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*Full Length Research Paper*

# Determination of Rate of Insecticide (Ethiozinon 60 EC) Application on Mound for Controlling Termite at Finchaa Sugar Estate

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**A trial for determination of the rate of Ethiozinon 60% EC application on active mound was accomplished with the objective of identifying optimum and effective rate to treat mound and evaluating the combined control potential of the insecticide and queen removal practices for controlling termites at the Finchaa Sugar Estate. To meet this objective, field experiment consisting of 13 treatments was accomplished in three replications. Accordingly, Analysis of variance (ANOVA) showed there was highly significant (at p < 0.01) variation among the treatments in reducing termite population. Besides, the overall mean percent of efficacy data indicated that almost all plots receiving insecticide application except two treatments (Ethiozinon 60% EC @ 4.5 liters per hectare alone and in combination with queen removal practice) had showed better performance in controlling termite population and the efficacy of control ranged between 68 and 91 percent. Moreover, the final visual assessments of the termite mounds activity, particularly those received insecticides alone and in combination with queen removal has shown better control of the pest population and as a result no recovery of termite mound was observed. Therefore, the plantation can use two folds of the recommended insecticide rate (Ethiozinon 60% EC@ 4.5 liters per hectare) alone or in combination with queen removal practice in order to achieve successful control of termite in and around sugarcane fields of Finchaa Sugar Estate.**

**Keywords:** Mound, termite, insecticide.

## INTRODUCTION

Termite is one of the most important soil dwelling insect pest in the Sugarcane Plantations of Ethiopia (Tesfaye and Solomon, 2007) and it has been causing a serious problem since 1976 (ARS, 1979) particularly at Finchaa Sugar Estate. The crop is vulnerable to termite attack at all growth stages (i.e. seed setts, young shoots and stools, and stalks) (Harris, 1969; Miranda et al, 2004). Termite may attack any part of sett, but in the hard-rinded varieties, they prefer to attack the ends, eye buds and root bands (Choudhary et al., 1986 and Mill, 1992). A major infestation of termites occurred on setts at the time of planting results in total failure of germination, if left un-protected. At germination stage, the termite losses up to 90-100 percent have been recorded in sugarcane (Salihah et al. 1988; Sattar and Salihah, 2001). Moreover, in the late growth stages, it could result heavy damage on cane yield. This damage can be particularly severe in periods of low rainfall or at water stress condition and also more severe on plant cane crop than ratoon fields (Roonwal, 1981). Tesfay and Solomon (2007) indicated that termite caused 17, 13 and 10 % of dead setts, chopped shoots and stalks,

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respectively at Finchaa Sugarcane Plantations. Termite infestation caused 30-60% destruction of buds (Teotia et al., 1963 and Roonwal, 1981). According to Avasty (1967), temites caused a yield loss in the range of 33-40%.

Today, there are many safe and simple practices of termite management in sugarcane plantation including cultural practices, biological control, plant resistance, natural products, physical barriers and baiting systems, but insecticides are still playing a key role for the termite's control (Clowes and Breakwell, 1998; Ahmed et al., 2007). In Ethiopian Sugar Estates, particularly at the Finchaa Sugar Factory, six insecticides, namely Ethiozinon 60 EC@ 4.5 lt/ha, Basudin 600 EW@ 4.5 lt/ha, Regent 500 SF@ 0.25 lt/ha, Confidor 200 SL@0.75 lt/ha, Talstar 100 EC@ 2 lt/ha and Pyrinex 48 EC@ 3.0 lt/ha are in use (recommended) for the control of termite at field condition (Firehun et al., 2009). But there is no recommended insecticide application rate for the control of termite especially those forming a mound and it was made simply by estimating the rate using the above recommendation for field application.

This rough estimation did not consider the underground part of the mound rather simple estimation of the topical surface area of the mound (Personal communication). Thus, Agricultural operation of Finchaa Sugar Factory has requested us in order to have insecticide application rate for mound application in the area. Hence, this trial was conducted to determine insecticide application rate for termite mound and to evaluate the combined effect of insecticide application and queen removal practices for the control of termite at the Finchaa Sugar Estate.

## MATERIALS AND METHODS

The experiment was done at the Finchaa Sugar Estate for two months period in 2013 cropping season. The trial was conducted to determine insecticide application rate on active termite mound and to evaluate the combined control potential of the insecticide and queen removal practices. For this study selection of active and nearly equal sized termite mounds within and around sugarcane plantation fields were done. Thirteen treatments were tested in the trial (Table 1). Insecticide application rate per mound were adjusted simply by measuring the above ground/topical surface area of the mound. Before insecticide application, destruction of the mound (opening of mounds) was made both manually and mechanically in order to remove the queen and to apply the solution uniformly. Insecticide was diluted /applied by using and adjusting at a rate 300 liters water per hectare for evenly distribution of the solution within the mound.

The experiment was accomplished in locations where termites were problematic i.e in the hotspot areas considering each of the thirteen mounds were located around three different locations whereby the thirteen mounds in one location were considered as a replication. Single mound was considered as a plot and a total of 39 mounds were used for this experiment. To study the efficacy of applied treatments, data on termite population were taken six times at ten day interval. For each active mound termite population, count was made by taking soil sample at the depths of 0-30 and 30-60cm and was counted by spreading the soil on white sheet. Moreover, at the end of the trial each mound was visually evaluated for activity of the mound with the research team in order to verify the control potential of each treatment. Finally, data were subjected to statistical analysis using the SAS software package (SAS, 1999) and treatment mean separation was made with Duncan Multiple Range Test. The Percent efficacy of the test insecticide was also calculated by the following formula (Alam et.al. 2012):

$$\% \text{ Efficacy} = (Pu-Pt)/Pu * 100$$

Where;
Pu = population of termite in untreated and
Pt = population of termite in treated plots

**Table 1.** Treatments tested in the trial

| No | Treatments |
|---|---|
| 1 | Free check (Unsprayed) plot |
| 2 | Ethiozinon 60 EC@ 4.5 litre/ha(recommended insecticide) |
| 3 | Ethiozinon 60 EC@ 4.5 litre/ha X 2 |
| 4 | Ethiozinon 60 EC@ 4.5 litre/ha X 4 |
| 5 | Ethiozinon 60 EC@ 4.5 litre/ha X 6 |
| 6 | Ethiozinon 60 EC@ 4.5 litre/ha X 8 |
| 7 | Ethiozinon 60 EC@ 4.5 litre/ha X 10 |
| 8 | Ethiozinon 60 EC@ 4.5 litre/ha + Queen Removal |
| 9 | Ethiozinon 60 EC@ 4.5 litre/ha X 2 + Queen Removal |
| 10 | Ethiozinon 60 EC@ 4.5 litre/ha X 4 + Queen Removal |
| 11 | Ethiozinon 60 EC@ 4.5 litre/ha X 6 + Queen Removal |
| 12 | Ethiozinon 60 EC@ 4.5 litre/ha X 8 + Queen Removal |
| 13 | Ethiozinon 60 EC@ 4.5 litre/ha X 10 + Queen Removal |

## RESULTS AND DISCUSSION

### Efficacy of insecticides on population control of termites

Analysis of variance (ANOVA) showed there was highly significant (at $p< 0.01$) variation among the treatments in reducing termite population (Table 2). Accordingly, plot that received four folds of the recommended insecticide rate in combination with queen removal had shown significantly superior control of termite population as compared to other treatments after 30 days of application (Table 2). Similarly, plots that received a higher rate in isolation and in combination with queen removal had shown superior percent control as compared to others at sixty days after application.

Moreover, the terminal score value revealed that plot received two folds, two folds + queen removal, six folds + queen removal and eight folds + queen removal were among the treatments that resulted in 100% control. Percent control that ranged between 0 and 100 percent efficacy was observed in this trial. Sugarcane plants near the untreated plots or mounds were observed to be affected severely by the termites (Figure 1.). After sixty days, all plots received insecticide application except two treatments (Ethiozinon 60% EC @ 4.5 liters per hectare alone and in combination with queen removal practice) has shown better control of termite mounds and the control potential ranges between 76 and 100 percent efficacy (Table 2).
The overall mean percent efficacy data indicated that almost all plots received insecticide application except

two treatments (Ethiozinon 60% EC @ 4.5 liters per hectare alone and in combination with queen removal practice) had showed better performance in controlling termite population and it was in the range of 68 and 91 percent (Table 2).

Similar studies by Deka et al., 1999 observed that, with different formulations of insecticides (fenvalerate 0.4% dust, malathion 10% dust and sugarcane press mud) against O. obesu s, a 10% formulation of malathion was effective. Singh and Singh (2002) in their field evaluation of neem based formulations found that, Nimbicidine and Nemactin were effective for up to two months and Rakshak, Multineem, Neemgourd and Vanguard were effective for up to one month. Similarly, antifeedant activity of Thiamethoxam formulation (ACTARA 25 WG) against the African termites viz., Trinervitermes trinervius and O.smeathmani, showed that the products are consumed by the termites rather than repelled (Huang et al., 2005). Sattar and Salihah, 2001 also revealed the efficacy of the insecticides such as tenekil, thiodan and chlorpyrifos in controlling termites.

**Figure 1.** Damage on sugarcane by mound forming termite in untreated mounds at Fincha

**Table 2.** Efficacy of treatments in the control of termite

| | | Termite control efficacy (%) | | | | |
|---|---|---|---|---|---|---|
| **No** | **Treatment ( Rate/ha)** | **30 DAT** | **40 DAT** | **50 DAT** | **60 DAT** | **Mean %** |
| 1 | Free check (Unsprayed) plot | 0.00c | 0.00c | 0.00d | 0.00c | 0.00f |
| 2 | Ethiozinon 60 EC@ 4.5 L/ha | 28.93bc | 49.06b | 47.39bc | 49.36b | 47.77d |
| 3 | Ethiozinon 60 EC@ 4.5 L/ha X 2 | 76.31ab | 71.81ab | 100.00a | 100.00a | 84.31ab |
| 4 | Ethiozinon 60 EC@ 4.5 L/ha X 4 | 86.60a | 71.67ab | 86.38ab | 77.76ab | 79.62abc |
| 5 | Ethiozinon 60 EC@ 4.5 L/ha X 6 | 75.66ab | 59.34ab | 77.46abc | 79.52ab | 72.38bc |
| 6 | Ethiozinon 60 EC@ 4.5 L/ha X 8 | 72.26ab | 79.14ab | 69.48abc | 89.05a | 75.74bc |
| 7 | Ethiozinon 60 EC@ 4.5 L/ha X 10 | 82.28a | 87.77ab | 73.90abc | 76.67ab | 78.97abc |
| 8 | Ethiozinon 60 EC@4.5 L/ha + Queen Removal | 57.22ab | 55.62ab | 46.64c | 49.61b | 55.75de |
| 9 | Ethiozinon 60 EC@ 4.5 L/ha X 2 + Queen Removal | 55.59ab | 73.21ab | 86.97ab | 100.00a | 72.83bc |
| 10 | Ethiozinon 60 EC@ 4.5 L/ha X 4 + Queen Removal | 95.76a | 100.00a | 90.80a | 93.52a | 91.45a |
| 11 | Ethiozinon 60 EC@ 4.5 L/ha X 6 + Queen Removal | 55.68ab | 69.86ab | 80.70abc | 100.00a | 67.83cd |
| 12 | Ethiozinon 60 EC@ 4.5 L/ha X 8 + Queen Removal | 57.67ab | 75.18ab | 100.00a | 100.00a | 73.61bc |
| 13 | Ethiozinon 60 EC@ 4.5 L/ha X 10 + Queen Removal | 65.99ab | 96.69a | 100.00a | 81.95ab | 82.23abc |
| | CV % | 39.54 | 34.68 | 28.09 | 23.71 | 11.99 |

**NB:** *DAT days after Treatment **Means followed by the same letter along columns are statistically non-significant at 5% probability level according to DM

Moreover, the final visual assessments of the termite mounds activity (table 3) particularly those received insecticides alone and in combination with queen removal has shown better control of the pest population and it had revealed a similar trend with the above result. Thus, except plots that received Ethiozinon 60% EC @ 4.5 liters per hectare alone and in combination with queen removal practice had resulted in the recovery of termite mound at least on one replication.

**Table 3.** Assessment result through visual observation on termite mound

| No | Treatment (Rate/ha) | Visual observation on mound activity after 60DAT | | | |
|---|---|---|---|---|---|
| | | Rep. I | Rep.II | Rep.III | Mean control |
| 1 | Free check (Unsprayed) plot | Unaffected/active | Unaffected/active | Unaffected/active | 0 |
| 2 | Ethiozinon 60 EC@ 4.5 litre/ha(recommended rate) | Re-constructed | Re-constructed | Controlled | 33.33 |
| 3 | Ethiozinon 60 EC@ 4.5 litre/ha X 2 | Controlled | Controlled | Controlled | 100 |
| 4 | Ethiozinon 60 EC@ 4.5 litre/ha X 4 | Controlled | Controlled | Controlled | 100 |
| 5 | Ethiozinon 60 EC@ 4.5 litre/ha X 6 | Controlled | Controlled | Controlled | 100 |
| 6 | Ethiozinon 60 EC@ 4.5 litre/ha X 8 | Controlled | Controlled | Controlled | 100 |
| 7 | Ethiozinon 60 EC@ 4.5 litre/ha X 10 | Controlled | Controlled | Controlled | 100 |
| 8 | Ethiozinon 60 EC@ 4.5 litre/ha + Queen Removal | Re-constructed | Controlled | Controlled | 66.67 |
| 9 | Ethiozinon 60 EC@ 4.5 litre/ha X 2 + Queen Removal | Controlled | Controlled | Controlled | 100 |
| 10 | Ethiozinon 60 EC@ 4.5 litre/ha X 4 + Queen Removal | Controlled | Controlled | Controlled | 100 |
| 11 | Ethiozinon 60 EC@ 4.5 litre/ha X 6 + Queen Removal | Controlled | Controlled | Controlled | 100 |
| 12 | Ethiozinon 60 EC@ 4.5 litre/ha X 8 + Queen Removal | Controlled | Controlled | Controlled | 100 |
| 13 | Ethiozinon 60 EC@ 4.5 litre/ha X 10 + Queen Removal | Controlled | Controlled | Controlled | 100 |

## CONCLUSIONS AND RECOMMENDATION

The overall mean percent efficacy data indicated that almost all plots received insecticide application except two treatments (Ethiozinon 60% EC @ 4.5 liters per hectare alone and in combination with queen removal practice) had showed better performance in controlling termite population and it was in the range of 68 and 91 percent. Thus, the plantation can use two folds of the recommended insecticide rate (Ethiozinon 60% EC@ 4.5 liters per hectare) alone or in combination with queen removal practice in order to achieve successful control of mound forming termite in and around sugarcane fields of Finchaa Sugar Estate by analyzing the cost and benefit of the treatments. Moreover, proper measuring of the mound area is very vital and also usage of sufficient amount of water for uniform distribution of the chemical is detrimental.

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