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Nandini

Department of Entomology,
College of Agriculture Navile
University of Agricultural and
Horticultural Sciences,
Shivamogga, Karnataka, India

M Manjunatha

Department of Entomology,
College of Agriculture Navile
University of Agricultural and
Horticultural Sciences,
Shivamogga, Karnataka, India

M Bheemanna

Department of Entomology,
College of Agriculture Raichur
University of Agricultural
Sciences, Raichur,
Karnataka, India

BR Gurumurthy

Department of Crop physiology,
College of Agriculture Navile
University of Agricultural and
Horticultural Sciences,
Shivamogga, Karnataka, India

Physical and biochemical analysis in relation to incidence of rice weevil, *S. oryzae* in different Split legume

Nandini, M Manjunatha, M Bheemanna and BR Gurumurthy

Abstract

The experiment was carried out under laboratory condition at PRFQAL University of Agricultural Sciences, Raichur. The physical and biochemical analysis in relation to incidence of rice weevil, *S. oryzae* in different split legumes before and after three months of storage revealed that there was significant increase in adult population among the tested split legumes with the highest infestation in field bean dhal subsequently with an increase in weight loss also. With respect to biochemical content there was a significant reduction in fat, fiber, carbohydrates and increase in protein, ash and moisture content.

Keywords: Rice weevil, split legumes, nutritive changes, physical changes

Introduction

The legumes are rich in protein and form a major constituent of diets of masses in developing countries like India. Pulse contains 20 to 30 per cent of the protein which is almost three times higher than that of cereals. The losses during storage are more in case of pulses compared to cereals (Huysmans) [10]. During storage, legumes deteriorate qualitatively as well as quantitatively due to various physio-chemical and biological factors like temperature, humidity, storage structures, micro-organisms, fungi, insects rodents and birds. The insect is the major cause of weight loss, quality deterioration of stored legumes. One of the species, rice weevil, *Sitophilus oryzae* (Linnaeus), (Coleoptera: Curculionidae) is the predominant pest causing considerable grain loss during storage (Champ and Dyte) [3]. It is a pest of international or the importance of a variety of stored grains viz., wheat, maize, rice and sorghum. Larvae and adults are internal feeders, the feeding process reduces the quality and weight of the grain and produces large amount of grain dust (Hardman) [9]. Apart from the physical loss in weight there are changes in colour, smell or taste, contamination with toxins, pathogens, reduction in nutritional value and loss of viability.

Historically, *S. oryzae* has been associated with stored cereals (Cotton [6]; Chu and Wang [4]. but can breed in commodities other than cereal grains such as yellow split peas and pasta. It has been observed that losses in storage can be reduced substantially if legumes are stored as dhal rather than whole grain which are more prone to attack by storage insect pests (Muehlbauer and Kaiser) [13]. But, some recent reports (Coombs *et al.* [5]; Halloway and Smith [8]; Pemberton and Rodriguez [15]) indicated their ability to feed on some legumes. In India, the *S. oryzae* was recorded for the first time to feed on split red gram dhal at Coimbatore (Vijay *et al.*) [17]. However, reports about its occurrences on legumes are scanty. So the present study was planned to determine Physical and biochemical analysis in relation to incidence of rice weevil, *S. oryzae* in six different split legumes after three months of storage

Material & Methods

The experiment was carried out by using 100 g of each known variety of six selected split legumes viz., field bean dhal (Hebbal), bengal gram dhal (JG-11), green gram dhal (BGS- 9), black gram dhal (Rashmi), red gram dhal (Asha) and kesar dhal (local) and was kept in cloth bag. Ten pairs of adult insects were released and the cloth bag was tied with a twine thread. Each treatment was replicated thrice and stored for three months. At the end of each storage period, adults were isolated from each bag and samples of split legumes dhals were taken from each bag to determine dhal weight loss, moisture content and percentage was calculated and

Correspondence

Nandini

Department of Entomology,
College of Agriculture Navile
University of Agricultural and
Horticultural Sciences,
Shivamogga, Karnataka, India

biochemical changes induced by insect infestation was analysed both in uninfested and infested split legumes using the Association of Official Analytical Chemist by AOAC 2005 [1] procedure before and after three months of storage. a) Fat estimation through pelican SOCS plus apparatus



Fig a): Socsplus – SCS (Fat estimation)



Fig b): Fibraplus FES (Fiber estimation)



Fig c): Kjeltac auto titration unit for protein estimation

Results and Discussion

The physical and biochemical analysis in different split legumes revealed that the highest number of *S. oryzae* adult population emerged with per cent dhal weight loss was noticed in field bean dhal after 90 days of storage followed by bengal gram dhal. However, as the population decreased the per cent weight loss also decreased in all the split legumes.

With respect to the biochemical content of different split legumes revealed that there was a significant increase in protein, moisture content and ash content at 90 days after storage except for black gram dhal and kesar dhal where the per cent increase in protein was not significant and in kesar dhal the per cent moisture content was not significant. However, there was a significant decrease in the percentage of fat in all the split legumes except black gram dhal and kesar dhal. With regard to the percentage of fiber content there was significant decrease at 90 days after storage in all the split legumes except in green gram dhal and kesar dhal. With regard to percentage of carbohydrate there was non-significant difference with all the dhal except in field bean and bengal gram dhal where per cent decrease was significant.

(petroleum ether 70 ml), b) Fiber estimation through Fibraplus- operational procedure, c) Protein estimation through Kjeltac method (Auto titration method), Total available carbohydrate (as% glucose) through the Clegg-Anthrone method and ash estimation through muffle furnace.

In the present findings, increase in moisture, protein, ash and reduction in fat, fiber and carbohydrate are in conformity with those of Modgil [11], Beenam and Ranjana [2], Gopinath *et al.*, [7] Pankaj and Singh [14] and Soujanya *et al.* [16]. But the present findings are in contradictory with Mofunanya and Namgbe [12] who documented the decrease in moisture due to *S. oryzae* infestation. This may be attributed to the metabolic activities of pest and or respiratory activity of the dhal. This is probably because the pest utilizes the moisture in infested dhals for growth and other activities. With respect to ash, increase due to infestation may be attributed to feeding activities of *S. oryzae* generating a lot of residue in the form of ash. The decrease in the fat content is due to direct feeding on cotyledon of the split legume which is having high oil content when compared to dhal coat or embryo of the whole grain. The increase in protein content might be due to increase in uric acid, non-protein nitrogen and also due to the presence of insect body fragments and body parts inside the grain. The decrease in carbohydrate could be attributed to break down of starch during storage due to insect and dhal activity as well as consumption of carbohydrates by the insect.



Fig. d) Oil from different Split legumes

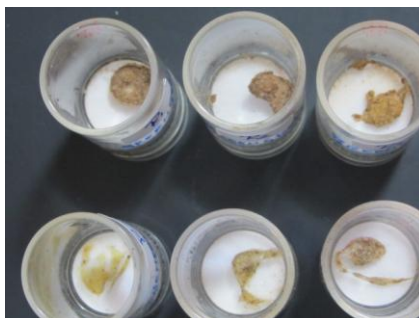


Fig. e) Fiber from different split legumes



Fig. f) Ash form

Table 1: Level of infestation by *S. oryzae* on different split legumes 90 days after Storage

Split legumes	Number of adults released/100g of dhal	Mean number of adults emerged / 100g of dhal	dhal weight loss (%)
Field bean (Hebbal)	20	155.33 ^a (12.41)*	12.77 ^a (20.95)**
Bengal gram (JG-11)	20	127.67 ^b (11.52)	9.00 ^b (17.47)
Red gram (Asha)	20	74.00 ^c (8.49)	6.17 ^c (14.39)
Black gram (Rashmi)	20	64.33 ^c (8.08)	5.40 ^c (13.44)
Green gram (BGS-9)	20	41.00 ^d (6.48)	3.90 ^d (10.79)
Kesar dhal	20	24.33 ^e (5.03)	1.50 ^e (7.04)
S.Em±		0.20	0.40
CD @ (P=0.01)		0.86	1.73
CV (%)		3.98	4.97

NOTE: Means followed by same letters in a column are not significantly different (P=0.01) by DMRT

* Figures in the parentheses are $\sqrt{x+1}$ transformed values

** Figures in the parentheses are angular transformed value

Table 2: Physical and biochemical analysis in relation to incidence of *S. oryzae* in six split legumes (after 90 days of storage)

	(% Protein)				(% Moisture)				(% Ash)			
	Before	After	% increase	T _{cal}	Before	After	% increase	T _{cal}	Before	After	% increase	T _{cal}
Field bean	25.25±0.33	31.55±0.15*	24.95	0.002	10.50±0.50	13.63±0.41*	29.80	0.004	1.59±0.24	3.11±0.19*	95.60	0.004
Bengal gram	22.43±0.76	26.81±1.50*	19.53	0.011	10.00±0.50	12.73±0.83*	27.30	0.011	1.68±0.19	3.86±0.40*	129.76	0.008
Red gram	24.37±0.52	28.57±0.05*	17.23	0.006	10.50±0.50	13.33±0.98*	26.95	0.044	1.34±0.03	3.54±0.18*	164.18	0.002
Black gram	24.41±1.80	28.27±0.27	15.81	NS	11.00±0.50	13.93±0.51*	26.63	0.032	2.44±0.23	4.48±0.30*	83.61	0.001
Green gram	24.86±0.39	28.94±0.39*	16.41	0.001	10.00±0.00	12.56±0.60*	25.60	0.018	2.53±0.30	4.24±0.35*	67.59	0.001
Kesar dhal	25.28±0.24	25.81±0.71	2.10	NS	10.00±0.50	11.13±1.36*	11.30	NS	2.14±0.16	4.03±0.20*	88.32	0.003
	(% Fat)				(% Fiber)				(% Carbohydrate)			
	Before	After	% decrease	T _{cal}	Before	After	% decrease	T _{cal}	Before	After	% decrease	T _{cal}
Field bean	0.94±0.05	0.63±0.04*	32.98	0.009	1.31±0.10	0.78±0.14*	40.46	0.001	0.07±0.00	0.05±0.01*	28.57	0.020
Bengal gram	4.00±0.09	3.36±0.04*	16.00	0.010	1.27±0.10	0.86±0.03*	32.28	0.013	0.11±0.01	0.07±0.01*	36.36	0.038
Red gram	2.05±0.12	1.42±0.23*	30.73	0.011	1.47±0.23	1.20±0.21*	18.37	0.003	0.08±0.00	0.06±0.01	25.00	NS
Black gram	1.32±0.33	1.00±0.17	24.24	NS	0.94±0.03	0.87±0.01*	7.45	0.013	0.06±0.01	0.04±0.01	33.33	NS
Green gram	1.13±0.23	0.78±0.18*	30.97	0.010	0.85±0.02	0.82±0.02	3.53	NS	0.07±0.01	0.03±0.00	57.14	NS
Kesar dhal	0.64±0.02	0.55±0.07	14.06	NS	2.14±0.03	2.06±0.10	3.74	NS	0.07±0.02	0.06±0.02	14.29	NS

Values are mean ± SD, N=3, * = Significant ($p \leq 0.0$)

Conclusion

Thus from the present study, it can be concluded that infestation of rice weevil in different split legumes increases the protein, Ash and moisture content which is favorable for multiplication of fungal flora and decreases the dhal weight. Increase in protein content is attributed to insect metabolites like uric acid, which is nitrogenous in nature and it also observed that the decrease of the crude fat, total carbohydrates and fiber in infested dhals. Thus both quantitative and quantitative losses was noticed which creates unhygienic due to presence of insects excreta. Hence consumption of infested dhal should be avoided.

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