluated against two-to-three-week old adult beetles according to the method described by Laudani *et al.* [14] and McDonald *et al.* [15] with some modifications. Filter paper strips (Whatmann No. 1, 8x8 cm) were treated with 1 ml of 1 % oil in acetone and dried at room temperature. The treated paper strips were joined lengthwise edge-to-edge to untreated paper strips (8x4 cm) with celotape on the underside of the strips. Two glass rings (4.5 cm in height and 7 cm in dia.) were placed over two matched strips in such a way that the joined edges bisected the ring providing equal areas of treated and untreated papers. Ten adults were released in each test arena and the number of insects on treated and untreated halves was recorded twice daily (9 a.m. & 3 p.m.) for 5 days. There were 8 replicates for each treatment and tests were made at 1,2,4 and 8 weeks after treatment of the paper strip. The average percent repellency for each 5 days was calculated by doubling the difference between the percent of insects on treated half and the 50 % distribution expected if only untreated papers were used [16]. The mean repellence from exposure at periods of 1 week, 2 weeks, 1 month and 2 months after application was assigned a class by using the following scale: Class I, 0.1 to 20 %, Class II, 20.1 to 40 %; Class III, 40.1 to 60 %; Class IV, 60.1 to 80 % and Class V, 80.1 to 100 %.

Table 1. Repellency of some plant oils against *Tribolium castaneum* (Herbst.)

S. No.	Scientific names of plants	Oil source	Percent mean repellency after				Average repellency (%)	Repellency class
			1st week	2nd week	4th week	8th week		
1.	*Intsia bijuga** (Coteber) Kuntze (Iple iple)	Seeds	89.39± 1.74	93.5± 2.16	84.5 ± 4.81	94.47± 2.11	90.46	V
2.	*Azadirachta indica* L. (Neem)	"	98.05± 0.89	95.35± 2.09	85.94± 5.43	52.5 ± 2.99	82.96	V
3.	*Ocimum basilicum* L. (Sweet basil)	"	89.23± 4.37	66.75± 8.48	46.5 ±12.8	98.05± 0.98	75.13	IV
4.	*Allium sativum* L. (Garlic)	Bulbs	47.09± 4.44	93.24± 2.75	88.12± 2.92	48.21± 6.31	69.16	IV
5.	*Tagetes errecta* L. (Marigold)	Flowers	67.18± 8.69	62.58± 4.32	61.52± 6.08	72.01± 3.18	65.82	IV
6.	*Momordica charantia* L. Bitter gourd or "Karela"	Seeds	73.71± 9.56	70.94± 3.37	74.29± 1.29	43.12± 8.10	65.52	IV
7.	*Apium graveolens* L. (Celery)	"	92.68± 7.22	40.25±15.85	34.5 ±16.89	90.86± 3.90	64.57	IV
8.	*Cuminum cyminum* L. (Cumin)	"	89.77± 2.75	17.25±25.59	42.5 ±16.85	85.92± 4.01	58.86	III
9.	*Lagenaria vulgaris* Ser. (Bottle gourd)	"	55.95±10.9	55.31± 4.43	58.48± 6.79	25.57± 5.42	48.83	III
10.	*Brassica juncea* (L.) Czern. (Mustard)	"	38.72±10.5	40.94±11.76	44.32± 4.99	40.0 ±25.5	40.99	III
11.	*Annona squamosa* L. (Sharifa)	"	33.15±11.29	53.48± 8.16	46.82± 9.46	16.25±27.31	37.43	II
12.	*Ageratum houstonianum* Mill. (Common bedding plant)	"	61.76± 6.75	44.32± 5.5	27.57± 8.54	13.97± 9.4	36.91	II
13.	*Jatropha curcas* L. (Jatropha)	"	33.37±10.16	55.16± 7.38	62.72± 6.99	−5.5 ±20.44	36.44	II
14.	*Cymbopogon citratus* (Roxb) Wats. (Lemon grass)	Leaves	63.87± 7.27	6.56±10.68	55.70± 6.43	17.03± 7.23	35.79	II
15.	*Foeniculum vulgare* Miller (Fennel)	Seeds	48.21± 9.89	25.31± 4.65	34.06± 3.91	12.92± 3.12	30.13	II
16.	*Eucalyptus globulus* Labill. (Eucalyptus)	Leaves	80.65± 4.89	−31.43±15.92	27.5 ± 7.61	32.95± 4.87	27.42	II
17.	*Ricinus communis* L. (Castor)	Seeds	31.66±10.57	34.44± 6.27	43.61± 8.21	−15.5 ±20.19	23.55	II
	Control	–	3.38± 3.68	8.47± 4.86	8.3 ± 3.45	4.40± 3.40	6.12	I

*Iple iple is a leguminous species attaining the height of a tree, widely grown for forage, wood, forestation and soil improvement in low lands of tropics. The seed oil of this plant is nonvolatile and nonirritant to the skin.

RESULTS

The data on the repellent activity of 17 vegetable oils observed over a period of 60 days are presented in Table 1. It was observed that in the first week most of them showed repellent activity from Class III to V, with the maximum being from *Azadirachta indica*. The repellent activity decreased in subsequent weeks to Class II to III. The best repellent activity was found in *Azadirachta indica* and *Intsia bijuga*. The difference between the effectiveness of these two oils was relatively small. Iple iple and neem oils showed 90.46 and 82.96 % repellency (Class V) respectively. Five other plants *Ocimum basilicum, Allium sativum, Tagetes errecta, Mómordica charantia,* and *Apium graveolens* showed repellency ranging from 64.57 to 75.13 % (Class IV) while *Cuminum cyminum, Lagenaria vulgaris* and *Brassica juncea* exhibited repellent activity of Class III (40.99 to 58.86 %). The other seven vegetable oils lost their effectiveness during the 8th week of experiment.

DISCUSSION

Present studies show that oil from iple iple seeds can be favourably compared with the neem oil as far as its repellent property against *Tribolium castaneum* is concerned. Filter paper treated with iple iple seed oil was strongly repellent to red flour beetle at the application rate of 1 % concentration. Its average repellence was 90.46 % for a period of 2 months, while the well known neem oil gave repellence figure of 82.96 %. Both these oils show repellance equivalent to class V in the scale used as the standard for promising repellents [14,15]. The studies also show that repellence of iple iple oil far exceeds the well known mustard oil widely used for protecting food grains by villagers in Indian subcontinent.

Further studies of the insecticidal properties and antifeedant activity of iple iple oil for stored-product insect control are warrented. It is known that an extract from plant may give best repellency, but it may not possess antifeedant activity [17]. There is also need for further work on the composition of ipil ipil oil, especially with respect to the isolation of the active compound responsible for repellency in the hope of its exploitation.

REFERENCES

1. J. Pereira, J. Stored Prod. Res., **19**, 57 (1983).
2. H.C.F. Su, J. Econ. Entomol., **70**, 18 (1977).
3. K.B. Jadhav and L.D. Jadhav, J. Fd. Sci. Technol., 14, 110 (1984).
4. A.V. Schoonhoven, J. Econ. Entomol., **71**, 254 (1978).
5. S.R. Singh, R.A. Luse, L.K. Leuschner and D. Nangju, J. Stored Prod. Res., **14**, 77 (1978).
6. H.C.F. Su, R.D. Spiers and C.M. Patric, J. Econ. Entomol., **65**, 1433 (1972 a).
7. H.C.F. Su, R.D. Spiers and C.M. Patric, J. Econ. Entomol., **65**, 1438 (1972 b).
8. R.C. Mishra and K. Jitender, Indian Perfumer , **27**, 73 (1983).
9. J.A. Morris, A. Khettry and E.W. Seitz, J. Am. Oil Chem. Soc., **56**, 595 (1979).
10. S.R. Krishnarajah, V.K. Ganesalingam and U.M. Senanayake, Trop. Sci., **25**, 249 (1985).
11. S.R. Krishnarajah and V.K. Ganesalingam, J. Nat. Sci. Conc., Sri Lanka, **9**, 79 (1981).
12. C.C. Abraham, B. Thomas, K. Karunakaran and R. Gopalakrishnan, Agr. Res., J. Kerala, **10**, 59 (1972).
13. H.C.F. Su, J. Entomol. Sci., **2**, 169 (1986).
14. H. Laudani, D.F. Davis and G.R. Swank, Tech. Assoc. Pulp Paper Ind., **38**, 336 (1955).
15. L.L. McDonald, R.H. Guy and R.D. Spiers, USDA Mktg. Res. Rep., 882, 8 . (1970).
16. H.B. Gillenwater and L.L. McDonald, J. Ga. Ent. Soc., **10**, 151 (1975).
17. M.M. Malik and S.H.M. Naqvi, J. Stored Prod. Res., **20**, 41 (1984).