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Management of Field Rodents in Organically Cultivated Groundnut (*Arachis hypogaea* L.)

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ABSTRACT

Groundnut is an important oilseed crop that is prone to serious rodent attacks. The present study was conducted in Tippagonda nahalli during 2019 -2020 to estimate the crop damage by rodents in organically cultivated groundnut and to manage rodent's ecofriendly. The study revealed that the peak rodent damage was recorded in the pod formation and harvesting stage of the crop by gnawing the mature pods and hoarding the mature pods. The management studies indicated that integrated modules of cultural and botanicals reduced the rodent incidence and in the present studies. Removal of weeds, spraying of the botanical mixture in the vegetative stage, placement of snap trap @ 50/ha during pod formation stage and smoking in burrows with chilli powder (once a month). Reduced rodent infestation effectively.

Keywords Rodents, Organic cropping, Eco friendly, Cultural methods.

INTRODUCTION

The groundnut, (*Arachis hypogaea* L.), is one of the vastly produced oilseed crops and its highest production is found in China (32.95%) followed by India (18%) and the USA (6.8%) (Pound and Phiri 2010). Groundnut is always prone to rodent attack being the rich source of proteins and rodent damage in groundnut begins at the sprouting stage and lasts up to harvest (Parshad 1999). In India, rodent losses in groundnut range from 4 to 26% (Mittal and Vyas 1992). During the rodent outbreak in Gujarat, rodents damaged up to 85% of the crop (Singla and Babbar 2015). Bindra and Sagar (Parshad 1999) reported a loss of 50 kg/ha yield of groundnut due to rodents in Punjab. Rodents damage the branches of the plant during burrowing, cause damage through cutting and feeding and hoarding the pods (Singla and Babbar 2015). Hoarding of groundnuts by field rodents has been recorded by Kocher *et al.* (2008). An enclosure study of groundnut damage by the rat-like hamster, *Cricetulus triton*, has revealed 14.8–19.6% damage (Nyamweha *et al.* 2021). Organic farming is very native to this land. It is being followed from ancient times, which has manifested in such a way that to keep the soil alive and in good health by use

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of organic wastes and nowadays it is getting importance and in Karnataka alone 51468.458 ha total area is cultivated under organic farming systems (Yadav 2010). Plant metabolites and compounds' application deter rodents from feeding on crops or destroying infrastructure by affecting individual fitness, reproduction and behavior on both the sexes (Hansen *et al*. 2016). Timings of rodent management are crucial to get good control at a reasonable cost. Controlling rats before the peg formation brings a substantial increase in yield (Hussain *et al.* 2003). Hence fort in the present study, an effort was made to estimate the damage caused by rodents and mitigate them by evolving an ecofriendly management module by physical and cultural methods.

MATERIALS AND METHODS

Study area : The study was conducted in the farmer's agricultural plots of Tippagondanahalli village, Bangalore south taluk, Bangalore district Karnataka State.

Damage assessment : Damage to the crop by wild boar was assessed for two years (2019, 2020) of five hectares in the study area by recording the live burrow counts and damage percent as described below.

Live burrow count method (LBC/ha) : Live burrow or active burrows were marked by the presence of freshly excavated soil and cut parts of various plants ; all the burrows found were marked and was plugged with the soil in the evening and in the next early morning, all reopened burrows were counted and these counts were expressed as live burrow count per hectare (Jain *et al.* 1993).

Rodent damage estimation : Rodent damage was estimated in the form of percent pod damage which was recorded at the center and four sides of the field at ten sites. At each site, 3 × 3 m quadrats were marked. Five plants were uprooted randomly from each quadrat and counted the total number of pods and the pods damaged by rodents (signs of rodent gnawing to the pod) per plant. Pod damage percent were calculated using the formula (AINP 2018) :

$$\frac{\text{Damaged pods}}{\text{Total pods}} \times 100$$

Management of rodents : The field evaluation was conducted at groundnut fields of the above-mentioned study area for two years (2019, 2020) *kharif* seasons, with the following treatments.

T_1- Removal of weeds, thinning of bunds, deep plowing before sowing, placement of T perches in the vegetative stage, snap trap placement @ 50/ha during pod formation stage and smoking in burrows with chili powder (once a month).

T_2- Thinning of bunds before sowing, placement of botanical mixture (botanical 1) in the vegetative stage, snap trappla cement @ 50/ha during pod formation stage and placement of T perches.

T_3- Removal of weeds, spraying of the botanical mixture (botanical 2) in the vegetative stage, snap trap @ 50/ha during pod formation stage and smoking in burrows with chili powder (once a month).

T_4- Placement of botanical mixture (botanical mixture 1) after sowing, spraying of the botanical mixture (botanical mixture 2) in the vegetative stage, application of botanical mixture (botanical mixture 3) for 2 days (once a month).

T_5- Thinning of bunds before sowing, placement of botanical mixture (botanical 1) vegetative stage, snap trapplacement @ 50/ha during pod formation stage and placement of T perches.

T_6- Bromadiolone baiting at germination and pod formation stage (Standard check).

T_7- Control.

Botanical mixture 1 : Add cassava flour to fruit juice of tuba (*Croton tiglium*) in the ratio of 1:1 ; the

Table 1. Rodent damage at crop growth stages of groundnut.

Stage	2019		2020		Pooled	
	LBC/ha	Damage (%)	LBC/ha	Damage (%)	LBC/ha	Damage (%)
Germination	28 ± 1.2	4.22 ± 2.3	26 ± 2.1	5.15 ± 1.8	27 ± 1.6	4.69 ± 2.0
Pod formation	52 ± 3.2	6.78 ± 3.9	54 ± 3.3	7.23 ± 2.4	53 ± 3.2	7.01 ± 3.1
Harvesting	86 ± 2.1	8.23 ± 1.9	86 ± 2.1	9.21 ± 1.8	86 ± 2.1	8.72 ± 1.8

above mixture is sun-dried and powdered to these 2 cups of boiled rice is mixed and placed as a bait (Torres 2016).

Botanical mixture 2 : 500 g of neem leaves, 500 g of bel leaves, 500 g of gliricidia leaves, 500 g of vitex leaves are boiled in 10 L of water for 30 min and filtered to this 2 L of cow urine and chili powder was added and kept for 3 days and above mixture is diluted and sprayed (Madhu *et al.* 2015).

Botanical mixture 3 : *Gliricidia* bark and leaves are boiled in 2 L of water for 20 min and filtered, the maize was soaked over night in filtered solution and the maize was used as bait (AINP 2018).

The experiments were laid by Randomized Block Design with three replications. Each block measuring about one acre and the efficacy of treatments was assessed by recording live burrow counts at the harvesting stage and total yield obtained after the harvesting. The above-recorded data was subjected for statistical analysis, one-way analysis of variance (ANOVA) with the significance of differences ($p \leq 0.05$) was calculated and it was followed by Duncan multiple range tests.

RESULTS AND DISCUSSION

Crop damage

The study on the incidence of rodents in groundnut revealed that the maximum damage was recorded during the harvesting stage with 8.72% with 86 LBC/ha and it was followed by pod formation and sowing stages with crop damage of 7.01, 4.69% with 53 and 27 LBC/ha respectively (Table 1). During the pod formation stage and harvesting stage, the rodents damaged the pods by gnawing, eating the nuts and hoarded the pods in the burrow with exposed roots and damaged empty groundnut pods. Whereas, after the sowing of seeds the damage was noted by consuming the sown and sprouted seeds the results were in accordant to studies conducted by Parshad (1999) and similar records were also reported by Adarsh (2013).

Management

The year-wise yield and LBC/ha data indicated that all the treatments were statistically significant ($p \leq 0.05$) and were effective in reducing the rodent incidence in groundnut compared to control plots. In 2019 among the various treatments (T_3) Removal of weeds, spraying of the botanical mixture (botanical 2) in the vegetative stage, placement of snap trap @ 50/ha during pod formation stage and smoking in burrows with chilli powder (once a month). Recoded the highest yield of 1263.33 kg/ha with an LBC of 25.05/ha was recorded and it was followed by (T_1) Removal of weeds, thinning of bunds, deep ploughing before sowing, placement of bird T perches in vegetative stage, placement of snap trap @ 50/ha during pod formation stage and smoking in burrows with chilli powder (once a month) (1242.67 kg/ha, 28.25 LBC/ha), (T_4) Placement of botanical mixture (botanical mixture 1) after sowing, spraying of botanical mixture (botanical mixture 2) in vegetative stage and application of botanical mixture (botanical mixture 3) for 2 days (once a month) (1183.00 kg/ha, 33.42 LBC/ha) (T_5). Thinning of bunds before sowing, placement of botanical mixture (botanical 1) vegetative stage, placement of snap trap @ 50/ha during pod formation stage, placement of bird T perches (1145.00kg/ha, 43.10 LBC/ha) (T_2). Thinning of bunds before sowing, placement of botanical mixture (botanical 1) in vegetative stage, snap trap placement @ 50/ha during pod formation stage and placement

Table 2. Efficacy of different rodent management modules in groundnut during 2019-2020 *kharif*. (Standard mean ± standard deviation) ; F test–*significant at p ≤ 0.05 ; Figure in parenthesis indicates the ARCSIN 0 value.

Treat-ments	2019		2020		Pooled	
	LBC/ha	Yield (kg/ha)	LBC/ha	Yield (kg/ha)	LBC/ha	Yield (kg/ha)
T_1	28.25 (5.3±0.19)^{e}	1263.33±8.48^{b}	26.41 (5.1±0.19)^{e}	1230.33±14.47^{b}	27.33 (5.22±0.19)^{e}	1236.00±9.26^{b}
T_2	53.19 (7.2±0.16)^{b}	1084.67±5.86^{d}	52.98 (7.2±0.15)^{b}	1052.67±29.02^{c}	53.09 (7.28±0.15)^{b}	1068.00±17.44^{e}
T_3	25.05 (5.0±0.13)^{f}	1242.67±4.04^{b}	24.11 (4.9±0.11)^{f}	1248.00±28.48^{ab}	24.58 (4.91±0.12)^{f}	1255.50±18.48^{b}
T_4	33.42 (5.7±0.16)^{d}	1183.00±11.27^{c}	33.70 (5.8±0.18)^{d}	1174.00±14.42^{c}	33.56 (5.79±0.17)^{d}	1178.51±12.85^{c}
T_5	43.10 (6.5±0.11)^{c}	1145.00±15.39^{c}	42.77 (6.5±0.17)^{c}	1134.00±12.12^{d}	42.94 (6.55±0.14)^{c}	1139.21±13.76^{d}
T_6	18.32 (4.2±0.16)^{g}	1318.67±10.50^{a}	18.97 (4.3±0.19)^{g}	1280.00±16.09^{a}	18.60 (4.31±0.18)^{g}	1299.01±13.34^{a}
T_7	82.60 (9.0±0.15)^{a}	910.67±10.52^{e}	82.91 (9.1±0.14)^{a}	925.00±15.39^{f}	82.76 (9.09±0.14)^{a}	917.50±12.96^{f}
F test	**	**	**	**	**	**
SEM ±	0.11	10.16	0.71	6.78	0.41	10.16
Cd (5%)	0.10	54.25	0.12	34.25	0.14	29.78
CV%	1.93	7.31	1.14	8.56	1.93	6.58

of bird T perches (1084 kg/ha, 53.19 LBC/ha) when compared to control (910.67 kg/ha, 82.60 LBC/ha). However, in the standard check, a yield of 1318 kg/ha with 18.32 LBC/ha was recorded.

Similar trends were also followed in 2020 a yield of 1248 kg/ha and 24.11 LBC/ha was recorded in the treatment T_3 (Removal of weeds, Spraying of the botanical mixture (botanical 2) in the vegetative stage, snap trap @ 50/ha during pod formation stage, smoking in burrows with chili powder (once a month)) and in control, 925.00 kg/ha, 82.91 LBC/ha was recorded. An yield of 1230.33 kg/ha with an LBC of 26.41 LBC/ha was recorded in treatment (T_1) Removal of weeds, thinning of bunds, deep ploughing before sowing, placement of bird T perches in vegetative stage, snap trap @ 50/ha during pod formation stage, smoking in burrows with chilli powder (once a month) and it was followed by (T_4) Placement of botanical mixture (botanical mixture 1) after sowing, Spraying of botanical mixture (botanical mixture 2) in vegetative stage and application of botanical mixture (botanical mixture 3) for 2 days (once a month) (1174.00 kg/ha, 33.70 LBC/ha) (T_5). Thinning of bunds before sowing, placement of botanical mixture (botanical 1) vegetative stage, placement of snap trap @ 50/ha during pod formation stage and placement of bird T perches (1134.00 kg/ha, 42.77 LBC/ha), (T_2) Thinning of bunds before sowing, placement of botanical mixture (botanical 1) in vegetative stage, placement of snap trap @ 50/ha during pod formation stage and placement of bird T perches (1052.67 kg/ha, 52.98 LBC/ha). However, in standard check a yield of 1280 kg/ha with 18.87 LBC/ha was recorded.

However, the results of the pooled data (Table 2) indicated that T_3 (Removal of weeds, Spraying of the botanical mixture (botanical 2) in the vegetative stage, Snap trap @ 50/ha during pod formation stage and smoking in burrows with chilli powder (once a month)) (1255.50 kg/ha ; 24.58 LBC/ha) followed by T_1 (Removal of weeds, thinning of bunds, deep plowing before sowing, Placement of bird T perches in the vegetative stage, Snap trap @ 50/ha during pod formation stage and smoking in burrows with chilli powder (once a month) (1236.00 kg/ha ; 27.33 LBC/ha) and T_4 (Placement of botanical mixture (botanical mixture 1) after sowing, Spraying of the botanical mixture (botanical mixture 2) in the vegetative stage, application of botanical mixture (botanical mixture

3) for 2 days (once a month). (1178.51 kg/ha ; 33.56 LBC/ha) were found effective in controlling the rodents in groundnut field.

Though the application of rodenticides provides a reduction in the high-density rodent population in the initial stage their population gets reemerged in a short duration due to bait shyness and resistance and prolific breeding (Singla *et al*. 2013). Since the main manifesto in organic farming is to non-utilization of inorganic compounds an eco-friendly conventional method is indeed needed. It was reported that integrated rodent management increased rice yield over conventional management based on synthetic rodenticides (Singleton *et al.* 2005). It was also reported that ecologically based rodent management practices are equally effective as typical practices for rodent management but more promising in combination with synthetic rodenticides (Sudha Rani *et al.* 2014). In the present study, instead of synthetic rodenticides plant products have been utilized, Hansen *et al.* (2016) report that the application of plant products deters rodents from feeding on crops despite numerous candidate compounds that affect individual fitness, reproduction and behavior. Burrow smoking operation in all the stages of the crops a monthly basis alone offered better results along with trapping with local bamboo traps (Phukon *et al.* 2019). It was also reported that use of traps in combination with synthetic rodenticides could be effective in the management of rodent pests (Borah and Mallick 2016). Sridhara (2006) also reports that placement of T perches is an effective way to control the rodent population by attracting predatory birds. Hence in the present study integration of all these cultural methods and botanicals provided an effective eco-friendly module for rodent management in the organic cropping system.

CONCLUSION

The present study revealed that the groundnut crop is critically exposed to rodent damage, the peak damage was recorded in the pod formation and harvesting stage of the crop by gnawing the mature pods and hoarding the mature pods. The management studies indicated that integrated modules of cultural and botanicals reduced the rodent incidence and in the present studies Removal of weeds, Spraying of the botanical mixture in vegetative stage, snap trap @ 50/ha during pod formation stage and smoking in burrows with chili powder (once a month). Reduced rodent infestation effectively. The present study conveys that in groundnut crops the management modules have to be initiated before the pod formation stage and the rodent management study reveals integrated cultural, physical and botanical methods are also effective in rodent management similar to the application of synthetic rodenticides.

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