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Evaluation of Different Formulations of Plant Products Against Rice Weevil, *Sitophilus oryzae* (L.) in Field Bean Split Dhal

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ABSTRACT

The experiment was carried out under laboratory condition in the Department of Agricultural entomology, UAHS, Shivamogga. The effective Concentration of all the products viz.,1 per cent sweet flag rhizome powder, 2 per cent neem leaf powder, 1.5 per cent ginger rhizome powder, 1 per cent cashew nut shell powder and 1.5 per cent zandu parad powder was formulated separately with wood ash and gel form and evaluated with 5 per cent malathion dust as standard check along with untreated control against Sitophilus oryzae L. adult mortality, F1 progeny, split field bean dhal damage and split field bean weight loss. Among the two formulations of different plant products tested wood ash and gel based Sweet flag rhizome powder at 1 per cent was found to be superior at 96hr after treatment followed by cashew nut shell powder at 1 per cent. The nest best treatments were ginger rhizome powder and zandu parad powder at 1.5 per cent. Whereas, neem leaf powder at 2 per cent was found to be least effective. However, all the plant products found effective when compared to untreated control.

Key words: *Sitophilus oryzae, Split dhal, gel entrapment, wood ash*

INTRODUCTION

The rice weevil, *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae), is one of the most destructive pests of stored cereals worldwide. It is classed as a primary pest, cosmopolitan in nature[4] and causes severe loss in rice, maize, barley and wheat[9]. Though the storage grain loss is caused by insect pests, pathogens and rodents it is generally believed that half of the storage loss is usually by the insects[2]. Considering the loss caused by storage insect pests, effective methods of control are of paramount importance.

The most common method of stored pest control is the application of malathion or fumigation with volatile substances (EDB, EDCT, Aluminium phosphide tablet *etc*.). Though, these chemicals offer efficient protection against pests, because certain undesirable side affects *viz.*, residual toxicity, application hazards, environmental pollution *etc*. Consumers are afraid to use such food with toxic effects and residual chemicals.

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In this context use of plant products having efficient insecticidal properties is followed by age old Indian farmers, most of which exist today as indigenous practices and are being realized as safe tool in the stored pest management. Keeping this in view, the present investigation was carried out using different formulations of plant products in combination with wood ash and gel entrapment to reduce the damage of *Sitophilus oryzae* on field bean split dhal.

MATERIAL AND METHODS

The experiment was carried out under in laboratory during 2014-15 in the Department of Agricultural Entomology, UAHS, Shivamogga. Effective concentration of all products *viz*., 1% sweet flag rhizome, 2% neem leaf, 1.5% ginger rhizome, 1% cashew kernel and 1.5% zandu parad powder was formulated with wood ash and gel and evaluated against *S. oryzae* with standard check 5% Malathion dust and untreated control.

Wood ash formulation: Dried plant product was weighed to get the desired concentration of each product and mixed with wood ash which is used as carrier.

Gel entrapment formulation: Gel entrapment includes Sodium alginate and Calcium chloride. To formulate plant product with gel, 4 % Sodium alginate was mixed with water and plant product which forms gel and the mixture is dropped slowly to a cold 1.5 % calcium chloride solution with the help of a broken pipette or spatula and decanted excess calcium chloride solution. The beads, thus formed, were allowed to cure at 4∘C overnight.

Experimental procedure: A known quantity of 100g field bean split legume seeds was thoroughly mixed with different treatments (both solid (wood ash) and gel form) in cloth bag and each treatment was replicated thrice. Ten pairs of rice weevils were collected from stock culture and were released into cloth bag and tied with rubber band. While collecting rice weevils from main culture they were kept in deep freeze for one to two minutes to inactivate and facilitate for counting and releasing. The observations were recorded on adult mortality, F1 progeny (adult emergence), per cent dhal damage and dhal weight loss.

Adult mortality was assessed for 4 days for every 24 hr. On day 5th, all insects, both dead and alive were removed from each cloth bag and the dhal placed back to their respective cloth bags. The per cent adult mortality was recorded on the basis of number of dead and live insects. Progeny emergence (F1) was recorded at 6 weeks. The containers were sieved out and newly emerged adult weevils were counted. At 6th week, the dhals were reweighed and the per cent dhals damage and weight loss was calculated. Damaged dhals were counted in each treatment and finally expressed as percentage. The percentage of damaged dhal was calculated by the following formula.

$$\text{Dhal damage (\%)} = \frac{\text{Number of damaged dhals}}{\text{Total number of dhal}} \times 100$$

Split legume weight loss was computed by using formula as suggested by Harris and Limblad (1978)

$$\text{Per cent weight loss} = \frac{\text{O.W. - C.W}}{\text{O.W}} \times 100$$

Where; O.W = Original weight of dhals on dry weight basis

C.W= Current weight of dhals on dry weight basis

The experimental data were analysed statistically using ANOVA (two factor completely randomised design). The level of significance used in F and T test was p=0.01. Critical differences were calculated wherever F test was significant.

RESULTS AND DISCUSSION

Results from table 1 and 2 clearly indicated that, sweet flag rhizome powder formulation with wood ash and gel form was found significantly superior over the other plant product formulation. However, among the formulation tested wood ash based found more effective compare to gel formulation against *S. oryzae* in split field bean dhal.

Sweet flag rhizome powder and malathion powder formulation with wood ash at 96hr

showed cent per cent mortality and with gel form recording (70 % and 86.67%), respectively followed by cashew nut shell powder formulation (95% and 65%), respectively (table 1). With respect to F_1 progeny the number of adults emerged per 100 g of split field bean dhal sample was recorded after 6 week of storage. There was no adult emergence in standard check, malathion and sweet flag rhizome powder in wood ash formulation; whereas, in gel form, emergence was noticed with 12 and 25 adults, respectively followed by cashew kernel powder formulation (13 and 35 adults). Among the treatments, per cent dhal damage was least in sweet flag rhizome powder (1.04 % and 25.45%) and malathion (0.00% and 12.30%) followed by cashew nut shell powder (13.95 % and 35.77 %) with wood ash and in gel formulation, respectively. Observation on dhal weight loss revealed that, dhals treated with malathion dust recorded (0.00 and 3.0%) and sweet flag rhizome powder (1.57 and 9.30%) showed minimum dhals weight loss in wood ash and gel form after 6 weeks of storage. This was followed by cashew nut shell powder (1.83% and 12.17%), respectively (Table 2). However, all the plant products with wood ash and gel form found effective over untreated control recording 40% and 0 % mortality, 90 and 225 adults, 45.07% and 93.50% seed damage and 30.50% and 74% seed weight loss per 100g seeds, respectively.

In recent years large number of plant extracts and secondary metabolites has been screened for their activities against stored product insects and they are reported to possess insecticidal, repellent or antifeedant activities against various stored product insects[6,13,15]. Reports also indicate that neem based products and sweet flag rhizome powder are very effective against *Sitophilus oryzae*[5] However, reports about its occurrence on legumes are scanty. Pemberton *et al.*[10] studied its breeding behaviour on carob, *Ceratonia siliqua* (L.), a tree legume native to the Mediterranean region. Coombs *et al.*[1] reported the successful development by Trinidad strain of *S. oryzae* on yellow split pea. In India, the pest was recorded for the first time to feed on red gram at Coimbatore[14].

Table 1: Evaluation of different formulations of plant product against *S. oryzae* in field bean split dhal

Plant products	Formulation	% Adult mortality				
		24hr	48hr	72hr	96hr	Mean
Sweet flag rhizome powder at 1%	Woodash	10.00 (18.44)	41.67 (40.23)	51.67 (45.98)	100.00 (90.05)	50.83
	Gel	0.00 (0.00)	36.67 (37.29)	60.00 (50.79)	70.00 (56.82)	41.66
Neem leaf powder at 2%	Woodash	1.67 (7.43)	25.00 (30.02)	41.67 (40.23)	70.00 (56.82)	34.58
	Gel	0.00 (0.00)	16.67 (24.11)	25.00 (30.02)	48.33 (44.07)	22.50
Ginger rhizome powder at 1.5%	Woodash	3.33 (10.52)	31.67 (34.26)	55.00 (47.89)	85.00 (67.25)	43.75
	Gel	0.00 (0.00)	23.33 (28.90)	46.67 (43.11)	56.67 (48.86)	31.66
Zandu parad powder at 1.5%	Woodash	6.67 (14.97)	35.00 (36.29)	50.00 (45.02)	85.00 (67.25)	44.16
	Gel	0.00 (0.00)	31.67 (34.26)	48.33 (44.07)	61.67 (51.77)	35.41
Cashew kernel powder at 1%	Woodash	6.67 (14.97)	40.00 (39.25)	61.67 (51.77)	95.00 (77.12)	50.83
	Gel	0.00 (0.00)	25.00 (30.01)	46.67 (43.11)	65.00 (53.76)	34.16
Malathion at 5% (Standard check)	Woodash	15.00 (22.80)	45.00 (42.15)	70.00 (56.82)	100.00 (90.05)	57.50
	Gel	25.00 (30.02)	43.33 (41.19)	65.00 (53.76)	86.67 (68.62)	55.00
Untreated control	Woodash	0.00 (0.00)	11.67 (19.99)	13.33 (21.42)	40.00 (39.25)	16.25
	Gel	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
		S.Em	CD 1%			
	Plant (P)	0.10	0.26			
	Formulation (F)	0.19	0.50			
	Hours (H)	0.14	0.37			
	P x F	0.27	0.70			
	P x H	0.21	0.54			
	F x H	0.38	1.00			
	Interaction (P x F x H)	0.53	1.40			
CV (%)		4.55				

Figures in the parentheses are angular transformed values

Table 2: Evaluation of different formulations of plant product with against F1 progeny adult emergence, seed damage and weight loss due to *S. oryzae* in field bean split dhal after six weeks of storage

Plant products	Formulation	F1 Progeny adult emergence	Seed damage (%)	Split dhal Wt loss (%)
Sweet flag rhizome powder at 1%	Wood ash	0.00 (0.71)*	1.04 (5.86)**	1.57 (7.19)**
	Gel	25.00 (5.05)	25.45 (30.31)	9.30 (17.76)
Neem leaf powder at 2%	Wood ash	30.00 (5.52)	29.07 (32.65)	12.00 (20.28)
	Gel	86.00 (9.30)	80.84 (64.08)	31.00 (33.85)
Ginger rhizome powder at 1.5%	Wood ash	21.00 (4.64)	20.56 (26.97)	7.00 (15.35)
	Gel	55.00 (7.45)	54.05 (47.35)	19.00 (25.86)
Zandu parad powder at 1.5%	Wood ash	15.00 (3.94)	14.60 (22.48)	6.00 (14.19)
	Gel	45.00 (6.75)	42.72 (40.84)	16.00 (23.59)
Cashew kernel powder at 1%	Wood ash	13.00 (3.67)	13.95 (21.94)	1.83 (7.79)
	Gel	35.00 (5.96)	35.77 (36.75)	12.17 (20.42)
Malathion at 5% (Standard check)	Wood ash	0.00 (0.71)	0.00 (0.00)	0.00 (0.00)
	Gel	12.00 (3.54)	12.30 (20.54)	3.00 (9.98)
Untreated control	Wood ash	90.00 (9.51)	45.07 (42.19)	30.50 (33.54)
	Gel	225.00 (15.02)	93.50 (75.27)	74.00 (59.37)

	S.Em±	CD @1%	S.Em±	CD @1%	S.Em±	CD@1%
Plant product (P)	0.10	0.27	0.53	1.46	0.51	1.43
Formulation (F)	0.05	0.14	0.28	0.77	0.27	0.76
Interaction (P x F)	0.14	0.38	0.74	2.07	0.73	2.02
CV (%)	2.89		2.72		4.32	

*Figures in the parentheses are $\sqrt{x+0.5}$

** Figures in the parentheses are angular transformed values

CONCLUSION

The present findings show that among the plant powder treatments sweet flag rhizome powder (1%) with wood ash and gel formulation against rice weevil, *S. oryzae* found effective by showing highest per cent of adult mortality and least adult emergence (F1 progeny), dhal damage and dhal weight loss compared to other plant products. This may be due to strong insecticidal and ovicidal property of sweet flag as reported by Kittur[7] and Shivanna[12]. All plant products are capable of blocking the spiracle of insects and this can lead to suffocation and death. Meanwhile, wood ash also play important role as respiratory poison in insects. The next best treatment was cashew kernel powder. The effectiveness of cashew kernel might be due to the oily nature, toxic substances or repellent compounds which alters insect behaviour and it is bitter, caustic and fumigatory with smokes that irritate and gives off choking fumes[11]. This might be the reason for low adult emergence. Mandal[8] reported that presence of cardol content of cashew nut has pronounced insecticidal properties might also caused lower adult build up and seed infestation percentage. The results of the study conclusively demonstrated that plant products can be used in management of *S. oryzae* infesting split dhal.

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