Advanced Research Journal of Microbiology Vol. 2 (1), pp. 074-077, September, 2015. Available online at www.advancedscholarsjournals.org © Advanced Scholars Journals

Full length Research paper

Assessment of the type and number of reproductives in *M. Subhyalinus* colonies in Ghimbi district western Ethiopia

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Accepted 10 September, 2015

Termite samples were collected between May 2011 and June 2012 across the distributional range of *M. subhyalinus* in Ghimbi District of western Ethiopia. Sampling was made in five directions in five PAs each about 18 km away from the town. Accordingly, five fields of different management history from each peasant association (PA) was selected across transect. The total number of samples (125) was organized and the frequency data of both the primary and secondary reproductives were obtained. Accordingly, 85 queens (68%), 83 kings (66.4%), and 14 (12.2%) secondary reproductives were recorded. In 9 (7.2%) of the samples both primary and secondary reproductives were observed. There were also 17 (13.6%) instances where none of the reproductives were found in actively performing colonies. In a few of the cases up to five secondary reproductives has been recorded in a single big mound. The result showed that in areas where the primary reproductives were removed the number of secondary reproducives significantly increased. Unlike the findings with other *Macrotemes* species, no multiple queens or kings was found in a single mound. It could be concluded that queen removal in *M. subhyalinus* colonies lead to the development of secondary reproductives that ensured survival of the colony. But no multiple primary reproductives were observed in contrast to the multiple secondary reproductives found in a single nest of these colonies.

Key word: Macrotermitinae, primary reproductives, secondary reproductives, queen removal, termite management.

INTRODUCTION

A colony of *M. subhyalinus* consists of functional reproductives, workers, soldiers, nymphs and eggs (Hickin, 1971, Pearce, 1997). This division into a number of different castes or morphologically and functionally distinct forms is one of the most interesting characteristics of termites (Hickin, 1971). There are two types of functional reproductives. These are primary and secondary or supplementary reproductives. The primary reproductives are the king and the queen, which develop from winged sexual forms that have shed their wings and found a colony. The wings are long, narrow, whitish or semitransparent with many distinct veins and the two pairs are almost exactly alike in size and appearance.
They are used only for a single wedding flight, after which they are broken off along a sature of weakness near the base (Metcalf, 1967).

The chief function of the swarm is the dispersal of the sexual individuals for the founding of new colonies (Klots and Klots, 1959). New colonies are formed when reproductives swarm or fly away from overcrowded colonies in the beginning of the rainy season either in the late afternoon or at night (Olkowski *et al.,* 1993). Before flight alates congregate away from the main colony and leave from holes or slits in the ground or wood to form special flight turret (Pearce, 1997). They then caste their wings after a short weak flight and disappear in couples, the male following the female under pieces of wood or into cracks in the soil. After this a small nuptial cell is excavated in which copulation takes place (Schmutterer, 1969). Not until a proper cavity has been found or prepared, a matter of perhaps a couple of weeks do they mate (Pearce, 1997).

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Having left the nest, succeeded in finding a mate and shed their wings they become kings and queen (Harris, 1971).

The swarming, winged forms are the only termites that normally appear in flight in the open air. The young and all the other castes stay in the same nest throughout their lives and are very delicate, thin skinned, pale colored, and blind. Unlike social Hymenopterans, the male (king) live long and mates repeatedly with queen and all termite eggs are fertilized (Metcalf, 1967).

The male (king) pass of their lives relatively unaltered, but the females (queens) develop large abdomens over a number of years as their egg laying capacity increases to the growing needs of the colony (Harris, 1971).

As the abdomen is swollen with eggs the queen is completely immobile. It is surrounded by attendants who constantly groom and carry off the eggs that issue in a steady flow from the queen body (Peter, 1962).

The queen is said to be an egg laying machine (Hickin, 1971). The king stays with the queen after the nuptial flight, helps her in constructing the first nest and fertilizes the queen intermittently as the colony develops (Chapman and Reiss, 1992).

After mating and later the female deposits and watches her first brood and eggs. It feeds the first young with saliva and other secretions. Soon after hatching, the nymphs are self reliant and feed themselves and their parents (Ross, 1965).

The supplementary or secondary reproductives are white wingless or with only a short wing pads (Ross, 1965) which develop either when one of the primary reproductives or both die or the egg laying capacity of the queen drops below a certain minimum level. In Macrotermitinae, the queen is also replaced when it gets old (Harris, 1961).

But most commonly they appear after the death of the primary king or queen or both. They never attain the stature of the original sexual forms and resemble the immature stages and are thus termed neoteinic kings and queens (klots and klots, 1959).

Since the replacement reproductives are not as fecund as the original queen, often several of them may be found in a colony on the work of the primary queen (Teale, 1962).

According to Harris (1961) Coaton reported 50 supplementary reproductives in Hodotermes colony in South Africa.

Termites are some of the most economically important insects known to humans. According to Wood and Johnson (1986) termite occurs over two-thirds of the land mass, involving some 100 countries with total human population of over 3 billion. Most of these countries are developing and over half of them have a gross national product (GNP) of less than US $500.

Although the poorer areas of the tropics and subtropics probably suffer more termite damage, it is in the developed countries, with their low action thresholds for urban pests, that the economic impact of termites has received the most attention (Su and Scheffrahn, 1998).

Subterranean termites account for 80% of the approximately $1.5 billion spent annually for termite control in the USA (Su, 1993).

In Japan it is estimated that roughly US$0.8-1.0 billion per year is used to prevent and control termite infestations, based on the sales of termiticides in 1996 (Fushiki, 1998; Tsunoda, 2003).

Termites also cause considerable damage on agricultural crops, rangelands, forestry seedlings, and wooden structures such as rural houses, stores, fences and bridges crossing streams. Abraham (1998) reported 45, 50, and 18 % field losses of cereal crops due to termites at Bako, Didessa, and Asossa, respectively.

According to the studies conducted in western Ethiopia, thatched roof huts are destroyed in less than five years and corrugated iron roof houses in less than eight years. Many of the wooden structures in the western parts of the country require maintenance every year.

As a result, trees are cut frequently to replace the structures destroyed by termites. This would in turn lead to deforestation, erosion and environmental degradation. Termites therefore have been regarded as serious pests of agricultural crops, forest trees and building in west wellega than in other parts of the country (Abraham Tadesse, 2008).

They contribute to severe soil degradation by reducing vegetation cover and leaving the soil surface barren and exposing it to the elements of erosion (Emana Gure, 1997).

A major focus of termite research in the past was on chemical methods for control with less attention placed on understanding termite behavior, biology and ecology (McDaniel and Kard, 1995).

This trend has changed over recent years because of environmental concerns over side effects caused by the use of these broad-spectrum persistent chemicals. For instance, in 1986, the National Academy of Science in North America concluded that the “risks outweighed the benefits” when organochlorine usage in termite control was evaluated (United States Environmental Protection Agency, 1987).

The use of organo-chlorines and queen removal has been in practice as a major component of termite control in western Ethiopia. While the reliance on organo-chlorines stopped following its ban and lack in market, the use of queen removal became questionable because of lack of detailed knowledge of termite biology and behavior (Abduraman, 1990).

Therefore it is important to study the type and number of reproductives in *M. subhyalinus* colony in Ethiopia. It is usually stated that queen removal may not eliminate a colony but the fate of the colonies after queen removal is not well established.

Additional methods that could make queen removal effective are also not researched.

Table 3.1. Number and percentage of kings, queens, and secondary reproductives of *M. subhyalinus* in 125 samples from May 2011 to June 2012

	Primary reproductives		Secondary reproductives	Queens and kings with secondary reproductives	Colonies with no reproductives
	queens	Kings			
Count	85	83	14	9	17
Percentage	68	66.4	11.2	7.2	13.6

Therefore, the objective of the current study was to evaluate the type and number of reproductives in colonies of *M. subhyalinus* in Ethiopia.

MATERIALS AND METHODS

Termite samples were collected between May 2011 and June 2012 across the distributional range of *M. subhyalinus* in Ghimbi District of western Ethiopia. Sampling was made along transect following the road from Ghimbi town in five directions in five PAs each about 18 km away from the town.

The selections of the farmers' field from the five PAs were based on the field history.

Accordingly, five fields of different management history from each PA were selected across transect, namely undisturbed crop field (which means neither chemical treatment nor queen removal had been practiced in the crop field in spite of the existing damage), both chemical mound treatment and queen removal had been practiced, mound was treated with chemical, the fields from which queen was removed and lastly undisturbed forest.

The PAs considered were Melka Gasi, Lalisa Yesus, Cuta Goci, Ghimbi (kebele 05) and Waligala Dalo.

The mounds were opened by walking across transect of five farmers' field from each PA.

In total 125 mounds were dug and the royal chambers were excavated and the reproductives were recorded from these colonies.

The royal chambers were excavated and the numbers of queens and kings and/or secondary reproductives were recorded. The sexuals and steriles were stored in 80% ethanol for later reference (Bagine et al., 1994).

The total number of samples (125) was organized and the frequency data of both the primary and secondary reproductives were obtained using Microsoft Excel.

The data were subjected to NCSS software for analysis of variance (Brandl et al., 2001).

RESULTS AND DISCUSSION

The result of the analysis showed 85 queens (68%), 83 kings (66.4%), and 14 secondary reproductives (11.2%) (Table 3.1). In 9 (7.2%) of the samples both primary and secondary reproductives were observed.

The fact that the number of queen and kings did not match may be from the active nature of the kings which might have escaped during mound opening.

In most of the samples, the primary and secondary reproductives did not exist together.

There were also 17 (13.6%) instances where neither the primary nor the secondary reproductives were found in actively performing colonies.

These colonies are probably in the process of forming secondary reproductives or we might also fail to locate small growing ones.

In a few of the cases, up to five secondary reproductives had been recorded in a single big mound. The identification of secondary or supplementary king was found to be difficult.

Published information is also scarce on the identification of secondary kings from the primary ones.

Supplementary queens are very small compared with the primary queens but are larger than and different from existing castes in a colony as indicated in (Figures 3.2).

The distribution of both primary and secondary reproductives of *M. subhyalinus* in fields of different management histories is shown in figure 3.1. Mean number of both primary and secondary reproductives were not significantly different from one another except in those fields in which the queen were removed as a means of termite management.

The number of secondary reproductives increased (0.76), while there was sharp drop in the number of primary reproductives (0.8).

This clearly indicated that when colonies were deprived of their king and queen the secondary or supplementary queens develop.

This result was therefore in agreement with Hinton (1974) and Myles (1999) who stated that secondary or supplementary reproductives replace or supplement primary reproductives of the termite colonies. Abdurahman (1990) also stated the ineffectiveness of termite management using queen removal.

But the interesting part of these findings is that unlike other *Macrotermes* species in east Africa, there was neither co- existence of primary queens nor kings (polygyny

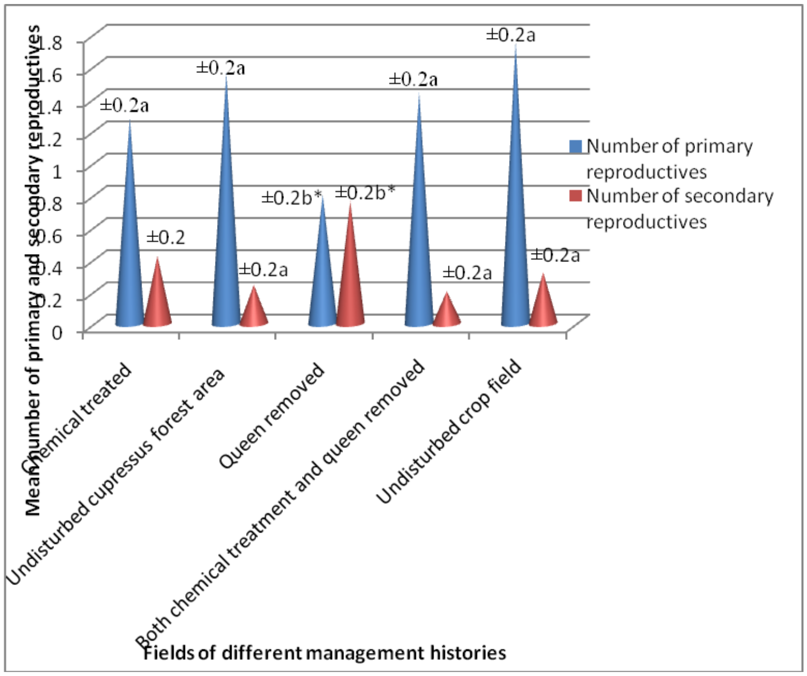

Figure 3.1. Mean number of primary and secondary reprouductives of *M. subhyalinus* in five fields of different management histories in 125 samples from May 2011 to June 2012 (mean ± SE)

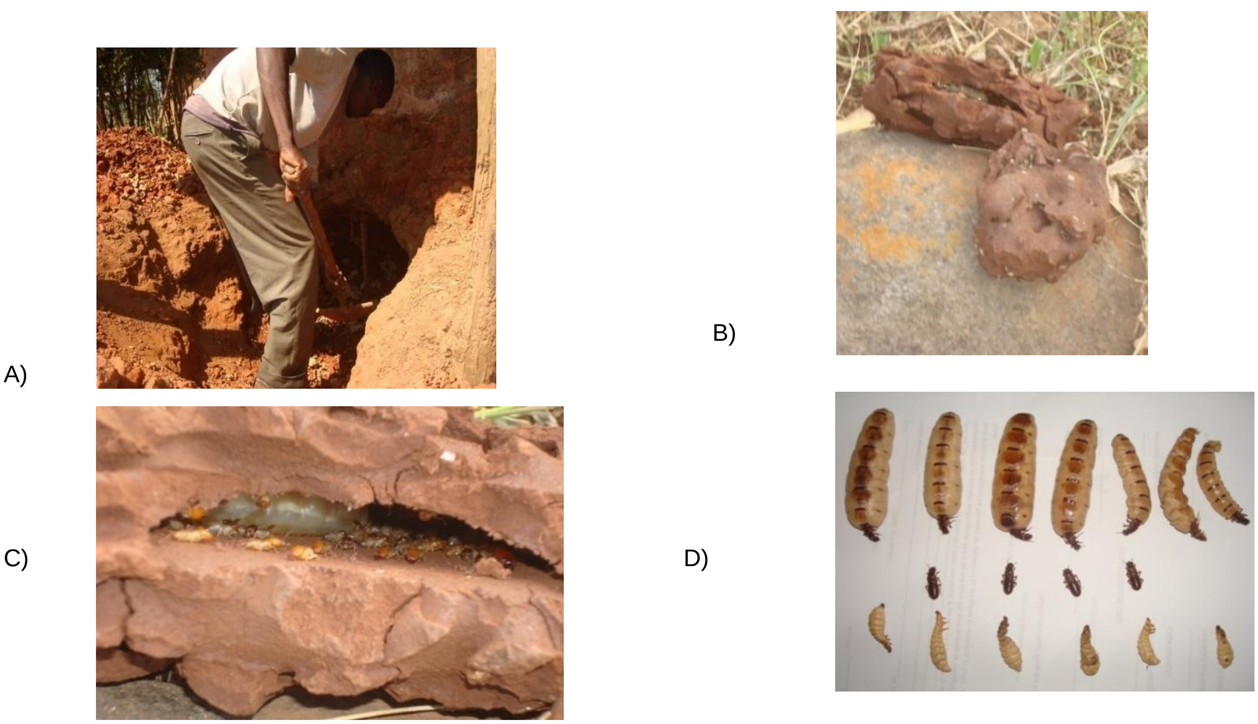

Figure 3.2 A) Mound opening B) Royal chamber C) Primary reproductives along soldiers and workers D) Queens, Kings and supplementary reproductives from top to bottom and E) *Masea lanceolata*

and polyandry, respectively). But Bagine et al. (1994) Darlington (1985), and Brandl et al. (2001) and (2004) reported polygyny in M*. michaelseni* (Macrotermitinae) in southern part of East Africa which actually belong to the genus. It could be concluded that queen removal in *M subhyalinus* colonies lead to the development of secondary reproductives that ensured survival of the colony. But no multiple primary reproductives were observed in contrast to the multiple secondary reproductives found in a single nest of these colonies.

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