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POTENTIAL OF *GLIRICIDIA SEPIUM* AS A REPELLENT AGAINST RICE FIELD RAT, *BANDICOTA BENGALENSIS*

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ABSTRACT

The efficacy of Ethanolic extract of *Gliricidia sepium* (Jacq.) Kunth ex Walp. was evaluated for repellency against Bandicoot rat, *Bandicota bengalensis* under no-choice and paired-choice conditions. Consumption of treated and untreated rice was compared to know the effect of *Gliricidia sepium* on feeding of the rats. Observations on feeding behavior of rats were recorded throughout the session. It was concluded that treatments with *Gliricidia sepium* significantly reduced the amount of rice taken by the rats ($p < 0.05$) and could be useful for deterring rodents from crops, stored grains and poultry farm structures where pesticides would be hazardous.

Keywords: *Gliricidia sepium*, *Bandicota bengalensis*, a.i (active ingredient), repellency, paired-choice, Integrated Pest Management.

INTRODUCTION

Rice is the second largest staple food crop, sharing 4.4 percent of value added in agriculture. It contributes 0.9 percent to GDP of Pakistan and has been a major source of export earnings in recent years. High quality rice is grown in Pakistan over an area of 2365 thousands hectares. Production of the crop is estimated at 4823 thousand tons (Pakistan Economic Survey 2010-11), with decrease of 29.9 percent over the last year. Decrease in production may be due to decrease in area, attack of pests and diseases. Rats are major pests of rice crop. Among rat species predominant in rice fields, the lesser bandicoot rat, *Bandicota bengalensis* is considered as a serious rice pest (Greaves and Khan, 1975; Sagar and Bindra, 1976; Fall, 1977; Greaves *et al*., 1977; Lathiya, 1978; Fulk, 1977; Fulk *et al.,* 1981; Fulk and Akhtar, 1981; Shakunthala and Sirikhari, 1983; Khokhar *et al.,* 1993). It occurs throughout the Indo-Pakistan subcontinent and South-East Asia (Smiet *et al.,* 1982; Roberts, 1997). Poison baiting is the most effective and common method in practice for rats management (Khan, 1986; Shafi *et al.,* 1991 and 1993; Pervez *et al.,* 2003). Several studies have been carried out on poisons and poison bait acceptance (Roger and Stephen, 1977; Shafi *et al.,* 1988; Pervez *et al.,* 1997 and 2003; Pervez, 2007). The hazards arising from the use of synthetic pesticides, to the environment, human health and livestock have been the subject of many reports in recent years (Brown *et al.*, 1988; Colvin *et al.*, 1988; Gray *et al.*, 1994; Parson *et al.*, 1996; Brakes and Smith, 2005). Trapping poses danger to children, pets and animals. Trapping and poisoning create problems like continuous monitoring and disposal of dead rats. In this situation a better approach may be to deter rats from the targeted area, rather to kill them. Many plants have repellent properties against rats; however no significant work has been carried out on the subject, except a few reports on rat repelling paints (Thompson, 1967; Stone, 1972; Ritchie, 2005). In this context, there is a need for identification of safe and inexpensive solutions of the problem. In many parts of the world natural products are still in use for insect pest control. Plant parts or extracts maybe used to combat rodent infestation proving them useful for rodent management.

Gliricidia sepium (Jacq.) Kunth ex Walp. (family *Fabaceae;* Chadhokar, 1982) is a leguminous, fast-growing, easily propagated, nitrogen-fixing tree used throughout the tropics for many purposes such as, fencing, shade, fodder, fuel wood, green manure, animal feed etc. (Adejumo and Ademosin, 1985; Seibert, 1987; Gohl, 1981; Simons and Stewart, 1994). *Gliricidia* originated from Central America, spread to many parts of the world. However, in Pakistan it is cultivated for the first time at Coastal Agricultural Research Station, SARC, PARC, Karachi (Solangi *et al.,* 2004). Preliminary studies on the major characteristics, agronomic features and nutrient value of *Gliricidia sepium* are carried out (Solangi *et al.,* 2010). Some studies have been carried out on nematicidal and antibacterial properties of Ethanolic leaf extract of *Gliricidia*. The extract also proved as a good mosquito repellant (Nazli *et al.,* 2008). The toxic properties of the seeds, leaves and bark of *G. sepium* give rise to the generic epithet of this species (*Gliricidia* = mouse killer). Poison derived from it can be used for rodent management by mixing with grains (Hochman, 1966; Sotelo *et al.,* 1986). Though poisonous to rodents and insects, the leaves contain 3-4% dry weight of nitrogen and small amount of phosphorus and potassium. The leaves of *G. sepium* have high feeding value with crude protein comprising 20-30% of the dry matter and 15% crude fiber content. There are

numerous reports of increases in weight gain and milk production in both large and small ruminants when *Gliricidia* forage is used as a supplement (Carew, 1983; Nochebuena & O'Donovan, 1986; Eys *et al.*, 1986). There are many reports on rat management by synthetic chemical poisons and trappings, but still there is a need for identification of potentially toxic/ repellent indigenous plant species, which may be useful in Integrated Pest Management against the menace rats. Keeping these facts in mind a study was undertaken to evaluate repellency of *Gliricidia sepium*, by surface coating of rice with the plant extract in low doses, against rice field rats, *Bandicota bangalensis* (bandicoot rat). These preliminary findings may be useful in further studies on role of *Gliricidia sepium* in rodent management.

MATERIALS AND METHODS

Plant collecting and processing: *Gliricidia sepium* (Jacq.) Kunth ex Walp. leaves were collected from Coastal Agricultural Research Station, SARC, PARC, Karachi. All the leaves were preserved in wax-quoted paper bags and brought to the laboratory for biological assays.

Plant Extraction: The fresh dried leaves of *Gliricidia sepium* (5kg) were ground and soaked in ethanol (commercial, doubly distilled, 10 lit). The filtrate was concentrated under reduced pressure at 40°C to a gum. This crude gum was used for activity purpose.

Collection of rats: *Bandicota bangalensis*, (bandicoot rat), were live trapped from rice fields, Thatta district, lower Sindh (24^{o} 45' N; 67^{o} 55' E) Pakistan. The rats were trapped by single catch traps, baited with pieces of guava and melon. The trapping was carried out in night and trapped rats were collected early in the morning.

Acclimation of rats: The rats of approximate same size were sexed, weighed and caged individually in laboratory for 15 days. Sub adults, pregnant and lactating females were discarded from the trials. The rats were fed on rice during acclimation period and the experimental trials. Water was provided *ad libitum*.

Treatment of rice: *Gliricidia sepium* leaf extract was mixed in four doses: 1.0g a.i. (active ingredient) (0.1%), 2.0g a.i. (0.2%), 5.0g a.i. (0.5%) and 10.0g a.i. (1.0%) per thousand-gram rice. For comparative evaluation plain rice were used in all the trials. Treated rice were fan-dried and stored in plastic bags.

Experimental Design: The experiments were designed as: (1) no-choice tests and (2) paired-choice tests. Ten rats (five male and five female) were used in all the trials. The weight of rats was recorded before the start of each trial. The rats were caged singly and offered 20g rice (each rat for each dose) in especially designed metallic feeding cups. Blotting papers were placed underneath the cages. Uneaten rice and spillage were collected after 24 hours and weighed, using a digital balance to calculate mean daily intake; active ingredient ingested was calculated. The left over rice were discarded due to fecal and urine contamination. Daily fresh rice were offered to the rats. During paired-choice tests, positions of the feeding cups were changed daily to avoid place preference. Behavior, health status and mortalities of the rats were recorded continuously. Each test lasted for 5 days with a two days rest period, practiced between the tests.

RESULTS AND DISCUSSION

Rodents threaten food production and act as reservoirs for disease throughout the world. In Asia alone, the rice loss every year caused by rodents could feed about 200 million people (Nils *et.al*, 2003). Since a long time many poisons and traps are being used to overcome the rodent problem. There are many reports and papers on the subject. Besides safety issues these practices require money, labor and regular monitoring. Instead of killing rats, we can deter them from crops, stored grain, poultry farms etc. Repellent properties of certain plants can be utilized in Integrated Pest Management. Very little work on rat deterrents has so far been carried out. The objective of the study was to discover plant deterrents for rodent management. Extract of *Gliricidia sepium*, mixed in rice proved it a good repellent, by giving 90.90, 86.65, 61.20 and 44.20 repellency at 0.1, 0.5, 1.0 and 2 of the extract respectively (Table 2). These findings are in line with Crocker *et al*., (1993), who studied repellence of *Cinamic* acid derivatives against *Rattus rattus* and found it effective by giving 62% reduction in feeding of the rats. *Gliricidia* mixed rice intake by the rats was remarkably less than plain rice (control) in No-Choice trials. Intake of female was more than male rats (Table 1).

Table 1. Evaluation of *Gliricidia sepium* acceptance (no- choice) by *Bandicota bengalensis.*

a.i (g)/ 1000g Conc. (%)	**No. of rats (M/F)**	**Mean body wt. (g)**		**Mean rice intake (g)**		**Mean a.i. intake (g/kg body wt.)**	
		M	**F**	**M**	**F**	**M**	**F**
(0.1)	10 (5/5)	310.80 ± 19.25	284.30 ± 11.75	10.20 ± 2.00	12.12 ± 0.80	32.81 ± 5.20	42.63 ± 9.42
(0.2)	10 (5/5)	290.00 ± 52.00	305.10 ± 18.20	6.82 ± 1.20	8.70 ± 1.94	47.03 ± 10.65	57.03 ± 8.75
(0.5)	10 (5/5)	217.56 ± 31.29	208.50 ± 27.25	3.25 ± 1.01	2.10 ± 2.32	74.70 ± 14.62	50.35 ± 6.50
(1.0)	10 (5/5)	225.40 ± 21.75	301.62 ± 29.20	1.34 ± 1.53	2.31 ± 1.82	59.45 ± 6.24	76.58 ± 15.25
Control (0.0)	10 (5/5)	277.80 ± 15.60	218.75 ± 30.56	15.22 ±2.57	17.58 ± 2.01	-	-

Table 2. Evaluation of *Gliricidia sepium* treated rice rejection (repellency) by *Bandicota bengalensis.*

a.i. (g) / 1000g Conc. (%)	**No. of rats (M/F)**	**Mean rice offered g/rat/day**	**Mean rice intake (g) by rats (both sexes)**	**Percent rice intake by rats (both sexes)**	**Percent rice rejection (repellency)**
(0.1)	10 (5/5)	20	11.16	55.80	44.20
(0.2)	10 (5/5)	20	7.76	38.80	61.20
(0.5)	10 (5/5)	20	2.67	13.35	86.65
(1.0)	10 (5/5)	20	1.82	9.10	90.90
Control (0.0)	10 (5/5)	20	16.40	82.00	18.40

Table 3. Relative acceptability of rice (with and without *Gliricidia* leaf extract) by *Bandicota bengalensis* under paired choice tests.

Concentration (%)	**Body weight (g) M**	**Body weight (g) F**	**Daily Intake of *Gliricidia* rice(M) (g/kg)**	**Daily Intake of plain rice (M) (g/kg)**	**Daily Intake of *Gliricidia* rice(F) (g/kg)**	**Daily Intake of plain rice (F) (g/kg)**
0.1	296.00 ± 8.15	257.85 ± 17.94	27.89 ± 3.01	59.65 ± 2.98	28.36 ± 4.01	69.78 ± 6.34
0.2	297.84 ± 8.74	255.54 ± 18.98	22.45 ± 1.31	57.09 ± 2.67	27.10 ± 4.92	61.61 ± 2.11
0.5	298.00 ± 8.93	285.01 ± 12.33	11.52 ± 2.14	51.79 ± 4.45	8.57 ± 1.97	59.29 ± 3.36
10.0	289.32 ± 8.86	275.70 ± 10.45	6.23 ± 1.38	59.90 ± 3.25	4.56 ± 1.42	64.39 ± 3.71

Table 4. Effect of *Gliricidia sepium* on behavior of *Bandicota bengalensis.*

a.i. (g) / 1000g Conc. (%)	**No. of rats (M/F)**	**Behavior of rats after five days feeding**
(0.1)	10 (5/5)	All the rats observed active and healthy.
(0.2)	10 (5/5)	No change observed in rat's activity & behavior.
(0.5)	10 (5/5)	Two rats observed dull & non-active.
(1.0)	10 (5/5)	Three rats observed sluggish & non-active.
Control (0.0)	10 (5/5)	All the rats observed active and healthy.

Paired-Choice trials were carried out to know the relative acceptability of *Gliricidia* mixed rice versus plain rice. The rats highly preferred plain rice than *Gliricidia* mixed rice (Table 3). During the trials behavior of the rats was continuously observed. Overall normal behavior and health was noted, however 2-3 rats seemed dull and sluggish at higher (0.5% & 1.0%) doses (Table 4). Due to less toxicity, for non-target animals, *Gliricidia* may potentially used to protect crops, stored grains and poultry feed from rodents. Rats eat and contaminate stored grains with their droppings, feces, urine and hair (Husain and Iqbal, 2002; Krasner, 2010). In poultry farms the rodents show their maximum activity in feed godowns (Parshad *et al*., 1987), where they can be repelled by *Gliricidia* coated poultry feed; however there is a need for further research in this regard.

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