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EFFICACY OF PLANT EXTRACTS AS IMPREGNATION OF CLOTH BAGS AGAINST RUST RED FLOUR BEETLE, *TRIBOLIUM CASTANEUM* (HERBST)

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ABSTRACT

The *neem* seed kernel extract (NSKE), mustard oil and *Undi* leaf extract 10.0 per cent impregnated bags (filled with wheat flour of variety, Raj. 3077) resulted in no of up to 75 days of application. After 75 days of treatment with NSKE 10.0 per cent impregnated bags only 3.00 – 15.00 per cent adult emerged. This was followed by *Undi* extract 10.0 per cent (4.00 – 29.33 adult emergence) and mustard oil 10.0 per cent impregnated bags (7.00 – 27.33 adult emergence). After 150 days of treatment, NSKE 10.00 per cent and 5.0 per cent impregnated bags resulted in significantly low adult emergence over control (untreated). No weight loss was inflicted by *T. castaneum* in treatment with NSKE 10.0 per cent, *Undi* leaf extract 10.0 per cent and mustard oil 10.0 per cent impregnated cloth bags revealed nil weight loss upto 75 days of treatment.

Key words: NSKE, mustard oil, *Undi* leaf extract, *Tribolium castaneum* (Herbst), adult emergence, weight loss.

INTRODUCTION

Wheat and wheat products are attacked by number of insect pests under storage; among them, the rust red flour beetle, *Tribolium castaneum* (Herbst (Tenebrionidae: Coleoptera) is a cosmopolitan species, causing considerable losses as secondary pest. A number of fumigants and other chemicals are used to control stored grain pests; but, toxic chemicals evidently pose several problems, *viz*., chronic and acute toxicity, development of insect resistance, environmental pollution and the like. One of the eco-friendly and economic approaches to keep the stored food grains free from insect attack, would be using the plant products as grain protectants. There are encouraging reports on the use of certain indigenous plant products as grain protectants and impregnation of packaging materials with plant products. These age old practices of exploiting plant products need scientific evaluation. The efficacy of indigenous plant products, extracts and oils has been evaluated (Joseph *et al.*, 1994; Bhargava and Meena, 2002 and Sahayaraj and Ravi, 2003) but definite information on mortality doses, efficacy of oil and extracts by treatment of packaging materials is meagre, which needs detailed investigation.

MATERIALS AND METHODS

The investigation on the effect of plant extracts through impregnation of cloth bags against rust red flour beetle, *Tribolium castaneum* (Herbst) was conducted in Department of Zoology-Entomology, B.B.D. Government PG College, Chimanpura (Shahpura), Jaipur during March, 2006 to November, 2007 under controlled condition of temperature (29 ± 1.5°C) and relative humidity (70 ± 5 per cent). To maintain the stock culture of insect, healthy wheat grains (variety, Raj. 3077) were sterilised at 60°C tempeature for 5 hours with the help of heavy duty oven to clear off hidden infestation and then were maintained at 29 ± 1.5°C temperature and 70 ± 5 per cent relative humidity for 48 hours for conditioning. The pure culture of *T. castaneum* was procured from the Department of Entomology, S.K.N. College of Agriculture, Jobner, Jaipur and was developed on crushed wheat grain from single gravid female. For maintaining subsequent insect culture, 20 pairs of newly emerged adult insects were released for oviposition in the glass jar (size 18 × 6.5 cm) containing 200 g crushed wheat grains. Further, the newly emerged adults were transferred in a earthen pot bin containing conditioned seeds in order to maintain a stock culture for continuous supply of large number of insects required for the experimentation.

The plant products *Neem* (*Azadirachta indica* seed kernel); *Karanj* (*Pongamia pinnata* leaf); *Neelgiri* (*Eucalyptus melanophloia* leaf); Aak (*Calotropis procera* leaf); *Datura,* (*Datura metel leaf*)*; Undi* (*Calophyllum inophyllum* leaf); *mustard* (*Brassica juncea* oil) were

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procured and extracts were prepared in acetone as the slovent. These extracts were used to impregnate the cloth bags. The experiment was laid out in completely randomised design with four replications. The cloth bags were filled up with wheat flour (Raj. 3077), opening stitched and kept with the general infested stock to have natural infestation of *T. castaneum*. There were two doses of plant extract and oil, *viz.*, 5.0 and 10.0 per cent. A control (acetone) and control (untreated) was maintained for comparison with the treatments. The adult emergence was recorded at every fortnightly interval by sieving the flour. After counting, the emerged adults and the cadaver adults were discarded from the sample to avoid further counting of the same. The weight loss in flour due to incessant feeding by the grub and adult stage was recorded by sieving the flour to exclude the excreta and insect stages. The per cent data on weight loss was transformed into angular values (arc sine Öpercentage) and number of adults into log X+1 values for analysis of variance.

RESULTS AND DISCUSSION

In all the treatments there was no adult emergence of to 45 days. After sixty days treatments with *Neem* seed kernel extract (NSKE), *Undi* leaf extract and mustard oil (10.0%) revealed zero adult emergence which was at par with the NSKE 5.0 per cent (0.33 adult). The next effective treatment was *Karanj* leaf 10.0 per cent (1.33 adults) which differed significantly over rest of the treatments (Table 1). The highest numbers of adults were found in the *Eucalyptus* 5.0 per cent (6.33 adults) which was at par with the *Calotropis* extract 5.0 per cent (6.00 adults), *Datura* leaf extract 5.0 per cent, *Eucalyptus* leaf extract 10.0 per cent, *Calotropis* leaf extract 10.0 per cent, *Datura* leaf extract 10.0 per cent and *Undi* leaf extract 5.0 per cent. The other treatments were ranked in the middle order of effectivity. All the treatments differed significantly over the control. Devi *et al.* (1988) stored tapioca chips in the bags treated with different concentrations of plant extracts and found that *Neem* extract was more effective than malathion. Darwish (1997) pointed out that the toxicity of extracts of *Neem* (*A. indica*) and *Datura* (*Datura stramonium*) leaves increased with the modified atmospheric conditions, *viz.*, 23 and 47 per cent CO_2. Upto 45 days of fabric impregnation no weight loss in flour due to *T. castaneum* infestation was observed. However, the same was observed after 60 days of treatment in most of the treatments (Table 2). No weight losses were observed in NSKE 10.0 per cent, *Undi* extract 10.0 per cent and mustard oil 10.0 per cent. Significant weight losses over the control (untreated). Minimum weight loss was recorded in the treatment of NSKE 5.0 per cent (0.01%) followed by *Karanj* leaf extract 10.0 per cent (0.35%) which differed statistically.

After seventy five days of treatment, the adult emergence in different treatments was in the range of 0.00 – 11.00, *vis-a-vis* 17.67 in the control (untreated). All the treatments differed significantly over the control. *Neem* seed kernel extract (NSKE) 10.0 per cent, *Undi* extract 10.0 per cent and mustard oil 10.0 per cent revealed zero adult emergence which was found significantly superior over rest of the treatments. The next effective treatments were *Karanj* leaf extract 10.0 per cent and NSKE 5.0 per cent (3.33 adults each) which differed significantly over rest of the treatments. The highest number of adults were found in *Eucalyptus* 5.0 per cent (11.00 adults). Ramamurthy and Venugopal (1997) reported that along with conventional insecticides, NSKE 5 and 3 per cent and *Neem* oil 2 per cent were also effective as impregnation of bags in avoiding *S. cerealella* damage. The weight losses observed after 75 days of treatment in NSKE 10.0 per cent, *Undi extract* 10.0 per cent and mustard oil 10.0 per cent was also zero. Minimum weight loss was recorded in the treatment of NSKE 5.0 per cent (0.81%) followed by *Karanj* leaf extract 10.0 per cent (0.84%), however, which were statistically at par each other.

After ninety days of treatment, the adult emergence in different treatments was in the range of 3.00 – 16.67, *vis-a-vis* 27.33 in the control (untreated). The adult emergence in *Neem* seed kernel extract (NSKE) 10.0 per cent and *Undi* extract 10.0 per cent was 3.00 and 4.00, respectively, which were significantly superior over rest of the treatments, except NSKE 5.0 per cent (6.00 adults) which was at par with the *Undi* extract 10.0 per cent. The highest numbers of adults were found in the *Datura* leaf extract 5.0 per cent (16.67 adults) followed by *Eucalyptus* 5.0 per cent, *Calotropis* extract 5.0 per cent, *Undi* extract 5.0 per cent, *Eucalyptus* 10.0 per cent, *Calotropis* extract 10.0 per cent, *Karanj* leaf extract 5.0 per cent, mustard oil 5.0 per cent and *Datura* leaf extract 10.0 per cent. The weight loss observed after 90 days of treatment in NSKE 10.0 per cent was 0.71 per cent which differed significantly over all the treatments. However, all the treatments exhibited significant weight losses over the control or untreated (6.09%). Minimum weight loss was recorded in the treatment of *Undi* 10 per cent (0.96%) followed by NSKE 5.0 per cent (1.40%) which were statistically at par to each other.

After 105 days of treatment, adult emergence in different treatments ranged from 6.00 – 24.00 *vis-a-vis* 33.67 in the control (untreated). All the treatments differed significantly over the control except *Datura* leaf extract

Table 1. Effect of plant product impregnated cloth bags on the *T. castaneum* adult emergence in wheat flour after different periods of storage

Materials/Extract	Dose	Periods of storage (days)						
		60	75	90	105	120	135	150
1. Neem seed kernel	5%	0.33 (0.12)	3.33 (0.64)	6.00 (0.85)	10.33 (1.05)	15.67 (1.22)	18.67 (1.29)	19.67 (1.32)
	10.00%	0.00 0.00	0.00 0.00	3.00 (0.60)	6.00 (0.85)	9.33 (1.04)	13.33 (1.16)	15.00 (1.20)
2. Karanj leaf	5%	3.67 (0.67)	7.67 (0.94)	12.33 (1.12)	20.67 (1.34)	28.33 (1.47)	33.00 (1.53)	42.00 (1.63)
	10.00%	1.33 (0.37)	3.33 (0.64)	10.33 (1.05)	14.33 (1.18)	18.67 (1.29)	23.67 (1.39)	33.33 (1.54)
3. Eucalyptus leaf	5%	6.33 (0.87)	11.00 (1.08)	16.00 (1.23)	19.67 (1.32)	28.33 (1.47)	35.67 (1.56)	43.67 (1.65)
	10%	5.33 (0.80)	10.00 (1.04)	14.00 (1.18)	18.67 (1.29)	26.33 (1.44)	31.67 (1.51)	40.67 (1.62)
4. Calotropis	5%	6.00 (0.85)	10.33 (1.05)	15.00 (1.20)	17.67 (1.27)	25.33 (1.42)	27.67 (1.46)	33.67 (1.54)
	10.00%	5.33 (0.80)	9.00 (1.00)	13.00 (1.15)	16.67 (1.25)	23.33 (1.39)	26.67 (1.44)	30.67 (1.50)
5. Datura leaf	5%	5.67 (0.82)	10.33 (1.05)	16.67 (1.25)	24.00 (1.40)	27.00 (1.45)	29.33 (1.48)	34.33 (1.55)
	10.00%	4.33 (0.73)	9.00 (1.00)	11.00 (1.08)	15.67 (1.22)	23.33 (1.39)	26.67 (1.44)	30.67 (1.50)
6. Undi	5%	4.33 (0.73)	7.00 (0.90)	11.00 (1.19)	18.33 (1.29)	26.00 (1.43)	32.00 (1.55)	37.33 (1.58)
	10.00%	0.00 0.00	0.00 0.00	4.00 (0.70)	10.00 (1.04)	14.33 (1.19)	23.00 (1.38)	29.33 (1.48)
7. Mustard oil	5%	3.00 (0.60)	5.67 (0.82)	11.00 (1.08)	18.67 (1.29)	25.00 (1.41)	31.67 (1.51)	37.33 (1.58)
	10.00%	0.00 0.00	0.00 0.00	7.00 (0.90)	13.67 (1.17)	17.00 (1.26)	22.67 (1.37)	27.33 (1.45)
8. Control (Acetone)	-	13.33 (1.16)	17.00 (1.26)	27.00 (1.45)	34.33 (1.55)	41.33 (1.63)	49.67 (1.71)	58.00 (1.77)
9. Control (Untreated)	-	13.00 (1.15)	17.67 (1.27)	27.33 (1.45)	33.67 (1.54)	41.33 (1.63)	49.00 (1.70)	59.67 (1.78)
S.Em. ±	-	0.04	0.05	0.06	0.07	0.06	0.07	0.08
CD (p=0.05)	-	0.12	0.14	0.18	0.21	0.18	0.20	0.25
CD (p=0.01)	-	0.16	0.17	0.21	0.25	0.21	0.24	0.28

* Figures in parentheses are log X + 1 values.

5.0 per cent. NSKE 10.0 per cent (6.00 adults), *Undi* extract 10.0 per cent (10.00 adults) and NSKE 5.0 per cent (10.33 adults) were at par in their efficacy. The highest number of adults were found in the *Datura* leaf extract 5.0 per cent (24.00 adults) followed by *Karanj* leaf extract 5.0 per cent (20.67 adults), *Undi* extract 5.0 per cent (18.33 adults), *Eucalyptus* 5.0 per cent (19.67 adults), mustard oil 5.0 per cent (18.67 adults), *Eucalyptus* 10.0 per cent (18.67 adults), *Calotropis* extract 5.0 per cent (17.67 adults), *Calotropis* extract 10.0 per cent, (16.67) and *Datura* leaf extract 10.0 per cent (15.67 adults). After 105 days of treatment, the weight losses observed in NSKE 10.0 per cent was 1.45 per cent which differed significantly over all the treatments. All the treatments exhibited significant weight losses over the control or untreated (7.03%) except *Datura* leaf extract 5.0 per cent (5.70%).

Table 2. Effect of plant product impregnated cloth bags on weight loss caused by *T. castaneum* in wheat flour after different periods of storage

Materials/Extract	Dose	Periods of storage (days)						
		60	75	90	105	120	135	150
1. Neem seed kernel	5%	0.01 (0.57)	0.81 (5.16)	1.40 (6.80)	2.51 (9.12)	3.80 (11.24)	4.60 (12.38)	4.90 (12.79)
	10.0%	0.00 0.00	0.00 0.00	0.71 (4.83)	1.45 (6.92)	2.40 (8.91)	3.61 (10.95)	3.81 (11.26)
2. Karanj leaf	5%	0.92 (5.50)	1.80 (7.71)	3.11 (10.16)	4.13 (11.72)	6.19 (14.41)	8.10 (16.53)	9.12 (17.58)
	10.0%	0.35 (3.40)	0.84 (5.26)	2.41 (8.93)	3.52 (10.81)	4.23 (11.87)	5.92 (14.08)	8.11 (16.55)
3. Eucalyptus leaf	5%	1.58 (7.22)	2.49 (9.08)	3.92 (11.42)	4.82 (12.68)	6.99 (15.33)	8.01 (16.44)	8.93 (17.39)
	10.0%	1.32 (6.60)	2.22 (8.57)	3.41 (10.64)	4.62 (12.41)	6.12 (14.32)	7.82 (16.24)	8.82 (17.28)
4. Calotropis	5%	1.48 (6.99)	2.51 (9.12)	3.60 (10.94)	4.02 (11.57)	5.85 (14.00)	6.67 (14.97)	7.70 (16.11)
	10.0%	1.28 (6.50)	2.12 (8.37)	3.10 (10.14)	3.90 (11.40)	5.60 (13.69)	6.00 (14.18)	7.05 (15.40)
5. Datura leaf	5%	1.40 (6.80)	2.40 (8.91)	4.10 (11.16)	5.70 (13.81)	6.95 (15.29)	7.01 (15.35)	8.24 (16.68)
	10.0%	1.01 (5.77)	2.00 (8.13)	2.53 (9.15)	3.88 (11.36)	5.89 (14.05)	6.67 (14.97)	7.11 (15.46)
6. Undi	5%	1.08 (5.97)	1.67 (7.43)	2.50 (9.10)	4.10 (11.68)	6.01 (14.19)	7.00 (15.34)	8.11 (16.55)
	10.0%	0.00 0.00	0.00 0.00	0.96 (5.62)	2.40 (8.91)	2.72 (9.49)	5.00 (12.92)	7.21 (15.78)
7. Mustard oil	5%	0.75 (4.97)	1.12 (6.07)	2.65 (9.37)	4.10 (11.68)	5.00 (12.92)	6.50 (14.77)	8.10 (16.54)
	10.0%	0.00 0.00	0.00 0.00	1.56 (7.17)	2.40 (8.91)	3.00 (9.97)	4.10 (11.68)	5.18 (13.16)
8. Control (Acetone)	-	2.90 (9.80)	3.50 (10.78)	6.10 (14.30)	7.00 (15.34)	8.11 (16.55)	9.00 (17.46)	9.20 (17.66)
9. Control (Untreated)	-	2.88 (9.77)	3.52 (10.81)	6.09 (14.29)	7.03 (15.38)	8.14 (16.58)	9.01 (17.47)	9.27 (17.73)
S.Em. ±	-	0.16	0.18	0.22	0.25	0.39	0.47	0.50
CD (p=0.05)	-	0.48	0.55	0.66	0.75	1.20	1.40	1.51
CD (p=0.01)	-	0.55	0.66	0.78	0.88	1.37	1.55	1.74

* Figures in parentheses are angular transformed values.

After 120 days of treatment, NSKE 10.0 per cent, *Undi* extract 10.0 per cent and NSKE 5.0 per cent recorded adult emergences of 9.33, 14.33 and 15.67, respectively which were at par with each other. The highest number of adults were found in *Eucalyptus* 5.0 per cent (28.33), *Karanj* leaf 5.0 per cent (28.33 adults) followed by *Datura* leaf extract 5.0 per cent (27.00 adults), *Undi* extract 5.0 per cent (26.00 adults), *Calotropis* leaf extract 5.0 per cent (25.33 adults), *Eucalyptus* leaf extract 10.0 per cent (28.33 adults) mustard oil 5.0 per cent (25.00 adults), *Calotropis* leaf extract 10.0 per cent (25.33 adults) and *Datura* leaf extract 10.0 per cent (23.33 adults). All the treatments exhibited significant weight losses over the control or untreated (8.14%).

After 135 days of treatment, the adult emergence in different treatments ranged from 13.33 – 35.67, *vis-a-vis* 49.00 in the control (untreated). The NSKE 10.0 per cent

(13.33 adults) and NSKE 5.0 per cent (18.67 adults) found at par in their efficacy. The highest number of adults were found in the *Eucalyptus* 5.0 per cent (35.67 adults) followed by *Undi* extract 5.0 per cent (32.0 adults), *Karanj* leaf extract 5.0 per cent (33.00 adults), mustard oil 5.0 per cent (31.67 adults), *Datura* leaf extract 5.0 per cent (29.33 adults) and *Calotropis* extract 5.0 per cent (27.67 adults). Kumar *et al.* (2006) studied toxic effect of the extracts of *Karanj* (*P. pinnata*) bark, leaves and seeds against *T. castanium*, the leaf extract showed toxicity followed by bark extract and methanolic fraction of oil.

After 150 days of treatment, the adult emergence in different treatments ranged from 15.00 to 43.67, *vis-a-vis* 59.67 in the control (untreated). The NSKE 10.0 per cent (15.00 adults) and NSKE 5.0 per cent (19.67 adults) was at par in their efficacy. Islam and Talukder (2005) reported higher direct toxicity of *Neem* seed extract (100 mg/ insect) to red flour beetle.

After 150 days of treatment, the weight loss observed in NSKE 10.0 per cent was 3.81 per cent, which differed significantly over rest of the treatments. The next effective treatments were NSKE 5.0 per cent (4.90%) and mustard oil 10.0 per cent (5.18%) that were at par to each other.

The effectiveness of plant products in a decreasing order was as : neem seed kernel extract (10%)> neem seed kernel extract (5%)>mustard oil (10%)> *Datura* leaf extract (10%)>*Calotropis* extract (10%)>*Undi* extract (10%)> *Calotropis* extract (5%)>mustard oil (5%)>*Karanj* leaf extract (10%)>*Undi* extract (5%)> *Datura* leaf extract (5%)> *Eucalyptus* leaf extract (10%)>*Eucalyptus* leaf extract (5%)> and *Karanj* leaf extract (5%).

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