Impact of Different Levels of Nitrogen in Liquid Fertilizer (Sidalco) on the Population Dynamics and Within Plant Distribution of *Aphis gossypii* and *Thrips palmi* and Yield of Eggplant
ABSTRACT
Increased use of “Sidalco” liquid fertilizer by vegetable farmers in Ghana has attracted the attention of researchers. However, very little literature on the impact of this fertilizer on the aggregation patterns of common but important insect pests of vegetables is available, necessitating this work. The objective of the study was to evaluate the impact of different levels of Nitrogen in liquid fertilizer (Sidalco NPK) on the population dynamics and within plant distribution of *Aphis gossypii* (Glover) and *Thrips palmi* Karny in eggplant (*Solanum melongena* L). The study was conducted in both the major (April - July) and minor seasons (August - November) of 2011 at the Nkrumah University of Science and Technology, Kumasi, Ghana. The treatments were; (i) Sidalco liquid fertilizer (NPK 10:10:10) + 1% sulphate of ammonia solution, (ii) Sidalco liquid fertilizer (NPK 10:10:10) + 0.5% sulphate of ammonia solution and (iii) Sidalco liquid fertilizer (NPK 10:10:10) and these were applied directly on leaves, weekly for eight weeks. An untreated control was also maintained. Low densities of both insects were collected in both seasons. Whereas a comparable number of *A. gossypii* was collected in both seasons, *T. palmi* population was higher in the minor season than in the major season. Significantly more *A. gossypii* aggregated in the lower canopy than in the upper canopy in the major season, but the results were mixed in the minor season. Similarly, more *T. palmi* was collected in the upper canopy than the lower canopy in the minor season, but the results were mixed in the major season. Plots with the highest doses of N received the highest number of *A. gossypii* and *T. palmi* in both seasons. The plots with the highest doses of N recorded the highest yield in both seasons.

**Key words:** Liquid fertilizer, thrips, aphids, population dynamics
1.0 INTRODUCTION

Eggplant (**Solanum melongena** L.) is a tropical and subtropical plant which grows in high temperatures and can produce up to 15 kg of fruits per plant. It comes in various colors and tastes from bland to sweet or slightly bitter [1]. Eggplant cultivation in Ghana is done in many ecological zones with or without pepper, okra and other crops by subsistence farmers and monocropping is practiced in commercial farms. Almost every household in Ghana consumes eggplant fruit (garden egg) in the form of soup or stew daily due to its associated good nutritional value [2] and therapeutic properties [3].

According to [4], production of eggplant is highly concentrated, with 90% of output coming from five countries and about 1,600,000 ha devoted to its cultivation worldwide. Both local and exotic varieties of eggplant are grown in Ghana mainly for local consumption. Yield of eggplant in Ghana is low prompting farmers to use fertilizers for increased productivity. Foliar nutrition is ideally designed to provide many elements to a crop that may be limiting production at a time when nutrient uptake from the soil is inefficient or nonexistent [5]. Farmers are being encouraged to patronize foliar fertilizers on the market for increased yield due to the long time effect of these inorganic fertilizers on the soil through soil amendments.

Several studies have been done on fertilizer supply through the leaves and on viable fertilization alternatives on a number of nutrients like potassium [6], boron [7], phosphorus [8] and silicon [9] using lower amounts that would provide the needed nutrient or else stimulate its beneficial effects [10]. These studies highlight the importance of foliar fertilizers in the face of certain problems associated with excessive use of fertilizers applied to the soil. Studies on insects’ aggregations in response to fertilizer applications have also been undertaken by several workers.
However, behavioral variations in insects in host plants in response to fertilizer applications have varied among host plants and insects, emphasizing the need to investigate how plant phenology and architecture as affected by plants influences the distribution of insects on host plants. However, there is little literature on the distribution of these pests within eggplant and seasonal fluctuation of their numbers as affected by liquid fertilizer. Sidalco (Eagle Media House Lt, UK: Wienco Ghana limited, Ghana) foliar N fertilizer (SLF) was introduced onto the Ghanaian market recently for use on mainly vegetable crops but very little information is available on its effects on insect pests of vegetable crops. It is against this background that this study was carried out with the objective to determine the effect of different levels of N in liquid fertilizer (Sidalco) on the aggregation and distribution of *Aphis gossypii* (Glover) and *Thrips palmi* Karny within eggplant.

The specific objectives of this study were to determine the impact of different levels of N liquid fertilizer (Sidalco) on the;

i. population dynamics of *A. gossypii* and *T. palmi* on eggplant

ii. distribution of the insects within eggplant, and

iii. yield of eggplant

2.0 MATERIALS AND METHODS

2.1 Study Site and Location

The study was carried out at the Department of Crop and Soil Sciences’ experimental site (Plantation) of the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana from April to November, 2011. The area lies within semi-deciduous forest zone with bimodal rainfall. The major season spans from April - July and the minor season from August-
November. The mean highest and lowest monthly temperatures for the area were 33.3 and 21.7 °C, respectfully and the mean highest and lowest monthly rainfalls were 241.6 and 71.5 mm, respectively [11]

2.2 Experimental Field and Treatments

The experimental field comprised four blocks, each measuring 31.0 m by 10.0 m. Each block also comprised four treatment plots, each measuring 10.0 m x 7.0 m, with an alley of 1.0 m between them. Between each of the four blocks was an alley of 2.0 m. There were five rows of ten plants per treatment plot. The sources of the N-fertilizers were NPK (10:10:10) in Sidalco liquid fertilizer and Sulphate of ammonia solution (1% and 0.5%). The NPK was applied two weeks after transplanting after which the Sulphate of Ammonia was added two days later, and this was repeated weekly for eight weeks. A knapsack sprayer (CP 14) was used to apply the treatments.

An initial soil test was done to ascertain the soil’s nutrient status before the study was undertaken. The study was arranged in a randomized complete block design with four replications. The treatments i) T1: Control (No Fertilizer Application), ii) T2: SLF (NPK 10:10:10) + 1 % Sulphate of Ammonia, iii) T3: SLF (NPK 10:10:10) + 0.5 % Sulphate of Ammonia and iv) T4: SLF (NPK 10:10:10). Sidalco liquid fertilizer was chosen for this study because it is a new product being promoted for use on crops, especially vegetables for increased yield, and that was also why eggplant was chosen.

2.3 Source and Variety of Seeds

Eggplant variety “Oforiwaa” which is popular in most local communities and early maturing was obtained from the Horticulture Department of the Crops Research Institute of the Council for Scientific and Industrial Research (CSIR – CRI), Fumesua, Kumasi, Ghana.
2.4 Planting and other Agronomic Practices

The seeds were sown on a raised seedbed with friable soil in rows 10 cm apart. Redomil fungicide solution was mixed with the soil as pre-disinfectant and also applied to the seedlings on the nursery bed to prevent damping-off disease. The seedlings were transplanted on the main field after four weeks at one seedling per hill with 1.0 m inter- and intra- row spacing. Weeds were controlled by the use of a hoe at 14, 28, 42 and 56 days after transplanting (DAT).

2.5 Insects’ Data

Insect samples were taken from the three middle rows starting at two weeks after transplanting and continued weekly for eight weeks. Sampling of insects was between 0800 and 1000 h. At the three-leaf stage when sampling began, the above-ground parts of five plants of each treated plot were randomly cut and put into separate high density polyethylene plastic containers containing 70% ethanol. This continued for three weeks. From the 4th week, the plant canopy was partitioned into upper and lower canopies and a leaf from each canopy level was cut into the plastic containers containing 70% ethanol. Sampling of flowers for insects was not included because negligible number of insects was collected from them. The samples were transported to the laboratory for identification with the aid of a stereomicroscope at 10-40x magnification. No insecticides were applied to the plants and the study was undertaken in both the major and minor seasons.

2.6. Yield data

Harvesting of matured fruits started eight weeks after transplanting and it was done five days interval for four consecutive weeks. Harvested fruits of each treatment were counted and weighed in the laboratory using a Switzerland-made Metler Toledo PB302 electronic weighing scale.
2.6 Data Analysis

Data for each season were subjected to analysis of variance [ANOVA] using SAS (9.0) GLM procedure (SAS institute, 2010). For the insects, data were pooled over date and data for each season transformed using square-root transformation to normalise the distribution of the insect population and separate analyses performed for each season. Analysis of the data for the two canopies (upper and lower) was run separately. Tukey’s procedure was used for mean separation at 5% probability level.

3.0 RESULTS

3.1 Soil Routine Analysis
The results of the initial soil analysis of the experimental site are shown in Table 1. The initial percent N recorded was low.

Table 1. Initial nutrient content of the soil

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Carbon</td>
<td>1.04%</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>0.09%</td>
</tr>
<tr>
<td>Organic Matter</td>
<td>1.79%</td>
</tr>
<tr>
<td>Calcium/100 g of Soil</td>
<td>4.01</td>
</tr>
<tr>
<td>Magnesium/100 g of Soil</td>
<td>2.40</td>
</tr>
<tr>
<td>Potassium/100 g of Soil</td>
<td>0.09</td>
</tr>
<tr>
<td>Sodium/100 g of Soil</td>
<td>0.21</td>
</tr>
</tbody>
</table>

*A. gossypii* population dynamics in response to N application in major season

3.2 *A. gossypii* population dynamics in response to N application in major season of 2011

The highest densities of *A. gossypii* were recorded in treatment 2 (Sidalco liquid fertilizer, SLF + 1% Sulphate of Ammonia) plots with two peaks of 4.0 and 4.98 per leaf on 9th June and 23rd June, 2011, respectively. The plot treated with SLF + 0.5 % Sulphate of Ammonia (treatment 3)
recorded a gradual increase of *A. gossypii* and peaked at 3.5 per leaf on 9th June and 3.5 per leaf on 30th June. The population of the insect in the Sidalco liquid fertilizer treated plots (treatment 4) was at a peak of 3.5 per leaf on 9th June before declining thereafter. The control plots (treatment 1) however, had a peak of 1.7 per leaf on 9th June and 1.5 per leaf on 30th June (Figure 1).

![Figure 1. Mean densities (±SEM) of *Aphis gossypii* per eggplant leaf in fertilizer treatments from May to July (Major season) in Kumasi, Ghana.](image)

Treatment 1 = Control; Treatment 2 = Sidalco liquid fertilizer + 1 % sulphate of ammonia; Treatment 3 = Sidalco liquid fertilizer + 0.5 % sulphate of ammonia; Treatment 4 = Sidalco liquid fertilizer only.

3.3 *A. gossypii* population dynamics in response to N application in minor season of 2011

Mean densities of *A. gossypii* in the minor season were lower than that recorded in the major season. The density *A. gossypii* increased steadily and peaked at 3.8 per leaf on 15th September and declined thereafter in the treatment 2 plots (Sidalco liquid fertilizer, SLF + 1 % Sulphate of)
The density of insects in the treatment 3 plots (SLF + 0.5 % Sulphate of Ammonia) also followed a steady increase and peaked at 2.9 per leaf on 22
\textsuperscript{nd} September and declined thereafter. Densities of \textit{A. gossypii} in treatment 4 (Sidalco liquid fertilizer treated plots) peaked at 2.6 per leaf on 22
\textsuperscript{nd} September and also declined thereafter. The control plots (treatment 1) recorded a steady increase and peaked at 1.6 per leaf on 6
\textsuperscript{th} October only to decline thereafter (Figure 2).

\textbf{Figure 2.} Mean densities (±SEM) of \textit{Aphis gossypii} per eggplant leaf in fertilizer treatments from August to October (Minor season) in Kumasi, Ghana.

<table>
<thead>
<tr>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
<th>Treatment 4</th>
</tr>
</thead>
</table>
| Control     | Sidalco liquid fertilizer + 1 % sulphate of ammonia; Treatment 3 = Sidalco liquid fertilizer + 0.5 % sulphate of ammonia; Treatment 4 = Sidalco liquid fertilizer only.

\subsection*{3.4 \textit{T. palmi} population dynamics in response to N application in major season of 2011}

Generally, mean densities of \textit{T. palmi} were very low. The peak density of \textit{T. palmi} was recorded on 16\textsuperscript{th} June for all treatments (Figure 3). Whilst the control plots (treatment 1) had a peak of 1.0 per leaf, 1.8, 1.5 and 0.9 of \textit{T. palmi} per leaf were respectively recorded in the treatment 2
(Sidalco liquid fertilizer, SLF + 1% Sulphate of Ammonia), treatment 3 (Sidalco liquid fertilizer, SLF + 0.5% Sulphate of Ammonia) and treatment 4 plots (Sidalco liquid fertilizer). Treatment 2 plot received another high density of 1.8 per leaf on 30th June whilst treatment 3 also had a density of 1.5 per leaf on 6th July.

![Figure 3. Mean densities (±SEM) of Thrips palmi per eggplant leaf in fertilizer treatments from May to July (Major season) in Kumasi, Ghana.](image)

Treatment 1 = Control; Treatment 2 = Sidalco liquid fertilizer + 1% sulphate of ammonia; Treatment 3 = Sidalco liquid fertilizer + 0.5% sulphate of ammonia; Treatment 4 = Sidalco liquid fertilizer only.

### 3.5 *T. palmi* population dynamics in response to N application in minor season of 2011

Mean densities of *T. palmi* for treatment 2 (Sidalco liquid fertilizer, SLF + 1% Sulphate of Ammonia) peaked at 2.0, 2.1 and 2.2 per leaf on 8th September, 15th September and 29th September, respectively, before it declined thereafter. Treatment 3 (Sidalco liquid fertilizer, SLF + 0.5% Sulphate of Ammonia) also peaked at density of 1.7 per leaf on 22nd September and declined thereafter. Peak densities of 0.8 and 1.1 per leaf were recorded on 15th September for
treatment 1 (control plots) and treatment 4 (Sidalco liquid fertilizer), respectively, and also recorded 1.4 and 1.5 per leaf on 6th October (Figure 4).

**Figure 4.** Mean densities (±SEM) of *Thrips palmi* per eggplant leaf in fertilizer treatments from August to October (Minor season) in Kumasi, Ghana.

Treatment 1 = Control; Treatment 2 = Sidalco liquid fertilizer + 1% sulphate of ammonia; Treatment 3 = Sidalco liquid fertilizer + 0.5% sulphate of ammonia; Treatment 4 = Sidalco liquid fertilizer only.

3.6 Distribution of *A. gossypii* (major season)

There were no significant differences in the densities of *A. gossypii* that aggregated in the lower and upper canopies of the control plots. However, there were significant differences (*P* < 0.05) in their numbers in the lower and upper canopies in the N treated plots (Table 2).
Table 2. Mean (±SEM) distribution of *Aphis gossypii* per eggplant leaf in fertilizer treatments from May to July (major season) in Kumasi, Ghana in 2011.

<table>
<thead>
<tr>
<th>Canopy</th>
<th>Control</th>
<th>SLF + 1 % S A</th>
<th>SLF + 0.5 % S A</th>
<th>SLF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower</td>
<td>0.70 ± 0.11 a</td>
<td>3.66 ± 0.19 a</td>
<td>2.87 ± 0.16 a</td>
<td>2.27 ± 0.17 a</td>
</tr>
<tr>
<td>Upper</td>
<td>0.53 ± 0.11 a</td>
<td>1.82 ± 0.16 b</td>
<td>1.48 ± 0.15 b</td>
<td>0.97 ± 0.11 b</td>
</tr>
</tbody>
</table>

Means with same letter(s) within a column are not significantly different (*P* < 0.05; tukey test).

[SLF = Sidalco Liquid Fertilizer ; S A = Sulphate of Ammonia]

3.7 Distribution of *A. gossypii* (minor season)

The control treatment, treatment 1 and treatment 2 (Sidalco liquid fertilizer, SLF + 1% Sulphate of Ammonia) and Treatment 3 (Sidalco liquid fertilizer, SLF + 0.5% Sulphate of Ammonia) showed no significant differences in the aggregation of the insect between the lower and upper canopies; while the treatment 4 (Sidalco liquid fertilizer) received significantly higher number of *A. gossypii* in the upper canopy than that in the lower canopy (Table 3).

Table 3. Mean (±SEM) distribution of *Aphis gossypii* per eggplant leaf in fertilizer treatments from August to October (minor season) in Kumasi, Ghana in 2011.

<table>
<thead>
<tr>
<th>Canopy</th>
<th>Control</th>
<th>SLF + 1% SA</th>
<th>SLF + 0.5% SA</th>
<th>SLF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower</td>
<td>1.23 ± 0.13 a</td>
<td>3.27 ± 0.20 a</td>
<td>2.65 ± 0.19 a</td>
<td>3.19 ± 0.14 a</td>
</tr>
<tr>
<td>Upper</td>
<td>1.34 ± 0.12 a</td>
<td>3.37 ± 0.17 a</td>
<td>2.70 ± 0.14 a</td>
<td>2.39 ± 0.16 b</td>
</tr>
</tbody>
</table>

Means with same letter(s) within a column are not significantly different (*P* < 0.05; Tukey test).

[SLF = Sidalco Liquid Fertilizer ; SA = Sulphate of Ammonia]

3.8 Distribution of *T. palmi* (major season)

There were no significant differences in the densities of *T. palmi* in the treatments 2 (Sidalco liquid fertilizer, SLF + 1% Sulphate of Ammonia), treatment 3 (Sidalco liquid fertilizer, SLF +
0.5 % Sulphate of Ammonia) and treatment 4 (Sidalco liquid fertilizer); but significant differences were recorded between the lower and upper canopies in the control plots (Table 4).

Table 4: Mean (±SEM) distribution of *Thrips palmi* per eggplant leaf in fertilizer treatments from May to July (major season) in Kumasi, Ghana in 2011.

<table>
<thead>
<tr>
<th>Canopy</th>
<th>Control</th>
<th>SLF + 1 % SA</th>
<th>SLF + 0.5 % SA</th>
<th>SLF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower</td>
<td>0.40 ± 0.06 a</td>
<td>1.40 ± 0.11 a</td>
<td>0.85 ± 0.09 a</td>
<td>0.53 ± 0.08 a</td>
</tr>
<tr>
<td>Upper</td>
<td>0.75 ± 0.09 b</td>
<td>1.13 ± 0.12 a</td>
<td>0.89 ± 0.09 a</td>
<td>0.45 ± 0.06 a</td>
</tr>
</tbody>
</table>

Means with same letter(s) within a column are not significantly different (*P* < 0.05; Tukey test).

[SLF = Sidalco Liquid Fertilizer; SA = Sulphate of Ammonia]

3.9 Distribution of *T. palmi* (minor season)

 Whereas there were no significant differences in the number of *T. palmi* collected from the canopies in the control, treatment 1, treatment 2 (Sidalco liquid fertilizer, SLF + 1% Sulphate of Ammonia) and treatment 4 (Sidalco liquid fertilizer) plots, there were significant differences in treatment 3 (Sidalco liquid fertilizer, SLF + 0.5% Sulphate of Ammonia) (Table 5).

Table 5: Mean (±SEM) distribution of *Thrips palmi* per eggplant leaf in fertilizer treatments from August to October (minor season) in Kumasi, Ghana in 2011.

<table>
<thead>
<tr>
<th>Canopy</th>
<th>Control</th>
<th>SLF + 1% SA</th>
<th>SLF + 0.5 % SA</th>
<th>SLF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower</td>
<td>0.89 ± 0.11 a</td>
<td>1.81 ± 0.17 a</td>
<td>1.17 ± 0.14 a</td>
<td>1.43 ± 0.12 a</td>
</tr>
<tr>
<td>Upper</td>
<td>1.11 ± 0.12 a</td>
<td>2.12 ± 0.15 a</td>
<td>1.67 ± 0.15 b</td>
<td>1.40 ± 0.14 a</td>
</tr>
</tbody>
</table>

Means with same letter(s) within a column are not significantly different (*P* < 0.05; Tukey test).

[SLF = Sidalco Liquid Fertilizer; SA = Sulphate of Ammonia]
3.10 Yield

There were significant differences between the control and the N treatment plots with respect to fruit yield in the major season. There were also significant differences between the treatment 2 (Sidalco liquid fertilizer, SLF + 1 % Sulphate of Ammonia), treatment 3 (Sidalco liquid fertilizer, SLF + 0.5 % Sulphate of Ammonia) and treatment 4 (Sidalco liquid fertilizer) plots. However, there were no significant differences between the Treatment 3 and 4 plots in the fruit yield. Significant differences in the yield were observed among the treatments in the minor season (Table 6).

Table 6. The yield of eggplant treated with different levels of N in liquid fertilizer (both seasons) in Kumasi, Ghana.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Major season Yield (kg/ha)</th>
<th>Minor season Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLF + 1% SA</td>
<td>402.8a</td>
<td>370.0a</td>
</tr>
<tr>
<td>SLF + 0.5% SA</td>
<td>368.0b</td>
<td>311.8b</td>
</tr>
<tr>
<td>SLF</td>
<td>338.0b</td>
<td>273.0c</td>
</tr>
<tr>
<td>Control</td>
<td>258.8c</td>
<td>197.8d</td>
</tr>
</tbody>
</table>

Means with same letter(s) within a column are not significantly different ($P < 0.05$; Tukey test).
4.0 DISCUSSION

Population fluctuations and seasonal abundance of Aphis gossypii and Thrips palmi with the application of N fertilizer (Sildalco Liquid Fertilizer)

The presence of Aphis gossypii on plants is due to the availability of food in the phloem sap [12]. The increase in the population can be attributed to increase in N in the tissues of the plants as result of the application of the foliar fertilizer, which supported the finding that N may influence semio-chemicals and nutritional values of plants and also behavioral characteristics of herbivores ([13, 14]. [15] argued that improved nutrition in the insects contribute to increased reproduction, longevity and overall fitness of the pests. The increase in A. gossypii and T. palmi infestation began two weeks after transplanting of the seedlings. N content in host plants is generally considered an indicator of food quality that affects host selection by aphids and thrips [16]. The initial N in the soil appeared to be low as per the results of the initial soil analysis but the addition of N in the liquid fertilizer increased N content in the leaves which may have significantly impacted reproduction by aphids and thrips, resulted in population increase [17]. N was found to modify the plant nutrition and reduce the resistance against aphids [18, 19, 20] and [21]. N application usually results in partitioning in the form of phenols and amino acids (protein) in the crop, making the foliage extremely succulent and therefore susceptible to both diseases and pest incidence [22, 23, 24].

The number of A. gossypii recorded in the major season was comparable to that recorded in the minor season but [25] reported that aphids population could become very important in the cool dry season which is associated with the minor season in Ghana. T. palmi numbers, however, was slightly higher in the minor season than that recorded in the major season and this is in agreement with the report by [26] that thrips mostly attack eggplants during the cool dry season. Peaked abundance of the insects was recorded half way through the study period in both seasons.
which also coincided with the time of the highest succulence of the tissues of the plants, an indication that both insects prefer succulent to hardy tissues.

There were mixed results in the abundance of both insects in the canopy levels as far as the treatments are concerned making it difficult to pronounce clear behavioral activities of the two insects’ habitation within the canopy levels of the plants. It appears plant phenology plays a less important role in *A. gossypii* and *T. palmi* numbers than seasonal variation. [27] suggested same reason for the abundance of thrips in their work. It is unclear why negligible densities of *T. palmi* inhabited the flowers of the plants because thrips usually prefer flowers to leaves when the former start appearing. Several workers have alluded to this fact in their work [28, 29, 30, 31]. Generally, aphids are known to occur more on the leaves of plants than the flowers possibly because the leaves offer a more stable habitat to them than the flowers.

The number and weight of eggplant fruits do not depend only on environmental factors but on the combined effects of pests and diseases and good nutrition of the crop on the field. Higher number of fruits was recorded on the treatment with the highest N fertilizer. The control plots recorded the lowest yield. The mean weight of fruits was significantly higher in the highest N treatment plots than the lower N treatment plots, with the control recording the least. This result was expected because the N applied was expected to improve plant performance and increase leaf area and sunlight interception to enhance the rate of photosynthesis as reported by [32, 33]. Plots with high doses of N also recoded a higher yield; it has been reported that the main effect of N fertilization as the increases in the dry matter production in crops such as eggplant (*Solanum melongena* L.) [34], lettuce (*Lactuca sativa* L. ‘Vegas’) and lucerne (*Medicago sativa* L.) [35].
found that applying the equivalent of 5 g N/plant to maize in soil with about 0.096% total N increased mature dry matter weight by 9-26% compared to plants that received no N depending on variety and soil moisture. This agrees with the results of this study because increase in N led to increases in fruit yield. Despite the fact that aphids and thrips pest densities increased with increasing N treatment, their numbers did not affect yield. This could be due to the fact that the populations were not high enough to adversely affect yield.

REFERENCES


