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Organic Baiting of Subterranean Termites

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Abstract:*A longitudinal study was carried out in Nakasongola District located in Central Uganda to determine a suitable organic bait for subterranean termites. A random block experiment comprising three baits: maize cob, sugarcane bagasse and pine saw dust, each with 5 replicates was carried out for a period of five weeks as follows:Termite bait stations were placed around 5 randomly selected active Macrotermes bellicosus termitaria found within the same hectare. Each mound was surrounded by three 2.5 dm^3 bait stations placed in a circle, 1m from the center of the mound. As bait, the three stations comprised maize cobs, sugarcane bagasse and pine saw dust respectively. For five weeks, the movable buckets were picked each week and immediately their contents were poured into plastic basins, to separate the remaining bait from soil carried into the stations by termites, The volumes of remaining bait after each week of termite activity was measured using a calibrated 2.5 dm^3 bucket and recorded. Fresh bait was placed into the station and reset. Statistical analysis was carried out using one way analysis of variance, to determine significant differences in mean bait volume within traps following termite activity. Post hoc analysis was carried out using least significant difference. Analysis of variance revealed significant difference (p = 0. 000) in mean bait volume of maize cobs, sugarcane bagasse and pine saw dust in week 5 of the study. Post hoc analysis revealed significant difference in mean bait volume between cob and sugarcane bagasse (p = 0. 000) and cob and saw dust (p= 0. 000) in the fifth week of the study. There were no significant differences in mean bait volume of sugarcane bagasse and pine saw dust. Termites do exhibit bait preference with maize cobs being the most preferred among those tested.*

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I. Introduction

Termites are the largest group of insect detrivores comprising 90% of the 100 gm^3 insect biomass within tropical forest soils, making them fundamental in decomposition processes (Holt and Lepage2000). They are revered within rural communities due to their use in soil fertilityimprovement and as a food resourceforboth humansand livestock(Mali et al 2018). Their benefits in semi-arid grazing, cropping and forestry systems have however been marred by destruction of ecological relationships between termites and their predators coupled with shifts in termite composition and depletion of termite preferred feed resources (Mugerwa et al2008). Termites depend on litter as their number one food resource and absence or insufficient levels of this, makes them resort to herbaceous vegetation culminating in grassland vegetation denudation (Mitchell 2002). In addition, termite feeding range has extended into cultivated crop, making them well-regarded as pestiferous among rural farming communities (Mali et al 2018). Interventions geared towards termite deviation from crops and pasture by increasing litter biomass production through night kraaling, stover importation, utilization of crop residues and agroforestry (Pedenet al2013) have been attempted. In addition, intercropping termite prone maize with crops such as soy beans and ground nuts to mitigate termite activity has been carried out (Sekamatteet al2001). Other environmentally friendly efforts by communities to keep termite population in check such as use of resistant tree species, mound excavation to retrieve the queen and biological control using indigenous chicken have been attempted. However the efficacy of these methods remains notional since they have not been rigorously evaluated (Nyeko and Olubayo2005). In addition to termite trapping, repulsion and elimination (Culliney and Grace 2000; Nan-Yao 2007 and Bowen and Kard2012), bait testing using laboratory colonies (Swoboda and Miller 2004) and field termite harvesting through baiting for animal consumption have been done (Wells 2004). This could form an environmentally friendly and sustainable manner of controlling termite population. However, there is no readily available effective tested organic bait known. It is against the above background that a study to determine efficiency of maize cob, sugarcane bagasse and pine saw dust as organic termite baits was designed. Once a readily available effective organic bait is identified, continuous and sustainable termite harvesting for poultry feeding can be done (Wang and Henderson 2012). This would enable the use of termites as substitutes to fish as protein source in poultry nutrition.

II. Methods and materials

A random block experiment comprising three baits: maize cob, sugarcane bagasse and pine saw dust placed in bait stations, each with 5 replicates was carried out for a period of five weeks as follows: Termite bait stations were placed around 5 randomly selected active *Macrotermes bellicosus* termitaria found within the same hectare. Each mound was surrounded by 3 bait stations placed in a circle as described by Evans and Gleeson 2006. The bait stations used in this experiment were similar to a system designed for termite detection and control by (Thorn and Traniello1996). Each bait station comprised 2.5dm^3 stationary and movable lid containing plastic buckets as shown in Figure 1. The stationary bucket remained fixed into the ground throughout the study. All buckets contained 0.6 cm holes drilled an inch apart along their sides. When the movable bucket was inserted into the stationary bucket, the holes in the former aligned with those of the latter allowing termites to access the baits placed within the movable buckets, through underground galleries created by the colony to lead into the bait station. As bait, the three stations comprised maize cobs, sugarcane bagasse and pine saw dust respectively as shown in Figure 2.

Figure 1: Bait station

Figure 2: Bait stations with bait

Each of the baits was dampened with water before being placed into the bait stations. Cylindrical holes were dug into the ground in a circular pattern with a radius of 1m from the center of the mound. The stationary buckets were buried in these holes, leaving only their brim for firm placement of the movable buckets. Baits were placed into the stations and sealed off using the lid. Polythene and mulch were used to cover the bait stations and keep the area moist and damp. For five weeks, the movable buckets were picked every week and immediately their contents were poured into plastic basins, to separate the remaining bait from soil carried into the stations by termites. The volumes of remaining bait after each week of termite activity was measured using a calibrated 2.5 dm^3 bucket and recorded. Fresh bait was then placed into the movable bucket and the station was reset.Statistical analysis was carried out using one way analysis of variance, to determine significant differences in mean bait volume within bait stations following termite activity. Post hoc analysis was carried out using least significant difference (LSD).Data was analyzed using IBM SPSS statistics version 24.

III. Results

Compacted soil with galleries indicative of termite activity were found within maize bait stations as shown in Figure 3. While sugarcane bagasse often attracted predatory ants and had no indicators of termite activity as shown in Figure 4. Pine bait stations were seldom located by termites as shown in Figure 5.Analysis of variance showed no significant differences in bait volume among maize, bagasse and saw dust during the first four weeks. Significant difference in bait volume was however noted in week 5 of the study as shown in Table 1.

Figure 3: Termite activity

Figure 4: No termite activity

Figure 5: Minimal activity

Post hoc analysis revealed in the fifth week, significant difference in mean bait volume between cob and sugarcane bagasse (p = 0. 000) and cob and saw dust (p= 0. 000). There were no significant differences in mean bait volume of sugarcane bagasse and pine saw dust. Analysis of variance depicted no significant

differences in mean bait volume as a result of termite activity during the study within all groups of the maize, sugarcane bagasse and pine saw dust baits. Post hoc analysis using LSD however indicated significant differences in mean volume as a result of termite activity in maize cob bait between week 1 and 5 (p= 0.017), 3 and 5 (p=0.02) and week 4 and 5(p= 0.024).

Table 1: Mean bait volume within bait stations following consumption by termites

Period	**Maize cob**	**Pine saw dust**	**Sugarcane bagasse**		
	Mean (dm^3)	Mean (dm^3)	Mean (dm^3)	SEM	P value
Week 1	2.06^a	2.50^a	2.50^a	±0.146	0.397
Week 2	1.56^a	1.88^a	2.14^a	±0.262	0.696
Week 3	2.01^a	2.01^a	2.20^a	±0.234	0.939
Week 4	1.96^a	2.01^a	2.50^a	±0.201	0.514
Week 5	0.47^a	2.01^b	2.50^b	±0.281	0.001
$^{a, b}$Means in the same row with different superscript differ significantly					

IV. Discussion

Termite preference for organic matter is depicted by their presence within biomass litter. They however have to first locate the litter upon its initial placement. It therefore takes a while before termite activity is noticed in fresh litter as earlier demonstrated by Cornelius et al 2009. Bait location follows a similar trend and as the several maize cob baits get discovered by the termites, thesignificant differences in the mean volume of remnant bait as a result of termite activity manifest in the fifth week. No significant differences were observed with pine saw dust. This could probably be due to pine being a termite repellent (Mali et al2018). Even though the bagasse baits did register colony activity in the second and third week, the termites were deterred by ants from the bait stations for most of the study. Laboratory tests carried out by Castillo et al 2013 do show that addition of sugars to bait enhances termite preference for those baits. Since sugarcane bagasse contains sucrose, it probably would be an ideal termite attractant as demonstrated in a laboratory study by Grace 2005. However, Sekamatte et al2001 found that sugar based diets also attracted ants that predate termites.

Preference by termites for maize cobs during this study was in agreement with Wang & Henderson 2012 and Peden et al 2013. Wang & Henderson 2012 demonstrated in a laboratory, termite attraction to maize cobs. Peden et al 2013 showed termite affinity for maize by using maize stovers to divert termites from crop gardens. Termite affinity for maize has also been established among maize farmers as a major termite attractant (Mali et al2018). Being consumers of litter, termites are lured by presence of organic matter that they consume (Holt and Lepage2000).

V. Conclusion

Termites do exhibit bait preference with maize cobs being the most preferred among those tested.

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