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EFFICACY OF ESSENTIAL OILS AGAINST THREE STORED PRODUCT COLEOPTERA IN WHEAT STORED IN SUPERBAGS

Ranjeet Kumar*, Purnvarath S Pandey[1] and Ravindra Kumar Sohane[2]

Department of Entomology, Veer Kunwar Singh College of Agriculture, Dumraon, Buxar Bihar Agricultural University, Sabour, Bhagalpur 813210, Bihar, India
[1]Education Planning and Home Science Division, ICAR, KAB II, New Delhi 110012, India
[2]Bihar Agricultural University, Sabour, Bhagalpur 813210, Bihar, India
*Email: rkipm06@gamil.com (Corresponding author)

ABSTRACT

This study evaluates the efficacy of essential oils against *Sitophilus oryzae* (L.), *Rhyzopertha dominica* L. and *Tribolium castaneum* Herbst in wheat stored in superbags under laboratory condition. The results reveal that the essential oil of *Chenopodium botrys, Citrus reticulata, Lantana camara,* and *Pinus roxburghii* at 0.4% alone or in combination of *C. botrys*+ *C. reticulata, C. reticulata*+ *P. roxburghii, L. camara*+ *P. roxburghii, C. botrys*+ *P. roxburghii* at 0.2% each completely check the feeding and breeding of these pests. The essential oil of *C. botrys, C.reticulata, L.camara,* and *P. roxburghii* at 0.4% either alone or in combination (as above) at 0.2% check the infestation and weight loss, up to twelve months of storage.

Key words: Essential oils, *Chenopodium botrys, Citrus reticulata, Lantana camara, Pinus roxburghii,* alone or combination, wheat, superbags, storage, *Sitophilus oryzae, Rhyzopertha dominica, Tribolium castaneum,* fumigant toxicity

Sitophilus oryzae (L.) (Coleoptera: Curculionidae), *Rhyzopertha dominica* L. (Coleoptera: Bostrichidae) and *Tribolium castaneum* Herbst (Coleoptera: Tenebrionidae) are important pests of stored wheat. These insects spoil food and food security, thus, depends not only on primary agricultural production but sufficient post-harvest storage. It is essential to search the alternatives for traditional chemical fumigants, by exploring essential oils from plants like *Chenopodium botrys, Citrus reticulata, Lantana camara, Pinus roxburghii.* To deploy these in protecting stored wheat, their fumigant and contact toxicity, ovicidal activity, mortality and repellent activity need to be explored (Kumar et al., 2020; Rajendran et al., 2008; Tripathi et al., 2002). The superbags is a special type of polythene bag widely used for the storing the grain and seeds. These provide more airtight condition as compared to ordinary plastic bags. The storage of wheat in these, especially the effect of the essential oils from plants has been poorly studied. In the present experiment, attempt has been made to evaluate the efficacy of essential oils against three stored product beetles in wheat stored in superbags.

MATERIALS AND METHODS

The experiments were conducted at the Department of Entomology, Veer Kunwar Singh College of Agriculture, Dumraon, Buxar (Bihar Agricultural University, Sabour) during 2019-2020. Pure culture of *S. oryzae, R. dominica,* and *T.castaneum* were developed in the BOD incubator (27°C± 1; 70± 5% RH) in plastic jars of 1 kg capacity. These jars were having a lid with hole of 1.8 cm dia covered with 30 mesh copper wire net, holding grains of wheat variety HD-2967, and its flour fortified with 5% yeast powder (for rearing *T. castaneum*). Before use, grain was disinfested at 60°C for 12 hr in hot air oven. After disinfestations the moisture content of the grain was measured and raised to 13.5% by mixing water in the grains following Pixton (1967). Oils selected for the study were extracted by steam distillation in the laboratory by Clevenger Apparatus. The efficacy of four essential oils *Chenopodium botrys, Citrus reticulata, Lantana camara, Pinus roxburghii* and their combinations was evaluated under controlled conditions same as rearing condition. Thirty kg of wheat variety HD-2967 with moisture content (13.5%) was filled in superbags and 50 pairs of adults (0-7 days old) of *S. oryzae R. dominica* and *T. castaneum* were released in each. After 24 hr of release, required quantity of essential oil soaked on blank mat was inserted in each superbag, closed and sealed with strips. Each treatment was replicated three times. Observations were made after ten months of storage. The homogenous sample of 500 g from

Table 1. Efficacy of essential oils on the storage pests after use in superbags on wheat

S.No.	Essential oils	Con. %	Combi %	After 10 months of storage		After 12 months of storage	
				Adult emerged	% inhibition	Adult emerged	% inhibition
			S. oryzae				
1	*Chenopodium botrys*	0.4		0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
2	*Citrus reticulata*	0.4		0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
3	*Lantana camara*	0.4		0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
4	*Pinus roxburghii*	0.4		0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
5	*Chenopodium botrys+ Citrus reticulata*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
6	*Chenopodium botrys+ Lantana camara*	0.4	0.2E	4.8 (1.6)	72.42	15.0 (2.1)	57.56
7	*Chenopodium botrys+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
8	*Citrus reticulate+ Lantana camara*	0.4	0.2E	0.8 (0.6)	96.14	4.7 (1.6)	89.73
9	*Citrus reticulate+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
10	*Lantana camara + Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
11	Untreated control			10.7 (1.9)	0.0	28.0 (3.3)	0.0
	S.Em. ±			0.72		0.63	
	CD (p=0.05)			1.88		1.77	
			R. dominica				
1	*Chenopodium botrys*	0.4		0.0 (0.0)	100.00	0.0 (0.0)	100.00
2	*Citrus reticulata*	0.4		0.0 (0.0)	100.00	0.0 (0.0)	100.00
3	*Lantana camara*	0.4		0.0 (0.0)	100.00	0.0 (0.0)	100.00
4	*Pinus roxburghii*	0.4		0.0 (0.0)	100.00	0.0 (0.0)	100.00
5	*Chenopodium botrys+ Citrus reticulata*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
6	*Chenopodium botrys+ Lantana camara*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
7	*Chenopodium botrys+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
8	*Citrus reticulate+ Lantana camara*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
9	*Citrus reticulate+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
10	*Lantana camara+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
11	Untreated control			29.0 (2.7)	0.0	34.0 (2.9)	0.0
	S.Em. ±			0.41		0.46	
	CD (p=0.05)			1.23		1.27	
			T. castaneum				
1	*Chenopodium botrys*	0.4		0.0 (0.0)	100.00	0.0 (0.0)	100.00
2	*Citrus reticulata*	0.4		0.0 (0.0)	100.00	0.0 (0.0)	100.00
3	*Lantana camara*	0.4		0.0 (0.0)	100.00	0.0 (0.0)	100.00
4	*Pinus roxburghii*	0.4		0.0 (0.0)	100.00	0.0 (0.0)	100.00
5	*Chenopodium botrys+ Citrus reticulata*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
6	*Chenopodium botrys+ Lantana camara*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
7	*Chenopodium botrys+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
8	*Citrus reticulate+ Lantana camara*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
9	*Citrus reticulate+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
10	*Lantana camara+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	100.00	0.0 (0.0)	100.00
11	Untreated control			11.8 (2.3)	0.0	12.7 (2.4)	0.0
	S.Em. ±			0.26		0.36	
	CD (p=0.05)			0.77		0.98	

S. No.	Essential oils	Con. %	Combi %	After10 months of storage		After 12 months of storage	
				% Infestation	% Weight loss	% Infestation	% Weight loss
1	*Chenopodium botrys*	0.4		0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
2	*Citrus reticulata*	0.4		0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
3	*Lantana camara*	0.4		0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
4	*Pinus roxburghii*	0.4		0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
5	*Chenopodium botrys+ Citrus reticulata*	0.4	0.2E	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
6	*Chenopodium botrys+ Lantana camara*	0.4	0.2E	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
7	*Chenopodium botrys+ Pinus roxburghii*	0.4	0.2E	0.94 (0.7)	0.6 (0.3)	1.82 (0.8)	0.14 (0.1)
8	*Citrus reticulate+ Lantana camara*	0.4	0.2E	0.83 (0.3)	0.3 (0.1)	0.87 (0.4)	0.25 (0.2)
9	*Citrus reticulate+ Pinus roxburghii*	0.4	0.2E	0.3 (0.1)	0.3 (0.1)	0.04 (0.3)	0.0 (0.0)
10	*Lantana camara+ Pinus roxburghii*	0.4	0.2E	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
11	Untreated control			09.63 (2.8)	0.97 (0.7)	12.78 (2.8)	0.23 (0.4)
	S.Em. ±			0.11	0.38	0.25	0.26
	CD (p=0.05)			0.45	0.96	0.76	0.77

Infestation and weight loss due to infestation of *S. oryzae*, *R.dominica*and *T. castaneum* in wheat stored in superbags
Data in parentheses indicate log (X+1) transformed value; E= Each

each replication was taken for computation of % inhibition, infestation and weight loss. Data obtained were analyzed in completely randomized design after suitable log (1+X) transformation.

RESULTS AND DISCUSSION

The number of adults of *S. oryzae* emerged and % inhibition due to treatment of essential oils in stored wheat in superbags is given in Table 1; these data reveal that the essential oil of *C, botrys, C. reticulata, L. camara,* and *P. roxburghii* at 0.4% either alone or in combination of *C. botrys+ C. reticulata, C. reticulata+ P. roxburghii, L. camara + P. roxburghii C. botrys + P. roxburghii* at 0.2% each completely check the feeding and breeding of *S. oryzae* and inhibit 100.00%, after ten and twelve months of storage. The essential oils of *C. reticulata+ L. camara* were also found highly effective against *S. oryzae* after ten months of storage and this effectiveness slightly declined after 12 months of storage. Similarly, with *R. dominica* the % inhibition was observed with essential oils either alone or in combination with 100.00% inhibition. With *T. castaneum* also similar efficacy could be observed. The data on % infestation and weight loss also similar results (Table 1).

The essential oils of *M. koenigii, C. reticulata, C. citrinus* either alone at 0.2% or two component combinations were found highly effective against *S. oryzae* and *R. dominica* (Kumar et al., 2018). Essential oil of *Artemisia annua* evaluated by Tripathi et al. (2002) against *T. castaneum* and *C. maculatus* revealed adult repellent, and effects on larval or survival and adult emergence of *T. castaneum*. (Tunc et al., 2000) observed fumigant toxicity of essential oil from cumin (*C. cyminum*) against eggs of two *T. confusum* and *E. kuhniella* with 100% mortality. The essential oil of *C. botrys, C. longa, C. reticulata, L. camara, P. roxburghii* at 0.1, 0.2, 0.3, 0.4% were found highly effective against *S. oryzae*. The essential oil of *C. botrys, C. longa, C. reticulata, L. camara, P. roxburghii, C. winerianus, E. globules, C. flexuosus, C. martini* at 0.1, 0.2, 0.3, 0.4% were found highly effective against *R. dominica*. The essential oil of *C. botrys, C. reticulata, L. camara, P. roxburghii* at 0.1, 0.2, 0.3, 0.4 percent were found highly effective against *T. castaneum* as they caused 100% inhibition (Kumar et al., 2021).

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