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EFFECT OF MECHANICALLY DAMAGE PERCENTAGE AND OIL TREATMENT ON STORABILITY OF WHEAT IN METAL BIN

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Abstract: Storability of wheat grain was studies in terms of pest population, percent grain damage by insect, percent weight loss, germination percentage and moisture content of grain for different mechanically damage percentage of wheat grain in bulk as well as various quantity of oil treatment to the wheat grain. Individual effect of mechanically damage grain and castor oil treatment on insect infestation of lesser grain borer, percent grain damage and weight loss was found significant after three month of storage whereas their effect on germination percentage and moisture content was non-significant.

Key words*: wheat storage, metal bin, castor oil, grain damage, germination*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of important leading cereal crop with cultivated area (31.19 m ha) and the production (95.91mt.) achieved by India [2].Wheat occupies a central position in agriculture sector and our national economy, used as staple food. Seed are required to be kept in safe storage since they are harvested in the preceding season and usually used for sowing in the subsequent season often after a time gap of six months or longer. Thus proper storage is required to keep seeds in good condition. Pests are more causative factor of corrosion during storages. Among pests, lesser grain borer can effectively endure proliferate under conditions, where the multiplication of most of the insects is restricted. Lesser grain borer, *Rhyzopertha dominica* (F.) is one of the

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primary pests on different types of stored products, mainly grain. One of the alternatives to overcome this problem is application of natural products derived from aromatic plants with potential repellent and insecticidal effect on lesser grain borer, and no harmful effect on human environment [9]. Conventional control measures have been carried out by using insecticides applied directly on grain, or by gas fumigation. So the special attention should be given to pests in storage environment. Lesser grain borers mainly attack wheat, corn, rice and millet. Both the larvae and adults are primary pests. They bore irregularly shaped holes into whole, undamaged kernels and the larvae, immature stages, may develop inside the grain. Larval and adult feeding in and on grain kernels may leave only dust and thin brown shells. A sweet, musty odor is often associated with infestations of this insect. Karanj oil, neam oil, castor oil, are particularly effective as protectors against lesser grain borer [11].

MATERIAL AND METHODS

Wheat harvested by combine harvester were procured from farmer field and it was cleaned to remove broken grains. Mechanical damage grain were mixed in different percent weight (0, 3, 6, and 9%). These grains were treated with castor oil in three different level (i.e. 5, 10 and 15 $ml \cdot kg^{-1}$). Untreated grains were considered as control. The grains were stored in metal bin at room temperature.

Entomological observations such as pest population and percent grain damage by insect were recorded as under.

Pest population. A number of adult pest was counted from each randomly selected sample from each replication and recorded for pest population per sample.

Percent grain damage. A grain damage by pest was counted from 100 randomly selected grains from each sample and recorded percent grain damage.

Physical parameters such as moisture content, percent weight loss and germination percentage were recorded as under.

Moisture content. The moisture content was determined by an oven method, which is a direct method. The grain was weighed and dried, then weighed again according to standard procedures. The moisture content was calculated using the moisture content equations.

Grain moisture content was expressed as a percentage of moisture based on weight (wet basis).

$$M = \frac{w - d}{w} \times 100 \quad (1)$$

where:

w [kg] - wet weight,
d [kg] - dry weight,
M [%] - moisture content.

A representative sample was obtained to provide a useful moisture content evaluation.

Weight loss. Initial weight of wheat at storage time w_a and weight of wheat after six months d_b was noted and calculated as per following formula:

$$\%\, Weight\ loss = \frac{w_a - d_b}{w_a} \times 100 \tag{2}$$

where:

w_a [kg] - initial weight of wheat,

d_b [kg] - weight of wheat after six months.

Percent of germination. One hundred grain of each stored wheat sample were placed and soaked on blotting paper in the Petri dish. Each treatment was repeated eight times. After a period of 72 hours, number of germinated seeds in each Petri dish was counted. The experiment was conducted under Completely Randomized Design (*CRD*). The initial germination percentage of respective sample was calculated by using the following formula.

$$Germination\ \%age = \frac{No.of\ germinated\ seed}{Total\ no.of\ seed\ soaked\ in\ each\ petridish} \times 100 \tag{3}$$

Same procedure was followed after a period of three months to record the final germination % age for grains of wheat.

RESULTS AND DISCUSSION

The experimental work was carried out for two years during the year 2012-13 and 2013-14. Results of pool mean data are presented.

Pest population. The data regarding pest population after three month of storage are given in Tab. 1.

After three month of storage untreated (0% castor oil treatment) wheat grains were infested heavily hence it was discarded. Therefore, three months storage data were analyzed statistically. The mean results showed that the individual effect of mechanically damage grain and castor oil treatment on insect infestation of lesser grain borer was found significant after three month of storage of wheat. Pest population was found lower 2.70 in 0% mechanically damage grain with 15 ml·kg^{-1} castor oil treatment. The infestation of pest was slightly increased with increase of mechanically damage grain of wheat. The infestation of pest was found decreased with increase of castor oil treatment. The all interaction was found non-significant. The pest population remains low in all mechanically damage grain treated with 15 ml·kg^{-1} castor oil.

The mean results showed (Tab. 2) that insect infestation of lesser grain borer was started after two month of storage of wheat and remains up to eight month of storage. Pest population was increased after three month of storage and it was found maximum in untreated castor oil treatments. Hence, all untreated (control) treatment was disposed after three month of storages. The minimum pest population was found in the treatment of 15 ml·kg^{-1} castor oil for all mechanically damage grain after eight month of storage. The results were in line with Kumawat and Naga (2013) in which they observed no pest population in grain treated with 1.0% Neem oil, 1.0% castor oil, 1.0% mustard oil, and 1.0% Taramira oil up to 90 days of treatment.

Table 1. Pest population (Lesser grain borer, Rhizopertha dominica F.) after three month storage of wheat

Treatment	Average No. of adult/ sample					
	2012-13		2013-14		Pooled mean	
Mechanical damage	Square root √x+0.5 Transform value	Retrans form value	Square root √x+0.5 Transform value	Retrans form value	Square root √x+0.5 Transform value	Retrans form value
D1=0%	1.68	2.32	1.90	3.11	1.79	2.70
D2=3%	1.92	3.19	1.92	3.19	1.92	3.19
D3=6%	2.05	3.70	2.01	3.54	2.03	3.62
D4=9%	2.29	4.74	2.15	4.12	2.22	4.43
S.Em.	0.08		0.06		0.05	
CD at 5%	0.21		0.17		0.14	
Castor oil						
O1=5 ml	1.91	3.15	1.94	3.26	1.93	3.22
O2=10 ml	1.28	1.14	1.60	2.06	1.44	1.57
O3=15 ml	1.05	0.60	1.24	1.04	1.15	0.82
O4=0 ml	3.69	13.12	3.20	9.74	3.45	11.40
S.Em.	0.08		0.06		0.05	
CD at 5%	0.21		0.17		0.14	
DxO						
S.Em.	0.15		0.12		0.10	
CD at 5%	NS		0.35		NS	

Table 2. Pest population build up (Lesser grain borer, Rhizopertha dominica F.) during storage of wheat

Sr. No	Treatments		Average No. adult / Sample after months of storage							
	Mechanically damage percentage (%)	Oil treatment ($ml \cdot kg^{-1}$)	1	2	3	4	5	6	7	8
1	0	5	0	0	0.50	2.75	3.75	1.50	-	-
2		10	0	0	0.25	1.00	1.25	0.50	1.50	1.75
3		15	0	0	0	0	0.25	-	0.25	0.75
4		0	0	5.00	8.00	-	-	-	-	-
5	3	5	0	0	1.50	4.75	-	2.00	-	-
6		10	0	0	0.50	1.75	1.75	0.50	2.25	2.75
7		15	0	0	0	0.25	0.75	-	0.75	0.75
8		0	0	8.25	11.25	-	-	-	-	-
9	6	5	0	0.25	2.75	4.75	-	3.25	-	-
10		10	0	0	0.25	2.25	2.75	1.50	2.00	
11		15	0	0	0	0.50	0.75	-	1.00	1.00
12		0	0	8.75	10.75	-	-	-	-	-
13	9	5	0	0.25	3.25	5.75	-	3.25	-	-
14		10	0	0.50	1.00	2.00	2.75	1.75	3.00	
15		15	0	0	0	0.25	2.00	-	1.50	1.50
16		0	0	10.75	12.75	-	-		-	-

The powders and oils of *A. indica*, *A. occidentale* and *M. oleifera* seeds tested were toxic to the rice weevil, *S. oryzae* [10]. *A. indica* has been found to be effective against the maize weevil, *S. zeamais* and cowpea bruchid, *C. maculatus* [6]. This has been attributed to the presence of triterpenoids, which include azadirachtin, salanin and meliantriol in *A. indica* [6, 15]. The oil also blocked the spiracles which might have led to suffocation of the insects [1,7]. Most insects breathe through the trachea which usually leads to the opening of the spiracle. These spiracles might have been blocked by the powders and extracts thereby leading to suffocation [6,15].

Percent of grain damage. The data regarding percent grain damage after three month of storage are given in Tab. 3.

Table 3. Percent of grain damage by lesser grain borer after three month storage of wheat

Treatment	Percent of grain damage by lesser grain borer					
	2012-13		2013-14		Pooled mean	
Mechanical damage	Arcsin √x transform value	Retrans form value	Arcsin √x transform value	Retrans form value	Arcsin √x transform value	Retrans form value
D1=0%	9.57	2.76	13.70	5.61	11.64	4.07
D2=3%	12.65	4.80	14.78	6.51	13.72	5.63
D3=6%	13.24	5.25	15.94	7.54	14.59	6.35
D4=9%	15.38	7.03	18.58	10.15	16.98	8.53
S.Em.	0.54		0.41		0.34	
CD at 5%	1.54		1.17		0.95	
Castor oil						
O1=5 ml	9.10	2.50	15.86	7.47	12.48	4.67
O2=10 ml	4.14	0.52	14.08	5.92	9.11	2.51
O3=15 ml	2.65	0.21	8.98	2.44	5.82	1.03
O4=0 ml	34.95	32.82	24.08	16.65	29.51	24.26
S.Em.	0.54		0.41		0.34	
CD at 5%	1.54		1.17		0.95	
DxO						
S.Em.	1.08		0.82		0.68	
CD at 5%	3.07		2.34		1.91	

The mean results showed in Tab. 3 indicated that the individual effect of mechanically damage grain, castor oil treatment and storage bag/bin on damage of grain due to insect was found significant after three month of storage of wheat The percent damage of grain was found lower 4.07 in 0% mechanically damage grain, 15 ml·kg^{-1} castor oil treatment and storage metal bin respectively. The damage was slightly increased with increase of mechanically damage grain of wheat. The damage was found decreased with increase of castor oil. The damage of grain was found minimum in metal bin container treatments. The all interaction were found significant. The pest damage was found low in all mechanically damage grain, all 15 ml castor oil and all metal bin storage treatments as compared to control.

The mean results showed in Tab. 4 that damage of grain due to insect was started after two month of storage of wheat and remains up to eight month of storage. Damage

of grain was increase after three month of storage and it was found maximum in untreated castor oil treatments. Hence all untreated (control) treatment disposed after three months of storage. The minimum damage was found in the treatment of of 15 $ml \cdot kg^{-1}$ castor oil for all mechanically damage grain of 15 $ml \cdot kg^{-1}$ castor oil for all mechanically damage grain after eight month of storage. Kumawat and Naga (2013) reported for up to 90 days of treatment, no grain damage was recorded in 1.0% castor oil treated grain, and no grain damage was recorded in 1.0% Tarmira oil treated grain for up to 90 days of treatment.

Table 4. Percent grain damage during storage of wheat due to insect infestation of lesser grain borer

Sr. No	*Treatments*		*% of grain damage after months of storage*							
	Mechanically damage percentage (%)	*Oil treatment ($ml \cdot kg^{-1}$)*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1	*0*	*5*	*0*	*0*	*0.75*	*4.75*	*8.50*	-	-	-
2		*10*	*0*	*0*	*0.75*	*1.50*	*2.75*	*2.25*	*3.00*	*3.50*
3		*15*	*0*	*0*	*0*	*0*	*0.50*	*1.00*	*1.50*	*1.75*
4		*0*	*0*	*6.25*	*17.00*	-	-	-	-	-
5	*3*	*5*	*0*	*0*	*3.50*	*10.50*	-	-	-	-
6		*10*	*0*	*0*	*1.00*	*2.50*	*3.00*	*3.50*	*4.25*	*5.00*
7		*15*	*0*	*0*	*0*	*0.25*	*1.00*	*1.25*	*1.50*	*2.00*
8		*0*	*0*	*8.25*	*24.50*	-	-	-	-	-
9	*6*	*5*	*0*	*0*	*3.00*	*10.50*	-	-	-	-
10		*10*	*0*	*0*	*1.50*	*3.25*	*4.00*	*4.25*	*5.00*	
11		*15*	*0*	*0*	*0*	*0.50*	*1.50*	*2.00*	*2.25*	*2.50*
12		*0*	*0*	*10.5*	*24.50*	-	-	-	-	-
13	*9*	*5*	*0*	*1.00*	*4.25*	*15.00*	-	-	-	-
14		*10*	*0*	*0.25*	*0.75*	*3.75*	*4.75*	*6.25*	*7.00*	-
15		*15*	*0*	*0*	*0*	*1.00*	*2.25*	*2.75*	*3.00*	*3.25*
16		*0*	*0*	*12.50*	*30.25*	-	-	-	-	-

Weight loss. The data regarding weight loss after three month of storage are given in Tab. 5.

The mean results showed in Tab. 5 indicated that the individual effect of mechanically damage grain and castor oil treatment on weight loss was found significant after three month of storage of wheat. The percent weight loss was found lower 1.23 and 0.80 in 0% mechanically damage grain and 15 ml castor oil treatment respectively. The weight loss was slightly increased with increase of mechanically damage grain of wheat. The weight loss was found decreased with increase of castor oil. The all interaction were found non-significant.

However, looking to the mean data in Table No. 6 indicated that in all mechanically damage grain, weight loss was found low in all 15 ml castor oil treatments as compared to control after three and six month of storage. The weight loss was recorded high in the all control (untreated) treatments which may be due to high insect grain damage. Weight loss was found low in *D1O2, D1O3, D2O3, D3O3* and *D4O3* after six month of storage. The findings are in line with Arya and Tiwari (2013). They reported that indigenous

plant and animal origin bio products have been found significantly effective over untreated control as more insect mortality, less adult emergence, seed damage, weight loss with more percent seed germination.

Table 5. Percent of weight loss after three month storage of wheat

Treatment	*2012-13*		*2013-14*		*Pooled mean*	
Mechanical damage	*Arcsin √x transform value*	*Retrans form value*	*Arcsin √x transform value*	*Retrans form value*	*Arcsin √x transform value*	*Retrans form value*
D1=0%	*6.05*	*1.11*	*6.68*	*1.35*	*6.36*	*1.23*
D2=3%	*6.41*	*1.25*	*7.30*	*1.61*	*6.85*	*1.42*
D3=6%	*6.58*	*1.31*	*7.47*	*1.69*	*7.03*	*1.50*
D4=9%	*6.95*	*1.46*	*7.91*	*1.89*	*7.43*	*1.67*
S.Em.	*0.23*		*0.18*		*0.15*	
CD at 5%	*NS*		*0.52*		*0.42*	
Castor oil						
O1=5 ml	*5.42*	*0.89*	*7.27*	*1.60*	*6.34*	*1.22*
O2=10 ml	*4.63*	*0.65*	*6.59*	*1.32*	*5.61*	*0.96*
O3=15 ml	*4.49*	*0.61*	*5.74*	*1.00*	*5.12*	*0.80*
O4=0 ml	*11.45*	*3.94*	*9.76*	*2.87*	*10.61*	*3.39*
S.Em.	*0.23*		*0.18*		*0.15*	
CD at 5%	*0.67*		*0.52*		*0.42*	
DxO						
S.Em.	*0.47*		*0.36*		*0.30*	
CD at 5%	*NS*		*NS*		*NS*	
CV%	*17.68*		*12.18*		*14.88*	

Table 6. Percent weight loss after three month and six month of storage of wheat

Sr. No.	*Treatment*		*After 3 months*			*After 6 months*		
	Mechanically damage percentage	*Oil treatment (ml·kg^{-1})*	*2012 - 2013*	*2013 - 2014*	*Average*	*2012 - 2013*	*2013 - 2014*	*Average*
1	*0*	*5*	*0.65*	*1.20*	*0.925*			
2		*10*	*0.50*	*0.75*	*0.625*	*0.70*	*1.00*	*0.85*
3		*15*	*0.40*	*0.40*	*0.40*	*0.60*	*0.80*	*0.70*
4		*0*	*3.50*	*2.65*	*3.075*	-	--	
5	*3*	*5*	*0.90*	*1.35*	*1.125*	-	-	
6		*10*	*0.50*	*1.10*	*0.8*	*1.20*	*1.20*	*1.20*
7		*15*	*0.55*	*0.50*	*0.525*	*0.85*	*0.85*	*0.85*
8		*0*	*4.00*	*2.80*	*3.4*	-	-	
9	*6*	*5*	*0.80*	*1.50*	*1.15*	-	-	
10		*10*	*0.60*	*1.35*	*0.975*	*1.10*	*1.50*	*1.30*
11		*15*	*0.65*	*0.60*	*0.625*	*0.88*	*0.90*	*0.89*
12		*0*	*2.95*	*2.90*	*2.925*	-	-	
13	*9*	*5*	*0.90*	*1.75*	*1.325*	-	-	
14		*10*	*0.70*	*1.25*	*0.975*	*1.70*	*1.60*	*1.65*
15		*15*	*0.60*	*0.70*	*0.65*	*1.00*	*1.05*	*1.025*
16		*0*	*4.10*	*3.20*	*3.65*	-	-	-

Table 7. Percent of germination and percent of moisture content after six month of storage of wheat

Sr. No.	Treatment	% Germination after six month			% M. C. after six month		
		2012-13	2013-14	Average	2012-13	2013-14	Average
1	D1O2	92.5	68.0	80.25	7.74	9.94	8.84
2	D1O3	95.0	76.0	85.50	6.95	9.34	8.14
3	D2O2	90.0	66.0	78.00	7.06	10.37	8.71
4	D2O3	92.5	74.0	83.25	7.86	9.38	8.62
5	D3O2	90.0	64.0	77.00	7.55	10.48	9.01
6	D3O3	92.5	72.0	82.55	7.98	9.72	8.85
7	D4O2	85.0	62.0	73.50	7.92	10.68	9.30
8	D4O3	90.0	68.0	79.00	8.02	9.81	8.91

The mean data in Tab. 7 indicated that the percent germination was found 73.5% to 85.5% after six month of storage in remaining treatment. The germination was recorded higher in any mechanically damage grain with 15 ml castor oil treatment after six month of storage this may be due to low pest damage of grain. From the above mentioned results it can be concluded that mite are responsible for the reduction in germination of wheat grains. Bashir *et al*., (2009) also revealed that with the increase in mite population the germination of the seeds reduces. Based on these results it can be concluded that pests are mainly responsible for the germination loss in the stored grains [12]. The present findings are almost in agreement with those of Mamun and shajahan (2011) where they reported that with plant materials and extracts did not adversely affect the seed germination.

The mean data in Tab. 7 indicated that the percent moisture content of grain in remaining treatment was found 8.14% to 9.30% after six month of storage and it was found minimum(8.14%) in treatment 0% mechanical damage and 15 ml oil treatment and maximum (9.30%) in treatment 9% mechanical damage and 10 ml oil treatment respectively. Moisture content on grain was found slightly low in all 15 ml castor oil treatment as compared to 10 ml castor oil. Moisture content on grain was found low in year 2012-13 due to lack of rain during season. No adverse effect of plant oils was observed on seed viability for up to 270 days of treatments [11].

CONCLUSIONS

It may be concluded that the even after higher percentage of mechanically damage grain, castor oil treatment reduces the pest population, percent grain damage by pest, and weight loss. It has no adverse effect on germination.

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UTICAJ PROCENTA MEHANIČKIH OŠTEĆENJA I TRETMANA ULJEM NA SKLADIŠTENJE PŠENICE U METALNOM SILOSU

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Sažetak: Skladištenje zrna pšenice ispitivano je u zavisnosti od populacije štetočina, procenta oštećenja zrna od insekata, procenta gubitka mase, procenta klijavosti i sadržaja vlage zrna za za različite procente mehaničkih oštećenja zrna pšenice u skladištu. Ispitivane su i različite količine ulja za tretiranje zrna pšenice. Pojedinačni uticaj mehanički oštećenog zrna i tretman ricinusovim uljem na populaciju insekata, procenat oštećenja zrna i gubitak mase bili su značajni posle tri meseca skladištenja, dok njihov uticaj na procenat klijavosti i sadržaj vlage nije bio značajan.

Ključne reči: *skladištenje pšenice, metalni silos, ricinusovo ulje, oštećenje zrna, klijanje*

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